INTEGRATION OF SUSTAINABILITY DIMENSIONS INTO THE VALUATION OF PROCESS INDUSTRIES IN NIGERIA

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KUALA LUMPUR

2018

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THESIS SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

FACULTY OF BUILT ENVIRONMENT
UNIVERSITY OF MALAYA
KUALA LUMPUR

2018

UNIVERSITI MALAYA

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Registration/Matric No: BHA 130010

Name of Degree: DOCTOR OF PHILOSOPHY

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INTEGRATION OF SUSTAINABILITY DIMENSIONS INTO THE VALUATION OF PROCESS INDUSTRIES IN NIGERIA

ABSTRACT

The primary role of the valuer in response to the climate change-related issues would be to induce and adopt measures that can integrate sustainability adjustments into the valuation process. Real estate valuers, as stakeholders, could also play a contributory role to sustainable development by giving sustainability-driven advice to clients and reflecting sustainability capacities of process industries in property valuation based on investment value. Valuation theory and practice remain without a methodological approach for incorporating sustainability issues into process industries in Nigeria. Even now, it seems problematic to value process industries for sustainability on a basis other than market value, such as investment value, and for purposes such as individual investment and operational objectives. It denotes that a gap exists in the real estate valuation theory and practice. In the absence of an appropriate methodology, this study explores the Delphi method. The quantitative research method was employed. The study discusses the case for sustainability, emerging normative, and the evidence-based valuation approaches, sustainability indicators, green building tools and sustainability drivers, and the knowledge-based supports systems. It develops a valuation approach based on the modified cost method of valuation to specify the methodological advances for assessing the extent to which the sustainability features of the case study industry meet the specified sustainability criteria. The Delphi method sets twenty-three (23) experts into two heterogeneous panels. The experts identified 39 indicators and scored the indicators after individual industrial surveys, direct observation, and an examination of the environmental audit report on the case study industry. The GreenstarSA (2007) equal scoring weights of

10/2 was adopted for the determination of the scores by the experts. This study found sixteen (16) critical sustainability indicators (four from each of the four specified dimensions) for the paints' industry in Nigeria. It also obtained the Industrial Sustainability-Related Obsolescence Correction Factor (ISRO-CF) of 0.671 as the sustainability-based performance of the industry, and the fair value to the industry owner based on specific theoretical considerations such as externalities, impact compliance, expectation, substitution, and inducement. The data triangulation method was used to validate the study. The valuation approach builds knowledge for theory construction and evokes the design choices from the subjective-intuitive Delphi techniques of foresight through expert consensus opinion. For practical application purposes, it initiates the integration of the multidisciplinary dimension for valuing process industries which could be used as a template for estimating the industrial sustainability compliance for real estate valuation on the investment value basis. The prime expectations are that valuers can proceed with the valuation of process industries for sustainability, induce the keenness of industries to certify their buildings, while also making real estate valuation sustainability-compliant and responsible. Valuers' knowledge-support and perceptive studies justify the acceptability and suitability of the valuation approach and elicit the significant predictors of the support system. The study claims that there is an impact perspective to industrial sustainability in real estate valuation. The ISRO-CF approach complies with the RICS Valuation Practice Statements VPS.4 [2.5g: 3-4] of 2014.

Keywords: sustainability, process industries, Delphi method, property valuation, Nigeria

INTEGRATION OF SUSTAINABILITY DIMENSIONS INTO THE VALUATION OF PROCESS INDUSTRIES IN NIGERIA.

ABSTRAK

Dalam mendepani isu-isu yang berkisar di sekitar perubahan iklim, penilai punyai peranan utama untuk mendorong serta memajukan usaha ke arah menerapkan pengambilkiraan kelestarian dalam proses penilaian. Sebagai pemegang kepentingan, penilai harta tanah turut mampu untuk menyumbang ke arah pembangunan mapan dengan menawarkan khidmat nasihat yang berpandukan kelestarian serta mencerminkan kapasiti kelestarian industri proses apabila menilai harta tanah bagi nilai pelaburan. Setakat ini, teori dan amali penilaian dirundung ketiadaan pendekatan metodologi yang boleh menangani isu-isu kelestarian dalam industri proses di Nigeria. Ketika ini pun, penilaian industri proses kelihatan bermasalah untuk mencerminkan kelestarian bagi situasi di mana asas nilainya adalah selain daripada nilai pasaran, iaitu seperti nilai pelaburan. Begitu juga halnya dengan penilaian bagi maksud seperti untuk pelaburan peribadi dan untuk objektif operasi. Ini menandakan wujudnya jurang antara teori dan amali penilaian. Memandangkan ketiadaan tersebut, maka kajian ini dijalankan dengan menerokai kaedah Delphi. Pendekatan kuantitatif diguna pakai. Kajian ini mengutarakan penghujahan bagi amalan kelestarian serta membicarakan pendekatan penilaian yang normatif dan yang bersandarkan bukti muncul, petunjuk normatif, instrumen bangunan hijau dan pemacu kelestarian serta sistem sokongan berasaskan pengetahuan. Suatu pendekatan penilaian berlandaskan kaedah kos diubah suai dibangun bagi menunjukkan kemajuan metodologi yang dicapai dalam menilai setakat manakah ciri-ciri kelestarian industri kajian kes memenuhi kriteria-kriteria kelestarian yang ditetapkan. Dalam kaedah Delphi tersebut, sejumlah 23 pakar dibahagikan kepada dua panel yang heterogen. Pakar berkenaan telah mengenal pasti 39 petunjuk yang kemudiannya dimarkahkan menggunakan data dari kaji selidik industri individu, pemerhatian langsung dan rekod dalam laporan audit alam sekitar terhadap industri kajian kes. Pemberatan sama rata 10/2 GreenstarSA (2007) telah diguna pakai bagi menentukan skor oleh pakar terbabit. Kajian ini menemui 16 petunjuk kelestarian yang kritikal (empat dari setiap satu daripada empat dimensi yang ditetapkan) bagi industri cat di Nigeria. Kajian turut memperoleh nilai 0.671 bagi *Industrial Sustainability-related Obsolescence Correction Factor* (ISRO-CF) iaitu prestasi industri tersebut berdasarkan kelestarian yang juga merupakan nilai saksama kepada pemilik industri berdasarkan pertimbangan teori khusus seperti eksternaliti, pematuhan terhadap impak, ekspektasi, penggantian dan dorongan. Teknik triangulasi data digunakan untuk menentusahkan kajian. Pendekatan penilaian tersebut telah menjana pengetahuan untuk pembinaan teori serta membangkitkan pilihan reka bentuk daripada teknik ke depan Delphi yang subjektif-intuitif menerusi pendapat konsensus pakar. Bagi maksud aplikasi amali, ianya memulakan penggabungan pelbagai dimensi disiplin bagi menilai industri proses yang mana ini dapat digunakan sebagai template bagi menganggar kepatuhan kelestarian industri bagi penilaian harta tanah berdasarkan nilai pelaburan. Jangkaan utama adalah bahawa penilai bolehlah menjalankan penilaian yang lestari bagi industri proses, mendorong minat industri untuk mensijilkan bangunan mereka dan menjadikan penilaian harta tanah patuh serta bertanggungjawab terhadap kelestarian. Sokongan pengetahuan penilai dan kajian perspektif menjustifikasikan kebolehterimaan dan kesesuaian pendekatan penilaian serta mendapatkan peramal yang signifikan bagi sistem sokongan penilai. Kajian ini menggagaskan bahawa terdapat perspektif impak terhadap kelestarian industri dalam penilaian harta tanah. Pendekatan ISRO-CF mematuhi Penyataan Amalan Penilaian RICS VPS.4 [2.5g: 3-4] of 2014.

ACKNOWLEDGEMENTS

I would like to acknowledge and express my gratitude to the Tertiary Education Trust Fund (TERTFUND) for the opportunity afforded me to embark on this Ph.D. journey by providing the fund. The study leave granted by the Lagos State Polytechnic (LASPOTECH) as well as their unwavering financial commitment have assisted me towards the completion of my thesis. I feel greatly obligated to my supervisors; Dr. Yasmin Mohd Adnan and Professor Dr. Md Nasir Daud for their true-hearted guidance, unwavering support and constructionist comments at every step of the way. My gratitude is extended to Zurinawati, Shilah, Norizan and Hasnita who never felt discomforted by my incessant questionings and requests. The contributions of Dr. Abioye Lawal, the Former Rector of LASPOTEC, Dr M.O. Ajibola, Mr Tope Adebodun Baba Bimbo and Miss Nneka Allochukwu are invaluable.

Finally, I would like to extend my deepest gratitude to my parents, Late Madam Beatrice Modupe Ogungbesan, my irreplaceable mother, SAP Michael Oluwayemi Ibiyemi, my ever-caring father for their inestimable support and sacrifice. I am also grateful to my brothers Femi and Wole, for supporting me in every way throughout the programme. Last but certainly not least, I would like to express my deepest love and gratitude to my one and only, Mrs Noimot Abiodun Ibiyemi. It is impossible for me to forget to remember that we fought the war and won the battle together. My children, Mrs Abiola Awonuga (BB Tosh is Alive), Mr Olusola Ibiyemi (Shawn Baba), Mr Oluyemi Ibiyemi (MicON on the Beat SIBA), Mrs Olubunmi Akindejoye (FineDAB For Life) for their understanding, support, encouragement to this 'Old Soldier' Their request for me to complete this journey which I have embarked on, has certainly pushed me further. My grand-daughters, Funmi Anjola and Anuoluwapo Darasimi are titans in the making. I remember you and always will. My sons-in-law, Messrs Abayomi Awonuga and Bode[++] Akindejoye, are indispensable. All of you have my unalloyed love till my dying day.

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List of Abbreviations

ARY	All-Risks Yield
CDM	Classical Delphi Method
CDP	Carbon Disclosure Project
EMP	Environmental Management Plan
ESG	Environmental, Social, and Governance
F and F	Furniture and Fittings
GBCSA	Green Building Council of South Africa
GBRTs	Green Building Rating Tools
GRI	Global Reporting Initiatives
HVAC	Heating, Ventilation and Air-Conditioning
IEQ	Indoor Environmental Quality
ISRO-CF	Industrial Sustainability-Related Obsolescence Correction Factor
KRNW	Knowledge Resource Nomination Worksheet
LASEPA	Lagos State Environmental Protection Agency
LBS	Land, Buildings and Structures
LDCs	Less Developed Countries
MDCs	More Developed Countries
NESREA	National Environmental Standards Regulation Agency
PME	Plant, Machinery, and Equipment
RDM	Russian-Doll Model
SBAT	Sustainable Building Assessment Tool
SDG	Sustainable Development Goals
SI	Sustainability Indicators
SRI	Sustainability-Related Information
TBL	Triple-Bottom Line
VTTB	Value to the Business
WTP	Willingness to Pay

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This thesis presents a study that develops a valuation approach which integrates the sustainability dimensions into the valuation of process industries on the investment value basis. The approach assesses the extent to which industry sustainability features meet the local sustainability criteria and broadens the valuation theory for the sustainability applications to investment values for process industries. It is important for the property sector professional to acknowledge that several studies on climate change suggested that the improvement in the sustainability agenda for buildings has implications for greenhouse emissions and energy efficiency. It happens because buildings, as a great carbon dioxide emitter, play a key role in climate-change policy. They are significant target areas for addressing climate-related changes (Miller & Buys, 2008; Eichholz *et al.,* 2008; Michl *et al*., 2016). Change in climatic conditions can have consequences beyond the regions in which they occur. In the USA alone, Von-Paumgarten (2003) asserts that non-residential buildings consume 30-40% of the nation's energy, add 30-40% to air-bound emissions, use 25% and 60% of available water and electricity, and take up 35-40% of the municipal solid waste stream. These activities have direct cause-effect relationships with the reduction of glacier volume, global warming and higher temperatures (Friedman, 2008). Nevertheless, the notion that the property sector can respond keenly to climate change-related issues, through mitigation, inducement and adaptive measures have become the key invigorator of discussions in real estate sustainability and valuation (Warren-Myers, 2016). When this is the case, Runde and Thoyre (2010) wonders why valuers need to understand sustainability if they are only concerned with market values of real estate. Their primary focus ought to be on the sustainability discounts or adjustments that could reflect the avoidance, mitigation, the minimisation of adverse current and future social, environmental, and economic externalities.

In spite of seeming advancement in energy efficiency, waste management, and recycling, many industries are consuming superfluous aggregates of non-renewable energy and other key resources at petite sustainability capacities. These industries are unable to decouple economic growth from amplified consumption of energy and add-on resources. Certain businesses and sectors of industry have made some progress towards sustainability over the past twenty years. Nevertheless, these issues require concrete inducement efforts over the next fifteen (15) to twenty (20) years. However, it seems clear that recent efforts have not paid off as atmospheric CO_2 concentration, using ice-core proxy data and direct measurements has been on the vertical increase since 1950 (IPCC, 2014a). SDG (2015) reawakens to the realities of sustainable development (SD) with real-time figures regarding climate-change consequences such that policy makers and legislators have begun to recognise its significance and are progressively implementing strategies that hunt for environmental protection and social equity while still tailing economic progress and stability. In this vein, public and private sector organisations and the Professional Bodies, including the Royal Institution of Chartered Surveyors are embracing the triple-bottom line (TBL) and the Russian-Doll principles. Sustainable development is a global issue requiring local and international efforts to accomplish sustainability. Individuals, professionals, governments must seek ways of integrating green initiatives into their assessments, reporting, and decision-making at every level of human activities (SDG, 2015). It requires incorporating economic growth, socially-oriented development, and environmental resources management as mutually dependent, conjointly supportive and underpinning columns of enduring development. It calls for hands-on and multi-stakeholder approaches to dealing with development issues involving a broad range of actors - government, the private sector, professional bodies, civil society organisations, institutions of higher learning and research and progress partners.

There are several vital aspects of sustainability that affect property and potentially its value. Not only does property itself have an impact on the environment through its entire lifecycle, but environmental and social aspects of sustainability impact on property performance. Therefore, the key concerns for property performance and valuation are: *(1)* climate change: The impact of water, wind, temperature, and other environmental factors on an asset *(2)* Resource depletion: the impact of energy demand and reducing supplies of fossil fuel of materials and energy consumed by buildings *(3)* Broader attributes: the effect of social, health and other attributes on buildings, their demand and occupancy. The valuers, for that reason, are duty and responsibility-bound to: *(a)* reflect the markets' interpretation of the impact of sustainability on price or value and *(b)* induce stakeholders through their expert advice, to adopt sustainability initiatives in property design, construction management, and valuation instrumentations. Valuers need to upskill the range and depth of their existing expertise to analyse sustainability-related information and interprete the sustainability market. In addition, they need to comprehend the implications to valuations, of the increasing range of triple bottom line issues and recognise the synergic, and the interrelated nature of aspects previously viewed in isolation. In this vein, this would include the understanding that the valuation instrument might be used to induce industries to improve their sustainability compliance levels, and the realisation that valuers migrate from passive reflectors to active influencers of property market decision making. Thus, Senge (1994), Dixon *et al.* (2008) and Ibiyemi *et al.* (2015) advocate a compelling shift of mental mode to a shared vision. Valuers could share the vision that externalities are deviances of welfare generated by a given activity without being reflected in market prices. An external cost (benefit) is not paid (enjoyed) by those who have generated it. Market distortions are introduced if external costs are not internalised, as an appropriate valuation or property pricing interventions. Market distortions and misallocation of property resources have been widely reported in recent times. Nevertheless, valuation and assets pricing interventions should systematically avail themselves of an accurate estimation of the extent to which building sustainability features meet prescribed sustainability criteria to outline the optimum terms and settings for mitigation/abatement measures, and methods for the internalisation of externalities (Ricci, 2015).

Major new challenges confront process industries that undertake manufacturing activities, as a result of energy and natural resources depletion. Those challenges necessitate a critical redirection to industrial sustainability in product-development process operations and valuations. In this context, responsible valuation requires the valuers to collect sufficient sustainability data from the analysis of market transactions and non-market sources and; identify the indicators that can influence sustainable investment and development decision making and report appropriately. When market data is not available, the valuers must assess the extent to which properties meet prescribed sustainability criteria as a professional and social responsibility (RICS, 2014). Sustainability integration in property valuation is one way of inducing investors to produce carbon reducing built environment in response to climate-change. Indeed, Warren-Myers (2016) contends that the current discussions on sustainability in property valuation have been sustained by its linkages with climate-related issues, and the possibilities of the real estate sector to contribute to the adaptation and mitigation efforts.

To a large extent, until sustainability is explicitly recognised and discounted by property valuation as a professional and social responsibility, investors could continue to pledge uncertainty of initial or retrofitting costs and returns as an alibi to embrace sustainability pathways (Ibiyemi *et al*., 2015).

The real estate profession, as a progress partner, has to reconsider the ethical role it plays in the society: Indeed, for every profession, it is useful to reflect upon the changing conditions over the past years and observe what influenced these changes. Otherwise, it would be easy to assume that the current practices are sufficient (Miller *et al*, 2008). Moreover, Gilbertson and Preston (2005) expounds that there are reputational gains for real estate valuation that anticipates and responds to changes in the dynamics of the market and non-market places. However, the challenges for valuers in incorporating sustainability starts with finding the appropriate sustainability assessment approaches. The next consideration would be the issue of how to compare and reflect sustainability attributes building to building. The multiplicity of characteristics of sustainability interlaid with some sustainability-compliant variables already present in valuation make the assessment of sustainability as a single factor difficult to capture without double counting. Thus, the validity of sustainability inclusion into the valuation process would rely on the capacity, expertise and experience of the valuer (Lorenz & Lützkendorf, 2008a; Warren-Myers, 2013). As a result, valuers are required to focus on sustainability rebates that can minimise present and future adverse social, environmental and economic externalities while expanding their traditional role of interpreting market gyrations to becoming partners in inducing stakeholders and the market towards sustainability. It is both ethically and socially, a responsible role at this time (Lorenz & Lu̇t kendorf 2011; Runde & Thorye, 2010; Warren-Myers, 2012). Moreover, property professionals should seek ways of capturing sustainability in their assessments, reporting, and decision-making. The survival of professional valuation services in the sustainability era instructs that the public interest is protected (RICS Royal Charter, 1881; Gilbertson & Preston, 2005). If the profession be unsuccessful to protect public interest, it could decline in competitiveness. On the other hand, the valuation profession can become part to the vision about the future, by analysing the entire markets and helping corporations, governments, and individuals shape real property markets into sustainable, rational assets for the people across the world (Motta & Endsley, 2003). From the foregoing background information, the rationale of study is discussed as follows:

1.1.1 Rationale for the Study

The motivations for the study are stated hereunder:

(1) The valuation of process industries for sustainability is a neglected area and the researchers are slowest in responding to the challenges of sustainable development (SD) in the real estate sector (Lorenz, 2006)

(2) Studies on climate change suggest that property sustainability improvements have implications for GHG emissions and energy efficiency.

(3) The real estate identity now has an environmental aspect and an expanded socio-economic scope that require valuers to become active influencers of the property market.

(4) The property markets demand sustainability for higher premium and businesses for competitiveness.

(5) Sustainability has become a risk factor in property investment and development.

(6) New challenges for process industries contained in the 2015 SDG Goals. 9, 12 and 13 require valuers to up-skill the depth of their expertise to analyse SRI and assess how sustainability impacts on value.

The following sections in this chapter highlight the research gaps; state the research problems and the study questions that address issues that are raised in the research. It is followed by the research objectives and a brief description of the research methodology. The chapter ends with the limitation of the study, the definition of operational terms and the thesis outline.

1.2 Research Gaps

The theory and body of knowledge about sustainability and market value have been developing. A comprehensive review of real estate and sustainability literature shows that the studies include the theoretical analysis of real estate markets, value, and sustainability (Boughey, 2000; Easterbrook, 2000); Sustainability and property performance evaluation (Boyd and Kimmet, 2005); real estate development valuation applied to environmentally sustainable properties (Robinson, 2006); examination of the education and training on sustainability and its relationship to economics and valuation (Lűtzkendorf and Lorenz, 2006); RICS (2007) also examines the changing market dynamics and challenges in valuing sustainable real estate. Brinkman *et al.(*2008) investigates the dynamics of the market and examination of risk regarding climate change and the effect on corporate valuations; Muldavin (2009) analyses sustainability and its incorporation within valuation practice. CB Richard Ellis (2007), Bowman and Willis (2008) and Parker (2008) provide the overview of emerging evidence suggesting changes in the market, increasing issues regarding risk and obsolescence and its relationship with valuation issues. The other areas explored included the business case and responsible property investment (Sayce and Sundberg, 2009: Ellison *et al*. (2007); sustainability drivers, market valuation and review (JLL, 2006a; Reed, 2009; Runde & Thorye, 2010; Myers *et al.,* 2007: Myers, 2009; Warren-Myers, 2012, 2016); statement of norms regarding the valuation of sustainability, providing guidance, and caution in valuing sustainability (RICS, 2009, 2014, 2016); Sustainable design, investment, and value

(Lorenz & Lützkendorf, 2008a, 2011; Lützkendorf & Lorenz, 2005, 2011, 2012, 2015). Further details are contained in the literature mapping (section 3.5.2).

These studies are the major contributions to the plethora of studies and viewpoints build up on sustainability in real estate valuation, for which there is an abundant focus on market-predictive approaches. Sustainability issues relating to process industries which are linked with manufacturing and production sequences are less considered for valuation purposes. Research and discussions thus focused on sustainability issues concerning residential and commercial property investments, deep retrofit values, and risk related perspectives. The impact-sustainability compliance and the prescriptive aspects were seldom explored, neither was it expressed that valuers should expect industries to behave rationally to build their sustainability credentials. The principles of expectation are integrated into the comparative and investment methods of valuation, but it appears to require scope expansion for the purpose of sustainability integration.

This study recognises the gaps and seeks to bridge it by providing the basis required for valuing process industries that incorporate sustainability. While it is possible that publications on sustainability in non-market property valuation exist, there are no significant contributions in the sustainability literature. The prescriptive criteria are required to drive any anticipated market documentation of sustainability uptakes. In many countries, there are no sound sustainability criteria and rating scales. Therefore, ownership and consumer preferences are not likely to incline towards sustainability considerations unless induced to do so (Ibiyemi *et al.,* 2015).

1.3 Problems Identification

The fundamental problems pertaining to the absence of concern towards sustainability in real estate valuation underpin the main aim of this thesis. The research problems are that:

There is no methodological approach for the integrating industrial sustainability dimensions into process industry valuation for investment value basis. As a result, property valuation underestimates the social and environmental costs created by industries and ignores the sustainability compliance of industries. Also, the lists of sustainability indicators and their importance indices are seldom available to help to capture the dimensions of sustainability.

These are problems because value underestimation of social and environmental costs could lead to the misallocation of capital and resource degradation. Industrial business property owners could also get ceiling figures as worth or value to the owner without regard for sustainability. In itself, it is a disincentive for them to acquire sustainability credentials. Moreover, it has become hard to resolve the question of how valuers should proceed with the long-term integration of industrial sustainability in property valuations. Meanwhile, the immediate communities get some primary benefits by way of job creation and installation of some facilities, they are greatly burdened in particular when externality costs are not reflected in the industries' estimates of value to the business.

The implications of these problems were realised by Michl *et al.* (2016) as due to lack of knowledge, non-requirements of clients to request for sustainability reporting and the paucity of sustainability-related data.

1.4 Research Questions

From the statement of problems, five (5) research questions are raised for the study. These questions are to address the issues of sustainability and valuation of process industries so that the study aim can be achieved. The research questions are as follows:

RQ.1: What would be the case for integrating sustainability into real estate valuation and the emerging normative and evidence-based valuation approaches?

RQ.2: What are the appropriate industrial sustainability indicators and the Industrial Sustainability Correction Factor?

RQ.3: What would be the sustainability-corrected approach to value process industries by the investment value to the owner?

RQ.4: What is the sustainability-corrected investment value to the owner?

RQ.5: What are the perceptions, and the support of valuers concerning the industrial sustainability integration into real estate valuation, the sustainability-corrected valuation approach and what model describes the characteristics of the population of valuers under study?

1.5 Aim and Objectives of Study

The main aim of this study is to provide an approach for the integration of the sustainability dimensions into to the valuation of process industries on the investment value basis. The development of the research objectives is such that could help to promote the methodological approach and the broadening of the valuation theory for its operationalisation.

The objectives are as follows:

OBJ.1: To establish the case for incorporating sustainability into real estate valuation methodology in the context of the emerging normative and evidence-based valuation approaches.

OBJ 2: To ascertain the indicators that are appropriate for industrial sustainability and the Industrial Sustainability Correction Factor.

OBJ 3: To develop a sustainability-incorporated approach suitable for the valuation of process industries on the investment value basis.

OBJ 4: To determine the sustainability-corrected investment value to the owner of a case study industry in Nigeria as a test of the extent to which the industry currently meets local sustainability requirements.

OBJ 5: To investigate the Nigerian valuers' perception regarding the integration of industrial sustainability into real estate valuation, the support for the valuation approach, the structural linkages between the constructs and the applicable model for the population of valuers.

1.6 Research Methods

There are two parts to the research:

Part 1 (Main): It presents the case for sustainability in real estate valuation, and explains the relevant theories and the determination of the methodological approach requisite to sustainability integration into the valuation of process industries by the investment value basis This is made through the review of the literature and primary sources of data.

The principal focus of this thesis is as follows: *(1)* Industrial sustainability issues that cannot be indexed in the property market as a value parameter for the reason that the valuation is non-market based. *(2)* Sustainability impact-compliance valuation approach that can induce industrial investors' behaviour to sustainability ways and promote the emergence a sustainability market, and *(3)* The valuers' social, moral and ethical responsibility imposed by the RICS Royal Charter (1881) *(4)* Value in use or investment value of process industries for individual investment and other operational objectives. *(5)*

Response to SDG's global call for better links between property investment, social responsibility, and sustainability.

In consideration of the above, the real estate valuation principles of Market Substitution, Expectation in property valuation, and the Pigou's theory of Externality in environmental economics define the study. The study intends to identify and understand sustainability value from the non-market industrial property impact-compliance perspective. For that reason, it examines the value of sustainability from the impact-compliance of process operations based on the qualitative judgment of the sustainability requirements or criteria. Therefore, the theoretical framework is developed, and the variables assembled. The Delphi method is adopted, involving a total of twenty-three (23) experts to select the appropriate industrial sustainability indicators and provide scoring for the adoption of a correction factor.

Part II (Perception and Support Studies): This part involves the end-users study of their perceptions, support and the causal linkages of the theoretical constructs and modeling for the study population of valuers. Under this part, the first phase involves the data reduction process using the exploratory factor analysis and the reliability of factor loading. The second phase is to test the influences of the independent set of constructs on the dependent construct. The third phase is to derive an adjusted research model for the population and test the validity of the hypothesised model developed from theories related to valuers' support systems and potential sustainability benefits. This part also verifies and validates the acceptability and suitability of the proposed valuation approach.

1.7 Significance of the Study.

The prime importance to this study is that it should be able to show that there is an impact perspective to the study of sustainability in real estate valuation which can be incorporated within the valuation theory about the purpose of determining investment value or values-in-use. It is of immediate relevance to local and international interests. The research questions have been fashioned out so that the answers provided to them could justify new theory building regarding investment value. The significance of the appraisal of sustainability aspect in valuing process industries is to induce investors in process operations to improve their projects in line with the triple-bottom line postulations, minimising and mitigating or compensating for possible adverse impacts. It also provides opportunities to address environmental issues and a forum for a crusade against the injustice of compensating polluters at huge social costs. The initiative may also help to allocate resources rationally and appropriate value by internalising social costs associated with production processes where no market exists. Sustainability discipline could be enhanced as industrial process owners seeking high values for their businesses would have to comply considerably with prescribed local sustainability requirements. It seeks to change the behaviour of process industry investors in fulfilment of the valuers' cardinal social responsibility, and set limits of industrial productivity as a function of sustainability compliance, subjecting outcome values to "adequate potential sustainability practices."

The work is original, creative in concept and critical in judgment. The major contribution is the provision of the methodological and conceptual basis for integrating sustainability issues into the valuation of the non-market industrial real estates. Other contributions to society, valuation theory, and practice, research and industry are summarised in sections 1.7.1 to 1.7.4 hereunder.

1.7.1 Society

The study can enhance the peoples' deeper understanding of property sustainability issues and its immediate relevance to local and international interests. It stimulates boldness and pragmatism in tackling issues relating to sustainability, and complements other economic-based drives, such as market-based instruments (environmental tax and subsidy) as an integral concept of the overall sustainable development efforts to achieve sustainability.

1.7.2 Property Valuation Theory and Practice

The work extends the frontiers of knowledge in valuation by explaining valuation theory in the context of sustainability, externalities, inducement, and compliance. It provides a concise methodological approach for integrating sustainability aspects into non-market real estate valuation. Therefore, it offers a knowledge-content base to valuers about the relevant industrial sustainability indicators, the relationship between sustainability and non-market real estate values, and the implications for real estate valuation theory and practice. The study is a direct contribution by valuers towards sustaining our environment in the face of existential threats of global warming and climate change. It adapts practical skills leading to innovative ideas in the field of real estate valuation.

1.7.3 Research

It synthesises knowledge and contributes to original research by showing that there is an impact perspective to the study of sustainability in real estate valuation which can be incorporated into the valuation theory. It helps to appraise the sustainability issues through the prism of its multi-dimensionality and the multi-disciplinary Delphi approach.

1.7.4 Industry Investors

The study evolves methodologies that should persuade or induce industrial investors to comply with Sustainability Criteria for their specific operations. Potential industrial investors, operators, and partners seeking high values for their investments would explore pro-sustainability ways for the achievement. It promotes socially responsible investments through an expected change of behavior.

I.8 Research Scope

RICS (2009), Runde and Thoyre (2010) as well as Lorenz and Lützendorf (2011) emphasise the dependency of sustainability influences on the degree to which the specific market values sustainability. The study is primarily to identify and understand sustainability value from the non-market industrial property impact-prescriptive perspective, having regard to the principal focus enumerated in section 1.6. It therefore examines the value of sustainability from the impact- sustainability compliance of the process industry operations relative to the prescribed sustainability requirements or standards. The overall strategy is to induce compliance and simulate a substituted market through multi-disciplinary intervention, where sustainability can be read from the impact-prescriptive perspective. It is intended to complement existing internalising programs (pollution taxes, credits, and subsidies), and create disincentives for further CO_2 emissions and externalities. It is not envisioned to measure corporate industrial sustainability from the market-based perspective nor assess potential benefits on the sustainability performance of industries in relation to their business values.

The study opted to restrict the scope to process industries in Nigeria. It is constrained to a specialised type of industrial property operation, and this would allow the researcher to form focused conclusions that are amenable to clear interpretations and create a pedestal for further research that can be extended to other classes of industrial operations. A study devoted to more than one process would provide results that are unrelated because of the heterogeneous nature of industrial properties in each of the process sectors.

1.9 Thesis Outline

The thesis is presented in seven (7) chapters. Chapter 1 provides the introduction to the thesis. It presents the introduction, research gaps, statement of problems, research questions, research objectives, research methods, the significance of the study, the scope of the study and the thesis outline.

Chapter 2 presents an overview of the business, social, obsolescence and environmental cases for the integration of sustainability into real estate valuation and the potential benefits.

Chapters 3 provides a review of the literature on the sustainability in real estate valuation, which evaluates the various valuation approaches in the literature. It discusses the relationships between sustainability and property values, the drivers of the sustainability initiatives. It also covers the discussion on the sustainability dimensions, the Green Building Rating Tools (GBRTs), aspects of sustainability design, investment in development, and the sustainability-related information that might be required for valuation purposes. Finally, the research method for each objective, the literature mapping of past researches and the theoretical framework was developed based on the research problem.

Chapters 4 focuses on the research design and process, the Delphi method and validation processes. It explores alternative methods of judgment analyses and justifies the use of the Classical Delphi Method (CDM). The psychometric analyses of the field data for the perception and support studies support its useability and the reliability of the research outcome. The factor loadings measure the perceptions and Exploratory Factor Analysis (EFA) reduce the data into their component constructs. Finally, it describes the case study industry for valuation purposes and elicits the research method adopted for each objective.

Chapters 5 describes the case study industry for valuation purposes. provides the results of the main study through the provision of the data analysis for the selection of the industrial sustainability factors to be scored. The main study also presents the following result and analysis of data: The two-panel Delphi structure, the case for sustainability, analysis of the Relative Importance Index (RII) and group ranking, analysis of sustainability indicators scoring. The perception and support studies exhibit the data collection results showing the profile of respondent valuers, the exploratory structure and hypothesis testing for modelling.

Chapters 6 discusses the case for sustainability, and the valuation approaches. It deliberates on the development of the approach by considering the sustainability obsolescence and the correction factor elements that enabled the determination of the value to the owner. A research claim is made with evidence to support the claim. A discussion of the valuers' perception, support, and causal relationships form an integral part of this chapter.

Chapters 7 concludes with a final discussion of this study, together with an examination of its limitations, and recommendations. This chapter ends with the discussion of the theoretical and practical contributions and suggestions regarding future research.

Figure 1.1 provides the research report presentation, the overall structure of this study and the processes for the sustainability integration valuation (this study, 2016).

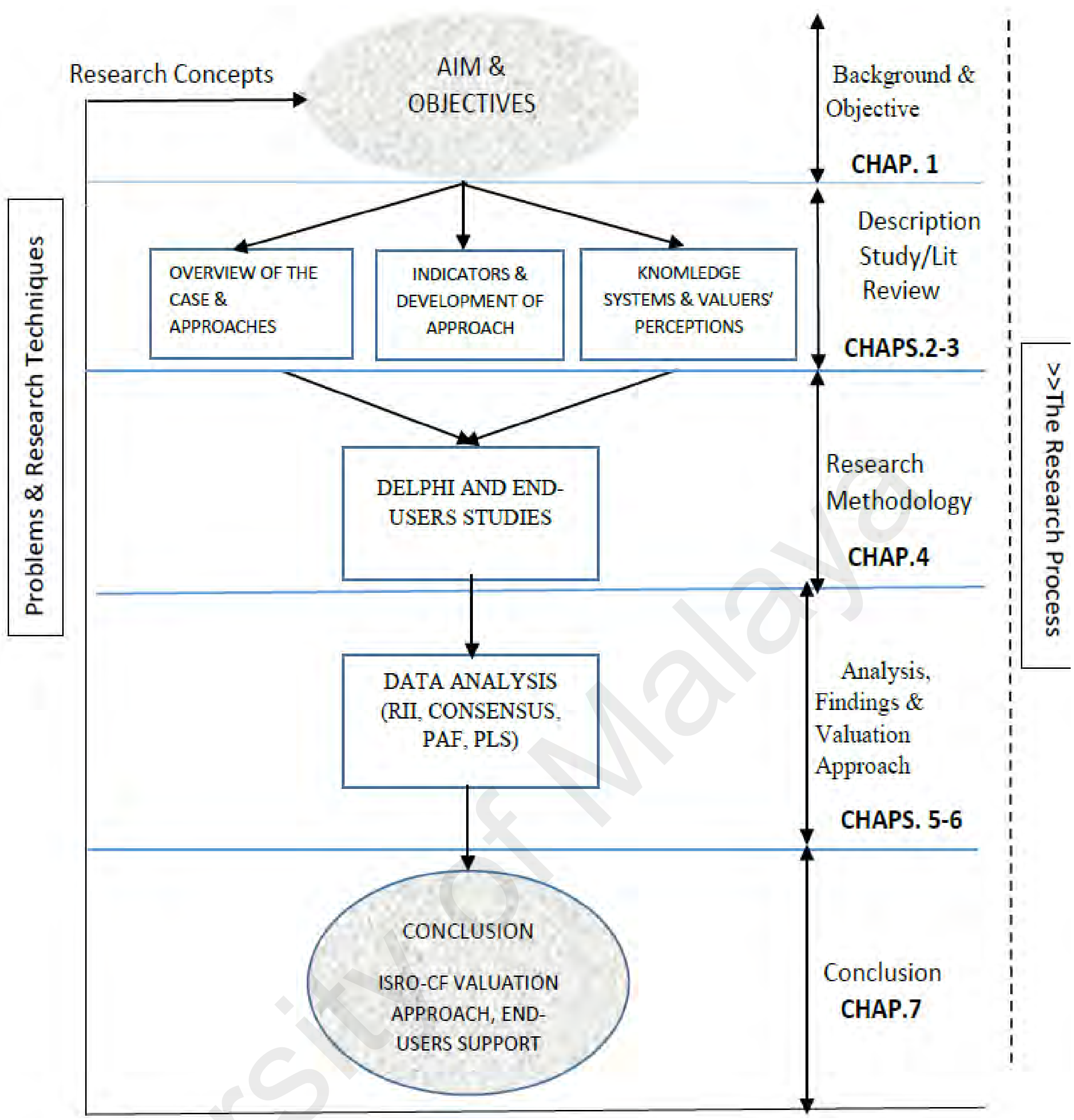


Figure 1.1: Overall Structure and Processes for the development of the Sustainability Integration Approach. (Adapted from Ramly, 1995),

The expected thesis outcome could provide an essential inducement to industrial investors to reduce environmental impacts and optimise their values to the business through compliance with the sustainability criteria. At the same time, it could also help to instigate and sustain the global fight for the survival of the Earth in which we live. The Professional Body would be encouraged to broaden the scope of sustainability to cover non-market industrial properties where no sustainability market exists using the appropriate methodological approach suggested in this study.

CHAPTER 2

THE CASE FOR REAL ESTATE SUSTAINABILITY

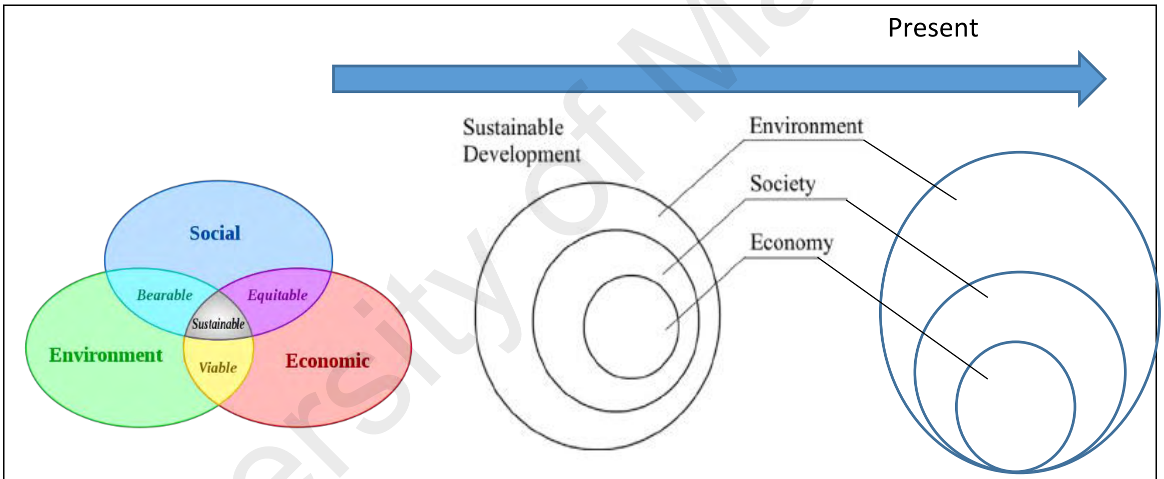
2.1 Introduction

The literature review was carried out to reveal the state of knowledge on the subject of study, the knowledge gaps which are in line with the research questions, the variables of study and other supplementary issues. Sustainability is important as it could be hard to maintain our quality of life as human beings, the diversity of life on earth, or the earth's ecosystems unless we embrace it. There are indications from all quarters that sustainability must be addressed to avoid running out of fossil fuels and timber, extinction of millions of animal species and causing permanent damage to the atmosphere. The root of a change to sustainable ways lies in understanding and striving for sustainability—in homes, the professions, in our communities, ecosystems, and around the world.

In dealing with the situation, section 2.1 of this chapter provides an overview of the case for sustainability with emphasis on insights into the environmental, economic and social dimensions in relation to property valuation, building obsolescence, business, associated benefits and the risk elements. Section 2.2 differentiates between green and sustainable buildings to avoid misconceptions and put property sustainability in perspective. It examines the case for sustainability in the real estate sector from the environmental, the sustainability-induced obsolescence, and the potential business and risks involved. In Section 2.3, green initiatives as well as their impacts were identified. Then, the social, economic and environmental benefits of green and sustainable buildings were discussed in detail. Sections 2.4 and 2.5 have the definition of operational terms and the summary of the chapter respectively.

2.2 The Case for Sustainability in the Real Estate Sector

Munasinghe and McNeely (1995) as well as Boyd (2005) contend that through balancing economic and social performance measures with environmental protection, the true sustainability can be achieved. However, in 2003, MacGregor argues in support of Dixon *et al.* (2008) that the three-pillar Triple-Bottom Line (TBL) model does not implicitly recognise the environment limits of growth because the basis is a balancing mechanism, which effectively trades off economic growth against the other two pillars. Conversely, MacGregor (2003) claims that the Russian Doll Model (RDM) implies that environment limits are an important constraining influence on economic growth. Figure 2.1 illustrates the evolution of the RDM for sustainable development (SD).



Three Pillars Model
Model
(Convergence represents
'Sustainability space')

Three Nested Ring Model
(Componential Russian Doll
cored/anchored by economy)

Nested Dependencies
(Ecologically-bounded
hierarchy ordered

Figure 2.1: Concentric representation of The Russian-Doll model for SD (Skringer, 2013)

The RDM model indicates that the environment, society and economy are viewed as three concentric circles: environment at the outermost, then society and economy at the centre. This alternative concept puts economic factors at the centre as the basis of wealth creation, driving the development engine, but at the same time is constrained by environmental and social considerations. In the RDM, development is sustainable if it provides good quality of life and stays bounded by ecological limits. Thus, to better evaluate the economic effects within sustainable development, the environmental impacts on social actions must be nested (Skringer, 2013; Jasimin & Ali, 2014). The RDM seems more suitable to adopt for real estate sustainability for the reason that economic forces are at the centre of real estate investment, but this time, are constrained by environmental forces such as the indoor environment, sustainable design and extended building life cycle. Figure 2.2 depicts the limitless possibilities in the market economy operate within the social and environmental limits.

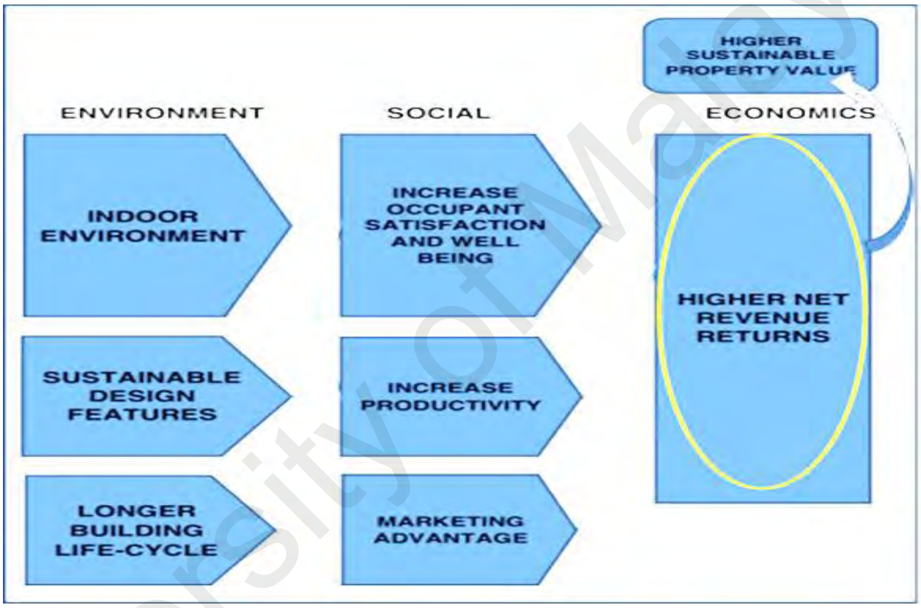


Figure 2.2: The Russian-Doll model for SD (Skringer, 2013; Jasimin & Ali, 2014)

The TBL model requires social and environmental impacts to be explored whilst the economic performance remains a fundamental part of the breakdown process (Ellison & Sayce, 2007).

2.2.1 Differentiating between Green Buildings and Sustainable Buildings

Green buildings (also known as green construction) refers to both a structure and the use of processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition (US EPA, 2009). In other words, green buildings primarily have energy efficient usage, water conservation, the efficient use of recyclable materials, non-toxic and other features than buildings that are just built to code (Ali & Al Nsairat, 2009). The primary components of industrial green buildings are energy efficiency, use of renewable energy, environmentally preferable building materials, quality, comfortable and healthy indoor environmental qualities (Syed-Yahya *et al.,* 2014). The balance between homebuilding and the sustainable environment requires close cooperation of the design team at all project stages (Sayce & Ellison, 2004). The green building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort (Yan & Stellios, 2006). USEPA (2009) has extensive programs and information on green building issues, including energy efficiency and renewable energy, water efficiency, environmentally preferable building materials and specifications, waste reduction, toxics reduction, indoor air quality, life-cycle assessment, siting and structure design efficiency, operations and maintenance optimisation.

Table 2.1 presents a differentiation between green buildings and sustainability in buildings.

Table 2.1: Differentiation between green and sustainable buildings (Von Thilo Ebert *et al.,* 2013)

<table>
<tr><td>Consumption of non-renewable energies</td><td rowspan="11">Green Building</td><td rowspan="13">Sustainable Building</td></tr>
<tr><td>Water consumption</td></tr>
<tr><td>Land use</td></tr>
<tr><td>Material consumption</td></tr>
<tr><td>Greenhouse gas emissions</td></tr>
<tr><td>Other atmospheric emissions</td></tr>
<tr><td>Effects on the ecology of the site</td></tr>
<tr><td>Solid waste / liquid waste</td></tr>
<tr><td>Indoor air quality, lighting, acoustics</td></tr>
<tr><td>Durability adaptability, flexibility</td></tr>
<tr><td>Operation and maintenance</td></tr>
<tr><td>Social and economic aspects</td><td></td></tr>
<tr><td>Urban development / planning related aspects</td><td></td></tr>
</table>

As in Table 2.1, Von Thilo Ebert *et al.* (2013) endorses that the green building focused on ecological and building-specific elements, such as designs and energy, while the economic, social and cultural dimensions of sustainability and planning-related issues are less considered. Sustainable buildings are properties with a range of features that make them more cost and energy efficient, functionally effective, profitable and marketable than conventional buildings. They also exhibit improved functionality, serviceability and adaptability as well as increased comfort and well-being of occupants while at the same time offering loss prevention benefits, risk reduction potential and decrease the impact on the environment throughout the building's entire life cycle (Kats *et al.,* 2003; Heerwagen *et al.,* 2004; Lorenz & Lützkendorf, 2008a; Jasimin & Ali, 2014).

2.2.2 Sustainability Initiatives for Real Estate Valuation

The theoretical basis for the integration of sustainability considerations into the property valuation process began in 1996 (Harrison & Seiler, 2011; Lorenz & Lützkendorf, 2011). In the scheme of sustainable development, the real estate sector has a great role to play. Property and construction in the Organisation for Economic Cooperation and Development (OECD) countries alone accounted for 24-40% of total energy use, 30% of raw energy use, 30-40% of solid waste generation. The sector holds the largest single share of global environmental degradation and impairment of quality of life (OECD, 2003; Lorenz, 2006). Buildings contribute significantly to climate change because they are great emitters of CO_2 (Reed & Wilkinson, 2007). In the 2006 study, Lorenz emphasises that actors within the property market, including property researchers, are slowest in responding to challenges imposed by sustainable development, and that efforts in achieving success in future would be dependent on the progress that can be made in integrating sustainability issues into property valuation theory and practice. Sustainability in real estate is an evolving body of knowledge, for which there is a need for further analysis in individual and broader markets to provide guidance, and knowledge of the implications and applicability of sustainability for the valuation profession (Warren-Myers, 2012). At the moment, an intense debate concerning the issues of sustainability is on-going within the valuation profession as a result of the steadily growing awareness to reflect sustainability considerations in the property valuation tasks. This is due to research providing some reliable empirical evidence from Salvi *et al.* (2010); Wameling & Ruzyzka-Schwob (2010) and Pivo and Fischer (2010) on the positive relationships between buildings' sustainability features and observed property prices. This indicates a change in market participants' perceptions, value systems and measures. As a consequence, valuation methods and processes have to reflect this change. Furthermore, a growing awareness of sustainability considerations among valuers also stems from the recognition that a proactive approach to the integration of sustainability issues into the valuation process may be beneficial in several ways as it could provide reputation gains and secure long-term competitiveness. The success of sustainability in property investment is limited by the valuers' sustainability assessment competences, insufficient historical evidence, data and information on the quantifiable effects on market value. Thus, the latitude for uncertainties in making comparative adjustments for property sustainability uptake is a probable risk (Warren-Myers, 2012).

Industry bodies have undertaken considerable research in investigating the relationship between sustainability and value through a variety of media. Although using a range of analysis methods, industry bodies have also developed research to compel the positive relationship between sustainability and market value. A representative example of industry-led research publications examining the relationship between sustainability and market value and drivers for the real estate market include the following: JLL (2007, 2008), Colliers International (2007), CB Richard Ellis (2007), Merrill Lynch (2005), Davis Langdon Consultancy (2007), Investa (2007) and JP Morgan (2008), Radanovic and De Francesco (2008). In addition, there are many other groups contributing to the growing body of knowledge on the subject of sustainability and market value. However, the applicability of the information in these studies to valuation practice is limited. It is imperative to establish the sustainability case and elicit its evolution in the property investment market. This helps to identify the trends in the commercial real estate market in particular and to inform valuers of the changing elements and perceptions within the emerging sustainability markets for market and non-market properties. The case for sustainability, from the property perspectives, can be examined from four main aspects: The environmental, the property obsolescence, risks and the business cases. The discussion on these perspectives is outlined as follows:

2.2.2.1 The Environmental Case

Research on climate change suggests that improvements in the sustainability agenda for buildings can have large effects on greenhouse emissions and energy efficiency. It happens because buildings play a key role in climate change strategy. They are important target areas for addressing climate-related changes (Miller and Buys, 2008; Eichholz *et al.,* 2008; Michl *et al*., 2016). Buildings contribute significantly to temperature rise and global warming because they are great emitters of carbon dioxide, CO_2. The resultant differences in temperature are the drivers of the winds and their circulation patterns. A rise in temperature also introduces new climatic conditions, variations in rates of evaporation and agricultural patterns and that is the key reason for more extreme rain and storms, coastal and inland flooding in some areas and hotter dry spells and longer droughts in others (IPCC, 2014a; WMO, 2011). There is valid evidence to compel the understanding of the climate change and global warming dynamics as the world's population continues to grow with accelerating urbanisation patterns, and human actions in daily life necessitate a better discretion of resource allocation and the impact of that allocation on the environment.

The environmental case for property sustainability is grounded in existing buildings accounting for up to 29% of global CO_2 emissions today, or the equivalent of 9 billion tonnes of CO_2 annually. IPCC (2014b) insists that aggregate carbon footprints could double by 2050 if new sound sustainability strategies in construction and manufacturing not adopted. Howe (2010) estimates that the stock of existing buildings and process industries are responsible for over 40% of the world's total primary energy consumption. Most building materials contain materials which are potentially harmful (Heralova, 2011). Formaldehyde emission from particle boards, carpets and rugs are difficult to recycle, degrade indoor environmental quality (IEQ) while particle boards production also consumes energy and impinges on human health. Aluminum sheets require intensive extraction processes. The manufacture of plastics, pipes, paints, tiles, rubber, beams and steel, veneer and plywood, require high energy consumption. Construction sites wastes constitute 40% of wastes to landfill and dump sites with 16% of fresh water demand and over 25% of global timber consumed in the process (Friedman & Camalleri, 1995; Reed & Wilkinson, 2007). Warren-Myers (2016) contends that the current reinvigoration of discussions regarding sustainability and real estate valuation functions on the increasing evidence of linkages of the property sector with climate change and the realisation that buildings can help mitigate temperature rise and climate change.

In the USA alone, buildings accounted for 39.4% of total US energy and 67.9% of electricity consumption in 2002: Residential buildings accounted for 54.6% of that total energy while commercial and industrial buildings accounted for the other 45.4%. Buildings in the USA contribute 38.1% of the national CO_2 emissions. Indoor levels of pollutants are higher than outdoor levels. Building construction and demolition debris averaged 136 million tons per year (US EPA, 2016). The building occupants use 12.2% of the total water consumed in the USA. 74.4% by homeowners and 25.6% of industrial and commercial users. The indication is that green development strategies be worked out when constructing new buildings, retrofitting existing buildings and the redevelopment of brownfields to reduce energy use, portable water conservation, increase recycling and IEQ, decrease the use of raw materials, preserve natural systems and moderate greenhouse gas (GHG) emissions.

In Australia, electricity accounts for the biggest source of energy in the buildings sector followed by gas, petroleum products, and coal. The mainstream of Australian electricity derives from brown coal, an emitter of 89% of GHG. On the other hand, gas explains only 7 percent of the total emissions (Reed & Wilkinson, 2007). Substantial reductions could occur if Australian buildings switched from electricity to gas as a source of energy. Nonetheless, current predictions of the emission levels are expected to double by 2018. In addition, it has been shown that building envelope performance has a significant effect on the requirements for heating, cooling and lighting in office buildings (AGO, 1999; Reed & Wilkinson, 2007). There is concordance that improvements in the performance of the thermal daylighting and natural ventilation of commercial building envelopes could reduce GHG (Moss *et al.,* 2006). New construction now has higher levels of thermal efficiency than any past period, and that has been attained from improved standards in building and construction codes and regulations (BCA, 2005). The improvements have helped in delivering energy-efficient building stock. Boardman (1991) demonstrates that the replacement of the existing stock of properties is less rapid that it could take hundreds of years to bring all stock up to preferred standards. The current replacement rate for Australian office stock is less than 3% per annum (JLL, 2006; Reed & Wilkinson, 2007). The examination of the proportions of energy use and GHG shows that heating was the largest single end use at 33% and the fourth largest on GHG emissions. Cooling, lighting, and ventilation increased in importance to an aggregate of 71% of total emissions.

Nevertheless, the actual proportion applicable to a specific building varies considerably from the average. The breakdown of emissions related to specific operational use vary across the climatic zones. Overall, the analysis of specific energy applications primarily responsible for GHG is 28% (cooling), 22% (air handling) (22%), lighting (21%) and heating (13%). Heating, ventilation, air-conditioning and lighting jointly account for 84% of commercial building sector GHG. In these areas, the opportunity to reduce emissions exists (AGO, 1999). When all building types are considered, the largest single source of greenhouse gas emissions in buildings is from offices. It is clear that innovations to reduce emissions of the buildings sector are required. In Victoria, for instance, the GHG emissions derived from commercial and industrial buildings is more than those from all the cars in Australia (Australian Building Codes Board, 2001)

Embodied energy, that is, the mining and manufacturing of materials and equipment, transport of the materials and the administrative functions, is a significant component of the lifecycle impact of a building. Hitherto, it was held that embodied energy was insignificant in comparison to operating energy use in buildings during the life cycle. However, this view has changed with research demonstrating that for some buildings, those using materials with high embodied energy, can equate to many years of operational energy. When buildings are renewed or transformed, additional embodied energy is hosted. The prime factor in reducing the impact of embodied energy is to design long life, durable and adaptable buildings. Materials specification have a substantial impact on the total amount of embodied energy in any building. Transport issues are the principal contributor to emissions to air in the city, and urban areas are fossil fuel combustion, particularly by motor vehicles. These account for the bulk of carbon monoxide (86%) and nitrous oxide (averaging 67%). The highest source of nitrous oxide was passenger vehicles with 204 kilo-tonnes (65%) of road vehicle emissions. While there are considerable research and development into alternative methods of fueling vehicles such as ethanol, hybrid cars, electric powered vehicles the majority are petrol fuelled. Based on 1990 data, the contribution of transport vehicles to total Australian greenhouse gas emissions (CO_2 equivalent) is just under 12% and Australia had the third highest globally measured per capita level of carbon dioxide emissions for transport. Furthermore, figures compiled in the Australian National Greenhouse Gas Inventory showed road transport to emit the largest volume of greenhouse gasses by the transport sector. CO_2 emissions from road transport totaled 55 million tonnes in 1994, accounting for 79% of total transport CO_2 emissions, an increase of 11% in CO_2 emissions since 1988. Air transport stood at 9 million tonnes an increase of 36% since 1988 while rail, and marine figures declined. Inevitably people need to travel to and from buildings and this where transport energy issues relate to property. For that reason, it is the location of the property, the building type and access to a range of transport nodes which all impact on the associated transport energy. The indication is that it could take hundreds of years to bring all the stock up to current best practice standards (JLL, 2007; Reed & Wilkinson, 2007).

In Nigeria, the increasing pace of socio-economic development has led to the systematic depletion of the natural resources with particular reference to land, water and air, erosion, pollution and desertification (Kümmel, 1989). The manufacturing sector accounts for 10% of the GDP, with an industrialisation policy at increased production of process goods, domestic and foreign trade. Aina (1992) lists the environmental degradation factors that can result in property value diminution, such as siting errors, less consideration for the climate in property decisions, construction, and non-use of use of plant materials. Gaseous emission of CO_2, oxides of sulfur, (SO_X), nitrogen (NO_X) and halons, when exposed to atmospheric moisture fall as acid rain. Acid rain holds corrosive effects on building materials, such as marble, ferrous and non-ferrous copper, aluminum, zinc, leather, paper, rubber and ceramics. During the dry season, black soot and particulates from asphalt and cement works settle as deposits on properties to make their colour unattractive, forming abrasive blasts in windy conditions. By 1986, according to Otegbulu (1992), Nigeria alone was flaring 16.8billion cubic metres of natural gas a year, resulting in the annual emission of 2700 tonnes of particulate matter, 160 tonnes of SO_X, 5400 tonnes of carbon monoxide (CO) and 27 tonnes of NO_X. At one of the flow stations, gas flaring led to 100% loss in the yield of all crops cultivated about 200metres from the flow station, 45% loss for crops 600metres radius and 10% for those one kilometre away. Industrial pollution also affects the income on land by decreasing the farm yield or affecting the health of the farmers. Blasting of limestone distresses building foundations and cause cracks on their walls. In mining areas, pollution affects foundations, causing increases in cost–in-use and frequent repairs. Many industrial solid wastes exude obnoxious odours which are very repulsive to man. Obnoxious odours led to the immigration of poor classes and emigration of high-class tenants in neighbourhood properties and a shift in land value patterns. Pollution threatens groundwater quality and the supply of drinkable water facilities to man and property. Noise pollution may cause hearing loss, and its vibrations may also pose threats to building foundations and walls (Asaju, 1992).

Konar and Cohen (2005) establishes the correlation between environmental performance and the intangible asset values of 500 firms. The study used two environmental performance measures: Toxic Release Inventory (TRI) emissions levels; and pending environment -related litigation. Also, greater firm market value regresses on reductions in toxic chemical releases. The study appraises the association between corporate environmental performance and the factors of production and other resources that permit a firm to earn profits over and above the return on its tangible assets. There is a strong environmental case for sustainability in property performance and impact minmisation (Konar & Cohen, 2005)

2.2.2.2 The property valuation and sustainability-induced Obsolescence case

The implementation of SD principles within real estate markets require the integration of sustainability aspects into the theory and practice of valuation (Lützkendorf & Lorenz, 2011). Heralova (2011) also indicates that environmental concerns and social wellbeing now influences the property markets to an extent the owners and users have begun to consider the benefits and risks connected with ownership. Moreover, valuations are carried in almost any phase of the building life cycle with the valuers as axes around which market information flows. The valuers' professional advice on investment risks and other related issues influence market outcomes. Warren-Myers (2012) asserts that the importance of sustainability uptake in the commercial property stock is paramount for reducing the negative impact of the built environment. Carbon footprints could be reduced when industrial sustainability sets the limits of production capacities for industries through internal financial control incentives (Ibiyemi *et al.,* 2015). Valuation instruments can be useful in the assessment of the value of assets to reflect the extent to which properties adopt the prevailing sustainability criteria (Runde & Thorye, 2010; RICS, 2014). The professional ethics and the resulting responsibility towards the society implies that valuers incorporate sustainability into real estate valuation (Lorenz, 2011). Other key arguments are:

(1) Market transactions in the USA, Germany and Switzerland have been observed to reflect the sustainability index as a critical value driver. Also, the foreseeable sustainability market developments are recognisable in differentiated user requirements, green legislation and sustainability reporting liabilities. (Warren-Myers (2012)

(2) Values to the business or owner not reflecting inducement for industrial sustainability uptake to industrial investors may not be a fair assessment of the investment value. For instance, how fair would the investment value be if the owner neither makes any effort to comply with the sustainability metrics nor the valuer makes any effort to induce him to do so (Ibiyemi *et al*., 2015)

(3) Valuers take the view that valuation could not be considered rational and socially responsible if they are mere market reflectors without being active influencers.

(4) Opportunistic and the enlightened investors could monopolise the market if properties are mispriced as a consequence of not reflecting sustainability.

(5) There could be the risk misallocation of investment capital or probable underinvestment in building sustainability if actors are not knowledgeable about sustainability and its value influences (RICS, 2009; Lorenz, 2011; Lützkendorf & Lorenz, 2012)

(6) It is increasingly becoming important for valuers to expect that industries would behave rationally in pro-sustainability ways (Ibiyemi *et al.,* 2015).

(7) Responsibility towards society and the environment for image gains, and the avoidance of reputational risks as a condition for continued economic success. (Lorenz, 2011).

(8) Buildings having substantial sustainability uptakes exhibit less impact on the environment and increases buyers and tenants' willingness to pay (Warren-Myers (2012).

The concept of obsolescence is important to the discussion of sustainability as obsolescence occurs when there is impairment to the desirability and usefulness of a property; this is brought about by technological changes or improvements in asset performance which makes properties not incorporating these evolutionary changes to become less desirable and valuable (API 2007). Sayce *et al*. (2004) examines the effect of sustainability in valuation methodology and propose that lack of property sustainability uptake equates to devaluing of assets, from the valuation point of view. Conceptually the model of Lützkendorf and Lorenz (2005) depicts the premium economic benefits accruable to sustainable buildings but Myers (2009) emphasises that sustainability is not about value-adding rather, it is preventing discounting and devaluing of property values as a result of non-compliance with industry demands of sustainability. Wurtzebach and Miles (1984) identify physical deterioration, economic, and functional obsolescence as the causes of depreciation. Baum (2005) adds that obsolescence causes depreciation in value of a property through a decline in its utility. Baum (2005) relates depreciation linearly to a loss in value, and in further support, identified (i) tenure specific factors, such as shortening of a lease, and (ii) property specific, such as a harmful environmental changes in the neighbourhood, as other factors. It was argued that the value of an investment depends on the return it produces, and return is a function of three main variables: income, return of capital and operating expenses. Since the rental value of a property will be reduced by depreciation, income is affected. Also, depreciation is evidenced by rising all-risks yields over time: as the rental value is reduced and the market yield increases, depreciation contributes to a twofold reduction in the available return of capital (Grover & Grover, 2015). Furthermore, repair, maintenance and insurance costs will increase, so that the depreciation could lead to rising operating expenses, thereby reducing net income. Obsolescence then could be regarded a risk element. The work of Bowie (1982) had earlier calculated that an apparent 4.5% return on a 65 year old prime property was cut down to 3.9% after depreciation.

Sustainability related attributes and characteristics of property assets are today starting to enhance and complement the traditional drivers of a property's economic value, investment risk and performance. Sustainability and obsolescence are also identified and recognised as having an impact on value, for which the valuers should build into their calculations (Warren-Myers, 2010; Lorenz & Lützkendorf, 2011; RICS, 2014; Ellard, 2015). According to Ellard (2015), sustainability edges with obsolescence in the practical world of valuation. Ellard enjoins valuers to build into their calculations, the extent to which a well informed buyer and the market might account for sustainability, preferably as evidenced by comparable transactions. The uptake of sustainability and sustainable practices has a direct impact on the value of property (Matthiessen & Morris, 2004; Suttell, 2006; Reed & Warren-Myers, 2010; Grover & Grover, 2015). Consequently, properties not incorporating sustainability changes may be less desirable or valuable, thus becoming a potential investment risk, and would have accelerated obsolescence, because they are unable to meet evolving needs of the market for sustainability (Baum, 2005; Sayce *et al,* 2007; Myers, 2009; Warren-Myers, 2012; API 2007, Lorenz & Lützkendorf, 2011; Ellard, 2015). Nevertheless, Reed (2009); Myers (2009) and Warren-Myers (2012) caution that sustainability is not only about value adding, but avoiding discounting and devaluing of property values as a consequence of non-compliance with the demands for sustainability. This view was also held by Reed (2009); Warren-Myers (2012) and Ibiyemi *et al*, 2015). Ibiyemi (2004) considers a non-market based approach, and explains that industrial sustainability-related obsolescence (ISRO) could relate to the extent to which industrial property features fail to conform to the demands of local sustainability. This was first suggested when the researcher presented the non-market impact-prescriptive approach to environmental sustainability and industrial property valuations in Nigeria. Ibiyemi (2004) argues that conceptually, obsolescence precedes a fall in value, indicative of the necessity for the property owner/proprietor to 'comply' with certain physical, economic, functional/technological metrics, including "sustainability" metrics. Obsolescence plays a significant role, among the other forms, in redefining building life, property income cycles, and stimulate significant industrial sustainability market sensitivities over a short period of time, where such markets do not now exist. These thoughts have been extensively shared by Myers (2009), API (2007) and Parnell and Sayce (2007).

There are many forms of obsolescence, but traditionally, three forms affect all properties: physical, functional and economic. Others include technological, locational, legal, and historical obsolescence. The concept of sustainability obsolescence is evolving from the green sector (Reed & Warren-Myers, 2010). Loss in value applies to a broad range of considerations that spans through the TBL expression of sustainability. The study of Myers (2009) concludes that investors are devaluing non-sustainable properties as a result of perceived increasing risks and obsolescence. Investors focused on potential risks and 'sustainability' obsolescence that could arise in their property portfolios, but valuers indicate that obsolescence had the least effect on market value relative to other variables. API (2007) and Parnell and Sayce (2007) postulate about the same time that properties not incorporating sustainability changes may become less desirable and valuable, because as the markets evolve, sustainability requirements are demanded and properties that are unable to respond to sustainability demands will have their obsolescence accelerated due to insensitivity. Baum (1991a, b) also recognise obsolescence and insist that it should be included in valuation assignments and inherently incorporated in the treatment of the initial and terminal yields.

It has been found that all investors have not altered the traditional financial parameters and requirements in their investment analysis techniques to incorporate sustainability

(Myers 2009). However, organisations and fund companies have begun to set sustainability-based requirements for potential resource maximisation. Investors, generally, have not altered their investment and acquisition models to incorporate sustainability and do not look likely to implement them in the immediate future. Myers (2009) explains that investors were concerned with escalating resource costs for energy and water and security of supply, as well as the probable regulative and legislative policies, such as emissions taxing. The investors also focus on ensuring mitigation and limitation of potential downside risks that could affect the financial viability of the portfolio. Overall, the lack of consideration in valuation practice of obsolescence could result in incremental misreporting of values as markets evolve and demand sustainability requirements. The probable outcome is that properties falling short of sustainability initiatives could be increasingly sensitive to increased risk and accelerated obsolescence (Parnell & Sayce, 2007). Miller and Buys (2008) notes that property owners who fail to upgrade their properties by integrating sustainability credentials could be ruled out of the market soon or late due to perceived higher returns, reduced outgoings, staff attraction to better work places and comfortable environment. It was also proclaimed by Michl *et al.* (2016) that properties that are not resource efficient as to satisfy occupiers' expanded needs should expect a diminution in value. Sayce *et al.* (2010) warns that such properties would require extensive retrofitting works that could accelerate physical deterioration. There are financial and market risks, such as rental growth loss and other adverse yield movements (Lorenz *et al*. 2007; Ellison *et al* 2007; McNamara, 2008). Lockwood and Deloitte, (2008) as cited in Jasimin and Ali (2014) recommends the adoption of green buildings to building owners, insisting that their buildings would be susceptible to obsolescence. One of the reasons for not buying or renting commercial premises at premium prices in Germany was in response to their poor social and environmental performance (Lorenz *et al*, 2007); a condition of which Eicholtz *et al.*, (2010) ascertains through the observation of loss in value of up to 2% for comparable properties within the same area. Similarly, the study of Miller and Buys (2008) on the tenants' perspective of retrofitting commercial properties predicts that tenants would discount for lack of sustainability features in their rental bids. The contention in theory would be that as operating costs for water and energy would be lowered, there would be a corresponding rent subsidy in non-sustainable buildings to compensate for this in the market place. More users should express higher willingness to pay (WTP) for the sustainability credentials. More so, large private and government tenants would not likely consider non-sustainable buildings while smaller tenants anticipate a non-sustainability discount. To this end, the implication is that Green Building Councils already envisages the development of a double-tier property market: One encouraging a "green" premium, and the other, a "brown" discount.

2.2.2.3 The case for sustainability as a risk factor in property valuation

Myers (2009) finds that investors were concerned with escalating resource costs, particularly for energy and water and security of supply. The looming regulative and legislative policies, for example, regarding emissions taxing, were of key concern to the investors and they were focused on ensuring mitigation and the limitation of the potential downside risks that could affect the financial viability of the portfolio. The key element of risk investors identified was the ability of the properties to secure future tenant demand, through the attraction and retention of tenants. Changing occupier needs and requirements, such as increasing corporate social responsibility requirements and carbon taxing, may be detrimental to properties which do not incorporate the desired attributes. As a result, the investors were apprehensive of the competitiveness of their properties in the future when other factors may engender the property obsolescence. Investors' reactions to these potential risks were to ensure properties within their portfolio were future proofed against increasing costs and resulting obsolescence. Nevertheless, some property investors assess sustainability levels in their property portfolios to identify assets deficient in the required sustainability levels, based on portfolio or regulatory requirements (Myers 2009). These assets were either upgraded while those properties unable to be made more sustainable without substantial cost, were earmarked for divestment or redevelopment. In addition, investors considered new acquisitions if the sustainability level required in the portfolio was not met since the cost of upgrading the asset to the required level was incorporated in the investment analysis. Reed and Myers (2010) considers that sustainability as a technological change affecting the commercial property is a potential risks relating to demand, competition, regulatory and legislative issues. Runde and Thoyre (2010) explains sustainability-related risks under the following categories as shown in Table 2.2: The risks categories are: *(1)* Resource use: Operational and Construction/Renovation. *(2)* Obsolescence *(3)* Transparency and Stakeholder Influence. *(4)* Externalities.

Table 2.2: The Sustainability Risk Assessment (Runde & Thorye, 2012)

RISK CATEGORY	EXAMPLES OF SUSTAINABILITY RISKS	POTENTIAL PROPERTY VALUE IMPACTS	
		Direct	Indirect
RESOURCE USE	• ↑ global demand for materials vs. fixed supply • ↑ energy cost, volatility; ↑ water cost, rationing	• ↑ replacement cost; ↑ TI & future renovation costs • ↑ operating expenses, ↓ NOI; Energy efficiency becomes paramount	• ↑ replacement cost may ↑ market barriers to entry; Renovate preferred over new construction; Life cycle costing
OBSOLESCENCE	• Consumption rate ↓, or patterns shift • ↑ need for properties to adapt to future uses and users (not yet identified) • Increased rate of change expected in future	• ↓demand for retail; change in type/location • ↑rate of depreciation; ↑ TI, cap ex cost for less adaptable properties	• ↓ economic growth due to ripple effect of consumer (70% GDP) • ↑ risk for special-purpose improvements
TRANSPARENCY & STAKEHOLDER INFLUENCE	• ↑ disclosure of energy efficiency • Non-financial stakeholders influence investor decisions	• GRI reporting that triggers green-up of REIT portfolio; carbon reporting	• Stigma for poor performers • Supply chain reporting requirements

Table 2.2, continued: The Sustainability Risk Assessment (Runde & Thorye, 2012)			
EXTERNALITIES	• Greenhouse gas (GHG) and climate change legislation • Community charges back project externalities • Poor indoor air quality.	• Carbon taxes, cap & trade; Project GHG emissions used as reason not to allow development • Impact fees; assessment • Health risk liability	• Stigma: ↓ marketability

Theoretically, global demand for sustainable materials are rising and those who are not complying with the new trend would contend with high energy costs and the accompanying mark-up in operation costs and volatility. Retrofit costs and life cycle costings could also be affected indirectly. The scenario depicts that property marketability can be impinged upon with a prospect of high impact fees. Hence, a risk-based approach could then work to the valuers' strengths, since they are accustomed to identifying existing and future property risks, and then accounting for their impact in the adjustment of the comparable and the overall capitalisation or yield rate selection. French (2017) recites the UK Energy Act of 2011 which prohibits the leasing of residential and commercial properties with certifications below F and G from April 2018. The affected properties would have maximum obsolescence rate of zero unless they are retrofitted, refurbished or redeveloped. The scenario presents a hybrid of legislative and obsolescence risks.

2.2.2.4 The business case

The Vancouver Valuation Accord (VVA) (2007) recognises the increasing need and demand for the business case for sustainability to be established where valuation plays a crucial role by embracing the initiative that valuers no longer wish to ignore climate change. Therefore, the Accord commits to: (1) review how sustainability relates to the practice and standards of valuation (2) working with stakeholders (3) promote awareness of and competency in the appropriate methods of addressing sustainability in valuations and worth appraisals (4) working with those within and outside the valuation professions worldwide (4) educate and inform about sustainability and its relationship to value and worth. (5) provide regular reporting of the collaborative progress via an agreed secretariat set up for that purpose. Professional bodies are encouraged to raise the professional awareness while governments legislate for changing practices via performance standard and upgrades and the universities are offering a full range of 'green' credentials through virtually every faculty and industry associations can promote the green agenda.

Schaltegger and Lűdeke-Freund (2012) indicates that the sustainability activities generate a useful business effect or an invaluable contribution to the economic success of the company which can be measured or argued for in a convincing way. Such effects could include cost savings, the increase in sales and profitability, customer retention or reputation. The causal relationship can be direct or indirect, but based on a sound and clear management argumentation. Globally, sustainability contributes positively to businesses in the long term (Bonini & Görner, 2011). The expectations for adaptation changes includes a review of their internal and supply chain emissions. Eccles *et al*. (2011) and Bonini and Görner (2011) view that strategic integration of sustainability performance adds social value bolster growth and profitability and also prepare companies to address stakeholder expectations, anticipate and recognise enduring trends of resource use. Also, IFC (2016) asserts that embedding sustainability into the company's business leads to enhanced reputation and increased brand value. The more a company demonstrates to stakeholders that its business is compelled by strong sustainability policies, the lesser the risks connected with that company. However, in contrast, frail environmental, social, and governance (ESG) performance can adversely impact the business reputation. According to IFC (2016), The rising demand by consumers and investors for sustainable products and services, the increased scrutiny and reporting on corporate responsibility, are driving companies to pay greater attention to their sustainability performance. Investors now consider environmental and social issues when selecting investments. Different sustainability reporting frameworks such as the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP) have become vital tools for investors in building informed investment decisions. The number of companies using GRI as a framework for reporting sustainability measures has increased by 73 percent in the last four years (Bloomberg, 2010).

The drivers of a business case for sustainability, directly and indirectly, influence economic success (Schaltegger, 2011). The drivers are comparable to the variables that affect a conventional business case, whereas the relationships between voluntary social and environmental management and economic success are often different from conventional economic cause-and-effect chains, and so is the kind of influence a social or environmental activity has on the economic drivers. The potential business case drivers reveal a broad range from direct to indirect influences on business success and economic performance. The most direct link may be through potential and actual costs. The role of potential and real costs reduction is often addressed as a driver about energy savings, the reduction of material flows or cleaner production approaches. The second link is the discount of technical, political, societal and market risks. Opportunity-oriented drivers of business cases for sustainability are addressed when sales and profit margins or the company´s reputation and brand value are increased. Moreover, other drivers such as market accessibility can play an important role depending on the circumstances and the company´s market strategy. Besides these drivers with a rather direct economic impact, some rather indirect effects are possible. One is the *attractiveness as an employer* which can be driven through recruiting and selection, induction and development programs.

Another is the *capability to innovate* which sustainability can improve because thinking in multiple dimensions is encouraged and more diverse knowledge sources from stakeholders and others are sought. Current empirical research of confirms these six main business case drivers as: (1) Costs and cost reduction (2) Risks and risk reduction. (3) Sales and profit margin. (4) Reputation and brand value (Attractiveness as employer, and (6) Innovative capabilities (Schaltegger and Lűdeke-Freund, 2012; Hansen, 2010; Revell and Blackburn, 2007). An important issue which is often neglected when assessing the effect of environmental and social activities on business success or economic performance is that their path of influence, that is, their cause-and-effect links, can be quite indirect, involving non-market links and actors such as political initiatives and NGOs. Also, these relationships can be stochastic which makes their management even more difficult. In consequence, creating and managing a business case for sustainability is a real management challenge which at the same time offers business opportunities and the potential to contribute to sustainable development. Nonetheless, this requires purposeful sustainable entrepreneurship and corporate sustainability management.

Myers *et al.* (2007) identifies primary investor-developer considerations for the determination of Market Value, Internal Rate of Return (IRR), Net Revenue, Net Present Value, Sale Price and Yields. However, the governments' view on the financial viability of sustainable buildings is inherently different to that of the private sector where the benefits are hard to prove. Government could provide subsides as incentives to develop sustainable buildings; the private sectors are less willing by default. The government perceives the benefits of sustainable buildings more through social and environmental prisms with some regard to financial while, on the other hand, the private sector may care less about health and environmental impacts and therefore might perceive lower financial benefits of building 'green'. Nevertheless, Lützkendorf and Lorenz (2005) presents a sustainable features-and resulting economic outcomes model in Figure 2.3. The model emphasises that energy efficiency could influence low operating and maintenance cost, lower vacancy rates and business interruption risks. The reducing impact on the environment is a function of lower vacancy risks, cash stability flow, litigation risks and compensation costs caused by the sick buildings syndrome (SBS).

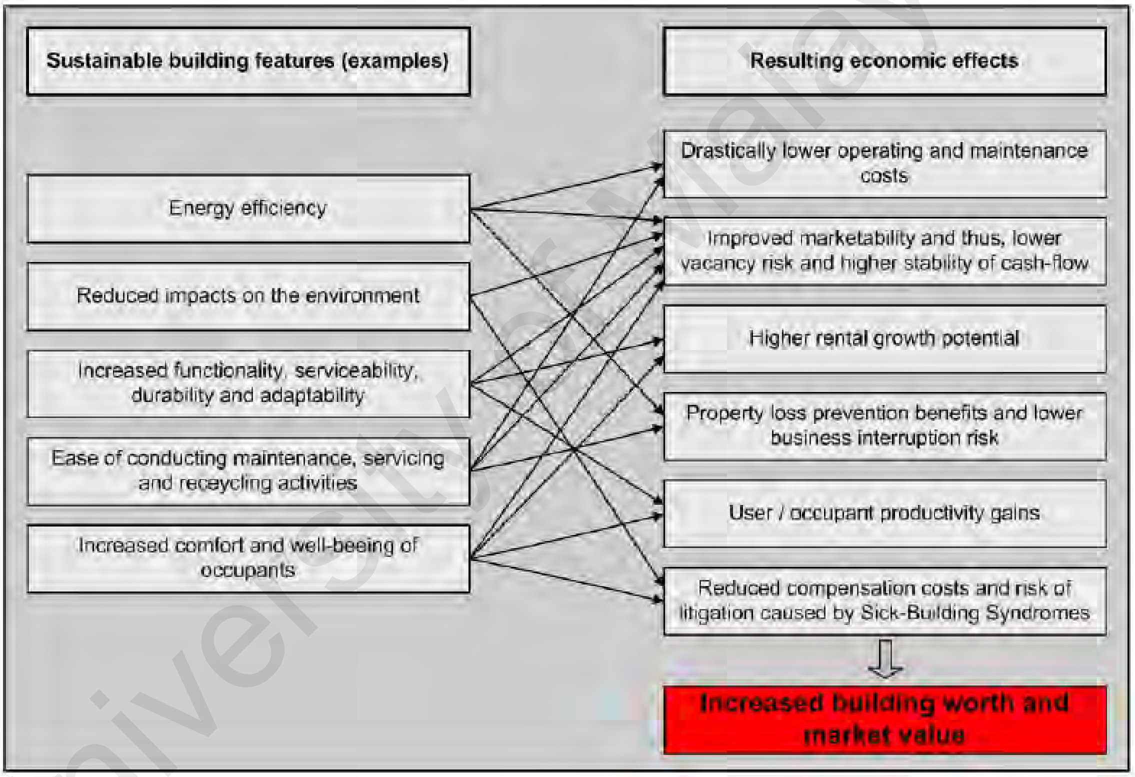


Figure 2.3: Main sustainable design features and economic outcomes. (Lützkendorf & Lorenz, 2005)

Property or real estate is a debt investment that primarily involves an initial capital outlay in return for a fixed periodic income over a predetermined period, whereby at the end the capital outlay will be returned (Robinson, 1989). It implies that capital growth and sustained rising income are often the primary concerns of investment in property. Hence, investors tend to seek out the best investment brand in which comparative financial viabilities of alternative investments and sustainability have become the most important factors for consideration.

2.3 Green Initiatives, impacts and Sustainability benefits in Real Estate

This section discusses the green initiatives and the potential sustainability benefits in the subsections 2.3.1 and 2

2.3.1 Green Initiatives

The green initiatives are the prime value drivers of sustainability. It comprises of environmental-driven building features as highlighted in Table 2.4. These are closely knitted with the impacts and associated theoretical values that are shown in Table 2.4 below.

2.3.2 Green building impacts and Sustainability benefits for Real Estates

Commercial and residential buildings can be managed by their owners or by facility managers. In some cases the drivers for both are similar, such as minimising operating costs, ability to attract tenants, achieving higher returns on assets and increased property values, enhanced marketability and reduced liability and risk (Madew, 2006). There are economic, environmental and social benefits which provide advantages to owners and occupiers of the sustainable building as it can deliver additional security on loans security, higher rental , less voids and sales duration, reduced customer or employee attrition or turnover, better stability of rent, higher occupancy rates (Kats *et al.,* 2003; Addae-Dapaah *et al.,* 2009). These advantages are likely to improve investment returns, although there is limited proof about the influence on asset value. The economic benefits are discussed in the following subsections:

2.3.2.1 Lowering operating costs

Direct operating costs include all expenditures incurred to operate and maintain a building over its full life. Obvious costs are energy and water consumption, security, cleaning, minor repairs and routine maintenance activities. However, this cost category also includes less obvious costs such as property taxes, insurance, and the costs of reconfiguring and upgrading space and services to accommodate occupant moves. The costs of major renovations are excluded as they are considered to be direct capital investments. Eichholtz *et al* (2010) states that green buildings save on operating costs such as energy for years to come. Energy efficiency reduces the operating costs of buildings and equipment and, hence, saves money. Cost initiatives (such as doing things in a different way) can achieve huge savings and investments in technical solutions can pay for themselves quickly.

Table 2.3 depicts the probable green impacts of initiatives and their possible value benefits. Reduced lighting loads, high efficiency appliances, increased insulation, passive solar heating, passive ventilation, water conservation measures and commissioning that uncover and correct inefficiencies all lead to savings in operational costs of energy, maintenance and capital costs. These cost savings can be used to market the project to prospective clients and tenants (Bowman & Wills, 2008)

Table 2.3: Green Initiatives and Value Benefits to Buildings (Madew, 2006).

GREEN OBJECTIVES	GREEN INITIATIVES	GREEN IMPACT	THEORETICAL VALUE
Sustainable Site Development	• Reduce site disturbance & soil erosion during construction. • Use of natural drainage systems (e.g. swales). • Preserve or restore natural site features. • Landscape and orient building to capitalize on passive heating and cooling.	• Improved site aesthetics. • Greater public support for the development and accelerated local approval process, hence lower carrying costs. • Lower energy costs.	• Reduced development costs, improved marketability, reduced ongoing maintenance costs, improved natural appearance, higher sales/rents, absorption and re-tenanting, NOI*/ROI** benefits. • For gross leases, higher NOI. May have impact for net leases*** if benefit can be demonstrated to tenants.
Water Efficiency	• Use captures rainwater for landscaping, toilet flushing, etc. • Treat and re-use greywater, excess groundwater and stream condensate. • Use low-flow fixtures and fittings (pressure assisted or composting toilets, waterless urinals, etc.) and ozonation for laundry. • Use closed-loop systems and other water reduction technologies for processes.	• Lower water consumption/costs.	• Lower tenant CAM**** charges. Direct NOI benefit for gross leases, potential for net leases requires communicating benefit to tenants.
Energy Efficiency	• Use passive solar heating/cooling and natural ventilation. • Enhance penetration of daylight to interior spaces to reduce need for artificial lighting. • Use thermally efficient envelope to reduce perimeter heating and size of HVAC. • Use energy management systems, monitoring and controls to continuously calibrate, adjust and maintain energy-related systems. • Use third-party commissioning agent to ensure that the installed systems work as designed. • Develop Operation and Maintenance manuals and train staff.	• Lower capital costs. • Occupant benefits. • Lower energy costs. • Operational savings (can offset higher capital costs). • Reduced capital costs of mechanical systems because control systems reduce the need for oversizing. • Lower operating costs. • Lower maintenance costs.	• Reduced operating costs, longer life cycle, lower development costs • Improved occupant productivity, lower churn, turnover, tenant inducement, etc. • Higher net income for gross leased buildings, improved yield. • Lower operating costs. On gross leases, higher ROI/NOI. On net leases, potential for improved ROI/NOI. • Marginality higher initial soft costs should be offset by long term operating cost benefits, higher ROI. •
Indoor Environmental Quality	• Control pollutant sources. • Use low-emission materials. • Ventilate before occupancy. • Enhance penetration of daylight and reduce glare. • Provide outdoor views. • Provide individual occupant controls when possible.	• Superior indoor air quality, quality lighting and thermal quality. • Fewer occupant complaints. • Higher occupant productivity.	• Risk reduction. • Greater marketability. • Faster sales and lets. • Improved churn/turnover. • Higher ROI/NOI.
Reduced Consumption of Building Materials	• Select products for durability. • Eliminate unnecessary finishes and other products. • Reuse building shell from existing buildings and fixtures from demolished buildings. • Use salvaged/refurbished materials. • Design for adaptability.	• Longer building lifecycle. • Lower maintenance costs.	• Lower depreciation typically after higher investment costs. • Lower construction costs, probable lower operating/maintenance costs, higher ROI/NOI.
KEY	* NOI: not operating income ** ROI: return on investment	*** Not lease: a lease that requires a lessee to pay all their operating costs resulting from their occupation of the premises	**** CAM: common area maintenance

2.3.2.2 Higher returns on assets and increase property values

Several studies have been undertaken on the link between building green and returns on assets and property values. The CH2 Business Case study 48 presents a strong argument for building green to increase the value of an asset (Madew, 2006). Property economists also predict a substantial rise in rents (50% or more) over the next two years. The environmental initiatives have a return on investment linked to improved productivity of employees. Perhaps the most definitive study linking increased property value to building green is the Royal Institution of Chartered Surveyors' report (Cannon & Vyas, 2008: Lützkendorf & Lorenz, 2005). RICS Report (2005) in partnership with ten government and private organisations studied buildings in North America and the UK to consider the financial value of green buildings and how they contribute to a sustainable community, balancing economies with the environment. It finds that green buildings earn higher rents, attract tenants and buyers more quickly, and cost less to operate and maintain. In summary, the report finds that green buildings are shown to: (i) improve an asset's value; (ii) secure tenants more quickly; (iii) command higher rents or prices; (iv) enjoy lower tenant turnover; (v) cost less to operate and maintain in most cases; (vi) attract grants, subsidies and other inducements to do with stewardship of the environment, increasing energy efficiency and lessening greenhouse gas emissions; and (viii) improve business productivity for occupants, affecting churn, renewals, inducements and fitting out costs amongst others. If there is one major area in which green buildings can add value, it is the benefit to business and if this can be realised it can even exceed the value of the real estate. RICS reports give examples of where such operating efficiencies do indeed draw demand and add value, not just to the business and the economy, but to investment and development. Reducing operating costs, capturing lease premiums and building more competitive, future proofed projects, provide a basis for higher premium valuations (Miller *et al*., 2008: Pivo & Fischer, 2009; Eichholtz *et al*., 2010)

There are a plethora of previous studies which indicate the positive impacts of respectable environment and company performance. Hart and Ahuja (1996) find that pollution prevention and emissions reduction initiatives have positive impacts on a firm's return on assets (ROA), return on sales (ROS) and return on equity (ROE) within two years, and that firms with the highest initial emissions levels show the larges 'bottom-line' gains. Russo and Fouts (1997) correspondingly indicate the matching notion that a firm's return on assets (ROA) improves as a firm's environmental performance improves while Murphy (2002) determined that a portfolio of firms with good environmental reputations earn significantly greater returns than both a portfolio of firms with neutral environmental reputations and a portfolio of firms with bad reputations.

2.3.2.3 Enhanced Marketability

Cannon and Vyas (2008) enlightens that the public generally perceives green buildings as modern, dynamic, and altruistic and that organisations associated with green buildings could benefit from these perceptions through increased market share, employee pride, satisfaction and well-being. Besides, green buildings receive free publicity and generates tenants' interest to the point of creating a waiting list for tenants. Building green creates a distinct product in the marketplace, which can be integrated with corporate image and used to market the property to attract and retain employees. Certification schemes such as LEED in the USA (Green Star in Australia), are useful marketing tool's since they help verify and substantiate green claims. In utmost cases, sustainable buildings can secure tenants more quickly and enjoy lower tenant turnover as well as improving business productivity for occupants, affecting churn, renewals, inducements and fitting- out costs among others. Green buildings command a premium by the advantage of the "award" which is granted by the rating systems and the affiliated brand name which investors use in marketing (Shiers, 2000; Holmes & Hudson, 2001; JLL, 2006b; Reed & Wilkinson, 2006). This makes the sustainable buildings attract higher profile tenants so as to command above-market rentals and thus capital values (Wasiluk, 2007, as cited in Addae-dapaah *et al.,* 2009).

According to the research findings by (Kats *et al*., 2003; JLL, 2006a ; Madew, 2006 ; Bowman & Wills, 2008), the economic benefits in sustainable building are as follows: (i) Improved tenant retention (ii) Shorter letting-up periods (iii) Enhanced brand and marketing edge (iv) Mitigation against future regulatory impacts (v) Increased market share (vi) Reduced vacancies (vii) Higher net revenue return (viii) Higher rents (ix) Reduced operating costs (x) Potential for reduced depreciation and obsolescence (xi) Efficient reporting to stakeholders (xii) Corporate Social Responsibility (CSR)

2.3.2.4 Reduced liability and risks

OECD (2003) reports that 'Environmentally Sustainable Buildings' health problems from indoor air pollution have become one of the most acute problems related to building activities. The report finds that pollutants from building materials, ranging from paints to backing materials, lead to occupational health issues as over 25% of an office worker's life, or 40% of their waking hours are spent inside commercial buildings. The new realisation is that conventional building practices expose people to raised levels of toxins. The 'Sick Building Syndrome' lawsuits are very common in the United States. Owners and property managers are increasingly facing legal action from tenants who attribute their health problems to sick buildings. As more data is compiled on the risks of poor ventilation and air supply, and cross contamination of illnesses, tighter controls on the Indoor Environment Quality (IEQ) of commercial buildings are now common place.

Since property owners are responsible for IEQ, it is prudent for owners to reduce their liability. By incorporating sustainable features, building owners are future proofing for changes in the business and regulatory environment, therefore ensuring they will not be at a competitive disadvantage in the future. With governments and large corporations incorporating green principles into their property requirements, tenants are demanding green while investors are using sustainability indexations to ascertain investments. By the incorporation of water management and energy conservation measures, a building is future proofed against future utility price increases (Addae-Dapaah *et al.,* 2009). Green buildings that incorporate natural lighting, ventilation, internal energy and water generation which are less reliant on external grids, are less vulnerable to grid related problems or failures such as brown-outs and black-outs or water shortages. In the USA, the insurance industry is becoming increasingly aware of lawsuits associated with building sickness and other indoor air quality issues, resulting in rising insurance costs and mould exclusion clauses. Some industry experts are predicting that insurance companies start linking lower premiums to green buildings. (Addae-Dapaah *et al.,* 2009)

2.3.2.5 Ability to attract government tenants

Jasimin and Ali (2014) state that buildings would have to conform to a number of green building requirements to secure government tenanciest in the USA and Canada. Most spatial requirements for office accommodation for State and territory governments have accommodation guidelines that clearly identify sustainability as a key component of their property requirements.

2.3.2.6 Capital cost savings

Optimising building environmental systems to interact synergistically can lead to substantial savings in capital costs. This can be made through the downsizing of the HVAC systems through energy efficient design not only produces savings in ductwork, but by reducing the requirement for bulky mechanical equipment more floor space can be made available for leasing (Madew, 2006)

2.3.2.7 Improved public profile and community relations

Building green demonstrates environmental responsibility. In the USA, this improved image has shown to have accelerated the approval process when dealing with zoning requests and environmental assessments (Parnell & Sayce, 2007)

2.3.2.8 Future proofing

Green buildings use less water and energy than conventional buildings, thereby providing a buffer against future increases in water and energy services costs and protecting against services shortages – another benefit that can be marketed to customers (Madow, 2006; JLL, 2006b)

2.3.2.9 Publicity

Green Buildings can generate media interest and publicity. The increased marketing potential of a superior building can recapture the additional capital cost associated with green building through faster leasing and reduced costs for promotional advertising (Madew, 2006).

2.3.2.10 Compressed schedule

An integrated team approach to design (as required when using Green Star) results in fewer design conflicts and subsequent change orders. American studies have shown that projects are routinely coming in on time and ahead of schedule (Lützkendorf & Lorenz, 2015)

2.3.2.11 A competitive edge in attracting and retaining talents

In competitive recruitment markets such as professional and financial services, tenants are realising the benefits of a building's environment to gaining a competitive edge in attracting talent and a resultant gains in productivity. Madew (2006) claims that retaining talents generates an increased awareness of the environment, climate change and environmental sustainability

2.3.2.12 Churn

Jasimin and Ali (2014) describes churn rate as the retainership of tenants or tenants' relocation rates in a building either internally or externally, including those who move but stay within an organisation, and those who leave a company and are replaced. Churn is caused by business restructuring, staff increases, staff reductions, and bad space planning and management whims. In 87% of the organisations in Australia, it is the Board or senior executive team that makes the decision to create churn. Most senior managers saw churn as part of doing business and 43% believe that it is a problem that should be minimised. The costs associated with churn include: (i) management and other employee direct hours in planning and execution; (ii) consultants and legal fees; (iii) building contractors and other fit out costs; (iv) packing and removal costs; (v) local authority approval fees; and (vi) specific employee time. Indirect costs may include additional management time, staff downtime and productivity losses, disruption to other parts of the facility, additional energy consumption at weekends or evenings, damage or loss during moving and so on (Reed & Wilkinson, 2007)

2.3.3 The Social and Environmental Benefits

Having reviewed the economic benefits, the social and environmental benefits associated with sustainability uptakes are then discussed. The social benefits are discussed in the literature as follows:

The intangible benefits support a positive relation between green workplaces and worker's satisfaction which can also lead to higher company staff retention, reduced absenteeism and improved health of the workers (Wasiluk, 2007; Wetering & Wyatt, 2011; Too & Too, 2011). Major companies perceived green buildings to offer not only cost savings through reduced energy consumption but also benefits such as increased productivity, decreased employee turnover, less sick leave and better morale (Too & Too, 2011). These positive benefits of green buildings are important justification for a firm's shift to a green workplace. Miller and Buys (2008) report that respondents in their research felt that to be located in a sustainable building would help staff morale and public perceptions. Through sustainability, companies can improve their competitive advantage in the recruitment and retention of talent because health and comfort are becoming increasingly important with the growing concern about staff welfare. Paevere and Brown (2008, as cited in Addae-dapaah *et al.,* 2009) states that green and sustainable buildings can be used as one of the employee benefits to attract and retain high quality workers.

Based on the close relation between workers' health and productivity, Gough *et al*. (2010) believes that through sponsored company wellness programs, employees can and will change their lifestyles if approached in the right way and when consistently reinforced through the process hence can be a two-fold advantage for the company. Firstly, workers' productivity will improve in the future for the organisation. This advantage is supported by RICS (2005) and Singh *et al.* (2010) who mentioned that the most significant impacts of green buildings on occupants include increased occupant productivity and satisfaction. Secondly, company morale increases with the company's interest and success in the betterment of employees' health. Kats *et al.* (2003) demonstrates the links between indoor environment, occupier health and productivity as a function of the building environment. Consequently, by considering the link between the indoor environment and productivity, one begins to understand how the quality of the indoor environment can directly impact the financial performance of an organisation and increased the value of buildings (Clements-croome & Baizhan, 2000). Kemppilä and Lonnqvist (2003, as cited in Gough *et al.*, 2010) indicates that improvements in productivity would have a notable positive effect on financial growth and improved standard of living. A correlation between the physical aspects of the office environment has been described by the various studies through some benefits of a physically, socially and pleasant office environment. For instance, reduction of sick leave and lower staff turnover, the commitment of workers, enhancement of quality and improvement of productivity and efficiency (Atkin & Brooks, 2009).

Dixon *et al.* (2008) reveals that improved indoor air quality helps to reduce the health and safety risks to occupants from Sick Buildings Syndrome (SBS). Better indoor air quality can also reduce asthma attacks and allergies by limiting the spread of contaminants and pathogens about 9%–20% (Fisk, 2002 cited in Addae-dapaah *et al.*, 2009). Sick buildings with poor indoor air quality also have been linked to headaches, eye, nose and throat irritation, dizziness and fatigue among occupants (Too and Too, 2011). Rask and Kato (2008, as cited in Armitage *et al.*, 2011) finds in their study based on twelve (12) Green Star-rated buildings and their occupants, that 100 per cent of employers and employees alike thought that the green building was better than expected with all things considered and the majority of occupiers indicated that they would not like to relocate to a non-green office building. In the same study, they found that 80 per cent of business managers believed staff absenteeism had decreased since they moved into the new Green Star-rated building. The common of prevailing research claims that green buildings produced happier and more productive workers (Fisk, 2000a; Fisk, 2000b; Singh *et al.,* 2010). The extensive research conducted by Heerwagen *et al.* (2004) recognises the strong correlations between sustainable design features (natural lighting, thermal comfort, air quality, worker-controlled temperature and ventilation) with reduced illness symptoms, reduced absenteeism and significant increases in the measured productivity of the workforce.

Many property organisations and tenants recognise that workplace productivity is linked directly or indirectly to the quality of the built environment. Building improvements such as better lighting or access to sufficient fresh air are likely to have a positive effect on productivity. It appears that small increases in productivity and staff retention can lead to significant monetary savings in tenants' workforce costs. Loftness *et al.* (2003) in their study by applying the cost benefits analysis had identified that productivity gains may increase due to the factors of lighting (0.7-23%), quieter working conditions (1.8-19.8%), improved ventilation (0.6-7.4%) and workstation controls (0.2-3%) whilst Kats *et al*. (2003) reports that productivity gains from less sick time and greater worker productivity are primarily generated from better ventilation, lighting and general environment.

The environmental benefits can be discussed in literature as follows:

Sustainable buildings offer a lower level of environmental risk by helping to minimise the environmental footprint of the real estate industry on the environment. A longer building life-cycle and a healthy environment for occupants are found to be some of the attributes commonly promoted as positive characteristics of a sustainable building (Ang & Wilkinson, 2008). The rational use of natural resources and appropriate management of the building stock will contribute to saving limited resources, reduce energy consumption and improve environmental quality (Roper & Beard, 2006). According to Murphy (2002), firms that are receiving environmental achievement awards realised subsequent increases in market value, while decreases in market value followed negative publicity.

Roper and Beard (2006) identify three categories of environmental benefits attributable to sustainable buildings as: (i) lower air pollutant and atmospheric GHG emissions (ii) reduced volumes of wastes (iii) use conservation of natural resources. Roper and Beard (2006) bases their identification and categorisation of benefits on the environmental impacts of sustainable buildings presented in Table 2.4. Table 2.4 implies that the sustainability expectations of the market in commercial buildings are heavily dependent on materials and energy use, CO_2 emissions, site preparation and treatment of wastes. Carassus *et al*. (2011) agrees with Roper and Beard (2006) that the measure of the environmental benefits relate to how the impacts shown in Table 2.4 are mitigated by the lowering of air pollutant and atmospheric GHG emissions, the reduction of construction wastes volumes, pollution and the use conservation of inputted natural resources.

Table 2.4 - Environmental Impacts of Sustainable Buildings (Adapted from Roper and Beard, 2006)

Construction	**Operation**	**Demolition**
Materials Use •Depletion of nonrenewable resources •Pollution and byproducts from materials manufacture •Construction materials' packaging waste	Energy Use •Air pollution: emissions of SO2, NOx, mercury, and other heavy metals and particulate matter from power plants; the building's energy consu mption; and transportation to the building. •Greenhouse gas (CO2 and methane) emissions, which contribute to global warming. •Water pollution from coal mining and other fossil fuel extraction activities, and thermal pollution from power plants •Nuclear waste, fly ash, and flue gas desulfurisation sludge from power plants that produce the electricity used in buildings •Habitat destruction from fuel extraction	Demolition waste (used steel, concrete, wood, glass, metals, etc.) •Energy consumption for demolition •Dust emissions •Disturbance of neighboring properties •Fuel use and air pollutant emissions associated with transporting demolition waste

Table 2.4, continued: Environmental Impacts of Sustainable Buildings (Adapted from Roper and Beard, 2006).		
Site Preparation and Use •Disturbance of animal habitats •Destruction of natural vistas •Construction-related runoff •Soil erosion •Destruction of trees that absorb CO2 •Introduction of invasive exotic plants •Urban sprawl (for greenfield sites) and associated vehicle-related environmental impacts (e.g., tailpipe emissions as well as impacts of highway, road, and parking lot con struction) •Water quality degradation from using pesticides, fertilizers, and other chemicals.	Building Operations •Runoff and other discharges to water bodies and groundwater •Groundwater depletion •Changes in microclimate around buildings and urban heat island effects •Ozone-depleting substances from air conditioning and refrigeration •Light pollution in the night sky •Water consumption •Production of waste water that requires treatment •Production of solid waste (garbage) for disposal •Degradation of indoor air quality and water quality from using cleaning chemicals	

The lowering of air pollutants (NO_X and SO_X) and GHG emisions (CO_2 and methane, CH_4) are reduced by decreasing fuel and electricity consumption through energy-efficient design, use of renewable energy, and building commissioning. The main features of sustainable design and construction highlighted in section 3.2.1.5, such as the building design, construction and the sustainable property investing principles contribute to substantial reduction in the waste volumes. The use conservation of natural resources is also influenced by the buildig design features like siting approaches, designing to reduce slopes, preservation of soil resources, wetlands, cultural and scenic areas.

In summarising the sustainability benefits, Murphy (2002) establishes, based on an extensive literature review, the companies that score well according to objective environmental criteria deliver stronger financial returns than the overall market and companies that score poorly have weaker returns. Workers' increased satisfaction, health and productivity in green buildings are mainly the result of better airflow, increased amounts of natural light and views, use of less-toxic building materials and furnishings, reduction of glare, increased thermal comfort, satisfying noise levels and individual controllability of systems (www.gbca. org.au). The thermal comfort and lighting are the main attributes linked to workers' increased productivity and satisfaction in green buildings. (Murphy, 2002).   Gough *et al.* (2010) suggests that productivity may be connected to the physical environment through layout and comfort. It can also be linked to the behavioural environment, which is likely to have a greater impact on office productivity. Haynes (2007) establishes a model to represent the concept of productivity with the dimensions of both the physical and behavioural environment. According to the findings on the factors affecting the value of sustainable buildings, the benefits of sustainable building attributes with the specific indicators is reflected in the higher value of the property as summarised about the RDM in Figure 2.4.

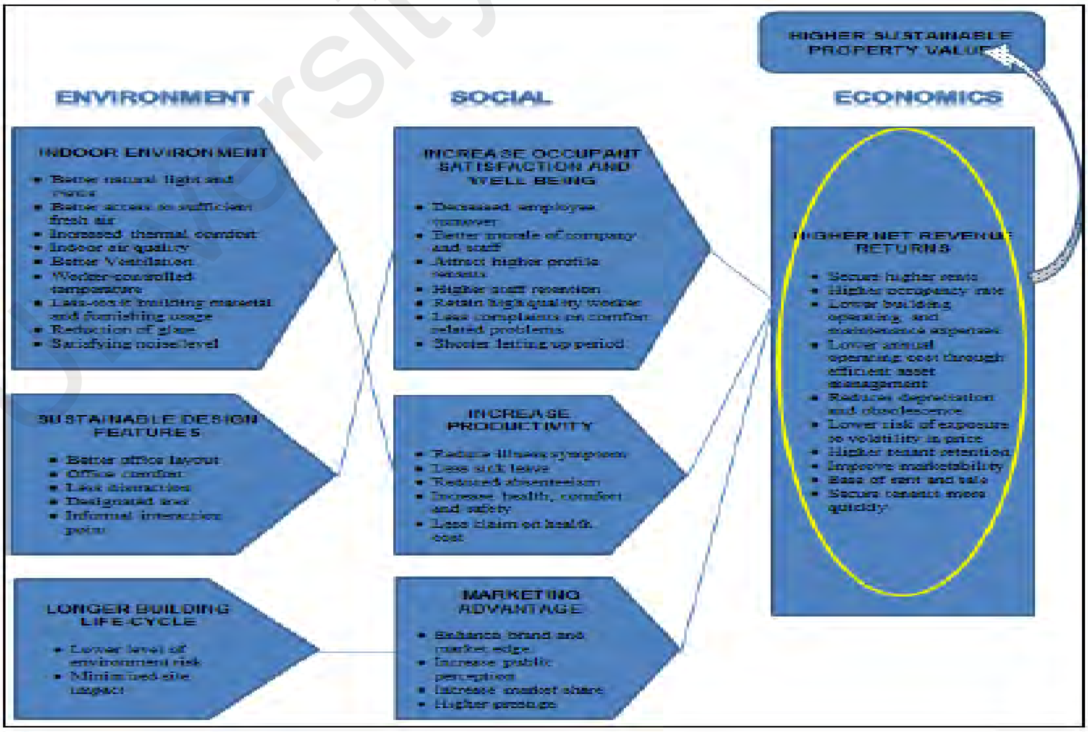


Figure. 2.4: Benefits of sustainable buildings and expected outcomes. (Jasimin and Ali, 2014)

The RDM in Figure 2.4 indicates that when the social and eneironmental benefits of sustainability provide the overriding limits to the economic considerations, the expectation would be higher revenue or capital returns.

The knowledge-based potential sustainability benefits selected for this study from the review of literature in section 2.3 can be found in section 3.2.1.4

2.4 Definition of Operational Terms

The following terms are operational in the study:

Process industries: Those industries where the primary production processes are either continuous or occur on a batch of materials that is indistinguishable. For example, a paints processing company making paints may make the paint in a continuous, uninterrupted flow from receipt of ingredients through packaging. Other process industries would include food, beverage, chemical, pharmaceutical, consumer packaged goods, and biotechnology industries.

Investment value - The value of an asset to the owner, a prospective owner or class of investors, for individual investment, operational objectives or other identified objectives (A non-market value). Investment value is same as worth or value to the owner.

Non-Market based (Impact) Approach – The NMbA approach is based on an assessment of quantifiable shortfall in sustainability requirements of the industrial process in relation to the prescribed sustainability requirements.

Market-based (Value) Approach (MbA) – The MbA approach is based on an assessment of quantifiable market indexation of sustainability features which are to be interpreted by the Valuer based on market evidence.

Sustainability features - The features in a building premises that indicate sustainability. Same as sustainability characteristics or credentials

Sustainability performance or capacity – The extent to which sustainability features meet the prescribed sustainability criteria or requirements.

Sustainability indicators – Sustainability rating checklists specified for industries by the sustainability rating authority or some accredited experts. This may also be referred to as sustainability requirements, checklists for sustainability, metrics, criteria, factors or standards.

Business Value - The *value of a business* or enterprise in consideration of the present and future rewards of ownership of all or part of the business, expressed in monetary terms. It represents the monetary value of the totality of the economic, business, commercial, and industrial activity itself of the business enterprise. It is the value of business as distinct from value to the business. (Same as market value).

Sustainability Obsolescence Correction Factor (ISRO-CF) – A factor that indicates the extent to which sustainability features meet the prescribed sustainability criteria. It is obtained from the mean scores generated by the Delphi experts.

Valuer – A valuation professional having full registration status with the appropriate professional body in Nigeria.

2.5 Summary

This chapter provides an overall description of the case for sustainability, the impacts of green initiatives and the myriad of potential benefits derivable from sustainability operations. It offers renewed thinking about the use of renewable fuel sources, reducing carbon emissions, protecting environments and a way of keeping the delicate ecosystems of our planet in balance. In short, sustainability looks to protect our natural environment, human and ecological health, while driving innovation and not compromising our way of life. The lack of evidence demonstrating the financial benefits of sustainability is preventing a more significant investment in sustainability, as stakeholders are hesitant to invest capital in initiatives that do not demonstrate a clearly positive effect on market value.

Sustainability has a multi-faceted list of benefits. The drivers in the property market are focused upon the financial viability of an investment. Investors view sustainability as either a business opportunity for huge profitability or a threat that will not pay-back or both. The uptake of sustainability could be accelerated if investors understood the direct impact on the value of their property portfolios. On the other hand, the RDM justifies the view that higher net returns is the core of property investment. Nevertheless, obsolescence and market risks are important aspects to consider when developing a valuation approach for market and non-market based properties for valuation purposes. The literature discussions in this chapter with respect to the case for sustainability integration centres on market properties. Specific literature on process industries are either scant or not available. However, it is evident that the environmental and obsolescence cases are substantially applicable to process industries also. The business case would find more relevance to business valuations and corporate sustainability.

CHAPTER 3

SUSTAINABILITY IN REAL ESTATE VALUATION

3.1 Introduction

Research works in the past covered various aspects of sustainability in real estate valuation ranging from the analyses of market values and sustainability, environmental sustainability and its applicability to real estate valuation, the identification debate about appropriate methodologies for commercial and residential properties and the consideration of value drivers in the valuation process. This chapter attempts to identify the dimensional sustainability indicators for process industries and provide a methodological approach to assessing the extent to which industrial sustainability features meet the prescribed indicators for inclusion into real estate valuation. It would be essential to explore industrial sustainability and factory planning, including, the property sustainability drivers that complement the conventional drivers as defined by a combination of regulations and market gyrations. Finally, the research framework shall be developed to outline the integration of sustainability into the valuation of a case study industry.

Section 3.2 of this chapter describes the sustainable development goals and the declaration of the Vancouver Accord. It identifies the role of the green building tools in providing the regulatory standards that underpin the compliance platforms upon which industrial sustainability assessment for real estate valuation could be based. Section 3.2.1.4 offers an overview of the mandatory and retrofitting strategies for social and environmental improvements that implies the integration of data-based knowledge for the transformation to information and compliance. Sections 3.2.1.5 and 3.2.1.6 recognise sustainable design and construction as the bedrock of connecting people to a renewed quality of life through the use of energy efficient process, durable designs, resource use management and responsible property investing. Section 3.2.2 covers the key linkages in sustainability and property values, including valued relationships with stakeholders and the need for valuers to offer sustainability-driven development and investment advice to their clients.

There have been controversies on the linkages between sustainability and property values in the past in spite of the numerous studies carried out to show positive correlations. Sayce *et al (*2010) finds scant empirical evidence of capital value growth on account of sustainability. Nonetheless, the several other empirical studies affirmed the linkages as shown in section 3.2.2. The sustainability dimensions and indicators were examined in sections 3.2.3 and 3.2.4. Further research development initiating the emerging valuation and the need for expanded sustainability-related information to capture the diverse sustainability aspects was discussed (sections 3.3.3-3.3.4). Section 3.4 examines the role of the valuer, the nature and behaviour of industries, industrial sustainability and the various factory planning methods. This chapter addresses the process industry property assets, concepts, classifications and valuation methods in section 3.4.6. Section 3.4.8 reviews the externality principles in relation to real estate valuation and sustainability. The state of knowledge and the identification of research gaps were considered in section 3.5. The framework for this study was discussed in section 3.6. The final section of this chapter provides the summary of the chapter.

3.2 Sustainability and Property Values

Sustainability and interrelated issues evolved from the green sector (Warren-Myers and Reed, 2010). However, the VVA of 2007 was the first RICS official declaration of commitment to the evolving significance of sustainability and the need for the valuers' understanding of its implications to valuations and appraisals. It mandated the review of sustainability and valuation, education, standards, and practices, with the aim of improving the understanding of their relationships. VVA (2007) imposes a social and professional responsibility on the Valuers in accordance the Royal Charter of 1881, IVS and other recognised standards: *(i)* To reflect market sentiment, in which value and sustainability may be at variance and recognise the evolving importance of sustainability. *(ii)* To review how sustainability relates to the practice and standards of valuation. *(iii)* To work with stakeholders and supporters to promote awareness and competencies in the appropriate methods of addressing sustainability in valuations and appraisals. *(iv)* To work with those within and outside the valuation professions worldwide to educate and inform about sustainability and its relationship to value *(v)* To report collaborative progress to an agreed secretariat set up for that purpose. The Accord represents a formal expression and commitment by signatories to advance the understanding, knowledge, education and practices about valuation and sustainability (VVA, 2007)

3.2.1 Drivers of Property Sustainability

Sustainability characteristics improve and complement the conventional utility value components of properties such as functionality, serviceability, durability and comfort (Lützkendorf and Lorenz, 2011). Nonetheless, regulatory and market forces shape these features. The major drivers are discussed in the following subsections.

3.2.1.1 Green Building Rating Tools

The World Green Building Council (WorldGBC), established in 2002, is a network of national green building councils in more than one hundred countries, making it the world's largest international organisation. The national councils are set up to change the way the built environment and communities are designed, built and operated to refine investors' choices a healthy environment and quality of life (USGBC, 2013). The WorldGBC's mission strengthens green building councils in member countries by championing their leadership and connecting them to a network of knowledge, inspiration and practical support. Green building rating systems emerged in the 90s with the Building Research Establishment Environmental Assessment Method in the United Kingdom (BREEAM). Since then, Leadership in Energy and Environmental Design in the United States (LEED), the Green Globes (Canada) and Green Mark in Singapore. The establishment periods (Figure 3.1) and the success of these systems and others has influenced other regions to frame their green building rating tools (GBRTs) (Larsson and Cole, 2001).

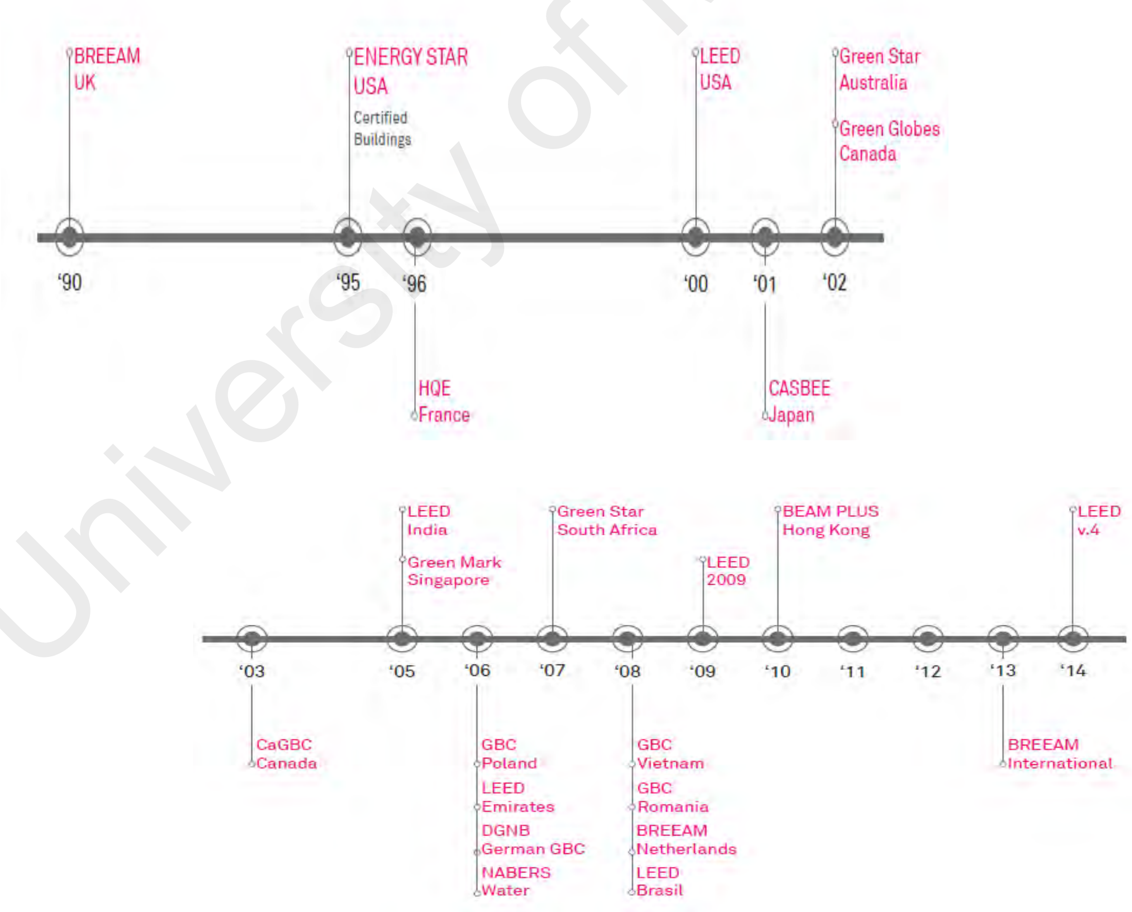


Figure 3.1: Establishment Periods for the GBRTs (McArthur *et al.,* 2014)

Laverick (2013) emphasises that the tools are embodied as guides for design, construction and management for sustainability in real estate development. The rating systems, with a similar objective of reducing negative impacts of real estate development, are pushing the green agenda by encouraging environmentally and socially responsible building practices. The systems help to distinguish between green buildings and conventional properties. There are increasing number of studies on green buildings, and discussions have begun around inventing new ways to evaluate green buildings and sustainability performances. GBRTs help ascertain the level of greenness of a particular building, and also act as an inducement for enhancing value to property owners (Darus *et al.,* 2009). Certification is awarded to innovative buildings that comply with a predetermined set of indicators and criteria, such as, energy efficiency, sustainable material and resource use, and indoor environmental qualities (IEQ). It has been reported that more than 600 tools concerning the environment have been developed since BREEAM, as cited by Reed *et al.,* (2009). Darus *et al.* (2009) and Zuo and Zhao (2014) reiterate that out of the over six hundred (600) tools, only about twenty tools (20) relate to either green or sustainable buildings. Nevertheless, modifications were made to these instruments to fit their local environments and cultures. The seven GBRTs are taken into account based on their direct relationship to the study context, their prevalent literature references and extensive use with modifications. BREEAM and the other six GBRTs are admitted into practice and have been utilised in many countries (Baldwin and Trinkle, 2011 as cited in Banani *et al.,* 2013). Models of these GBRTs include Leadership in Energy and Environmental Design (LEED) for the USA, CASBEE (Comprehensive Assessment System for Built Environment Efficiency) in Japan, Green Globes in Canada (GGC), Green Star in Australia (GSA), Green Mark for Singapore (GMS), and the Green Building Index (GBI) for Malaysia. Recognitions and special certifications are given to green buildings for compliant designs, construction and standard of living, through scoring structure and rating bands (Yusoff and Wen, 2014). The GBRT tools attempt to: (a) achieve durable improvement to optimise building performance and lessen environmental impacts, (b) provide a measure of a building's effect on upon the environment and (c) set credible standards' by which buildings can be judged objectively (Porter, 2000; Reed & Krajinovic-Bilos, 2013). Furthermore, the systems help to recognise best practices and stimulate the market to distinguish between the sustainability-driven real estate and the conventional properties. It also suggests building-related sustainability intake to potential investors, and retrofitting initiatives for existing buildings. Green buildings target reduction of the negative impact of real estate development on both the environment and human health (Porter, 2000). The main function of the assessment tools are primary on building specification evaluation including the design, construction and use (BREEAM, 2013). The available rating systems encompass the different possibilities to proceed with the proper scheme for certification purposes, depending on the typology of the building. The systems are the: New Construction, Existing Buildings, Core and Shell, Commercial Interiors, Retail Homes, Neighbourhoods Development, Schools and, Healthcare (USGBC, 2013).

The tools vary with regards to what they actually assess, how they operate and whether they can be compared directly using assessment tools with buildings from other countries. However, there similarities and differences can be discussed. Table 3.1 presents a summary of indicators to illustrate the differences in provisions and their prescribed scores. The later tools combined components from different systems of the first generation. Each tool provide a building rating which is used to market the building. The work compares the models for BREEAM, LEED, CASBEE, GSA, GGC, GMS and GBI. It is not feasible to compare all the 600 tools. The choice considers popularity, long and wide usage, coverage and comprehensiveness, clarity and applicability to existing and new buildings.

Table 3.1: Summary of available indicators to illustrate the differences. (Adapted from Syed Yahaya & Ismail, 2014; Cheng & Venkataraman, 2013)

INDICATORS	BREEAM	LEED	CASBEE	HK-BEAM	Green Globes	Green Star	Green Mark	GBI	Green Star SA
Energy Efficiency	❖ 19	❖ 35	❖	❖ 35	❖ 350	❖ 25	❖ 116	❖ 35	❖ 5
Materials & Resources/waste	❖ 12.5	❖ 14	❖	❖ 25	❖ 110	❖ 10	❖ 42	❖ 11	❖ 5
IEQ	❖ 15	❖ 15	❖	❖ 20	❖ 185	❖ 20	❖ 8	❖ 21	
Site Planning/Land Use & Ecology	❖ 10	❖ 26	❖	❖ 25		❖ 7	❖	❖ 16	❖ 5
Water Efficiency	❖ 6	❖ 10		❖ 12	❖ 80	❖ 15	❖ 17	❖ 10	❖ 5
Design & Innovation	❖ 10	❖ 6		❖ 5			❖	❖ 7	
Emissions & Efficiency	❖ 17.5				❖ 175	❖ 5			❖ 5
Environmental Management	❖ 12				❖ 100	❖ 8			
Transport	❖ 5					❖ 10			
Awareness & Education		❖							
Social Aspect		4							❖ 25
Economic Aspect									❖ 25
MAX WTD SCORE	*110*	*110*		*122*	*1000*	*100*	*190*	*100*	*75*
VERSIONS	1. Offices 2. Housing 3. Healthcare 4. Courts 5. Industrial Units 6. Prisons 7. Retail 8. Schools 9. Multi-residential 10. Neighbourhood	1. Offices 2. Homes 3. Neighbourhood development 4. Retail 5. Healthcare 6. Schools	1. Offices 2. Homes 3. Urban development 4. Cities 5. Market Promotion			1. Offices 2. Retail 3. Schools 4. (Industrial buildings) 5. Mixed use residential) 6. Mixed use) 7. (Healthcare)			1. Offices 2. Housing 3. Public & Educational buildings 4. Industrial 5. Health Care 6. Retail Centre

A study by BRE (2008) concludes that there are high levels of variation between the systems for the same 'grade' or 'rating' than might be expected. For example, BREEAM Excellent, LEED Platinum, and a 6-Star Green Star office building are not equivalent in terms of sustainability. As in the above table, with the remarkable exception of

GreenStarSA, also known as Sustainable Building Assessment Tool, all of the existing tools deal exclusively with the environmental dimension of sustainability (Sebake, 2008). The social aspect covers IEQ, transport, design and innovation, environmental management and education. The economic aspect concerns the local economy, efficiency, adaptability, capital and ongoing costs. The observation of Sebake (2008) is in agreement with the views of Gibberd (2005). As in the case of GBRTs in Africa, the Green Building Council for South Africa (GBCSA) was established by the South African Property Owners Association in 2007. It aims at promoting sustainable practices within the South African commercial and industrial property market. The comprehensiveness of the GreenStarSA (SBAT) is summarised as in Table 3.2

GBCSA has moved beyond the traditional 'green' focus to include the broader sustainability impacts explicitly. The GBCSA began using Green Star SA rating tools with an exclusive focus on environmental impacts. The inclusion of the socio-economic factors into the GreenstarSA tool was initiated in 2011 to support the extension of the GBCSA's vision (GreenstarSA, 2014).

Table 3.2 Comprehensiveness of GreenStarSA (SBAT). (Sebake, 2008)

	Summary of UM Millennium Development Goals, ISO Framework for Environmental Assessment, Global Reporting Initiative Guidelines, The Living Planet Report	BREEAM	CASBEE	EEWH	Green Star	LEED	SBAT
ECONOMIC	Poverty eradication						▪
	Develop Global Partnership						
	Employment						▪
	Labour / Management relations						
	HR Investment and procurement policies						▪
	Economic performance						▪
	Market presence						
	Indirect economic impacts						
ENVIRONMENTAL	Ensure environmental sustainability	▪	▪		▪	▪	▪
	Environmental impacts of buildings (materials)	▪	▪	▪	▪	▪	▪
	Environmental impacts of buildings (energy)	▪	▪		▪	▪	▪

	Table 3.2, continued: Comprehensiveness of GreenStarSA (SBAT). (Sebake, 2008)						
	Environmental impacts of buildings (water)		■		■	■	■
	Environmental impacts of buildings (waste)			■			■
	Environmental impacts of buildings (emissions)	■			■	■	■
	Environmental impacts of buildings (renewable resources)						■
	Environmental protection	■		■	■	■	
	Environmental legislation						
	Products and Services						
	Transportation	■			■		■
	Accessibility		■				■
	Adaptability	■	■				■
	Flexibility	■					■
SOCIAL	Training and education						■
	Quality of life						
	Diversity and equal opportunities						
	Health			■			■
	Public / stakeholder participation						■
	Public / stakeholder awareness						■
	Safety						■
OTHER	Durability	■					
	Maintainability	■					
	Indoor air quality	■			■	■	
	Indoor environments	■					
	Management				■		
	Design and innovation				■	■	

The fifteen (15) areas mentioned above have identical methods of assessment. A final assessment therefore is based on 75 indicators (15 areas x 5 criteria). The assessment is captured graphically as a web diagram (illustrated in Figure 3.2 below). This provides a simple holistic picture of the sustainability performance of the building.

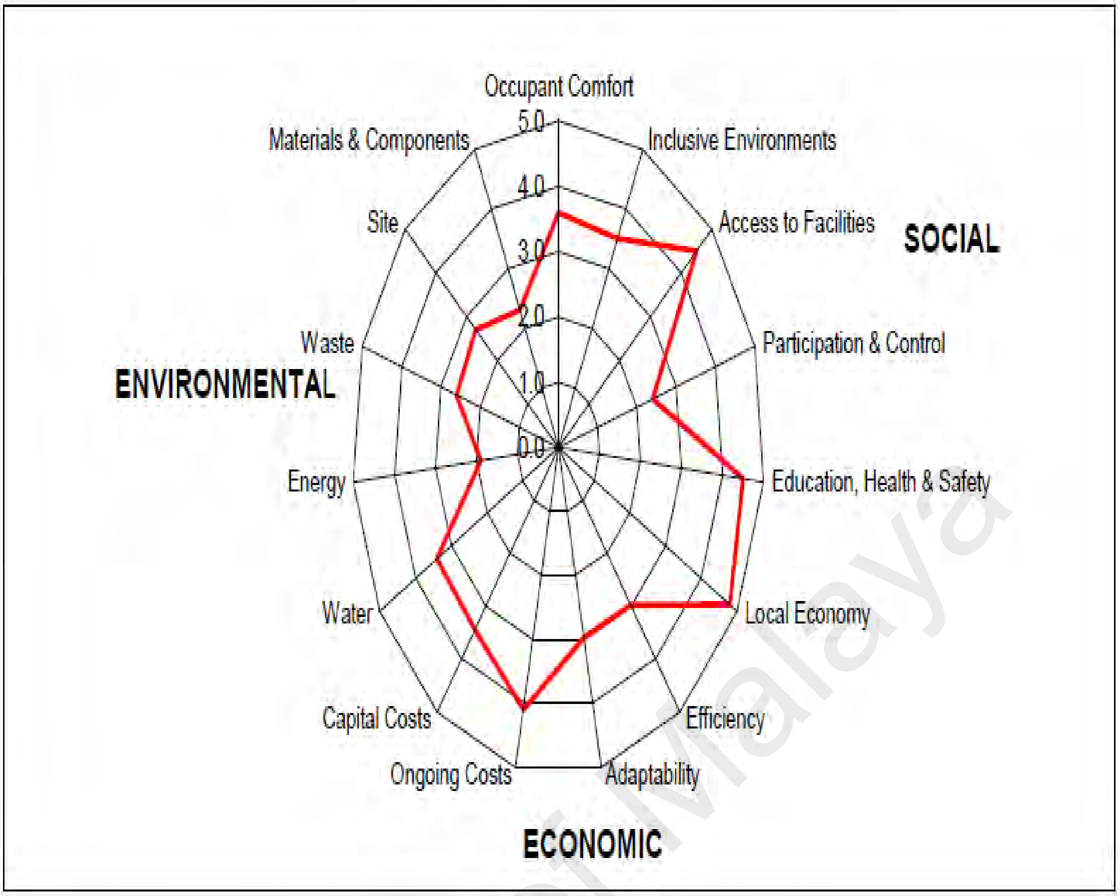


Figure 3.2: Comprehensive GreenStarSA SBAT Assessment tool (GreenstarSA, 2014)

The overlay (in red) indicates the assessment, the upper overlay, and the target score of 5.0. Each standard of assessment has specific criteria for the final grade award. SBAT assessment tool is comprehensive and it specifies its application to industries in explicit terms.

Cheng and Venkataraman (2013) stresses that some credits have been listed under different categories in different assessment standards to address similar issues. Categories like sustainable sites, management, land use and ecology and transport; materials and waste; indoor environmental quality (IEQ) and emissions share similar credits. Therefore the above mentioned categories are combined for a clear comparison. Gibberd (2005) and Cheng and Venkataraman (2013) present a comprehensive sustainability components that incorporate the provisions of other main tools including SBAT's 15 sustainability assessment areas in Table 3.3

Table 3.3: Comprehensive Sustainability Components from the GBRT and SBRTs (Cheng & Venkataraman (2013).

Dimensions	Sub-Groupings	Components/Indicators
1. ENVIRONMENTAL	Water-Related:	• Storm Water Management • Water Metering • Efficient Irrigation and Landscaping Methods • Efficient Equipment for Water Use • Plumbing and Leakage Detection • Water Recycling
	Energy-Related	• CO_2 Emissions • Energy & Electrical Metering and Monitoring • Optimized Energy Performance • Renewable Energy Usage • Efficient Lighting Equipment • Building Commissioning • Use of Energy Efficient Equipment
	Materials Components/ Wastes	• Waste Recycling • Sustainable Product Purchase and storage • Waste storage, collection and Disposal • Responsible Selection of Materials • Recycled Material Usage • Refrigerants & Cleaning agents • Adaptable and Maintainable Design
	Sustainable Sites/Management/Land Use and Ecology/Transport	• Building Orientation, Landscaping and Site Conservation • Building code compliance/Parking • Integrated Pest Management & Erosion control • Alternative Transportation • Environmental Management and Noise Pollution Design & Eco-Innovation • Building User Manual
	IEQ	• Thermal Control & Systems Control • Indoor Air Pollutant Control (e.g. Co_2 and Tobacco smoke) • Ventilation Control • Air Delivery Monitoring and Exchange • Acoustic Performance & Internal Noise levels • Daylighting • Electric Lighting levels • Post-Occupancy Comfort survey. •
2. ECONOMIC	• Local Economy • Efficiency of Use • Adaptability & Flexibility • Ongoing Costs • Capital Costs	

Table 3.3, continued: Comprehensive Sustainability Components from the GBRT and SBRTs (Cheng & Venkataraman (2013).	
3. SOCIAL	• Occupant Comfort • Inclusive Environments • Access to Facilities • Participation & Control • Education, Health & Safety Local contractors

The green and sustainability rating systems usually establish a link between characteristics and attributes of the building and real estate risks as well as the sustainability of a building. The assessment principles, criteria and standards used for risk and sustainability assessment are suitable, in principle, for the formulation of building requirements to minimise financial risks, ensure sustainability and support value stability and economic performance. RICS (2009) reports that these systems also constitute a checklist for the early stages of planning and are suitable for supporting goals setting and agreement between principals (e.g. client, investor) and agents (planner or general contractor). Investors are therefore advised to obtain and systematically evaluate the relevant information from existing systems for risk and real estate analysis and sustainability assessment.

3.2.1.2 Regulatory Greening and Retrofitting

Regulatory greening refers to environmental and social improvements by mandatory requirement and retrofitting compliance. However, this has only recently affected the commercial real estate industry in the UK and Europe, with the introduction of schemes like the European Union (EU) energy efficiency mandatory disclosures for commercial real estate. An identical scheme was introduced in Australia with mandatory disclosure from 1 December 2009 (Department of Environment, Water, Heritage and the Arts, 2010). GBRTs are easy to implement on new building constructions. Hence, there were trepidations of the implementation on existing buildings. These concerns have brought students and stakeholders to explore the potentials for retrofitting existing buildings

(Burton & Kesidou, 2005; Chileshe *et al*, 2013; Durmus-Pedini & Ashuri, 2010; Juan *et al.,* 2010; Ma *et al.,* 2012). Strategies that respond to specific green certification benchmarks were frequently debated at common forum (Rysanek & Choudhary, 2013; Shika *et al.,* 2012; Zakaria *et al*., 2012). Past researchers advocate strategies to convert conventional buildings into green buildings. Rysanek and Choudhary (2013) itemises strategies that can condense energy consumption during building refurbishment. They also debated the paramount strategies, given numerous conditions. On the other hand, Rysanek and Choudhary (2013) concentrates on energy reduction, Zakaria *et al*. (2012) offers ranked strategies for green refurbishments by confronting not only energy reduction but sustainable material selections and IEQ improvements. The strategies have proven operational in the commissioning of the green refurbishment of individual buildings (Konstantinou & Knaack, 2013). In spite of these efforts, past researches on the application of refurbishment strategies on large industrial building stocks are limited. Miller and Buys (2008) offers a beginning point for understanding the difficulty of integrating sustainability initiatives in older buildings. They explored the social dimension, and asserted that incorporating sustainability in the refurbishment process of older buildings could present technical, financial and social challenges from the perspectives of commercial office building tenants. However, they argued that there would always be a place for older non-sustainable buildings, or that most buildings would have to be retrofitted at some point to meet market expectations. Retrofitting was viewed as a way to "future-proof" for this inevitable change. Some felt that older commercial buildings could not be brought up to the ideal green standard and thus should be either demolished or turned into other uses. Others suggested that as sustainable buildings become mainstream, there may be a "non-sustainability discount" for residing in a building without sustainable features. In 2014, Benderwald *et al*. presents their guide to owner-occupiers, on how to calculate and present deep retrofit value to addresses prevailing uncertainties predicted by Miller and Buys (2008), and the expectation is that company executives and building professionals would be enabled to incorporate the benefits of deep retrofits in their decision making.

3.2.1.3 The Sustainable Development Goals and Other SD programmes

The Millennium Development Goals (MDG) and the Sustainable Development Goals (SDG) are intended to embody a universally shared common global vision of progress towards a safe, equitable and sustainable space for all human beings to thrive. They reflect the moral principles that enjoins everyone and country to be regarded as having a common responsibility for playing their part in delivering the global vision. In general terms, all of the goals have therefore been conceived as applying both as ambitions and as delivering challenges to all stakeholders. The goals and targets contain important messages and challenges for developed and developing countries alike (Osborn *et al.,* 2015). SDGs and other related programmes set new targets and methods of analysis to assist in identifying those which will represent for More Developed Countries (MDCs)s and the Less Developed Countries (LDCs) the leading transformational tasks, in the sense of requiring new economic paradigms and changes in patterns of behaviour as well as new policies and commitment of resources. The Rio+20 Outcome Document indicates that the goals are intended to be action-oriented, precise universal and easy to communicate. However, it is taking into account of the different national realities, capacities, levels of development and national priorities. They should be "focused on priority areas for the achievement of sustainable development."(SDG, 2015)

3.2.1.4 Knowledge-based Information Management, Support Systems and Perceptions of Valuers

Knowledge-based Information Management in long-term sustainability implies the investigation of attitudes and behaviour observable for its support (Fahy and Rau, 2013).

The Data-Information-Knowledge-Wisdom (DIKW) structure shown in Figure. 3.3 demonstrates phases of increased context, understanding and how sustainability data is transformed into information, then knowledge, and support wisdom. Cash *et al.* (2002) and Gloet (2006) contends that effective knowledge management (KM) and human resources management (HRM) linkages when applied to the development of leadership and administrative capabilities can support sustainability. Gloet (2006) evokes means by which organisations can build up leadership and management capabilities to support sustainability across business, environmental and social justice contexts. Petrini and Pozzeboh (2009) suggests that business intelligence (BI) has an important part to play in helping organisations implement financial support and monitor sustainable practices. The view was echoed by Holsapple and Joshi (2002) with support to researching into how the management of sustainability in organisations can be backed up by business intelligence (BI) systems. The work offers a conceptual model that tries to hold up the operation of integration of socio-environmental indicators into an organisational scheme for sustainability. Barrios and Trejo (2003) and Glantz (2001) formulate a framework for understanding the effectiveness of systems that link knowledge to action for sustainability by exploring the implications of data gathering, information and knowledge framework for research and practice. Fig. 3.3 presents the KM process in which science, technology, and education can make essential contributions to sustainability across a broad range of places and problems.

Figure 3.3: The Knowledge Management Process. (Glanz, 2001)

When the contribution increases, it seems unlikely that the transition to sustainability could be fast enough to prevent significant degradation of human life and the earth system. Cash *et al*. (2003) proposes the creation of bridges across spatial scales so that the location-specific demands and the knowledge central to sustainability can link with relevant national and international level research and development. Individual campaigns in research, innovation, monitoring, and assessment can contribute to sustainability. However, the full utility of such independent contributions devolves on developing integrated knowledge systems for sustainability support and implementation.

Babawale and Oyalowo (2011) appraises the perception of real estate valuers' towards sustainability in real estate valuation in Nigeria. The perception study was based on their knowledge about the potential sustainability factors identified as follows: High building value (HBV), cost savings (CS), lower risks (LR), productivity gains (PG) and quality of life (QL). A sample survey of 160 estate surveyors and valuers with head offices in any of the three chief administrative, commercial and industrial cities - Lagos, Port-Harcourt, and Abuja was used. They were requested to rate the importance of a range of sustainability features and potential sustainability benefits on the market value of a hypothetical property. The study sets the knowledge-based potential sustainability benefits (HBV), CS, LR, PG, QL) as unobserved variables and identified the Support concept in terms of valuers' willingness to: (i) invest in green rating tools (ii) recommend the green features to others (iii) reflect sustainability in property valuation (iv) understand the relationship between sustainability and property value. It presents evidence that there is a rising awareness of the need to incorporate sustainability into real estate valuation theory. Respondents tended to define real estate sustainability regarding its social, rather than economic or environmental features. The study suggests that Nigerian valuers must improve on their present knowledge of sustainability to effectively account for the sustainability dimensions in property valuations. It concludes that the awareness of sustainability considerations among valuers could provide the required support, reputation gains and long term competitiveness (Babawale and Oyalowo, 2011).

Following the literature reviewed in sections 2.3.2, 2.3.3 and 3.2.1.4, the five (5) knowledge-based potential sustainability benefits adopted for the perceptive and support study are High building value (HBV), cost savings (CS), lower risks (LR), productivity gains (PG) and quality of life (QL). The sixth factor (Support) in this study is also adopted from Babawale and Oyalowo (2011).

3.2.1.5 Sustainable Design, Construction and Investment

McLennan (2004) explains sustainable design as a skilful and conscious design to eliminate negative environmental impact in a manner that connects people with the natural environment. Sustainable design applications vary for disciplines, but have some mutual principles that can enhace the environmental benefits of sustainability. The principles are listed as:

- Low-slung-impact materials: Non-toxic, and recyclable materials which require miniature energy for processing. (Ryan, 2006)

- Energy efficiency: use of less energy-demanding manufacturing processes and products. (Ryan, 2006)
- Emotionally durable design: use of consumption and waste reducing resources that increase the resilience of relationships between people and products. (Vallero & Brasier, 2008)
- Design for performance (Anastas & Zimmerman, 2003).
- Design measures for carbon footprint measures, and assessment of resource use life-cycle assessment. (Vallero & Brasier, 2008)
- Development of sustainable and project design guides by private organisations and individuals. (Ryan, 2006)
- Redesigning industrial systems on natural lines through resource reuse and recovery (Hawken *et al.*, 1999)
- Service substitution: shifting the method of consumption to the provision of services which provide similar functions from personal ownership of products.(Ryan, 2006)
- Renewability: composted materials from nearby local sources (McLennan, 2004)
- Robust eco-design principles for the design of pollution sources. (Anastas & Zimmerman, 2003).

Other strategies of sustainable design include passive solar heating, day lighting, indoor air quality, natural ventilation, energy efficiency, embodied energy and construction waste minimisation, site preservation, water conservation, commissioning, renewable energy and landscaping (McLennan, 2004).

Lützkendorf and Lorenz (2015) describes sustainable construction (SC) as both an arrangement that uses progressions that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition. It positively impacts stakeholders-investors, developers, funders; the environment, employees, and the communities at large. Hence, how it is designed, how it is built, how it is used and maintained, and eventually - how it will be demolished once its useful life has ended ought to be carefully considered from the outset. BREEAM (2013) identifies the following strategies for SC: *(1)* Planning the timing of the purchases so that delivery is just-in-time for the required building stage *(2)* Avoiding the keeping of materials in storage for a long time to reduce tieing up funds, probable damage, spoilage and pilfering. *(3)* Identification of storage requirements for building materials that are for storing and the appropriate stores for them *(4)* Ensuring that building materials are stored correctly to avoid damage from damp, excess moisture, rain or daylight *(5)* Storage of materials safely to prevent theft. *(6)* Construction site wastes sorting, reduction through reuse packaging and exchanges *(7)* Good site conditions.

Sustainable property investing (SPI) describes utility-providing property investing as the whole building life cycle consideration which include the construction, acquisition, use, management, and maintenance. SPI embarks upon non-utility consuming actions which are utterly different from current property investment 'best practices'. The practices include: sustainability accounting and reporting, promotion of next-generation construction approaches and the use of organic materials for energy efficiency. Nevertheless, such buildings are of high sustainability performance and returns. Indeed, McDonough and Braungart (2003) suggests that these innovative approaches to construction are the most profitable ones and Murphy (2002) claims that those investors or companies who take the most proactive approach be the most successful ones. SPI adjusts actions at the strategic, business processes, building/portfolio, and stakeholder levels.

Responsible property investing (RPI) denotes property investment or management strategies that go beyond compliance with minimum legal requirements to address environmental, social and governance issues (Pivo, 2008). Pivo (2008) grouped RPI strategies into: *(1)* energy conservation that incorporates green power generation and purchasing, energy efficient design, or conservation retrofitting. *(2)* environmental protection – water conservation, solid waste recycling, habitat protection *(3)* voluntary certifications – green building certification, certified sustainable wood finishes; *(4)* public transport-oriented developments, such as transit development, walkable communities, mixed-use development; *(5)* urban revitalization and adaptability – infill development, flexible interiors, brownfield redevelopment; *(6)* health and safety – site security, avoidance of natural hazards, first aidreadiness; *(7)* workers' social wellbeing schemes for plazas, childcare on premises, indoor environmental quality, barrier-free design; *(8)* corporate citizenship – regulatory compliance, sustainability disclosure and reporting, independent boards, adoption of voluntary codes of ethical conduct, stakeholder engagement; *(9)* social equity and community development – fair labor practices, affordable/social housing, community hiring and training; and *(10)* local citizenship – quality design, minimum neighborhood impacts, considerate construction, community outreach, historic preservation, no undue influence on local governments.

Within the formwork of sustainable design, construction and investment, a sustainability assessment framework could be conceptualised in property and construction for property performance as synthesised in literature by Lützkendorf and Lorenz (2005) in Table 3.4. As shown in Table 3.4, the indicators at the design and assessment stages together with the information derived from their use are put together into a system of building-related information that allows for an integrated assessment of property assets. The idea is to have a 'building information system' which contains detailed building related information of every aspect which, depending on the purpose and on the viewpoint of the user be it the asset and facility managers, valuers, tenants, or others. Information can be retrieved at different levels of aggregation. (Lorenz *et al.,* 2005: Lützkendorf & Speer (2005). Sustianability-related information (SRI) is elaborated on in section 3.3.3

Table 3.4 Synthesis of sustainable design and construction for investment performance (Lützkendorf and Lorenz, 2005; Lorenz, 2006)

Criteria	Indicators for the design stage	Indicators for the assessment of existing buildings
	Object characteristics / Object performance	
Technical performance	Planned heat insulation class	Realised heat insulation class
	Planned sound insulation class	Realised sound insulation class
	Planned fire safety class	Realised fire safety class
	Planned load carrying capacity	Realised load carrying capacity
	Ease of conducting maintenance, servicing and recycling activities	Ease of conducting maintenance, servicing and recycling activities
Functional performance	Functionality and serviceability	Functionality and serviceability
	Adaptability and responsiveness	Adaptability and responsiveness
	Suitability for planned service life	Suitability for remaining service life
	Accessibility	Accessibility
	Environmental performance	
Energy use	Primary energy demand during occupation (calculated)	Primary energy demand during occupation (measured)
Raw material depletion	Use of fossil fuels	Use of fossil fuels
	Use of mineral resources	
	Use of biotic / renewable resources	
Land use	Planned degree of sealing of the lot	Current degree of sealing of the lot
	Ecological value of the lot / change of ground quality	
	Planned land use per unit (e.g. number of workstation)	Current land use per unit (e.g. number of workstation
Impacts on the environment	Global warming potential, GWP 100 (CO_2- equivalent)	Global warming potential, GWP 100 (CO_2- equivalent)
	Ozone depletion potential, ODP	Ozone depletion potential, ODP
	Acidification potential, AP (SO_2- equivalent)	Acidification potential, AP (SO_2- equivalent)
	Eutrophication potential, EP	Eutrophication potential, EP
	Photo-oxidant formation potential	Photo-oxidant formation potential
Waste production	Waste production during construction processes	Waste production during occupation and use
	Total waste accumulation (by categories)	Total waste accumulation (by categories)
Impacts on soil and ground water of lot	Material selection subject to separate checklist	Impacts on soil and ground water of lot

Table 3.4, continued: Synthesis of sustainable design and construction for investment performance (Lützkendorf and Lorenz, 2005; Lorenz, 2006)		
	Economic performance	
Life cycle costs	Construction costs	Cost for refurbishment and modification
	Projected maintenance and operating costs	Effective maintenance and operating costs
	Projected disposal costs	Effective / projected disposal costs
Development of income, value and/or worth		Income stream / current market value / current calculation of worth
	Social performance	
Health of occupants / users		Appearance of Sick Building Syndrome / Building Related Illness
		Appearance of black mould
Comfort and well-being of occupants / users	e.g. thermal comfort measured as PPD / PMV	Occupant / user satisfaction measured through post occupancy evaluations
Safety of occupants / users		Number of building related accidents
Indoor air quality		Olfactory freshness
	Material selection subject to separate checklist	Concentration of selected substances (total volatile organic compound)
		Concentration of radon
Comfort and well-being of neighbours		Disturbance through building / use and occupation of building
Cultural value		Existing monumental protection

The crucial starting point for design and building construction are the functional and technical specifications which are generated from clients/investors ideas based on prevailing permissible contexts. Design approaches adopted are classified as *(1)* Design to cost; *(2)* Design to LCC; *(3)* Design to value (4) Design for socio-economic performance; and (5) Design for the environment. The design approaches are factored into the following economic aspects which play a role in investment decision making identified by Lützkendorf and Lorenz (2015). Sustainable design approaches consider the following: *(a)* The overall budget: maximum investment sum, maximum construction cost. *(b)* Financing possibilities and costs (particularly project financing). *(c)* Lettability, marketability, marketing risks *(d)* Overall project risks *(e)* Achievable rents/required minimum rent *(f)* Investment return and yield expectations *(g)* Risk–return profile *(h)*

Stability, security of the cash flow, risk of losing the tenant(s) *(i)* Level of operating costs attributable to tenants/level of operating costs not attributable to tenants *(j)* Total costs of ownership (in the case of owner-occupiers). *(k)* Value, value stability, value development potential. Nevertheless, the specific individual and institutional interests and goals differ between groups of actors. Table 3.5 indicates which economic aspects are of particular relevance and interest for different groups of property market players.

The technical and functional requirements for specifying goals relating to a building's environmental, social and economic performance is a basis for design, decision making and assessment (CEN, 2010). CEN (2010) presents overall concept of sustainability assessment for sustainable investment buildings in Figure 3.4. The important assessment systems should be recognised by key actors to aid understanding and to be delivered on to the planners.

Table 3.5: Key economic performance aspects and their relevance to different players. (Lützkendorf & Lorenz, 2009).

	Risk-return ratio	Investment performance / total return	Construction cost / additional construction cost	Life cycle cost / total cost of ownership / full cost	Level of operating costs attributable to tenants	Level of operating costs non-attributable to tenants	Rent Level	Value / stability & development of value	Risk (asset specific)
Individual & institutional investors with medium-to long-term interests	√	√		√				√	√
Individual & institutional investors with short-term interests	√	√						√	√
Project developers			√				√	√	√
Landlords/awarding authorities and buyers of rental assets		√	√	√	√	√	√	√	√
Awarding authorities and buyers/owners of self-occupied assets			√	√				√	√
Tenants					√		√		
Financers	√	√	√	√			√	√	√
Fund managers	√	√		√	√	√	√	√	√

The planners in turn should present these tools in the complementary planning phase for checking the accomplishment of individual planning steps.

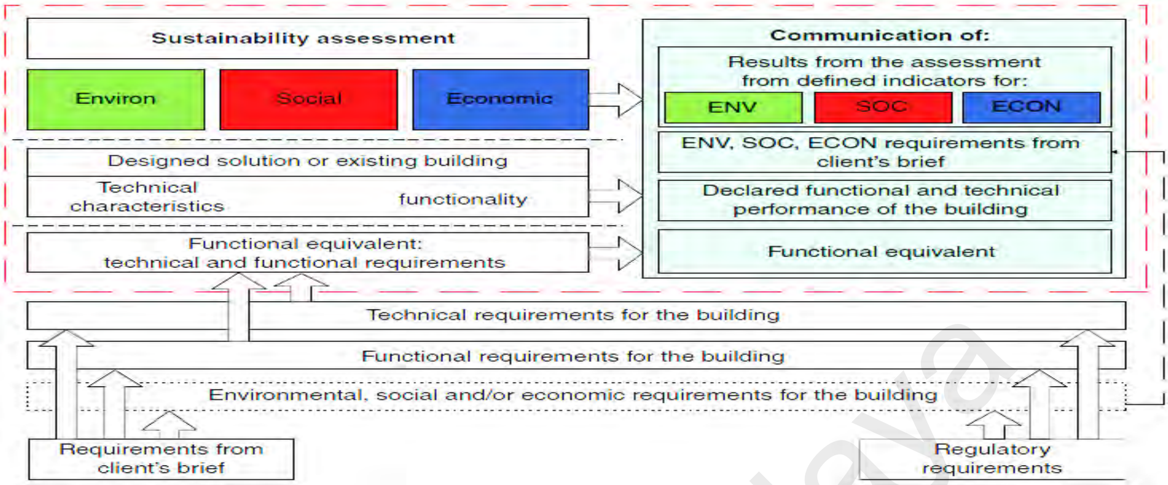


Figure 3.4: The overall concept of sustainability assessment of buildings. (CEN, 2010).

The major dimensions of sustainability in relation to their indicators are discussed further in section 3.2.3.

3.2.1.6 Other sustainability drivers

Industry, academia, government bodies and not-for-profit identify market-based drivers have been identified by various groups to encourage the uptake and adoption of sustainability practices particularly in the commercial real estate industry. JLL (2007) provides a list of the drivers as: increasing shareholder value and building value, tenant attraction and retention, staff attraction and retention, government reduction targets and accommodation criteria, demand for quality space, reduced operating costs, pressure from stakeholders and shareholders, demand for SRIs, global reporting and disclosure projects, risk mitigation and good governance, legislative changes, escalating cost of resources, brand protection, corporate social responsibility, increased global focus on climate change.

3.2.2 Linkages between Sustainability and Property Values

Sayce *et al*. (2010) assesses the evidence base to support the contention that there is an observable link between sustainability credentials, financial performance and commercial property prices – increased rents, lower yields and higher capital value. From the sample collected for analysis, the research team selected a range of over 130 research papers. The findings of the research are as summarised hereunder:

1. Recent studies undertaken in relation to US office buildings show some rental value differentiation in respect of accredited buildings with those that are not. The evidence base does not distinguish between grades of accreditation. However, substantive evidence of capital value shift was not explicit (Miller *et al.,* 2008; Fuerst & McAllister, 2008; Eichholtz *et al*., 2008; 2009)

2. No empirical evidence of capital value differentiation has been tracked in the UK. Notwithstanding, the Investment Property Databank (IPD) are observing the performance of some buildings against their sustainability credentials and significant results have been found (Eichholtz *et al*., 2008; Lorenz, 2011; RICS, 2014)

3. The opinion was abundant and formed a significant part of the study. Most of this work have been undertaken by real estate consultants and stretches from Europe, USA and Australia. However, many of these surveys show that potential occupiers state that they would be prepared to pay more for green or sustainable buildings, even in the downturn, on the grounds of potential cost savings. Nevertheless, when tested in actual behaviour, it was not proven empirically (Dixon *et al*., 2009).

4. There is a burgeoning body of theoretical literature that makes the case as to why there should be a differential in value. Often these are based on examination of worth appraisals, using the Discounted Cash Flow (DCF) techniques. The work of Boyd (2005);

Guertler *et al.*(2005); Robinson (2006); Ellison and Sayce (2006); Ellison *et al.* (2007); Bienert *et al.*(2008); Lorenz and Lützkendorf (2008a) and McNamara (2008) all argue that a value - sustainability relationship has been developing.

The merits of these studies lie in their contribution to informing market players and promoting a profound understanding of sustainability-related issues. There is also a byline that legislation and ethical considerations may play an increasing role in stirring forward. Much of the literature argues that sustainable buildings are worth more to occupiers, based on grounds that they are more economical to run and offer healthier working environments. Authors such as Kats (2003) and Robinson (2006) as well as the RICS's 2005 Green Value report point to occupational value benefits. However any evidence that tenants will be willing to pass on their cost savings in the way of additional rent is not proven, so the investment case lies in the presumption that such buildings will retain tenant attractiveness and, therefore, be less subject to social obsolescence.

In 2012, Warren-Myers synthesises the plethora of research that has been embarked on into the association between sustainability and market value in real estate, by critically analysing the researches and the applicability of sustainability and value research in valuation practice. Warren-Myers (2012) finds that existing researches conducted into the relationship between sustainability and market value are insufficient to establish concrete sustainability valuation theories for practice and that there is a lack of historical evidence and information on the quantifiable effects on the market value of this recent trend. The reports of RICS (2009) and Bambagioni (2013) insist that sustainability characteristics of buildings must be taken into account within property valuations and risk analyses, and their effects quantified and described in writing within the report. Lützkendorf and Lorenz (2012) agrees that sustainability aspects can be integrated into existing methods of valuation and risk analyses, with the responsibility of quantifying it in specific local environment resting with the valuation professional. They emphasise the transparent consideration of sustainability features in the Valuation Report and provide a checklist that included energy efficiency, environmental risks, resource use, recyclability, indoor air quality, user-needs, comfort and satisfaction, serviceability and health friendliness. Credible empirical evidence of the positive relationships between sustainability and observed property prices emerged in 2010 through the studies of Salvi *et al*. (2010); Wameling and Ruzyzka-Schwob, 2010; Pivo and Fischer, 2010). Lorenz (2011) thereafter presents further empirical evidence of the linkages in the USA, Netherlands, Australia, Germany, Japan and Switzerland as shown in Table 3.6. Evidence indicate that the Malaysia's Green Building Index (GBI) has hit the 150-million-square-foot mark of gross floor area in GBI-certified buildings, a 50-percent leap from its 100-million-square-foot milestone achieved two years ago (2014), which has made it the leading gross floor area certified by a single green certification organisation in Asia (Algburi, *et al.,* 2016). The achievement is a combination of more than 300 certified projects out of more than 700 registered projects to date. Moreover, the GBI index certified prime office buildings such as Menara Worldwide and G.Tower leased at about 13% higher than the average rate of RM.6.80 p.s.f. in 2009. It has also been observed in 2012 that 348 central office and residential towers certified by LEED Gold standards leased for RM 8.50p.s.f. while similar uncertified buildings attracted RM.6-7p.s.f. (Jasimin & Ali, 2014). In Prague, Czekoslovakia, the average price pre square metre of office net floor for conventional office space is 38800CZK while similar offices with low energy consumption index is about 40400CZK. On the average, the market value of low energy efficient office buildings are higher by about 4.12% (Heralova, 2011). Table 3.6 presents the overview of empirical evidence of sustainability-property value linkages.

Table 3.6: Overview of empirical evidence of sustainability-property value linkages. (Lorenz, 2011).

Study/Author	*Country*	*Property Type*	*Sustainable Credentials*	*Observed impact on*	*+/-*	*Magnitude*
Australian Department of the Environment, Water, Heritage and the Arts, 2008	Australia	Residential Homes	Energy Efficiency Rating, EER, (0 to 10 stars in 0.5 star increment)	Selling Price	+	1.23% - 1.91% for each 0.5 EER star
Brounen and Kok, 2010	The Netherlands	Residential Homes	Energy Performance Certificate (Class A, B, C)	Selling Price	+	2.8%
City of Darmstadt, Rental Index, 2010	Germany (Darmstadt)	Residential multi-family houses	Primary energy value below 250 kWh/m^2a	Rental Price	+	0.38€/m^2
			Primary energy value below 175 kWh/m^2a			0.50€/m^2
Eichholtz, Kok and Quiley, 2010	USA	Office Buildings	LEED	Selling Price	+	11.1%
				Rental Price	+	5.9%
			Energy Star	Selling Price	+	13%
				Rental Price	+	6.6%
Fuerst and McAllister, 2010	USA	Office Buildings	LEED	Occupancy Rates	+	8%
			Energy Star		+	3%
Fuerst and McAllister, 2008	USA	Office Buildings	LEED, Energy Star	Selling Price	+	31% - 35%
				Rental Price	+	6%
Griffin et. al, 2009	USA (Portland Seattle)	Residential Homes	Built Green, Earth Advantage, Energy Star, or LEED	Selling Price	+	3% - 9.6%
				Selling/Marketing Time	-	18 days
Pivo and Fischer, 2010	USA	Office Buildings	Energy Star, close distance to transit, location in redevelopment areas	Net Operating Income (NOI)	+	2.7% - 8.2%
				Rental Price	+	4.8% - 5.2%
				Occupancy Rates	+	0.2% - 1.3%
				Market Value	+	6.7% - 10.6%
				Income Returns/Cap Rates	-	0.4% - 1.5%
Pivo and Fischer, 2011	USA	Office, retail, industrial and apartment properties	Walkability (distance to educational, retail, food, recreational and entertainment destinations), measured as a Walk Score from 0 to 10	Market Value (office, retail)	+	0.9% for each unit increase in Walk Score
				Market Value (apartment)	+	0.1% for each unit increase in Walk Score
				Net Operating Income (office, retail)	+	0.7% for each unit increase in Walk Score
				Income Returns / Cap Rates	-	0.007% for each unit increase in Walk Score

Table 3.6: Overview of empirical evidence of sustainability-property value linkages. (Lorenz, 2011).						
Salvi et. al, 2008	Switzerland	Residential Homes	MINERGIE Label	Selling Price	+	7%
		Residential Flats		Selling Price	+	3.5%
Salvi et. al, 2010	Switzerland	Residential Flats	MINERGIE Label	Rental Price	+	6%
Wameling, 2010	Germany (Nienburg)	Residential Homes	Primary energy demand per m² and year (kWh/m²a)	Selling Price	+	Ca. 1.40€/m² per reduced Kwh/m²z
Wiley, Benefield and Johnson, 2008	USA	Office Buildings	LEED, Energy Star	Rental Price	+	7% -17%
				Occupancy Rates	+	10% - 18%
Yoshida and Sugiura, 2010	Japan (Tokyo)	Large residential condominiums	Tokyo Green Labeling System	Selling Price	-	6% - 11%

Table 3.6 shows that there are marked increases in rents actually paid and selling prices, but the methods used to extract these increases by were not disclosed, except for Miller *et al.* (2008); Warren-Myers and Reed (2010) challenge valuers to identify the "right" sustainability metrics in which to examine and compare real estate attributes and characteristics

In sum, the balance of theoretical evidence indicates that there are linkages between sustainability and property values which might become more apparent with the gradual development of a sustainability market. In practical terms, the market should underscore the importance of sustainability as a property value driver.

3.2.3 Property Sustainability Indicators and Dimensions

Sustainability dimensional characteristics enhance and compliment the traditional drivers of property values. The dimensions embrace the maximum utility for owners, users and the wider public out of the lowest possible use of land. RICS (2009) and Lützkendorf and Lorenz (2012) indicate that, for valuation purposes, four dimensions of sustaianability can be examined: The environmental, social, economic and the planning/cultural aspects.

The planning/cultural aspects have greater implications for process industries (Ibiyemi *et al*, 2015). Boyd (2005) and RICS (2009) present a list of the international sustainability indicators as representing the comprehensiveness of sustainability in buildings for valuation purposes as shown in Table 3.7.

Table 3.7. The comprehensiveness of sustainability indicators in buildings for valuation purposes. (Boyd, 2005, 2006; RICS, 2009)

Dimensions	Property Sustainability Indicators
Environmental Aspects	• Energy Use Efficiency and Renewability • Water and Consumption Efficiency • Emissions Control • Tobacco Smoke Control • Less Pollution • Waste Accumulation and Disposal • Recycling and Reuse • Indoor and Outdoor Environmental Quality • Materials and Resources Recovery • The Presence Of Plants That Remove Air Pollutants • Disclosure and Transparency Of Environmental Data • Regulation, Monitoring • Compliance, and Green Awards • Satisfactory Noise Level and Prevention • Thermal Comfort, Natural Daylighting and Views • Use Of Non-Toxic Building Materials • Functionality • Flexibility and Adaptability
Economic Aspects	• Life cycle costs • Value growth • Flexible use • The standard of service delivery • Savings from reduced energy • Water and wastes • Adequate public liability and service provider insurance • Workers' productivity and health • Transparency of marketing agreements • Monitoring stakeholders' concerns • Ease of maintenance
Social Aspects	• Wellbeing • Comfort, Post-Occupancy Comfort User • Safety and Lower Level Of Environmental Risks • Satisfaction • Functionality • Compliance with Health and Safety Regulations, • Quality of Communal Service Areas • Awareness and Training in Emergency Response • Appropriate Training for Security Personnel • Appropriate Training for Public Relations Personnel • Accident First Aid Facilities and Procedures and Wheelchair Access • Absenteeism • Health Costs

Table 3.7. The comprehensiveness of sustainability indicators in buildings for valuation purposes. (Boyd, 2005, 2006; RICS, 2009)	
Urban Planning/Cultural - related issues	• Sustainable Site Planning and Management • Design and Innovation • Industry Layout and Availability of Appropriate Internal Circulation • Public Transportation Availability and Proximity To Town Centres and Malls • Building Construction Orientation and Aspect • Compliance with Space Standards • Proximity to Child Care Facilities • Connection with Designated Green Space • Quality of overall Built Environment In Relation to Aesthetics and Visual Blending • Recognition of Indigenous People Through Cultural Space, Preservation of Heritage Values • Corporate Social Responsibility • Appropriate Signage • Utilities and Parking

However, Lützkendorf and Lorenz (2012) expresses the sustainability criteria for commercial properties from the investment perspective as: (i) Building-related (ii) Location-related and (iii) Process-related. The components are contained in Appendix Q. The concept of Lützkendorf and Lorenz (2012) also incorporates the four dimensions of property sustainability while explaining from the investors' viewpoint. The four dimensions are discussed as follows:

3.2.3.1 The Enviromental Aspects

From the environmental viewpoint, sustainable development focuses on the stability of biological and physical systems regarding ecological integrity, carrying capacity and biodiversity (Munasinghe & Shearer, 1995; Alvarez, 2011). The viability of subsystems that are critical to the global stability of the overall ecosystem needs proper interpretation. Reconciling these various concepts and operationalising them is a major challenge since all dimensions must have an equal attention and are mutually-inclusive. (Alvarez, 2011). The environmental aspects of property sustainability are classified as building-specific and are essentially the green features. The aspects concern the reduction of land and resource use, hazardous substances, emissions and the closing of material flows to minimise impacts (Lorenz, 2011). Nonetheless, Cheng and Ventakaraman (2013) classifies the environmental aspects into energy and water-related, material components and wastes, IEQ and sustainable site management (Table 3.3).

Energy and water-related issues focus on strategies for renewable energy usage, optimised energy performance, monitoring and emission reduction. The efficiency of water consumption is enhaced by recycling, metering and storm water management. Material wastes require collection, storage, disposal and recycling. IEQ leverages on acoustic performance, noise levels, ventilation, control of indoor air pollutants and post occupancy surveys. Site erosion, conservation, landscaping and signage are keys for sustainable site management.

The environmental aspects reduce risks through changes in energy and water prices that promotes efficiency features. Lützkendorf and Lorenz (2007) insists on compliance with environmental protection policies and the use of environment-friendly building products and materials, but noted that the dearth of environmental data accounts for the rarity of empirical results.

3.2.3.2 The Economic Aspects

The economic aspects to sustainability is based on the Hicks-Landahl theory of the optimal flow of revenue generation while at least maintaining a good stock of assets (or capital), which yield these benefits (Solow 1986; Alvarez, 2011). The flow is a function of the underlying concept of optimality, growth and economic efficiency employed in the use of scarce resources.

Sustainable design, construction and investment have been discussed in section 3.2.1.5. The economic aspects concern on the local economy in terms of life cycle costs and the development of income streams, market and investment values through construction costs, projected and effective maintenance, operating and disposal costs. Economic sustainability infers savings from sustainable design initiatives for reduced energy, water and wastes, savings from the monitoring of workers' health and productivity. Cheng and Ventakaraman (2013) categorises the economc aspects also in the context of local economy, efficiency of use, adaptability and flexibility, ongoing capital and operational costs (Table 3.3)

3.2.3.3 The Social Aspects

The social arm of sustainability is people-oriented and seeks to maintain the stability of social and cultural systems, empowerment, participation, social mobility, cohesion and cultural identity, including the reduction of destructive conflicts (Munasinghe & McNeely 1995; Alvarez, 2011). Equity is a significant aspect of social sustainability.

Lorenz (2006) identifies three different social approaches to property investment as *(1) Defensive property investing* which are the conventional mainstream property investment practices that adhere to written laws only. *(2) Responsible property investing* which seeks, consistent with investor financial goals and social responsibilities, to minimise the adverse impacts of property proprietorship, management, and development on the natural environment and the society (Pivo & McNamara, 2005). *(3) Sustainable property investing,* which, in addition to being responsible, meets all predefined socio-environmental performance requirements development including into community projects and urban revitalisation. Cheng and Ventakaraman (2013) further identifies occupants' comfort and satisfaction, inclusive environments, access to facilities, the monitoring of stakeholders' concern, health and safety, emergency response, security, gender equality and equity as benchmarks for social sustainability and vital elements in sustainable property investing. Other issues proposed by Boyd (2005) and Opoku (2015) include the planning and cultural issues, such as, the employment of local residents and the proximity to child-minding activities.

3.2.3.4 The Planning/Cultural Aspects

The planning and cultural issues have become a prominent and distinct dimension of sustainability in property valuation since the observation made by Boyd (2005). The planning and cultural issues formed integral but distinct part of the social sustainability considerations. Planning emphasises accessibility to designated green open spaces and town centres, recognising the indigeneous people through community engagement, aesthetics, pedestrian and traffic management, the preservation of heritate values and corporate social responsibility (Boyd, 2005, 2006; RICS, 2009).

Tibbs (1992), Tonnelli *et al.* (2013) and Herrmann *et al.* (2015) specify ten (10) of the industry-related environmental sustainability indicators used in the study (section 3.4.3). The other related property sustainability indicators used in the study and the criteria for their selection are discussed in section 3.2.4. Overall, the dimensions of sustainability are mutually-interdependent and connected, locally and globally interlinked (Siebenhuner, 2004, Schäfer *et al.*, 2010; Fahy & Rau, 2013)

3.2.4 The Sustainability Indicators used for the study

Having reviewed the property indicators by the various studies, including the studies relating directly with industrial sustainability, and considering the four (4) dimensions identified for property valuation purposes, this study has provided a list of thirty-four (34) indicators for the Delphi experts.

The selection of international sustainability indicators derived from the literature (section 3.2.3): Twenty-four (24) international sustainability indicators were selected from the studies of Boyd (2005), RICS (2009), Cheng and Venkataraman (2013) (Table 3.3; 3.7) and ten (10) industrial sustainability-specific indicators from Tibbs (1992), Tonnelli *et al.* (2013) and Herrmann *et al.* (2015) (section 3.4.3). The studies by Tibbs (1992), Tonnelli *et al.*(2013) and Herrmann *et al.*(2015) recognise the ten (10) environmental sustainability indicators related to industries as follows:

Environmental: Green House Gas (GHG) emission – Pollution control devices, regulation compliances, effluent treatments, recycling and removal, use of ODS; Other atmospheric emissions – Condition of air conditioning plants, refrigerants, and presence of plants that remove air pollutants; Solid and liquid waste – Waste disposal technologies; Indoor air quality – Absence of indoor pollution nets, ventilation, natural lighting and acoustics, noise abatement; Durability, adaptability and flexibility (suitability of building materials for refurbishment); Compliance with fire, and other safety regulations; Factory facilities – Lifts and escalators. All the indicators are selected because they are industry-specific. The other twenty-four (24) indicators comprising of the social (8), economic (7), planning/cultural aspects (9) rely on Boyd (2005), RICS (2009), Cheng and Venkataraman (2013). The indicators were selected based on the criteria of intrinsic relevance of each indicator to health and safety, public transportation, security, insurance and planning standards as suggested by Runde and Thoyre (2010). Nevertheless, the experts were also requested to add to the suggested list or remove from it as deemed necessary. The selection are as follows:

Social: Public transport availability, Compliance with health and safety regulations, Quality of communal service areas, Awareness and training in emergency response, Appropriate training for Security Personnel, Appropriate training for Public Relations Personnel, Accident First Aid Facilities and Procedures, and Wheelchair Access

Economic: Standard of service delivery, Savings from reduced energy, water and wastes, Adequate public liability and service provider insurance, Workers' productivity and health, Transparency of marketing agreements.

Planning/Cultural: Proximity to town centres and malls, Availability of appropriate internal circulation, Compliance with space standards, Proximity to child care facilities, Connection with designated green space, Land use – Quality of overall built environment, Recognition of indigenous people through cultural space, Preservation of heritage values, CSR, Monitoring stakeholders' concerns.

A total of thirty-nine (39) indicators were used in the study (section 5.2.2.7): The thirty-four (34) indicators selected from literature and validated by the experts, while the five (5) other indicators were inputted by them.

3.3 Property Sustainability Valuation Approaches

It is considered important to discuss the relevant concepts and procedures involved in real estate valuation for sustainability. Sections 3.3.1 and 3.3.2 fulfil this purpose.

3.3.1 The principles and methods of real estate valuation

Scarrett (2008) discusses the principles of real estate valuation to include the following: Supply and demand, expectation/anticipation, substitution, opportunity cost, change, competition, increasing and decreasing returns. Others are contribution, surplus productivity and balance, conformity and the land utilization principle. This study works with expectation/anticipation and the substitution.

3.3.1.1 Expectation or Anticipation

The principle of anticipation presupposes that value is created by the expectation of future benefits. It is not the past but the future which is important in obtaining opinion of value. The past records are significant only as they provide the basis for the estimation of future trends and conditions. The principle of anticipation assists us in defining value as the present worth of the rights to receive potential future benefits, tangible and intangible, accruing to ownership of property. In many cases, the quantity, quality and duration of future benefits may be estimated from available past and present records. Recent sale prices of comparable properties and results of market transactions in securities indicate the attitudes of informed buyers and investors in the market, concerning the present value of these anticipated benefits of ownership of a particular property.

3.3.1.2 Substitution

The principle affirms that when several commodities or services with substantially the same utility are available, the commodity with the least price attracts the highest demand and most extensive distribution. For example, if two houses offer approximately the same advantages, the prospective tenants will select the one with the lower rent. The principle of substitution applies to all valuation approaches: In the market data approach, property value tends to be set at the costs of acquiring an equally desirable substitute property, on the assumption that no costly delay is encountered in making the substitution. In the replacement cost approaches, no rational person will pay more for a property than that amount by which he can obtain, by purchase of a site and construction of a building, without undue delay, a property of equal utility. In the income approach, values tend to be set by the effective investment necessary to acquire, without undue delay, a comparable substitute investment property offering an equivalent net income and returns (Wyatt, 2007).

3.3.2 The Basis and Methods of Valuation

A basis of value is a statement of fundamental measurement assumption of a valuation. Market Value, Market Rent, Investment Value (Worth), Equitable Value, Synegistic Value and Luquidation Value are the bases recognised by the RICS-VPS4 (RICS, 2017). The five methods of valuation are *(1)* The Comparative Method *(2)* The Investment Method *(3)* The Profits Method *(4)* The Residual Method *(5)* The Cost Method (API, 2007). The valuation methods are used to arrive to the value of properties. The description of these methods are provided in Appendix A

3.3.3 Sustainability-related information for real estate valuation

It is found in literature that sustainability characteristics enhance and complement the traditional drivers of a property value. However, Lützkendorf and Lorenz (2011) indicate that the sustainability assessment systems coexist in isolation beside the traditional methods of the real estate valuation and risk analyses. The information requirements and structure of the information for valuation purposes were examined by Lützkendorf and Lorenz (2011).

Valuers by tradition tend to respond to market requirements rather than driving it (Lützkendorf & Lorenz, 2005). In 2011, Lützkendorf and Lorenz also reconsidered the previous submission about the valuers'sole market reflective role because of the observed dramatic changes in market needs towards sustainability and the increasing realisation by valuers to become active influencers in the marketplace. Nevertheless, a rising consciousness of the need to integrate sustainability issues into the property valuation process was also due to the empirical evidence of the research of Salvi *et al.* (2010); Wameling and Ruzyzka-Schwob (2010) and Pivo and Fisher, 2010). The studies show the affirmative relationships between sustainable building features and observed property values, a transformation in the perception of market participants, their value systems, and dealings. As a result, the valuation processes have to reflect the change. Of importance is the valuers' awareness that sustainability integration into real estate valuation could enhance their reputation and reserve professional competitiveness in the long run. However, the issue of double counting became important because the conventional methods of valuation methods and practices have always taken building characteristics into account which are part of the issues in sustainability. The researches demonstrate that within the various countries valuers are undertaking efforts to integrate sustainability aspects into their methods and practices. Consequently, information concerning the input of single buildings to sustainable development is becoming progressively important in the property sector and among valuers in particular (Lorenz & Lützkendorf, 2008a, 2008b). However, the overview of empirical evidence of sustainability-property value linkages and the magnitudes of price effects contained in Table 3.6 show that many studies find a positive relationship between property prices and buildings' sustainable credentials, thus providing supports which changes in market participants' value systems and measures have occurred. Hence, the informational demands of valuers would require further development and adjustment for property valuation purposes.

Lützkendorf and Lorenz (2011) provides a simplified procedure for information compilation for income-producing properties in Figure.3.5. The figure depicts the overlapping requirements of sustainability regarding functionality, serviceability and durability/useful economic life span. The overlapping requirements are identified in the main criteria group [building] as shown in Table 3.8. Key overlaps occur in accessiblity and transport, quality of layouts, space efficiency, flexibility, adjustability and storage space, safety maintenance and repair liabilities. Lützkendorf and Lorenz (2011) offers a list of SRI in Table 3.8 based on: *(1)* The traditional information requires for property valuation and assessment of risks (RICS, 2009) *(2)* Sustainability criteria in use within the property sector (GPA, 2010). *(3)* Research results of the linkages between sustainable building design features and values (Muldavin, 2010b). *(4)* the work of Meins, *et al.* (2010) on an Economic Sustainability Indicator (ESI) and (5) the cross section of sustainability assessment schemes and approaches for the property and construction industry (Lorenz & Lützkendorf, 2008a)

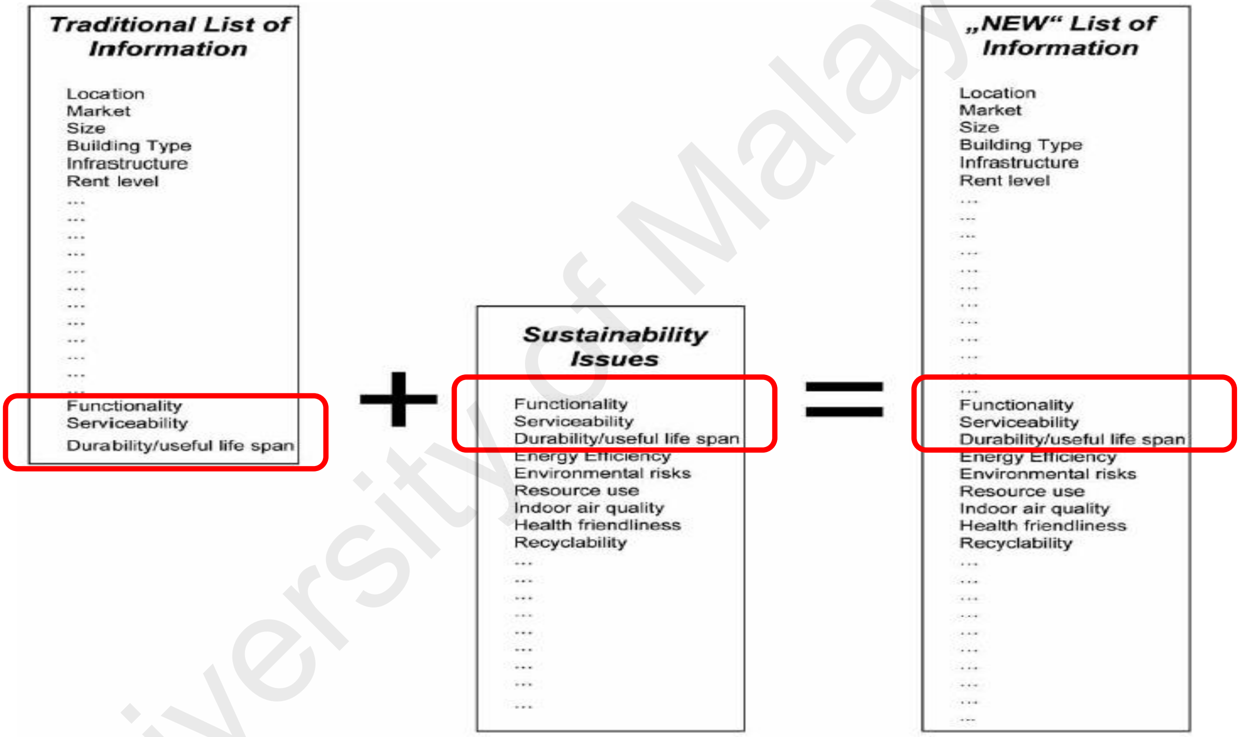


Figure 3.5: New structure of information for real estate valuation purposes (Lützkendorf & Lorenz, 2011)

As in Table 3.8, Sustainability-related information comprises issues on the environmental and health impacts of buildings and materials, emissions and energy performance, resource use and environmental risk, recyclability, climate change consequences and other qualities including equipment for heating, ventilation and air-conditioning (HVAC), the prolonged economic existence and resilience of the buildings. Specialist information of these types are beyond the routine valuers' site inspection. As a result, Lützkendorf and Lorenz (2011) insists that expanded but specific information relating to sustainability assessment be obtained through the facility managers on the technical and functional building qualities. Documentation of the design and planning process created during the design and planning stage for verification of conformity with national laws and standards could be obtained from the building designers and planners, building owners and planning authorities. For environmental and health-related aspects, the environmental manager could provide.

Respective property market actors have to develop further or adjust their instruments and methods so that they are capable of taking this additional information into account. Lützkendorf & Lorenz, 2009; 2010). The amplified interest through diverse groups of market participants in issues of sustainability generates not only a fresh demand for dependable information, but also the necessity for serving this information into conventional and new instruments and approaches of the property industry. Lutzkendorf and Lorenz (2011) has provided the lists of traditional information characteristics and variables, and incorporated a list of sustainability issues, to create a "new" list of information for valuation purposes (Table 3.7, 3.8). The incorporation and assessment of the additional variables within valuations could be as testing as identifying a single valuation input parameter (Muldavin, 2009; Sayce *et al.,* 2010). Increasingly, there is a need for direction as to how valuers assess sustainability in building stock, and how it is then to be approached in the valuation process.

Table 3.8 SRI for the description of buildings for valuation purposes (Lützkendorf and Lorenz, 2011)

ain Criteria groups	Sub criteria groups	Characteristic and attributes/information and indicators	A	B	C	D	E
Location	National market	Overall economic situation and attractiveness					
		Political, legal and administrative conditions and impacts (e.g. legal security)					
		Interest rate development					
	Macro-location	Transportation infrastructure/national transport connections					
		Socio-demographic development/population structure and development					
		Regional image					
		Economic structure and situation					
		Purchasing power					
	Micro-location	Suitability of the micro-location for property type and target occupiers					
		Image of the quarter/district					
		Transport connections					
		Quality of local supply facilities for target occupiers (shopping facilities, services, social and medical facilities)					
		Emissions (e.g. air pollution, noise)					
		Environmental situation, environmental risk, consequences of climate change					
		Other risks (e.g. technical/man-made disasters)					
Plot of land	Characteristic and configuration	Building permission and planning regulations					
		Layout, size, inclination, topography					
		Utilities supplies (e.g. energy water, waste water, etc.)					
		Characteristic of the soil (e.g. bearing capacity potential for rainwater drain, groundwater, suitability for geothermal energy)					
		Contamination/brownfields (e.g. through previous usage)					
		Other adverse effects (e.g. radon, electromagnetic fields)					
		Visual context (e.g. view)					
		Situation regarding sunlight/shading					
		Degree of sealing of the plot of land					
	Surroundings	Green areas, plantation					
		Contribution to maintaining local biodiversity					
		Internal and external accessibility					
		Layout, design and usage of open spaces					
		Safety, safety to traffic, exterior lighting					
Building	Basic building description	Building structure(age, size, cubature, construction type, main construction materials)					
		Availability of green roofs/green facades					
		Degree of modernization/revitalization (e.g. maintenance backlog)					
		Building equipment and appliances (e.g. heating system and energy source, solar heating, rainwater use, degree of automatization, etc.)					
	Technical quality	Structural safety, load bearing reserve					
		Heat insulation and moisture proofing of thermal building envelope					
		Noise protection/sound insulation (e.g. protection against airborne and structure-borne noise)					
		Fire protection (e.g. fire alarm/sprinkler systems, fire compartments)					
		Durability of building components (e.g. longevity, resilience)					
		Ease of conducting cleaning, servicing and maintenance works (e.g. surface, accessibility of building components)					
		Recyclability (e.g. easy disassembling of building components, disposal concept)					
		Quality of sanitary and electronic fixtures and fittings					
		Efficiency of heating, ventilation, air conditioning and refrigeration					
	Functional quality	Quality of the layout/space efficiency					
		Fitness for purpose					
		Barrier-free access (e.g. elevators, wide doors)					

		Flexibility and adjustability
		Suitability for re-use/re-development
		External and internal accessibility
		Usability of free areas (e.g. roof terrace)
		Storage space (e.g. for bicycles, perambulators)
	Environment quality	Resource use (e.g. use if renewable/non-renewable fuels, use of other biotic/abiotic resources drinking water usage)
		Impacts on the global environment (e.g. carbon footprint, impacts on biodiversity)
		Risks and impacts for the local environment and residents
	Design/Aesthetic quality	Architectural quality
		Art as part of the building
	Urban design quality	Public accessibility, enlivenment of the public space
	Cultural value	Historic monument
	Health/comfort/satisfaction of inhabitants, user and visitors	Health friendliness/comfort (e.g. thermal comfort, indoor air quality, health friendliness of materials, acoustic and vitual comfort)
		Safety (e.g. protection against burglary)
		Subjective sense of security (e.g. clear arrange routes and escape route)
		User participation (e.g. individual temperature controls)
Economic quality/cash flow	Market	General letting prospects, investment volume, expected rates of return
	Payments-in	Rental payments, advance payments for utilities
		Other payments-in (e.g. façade advertising, energy-feed-in)
		Rental growth potential, inflation expectations
	Payments-out	Payments for construction, acquisition, disposal
		Payments for operating costs attributable/non-attributable to tenants
		Marketing/Letting (e.g. estate agent's fee)
		Payments for revitalization/modernization
	Vacancy/letting situation	Vacancy rate, tenant retention, tenant fluctuation, duration of letting process
	Tenant and occupier situation	Number of tenants, tenants' image and solvency
		Duration and structure of rental contracts (e.g. also 'green lease')
Building Image	Brand value	Label, certification result
		Famous designer
Process quality	Planning quality	Form and extent of quality control of planning 9e.g. external assessment of planning documents)
	Construction quality	Form and extent of quality control during construction (e.g. measurements like air-tightness, thermography, sound insulation)
	Management Quality	Form and extent of documented maintenance and servicing activities

Explanation

A Information demand for "integrated approach"
B Traditional scope of valuers investigations
C information contained in results and documentations of the design and planning process
D Information contained in verifications of conformity with nationals laws & standards
E Information contained in sustainability assessment systems
F Information typically achievable through the facility manager

Fully applies
Partially applies

3.3.4 The Normative and the Evidence-based Valuation Approaches

Warren-Myers (2012) categorises valuation approaches into *(1)* The normative studies on how sustainability ought to affect value with case studies employed to demonstrate the normative theories and the quantitative studies to measure the effect of sustainability *(2)* Evidence-based Valuation methods

3.3.4.1 The Normative Studies

Normative research has been used to inform stakeholders of the perceived benefits of sustainability. Boyd (2005) and Lorenz (2006) debate on suitable methodologies. Though it is granted that attention to environmental and social features was clearly professed by occupiers and investors of sustainable properties (Boyd, 2005; Lützkendorf and Lorenz, 2005; Sayce *et al.,* 2004; Kimmet, 2006), the question of how to compute and integrate these effects in the valuation process is unsettled. Boyd (2005), Pivo (2005), and Robinson (2006) argue that conventional methods are applicable, while others such as Lorenz (2006) are of the opinion those methods will only lead to unbalanced value estimates. In support, Boyd (2005) presents a study of the impact of environmental and social sustainability of economic returns. By this, Boyd attempts to capture the interfaces of the triple-bottom line on real estate investment. The study tests whether these features would bring appreciable economic returns to the investor by utilising a case-study prime office building valuation in Brisbane, Australia. Alongside the DCF method. Boyd applies a model to define the dissimilarity between the returns attainable on a prime grade office property and a comparable environmentally and socially enhanced building. Boyd concludes that the market shows an indication of future demand for enhanced properties. Furthermore, that the application of traditional valuation methods in the assessment of the impact of the triple bottom-line is indeed achievable. With regards to economic sustainability, Rothschild (2005 as cited by Kauko, 2008) while agreeing with earlier studies asserts that economic sustainability cannot be measured through economic efficiency, but rather through economic security and quality of life. The study argues that price increases are balanced in the most sustainable residential property markets with increases in the quality of life, thus producing an economically efficient and economically sustainable real estate market compared to other submarkets. The implication of the empirical property modeling proposed by Kauko (2008) is that where markets are classified as sustainable, added value would be brought to the properties. Thus, sustainability valuation would be tied to the local market conditions. It would therefore, be possible to ascribe values to properties based on the sustainability submarket to which they belong. However, the challenge of how to locate and value for sustainability in the market remains. First, Kauko (2008) suggests a penalty could be deducted if the building is considered unsustainable and a bonus added if the building is deemed sustainable. It is thereafter assumed that as new real estate developments occur, this method of valuation would be adopted for transactions in that market. Thus, a database of valuations in a sustainable market context can be built up which can be used as a basis for comparative appraisal.

The study of Kimmet (2006) on the psychic income analysis could potentially contribute to the question of appropriate means of accounting for social sustainability. The study argues that rather than focusing on appropriate valuation methodology, the adoption of a psychic income premium into valuation practice would deliver a more comprehensive account of social sustainability. Kimmet (2006) defines the psychic income of a provider as the financial premium paid by customers enjoying a psychic benefit. It is, therefore, possible to view the sustainable property investment market as a specialised market catering only for particular types of organisations that value such distinctions. This will supposedly ensure that a premium can be paid as the psychic income deriving from the use of such sustainable properties. This premium can then be factored into the valuation process, thereby making it easier to adopt any valuation approach as appropriate. The major contention against the theoretical foundation proposed by Kimmet (2006) is the ascription of monetary value to the psychic income and the basis of recognizing the indicators that measure it. More research has to be carried out in this regard.

Robinson (2006) develops the concepts of price and worth, and outline valuation process to assist valuers in appraising environmental sustainability. Rent, capital growth and psychic income are the indicators of environmental sustainability in his study. A residual analysis of two hypothetical properties, a conventional office property and an environmentally sustainable property showed that the worth of the environmentally sustainable property building is substantially greater than the estimate of price commanded by the conventional building. This means that the application of the concept of worth into the traditional residual method of valuation would generate higher values and benefits for environmentally sustainable buildings. Robinson (2006) however, concedes that even though the concept can be readily accepted by owner-occupiers; its acceptance in the investment market depends on the ability of valuers to account for psychic income, improved rental values and technical performance of buildings and improvements in productivity and other occupants' advantages. Lorenz (2006) offers a useful analysis of the appropriateness of both modern and traditional methods to sustainability valuation practice. He contends that traditional approaches are helpful for the valuation of single properties and could, therefore, be adapted to value sustainability in properties. Conversely, modern methods such as hedonic pricing, fuzzy logic, and spatial analysis method are appropriate for mass valuations and so are best suited for valuing properties in a sustainable market. Lorenz (2006) particularly draws attention to the real options and the hedonic pricing methods (HPM). The real options method is favored for valuing sustainability because it is designed to analyse future opportunities (rather than projecting from current and past transactions), that may arise from a particular parcel of land or building. It is therefore particularly suited to account for the increased flexibility and adaptability that sustainable properties have to offer. The HPM, on the other hand, has the advantage of being user-friendly. It is useful for quantifying the value that market partakers place on different quantitative and qualitative property characteristics; making it easy to gauge the relationship between sustainability of construction and observed property prices. Hence, a more scientific basis for the value adjustments necessary to carry out sustainable property valuations is offered in the HPM. Availability of property transactions databases is however recognised as a major constraint on the use of modern methods in general and the hedonic pricing model in particular.

Other related normative studies addressed by Boughey (2000), Eastbrook (2000), Chao and Parker (2000), Gottfried (2004) and Reed (2009) on theoretical analysis of real estate markets, value and sustainability, economic theory and sustainability, energy savings, market trends and education and value-linked payback theory and the normative analysis of value drivers in the valuation process. However, some of the normative theories are interpreted into scenario, human capital and other environmental cost studies which are not applicable to the theory and practice of valuation (Warren-Myers, 2012). Examples are the big data reliant fuzzy logic and spatial analysis. Besides the global markets and the RICS rely on standardised valuation methods and reporting on established markets. RICS suggested that the traditional valuation techniques should identify the value of sustainability. The theoretical body of knowledge on the relationship between sustainability and market value has been developed from various forums and theories. However, the continuing requirement for evidence and proof by the industry has led to extensive development of hypothetical analyses, case studies and quantitative investigations. RICS (2005), JLL (2006), Bowman and Wills (2008) use the traditional income approach with theoretical assumptions regarding increased rents, reduced operating expenditure and heuristics adjustments to the capitalisation rates. Kimmet and Boyd (2004), as well as Boyd and Kimmet (2005) construct the theory of triple bottom line in which commercial real estate valuation was based on the criteria for sustainability offered by the Green Building Council of Australia and their environmental rating.

The normative theories are also demonstrated by case studies, hypothetical and data-based quantitative studies to measure the effect of sustainability. Warren-Myers (2012) classifies the studies into (1) cost-benefit analysis (CBA) (2) Quantitative studies (3) The valuation methods comprising the cost, residual and income approaches. Table 3.9 identifies the approaches taken to determine market value, and it then categorises by the type of analysis undertaken in a hypothetical case study and analysis of actual market data. The table presents a chart of the research into the relationship between sustainability and value has changed over time.

Table 3.9 Case and quantitative studies on sustainability in real estate (Warren-Myers, 2012)

Research		Life cycle and benefits analysis	Traditional valuation analysis	Quantitative analysis	Hypothetical analysis	Case study analysis	Actual market analysis
Chao and Parker (2000)	G	U			U		
Bartlett and Nigel (2000)	A	U				U	
Kats (2003)	G	U				U	
US Green Building Council (2003)	I	U			U		
Paumgartten (2003)	A	U			U		
Davis Langdon Consultancy (2004)	I	U				U	
Matthiessen and Morris (2004)	I	U				U	
Winter (2004)	I	U			U		
JLL (2004, 2006)	I	U	U		U		
Case (2005)	G	U			U		
Robinson (2005)	A	U	U			U	
Merrill Lynch (2005)	I	U				U	
RICS (2005)	I	U	U		U	U	
JLL (2006)	I	U	U			U	
Madew (2006)	I	U			U		
Robinson (2006)	A	U			U		
Suttell (2006)	A	U			U		
BD þ C (2006)	I	U				U	
Lorenz et al. (2006)	A			U			U
New Zealand Ministry for the Environment (2006, 2007)	G	U			U		
Lorenz et al. (2007)	A			U			U
Morris and Matthiessen (2007)	I	U			U		
Nelson (2007)	I				U		
Davis Langdon (2007)	I	U			U		
Ellison et al. (2007)	A		U		U		
Yudelson (2007)	I		U		U		
Bowman and Wills (2008)	I		U			U	
Lorenz (2008)	A		U			U	
Eichholtz et al. (2008, 2009)	A			U			U
Miller et al. (2007, 2008b)	A			U			U
Fuerst and Mcallister (2008a, b)	A			U			U
Pivo (2008)	A						
DeFrancesco and Levy (2008)	I	U			U		
Pivo and Fisher (2009)	A			U			U
Bienert et al. (2009)	A			U	U		

Notes: G - ¼ government produced study; I - ¼ industry/professional body produced study; A - ¼ academic research

However, the table indicates how research into the relationship between sustainability and value has progressed over time from predominantly CBA to quantitative and market value-based studies in recent years. Warren-Myers (2012) informs that the majority of the studies do not specifically address market value principles but focus on the value of sustainability, which is not necessarily same. The CBA focuses on the justification of retrofitting expenditure on the returns receivable, either through occupiers' health and loss of productivity, quantification of pollution effects, reduced operating costs or increased rents and prices. Although some of these studies provided evidence to justify the claims made, the inferences made regarding value neither capture the sustainability dimensions explicitly nor demonstrate market value comparison, which is obtained through valuation methods (Warren-Myers, 2012). Furthermore, cost-benefit ratios, life cycle analysis, payback ratios are economic assessment tools for performance evaluation. The methods fail to prove costs associated with property users' health and wellbeing or their willingness to pay an increased rent for improved occupiers' comfort and health. The methods neither interpreted the effects of sustainability nor show explicitly the relationship between sustainability and market value. Indeed, Kimmet (2006) submits that the pathway of computing human capital, occupiers or employees health effects and productivity have no direct relationship with real estate market value. Hence, their suitability for proper valuation that reflects sustainability issues is doubtable. Even so that the five methods of valuation do not strictly accommodate them because of their inappropriateness as valuation methods, inconclusiveness and lack of adequate information for assessments by valuers (Whipple, 1995; Muldavin, 2008).

Many of the studies focused on the cost approach in particular, for example, Davis Langdon Consultancy (2004), Matthiessen and Morris (2004), and English (2004). Although these studies provide an analysis of the cost, the equating of cost to value for the assets is discounted as an inappropriate method for determining market value for commercial properties in a mature market (Whipple, 1995). Whipple (1995) emphasises that the cost method be used for either insurance assessments or properties that do not have a market and comparable transactions. The cost method can be indispensable where no sustainability market exists (Ibiyemi *et al.,* 2015). Robinson (2006) employs the residual analysis where hypothetical development was used to identify the effect of sustainability on residual land value. However, assumptions and incorporation of income parameters made from normative research statements, such as additional amount based on occupier productivity. That elicits the potential effect of sustainability on the residual land component, but the outcome is betrayed by its hypothetical nature and assumptions of productivity is at variance with market comparison and property valuation principles. The balance of evidence is that the use of valuation methods, either in a theoretical context or case study analysis, has not provided certainty within the real estate market.

The studies of Pivo and Fisher (2009) and Warren-Myers (2012) examine the quantitative studies that investigated the value of sustainability in commercial real estates as presented in Table 3.10.

Table 3.10: Quantitative studies investigating the value of sustainability in commercial real estates. (Pivo and Fisher (2009) and Warren-Myers (2012)

Author	Approach	Database	Classifications and sample size	Rent increases (%)	Values	Result
Miller et al. (2007, 2008a, b)	Hedonic regression	CoStar	N-G 2,077 LEED 580 Energy 643	50.5 8.9	9.9% 5.3%	Sustainability increases rents, reduces occupancy and increases value/ square feet
Fuerst and McAllister (2008a, b)	Hedonic for sales and weighted-least-square regression	CoStar	N-G 3,626 LEED 350 Energy 1,015 Green 1,365	18.9 9.7 (9.2[a]) 11.8	31.4% 10.3%	Certified properties have a rental premium and the higher the rating, the higher the rent premium and higher transaction prices
Eichholtz et al. (2008, 2009)	Regression analysis	CoStar	N-G , 10,000 Green 494 LEED energy	2.8-3.5 0 3.5 (8.9[a])		Rental premium and capitalisation rate
Pivo and Fisher (2008, 2009)	Portfolio Portfolio analysis, Delphi and regression analysis	NCREIF	Energy Star Transit urban regeneration	NI 5.9 NI 4.5 NI 2 2.4	MV 13.5% MV 10.4% MV 1.1%	Net income and market values affected, capitalisation rates up to 50 basis points the overall impact on return

Notes: [a]Regression analysis; N-G – non-green building; LEED– LEED certified building; Energy – Energy Star certified building;; MV –market value as defined in Pivo and Fisher (2009); NI – net income: National Council of Real Estate Investment Fiduciaries (NCREIF)

However, the application of these studies, although, used actual case studies, the studies did not draw comparisons for the assessment and assumptions as required in valuation practice. Historic information about trends are the limitations of this approach. Sayce and Ellison (2003a, b) utilise study analyses based on the income approaches in which the researchers define sustainability and its relationship with different valuation variables.

The sustainability attributes identified were then weighted as to their relationship and level of effect on particular valuation variables. The application adapted the valuation model to a series of case studies such that a devaluing of the property occurred when sustainability variable was integrated into the assessment. However, the assessment is said to be both theoretical and arbitrary because treatment of sustainability variables and the impact on market value was not developed from market trends and evidence from the market dynamics. Lorenz (2011) presents a table of empirical evidence support of the effect of sustainability on rental and market values.

3.3.4.2 The Evidence-based Valuation Approaches

The normative studies paved the way for the evidence-based valuation methods, that is, analysis of actual market evidence. RICS (2011, 2014) avers that sustainability should be constructed into the valuation calculations that may include the discounted cash flow and elements of comparison. However, where sustainability is difficult to quantify and the market preparedness to pay for it is not-verifiable, valuers could determine the extent to which sustainability features meet the sustainability requirements. They insist that no new method of valuation should be used

Lorenz *et al.* (2007) employ the log-linear hedonic regression approach to investigate the relationship between the sustainability of construction and sale prices in residential units. It analyses price movements and price differences caused by different property characteristics and calculated the hedonic price index. Price changes subject to various property characteristics are then examined. Location outperformed other features. Clarity in obtaining sustainability levels would require higher order data that would meet the underlying assumptions for hedonic regression to validate the results. However, the studies of Fuerst and McAllister (2008a); Eichholtz *et al.* (2008, 2009); Miller *et al.*

(2008) and Pivo and Fisher (2009) use the US National Council for Real Estate Fiduciaries (CoStar Group/NCREIF) transaction databases for hedonic and the Delphi approaches. It finds a positive relationship between sustainability, and significant markup in market values in the USA. The NCREIF also allows access to market valuations of properties from which closer comparisons could be made. Table 3.10 presents quantitative studies that investigated the value of sustainability in some commercial real estates.

Lorenz (2011) highlights the empirical surveys of evidence-based outcomes in Table 3.6 Nonetheless, the consistency of the trend would depend on market dynamics, while the core traditional valuation methods also have pivotal roles to play. JLL (2006) and Bowman and Wills (2008) claim that some studies endeavoured to use the capitalisation of income and the DCF approaches in analysing the relationship and effect of sustainability on market value, but these studies are hard to find in the real estate sustainability literature.

Three major approaches that have been identified in the literature is summarised in Table 3.11). Sayce *et al.* (2010) explains that, although valuers should not lead the markets, but the observed prices are outcomes of haggling in the marketplace induced by the expert advice they offer. As a follow-up, Lorenz and Lützkendorf (2011) suggests that valuers can induce investors to leverage on risks reduction through market-proven sustainability initiatives, which in turn, influences property market outcomes. In sustainability, the notion of valuers as mere reflectors of the market comes under challenge. Valuers have always been both property market observers, informers and indirect active influencers of market outcomes (Hill *et al*., 2013; Ibiyemi *et al*., 2015) By 2016, the three approaches were categorised as compliant with the valuation methods of investment, comparative and cost (already described in section 3.3.2.

Table 3.11. Table showing evidence-based valuation approaches (Adapted from Lorenz & Lützkendorf (2011)

Approach 1: Direct adjustment of single valuation parameters		Approach 2 LUMP SUM		Approach 3 CORRECTION FACTOR
1. Valuation Assignment		1.Valuation Assignment		1.Valuation Assignment
2. Use valuation method as appropriate		2. Use valuation method as appropriate		2. Use DCF valuation approach
3. Determination of single valuation input parameter *with* consideration of sustainability issues (SI)	Sustainability sub-analysis (SSA): Comparable sale analysis, risk analysis, ecological rental indexes, CBA, LCC, certification & labelling, performance measurement	3. Determination of single valuation input parameter *without* consideration of SI		3. Determination of single valuation input parameter *without* consideration of SI
		Preliminary valuation result		Preliminary valuation result
		4. Adjustments (+) of lump sum to account for SI	SSA: Sustain-ability Scoring Model/Com-parable transactions	4. Sustainability Correction Factor (SCF)
4. Value judgment/Valuation Result		5. Value judgment/ Valuation Result		5. Value judgment/ Valuation Result

With regard to the approaches pertaining to accounting for sustainability in the valuation process. Three (3) approaches have been identified to be as follows:

(1) The direct adjustment of single valuation-input parameters (such as gross or net rents, risk premiums) within the determination of discount and capitalisation rates, maintenance costs and other capital expenditures, lease terms and lease provisions, growth rates, marketing costs and marketing time frames, and depreciation.

(2) The lump-sum adjustments on the preliminary valuation result; and

(3) The calculation of a sustainability-correction factor to adjust the preliminary valuation result.

The following sub-section provides the explanation of these valuation approaches:

3.3.4.2(a) The Direct Adjustment of Single Valuation-Input Parameters such as Gross or Net Rents, Risk Premiums within the Determination of Discount and Capitalisation Rates.

The first approach, which is the integrative approach of adjusting single valuation parameters appears to be a suitable approach for integrating sustainability issues into the valuation process. It is the most consistent with the RICS accepted valuation methods. However, the adjustments made to single valuation-input parameters are subjective and implicit but have to be justified with the strength of the sustainability sub-analyses in the valuation report (Muldavin, 2010a). The sub-analyses include those of market responses, conditions and the local and wider market environment. The market value is based on usual current parameters of comparable properties in the market while the estimation of worth may depart from such assumptions and evidence as it is not seeking to predict transaction price – but the value to an individual client. Regardless of whether the market value or a calculation of worth is undertaken, within integrative approaches, sustainability and common quality attributes of properties which are perceived to have an impact on value are factored into the valuation directly by adjusting the input parameters (Income and the ARY). The drawback is the great difficulty in finding comparable market evidence for estimating the input parameters. In addition, the assessment of the sustainability of a product requires an evaluation of the social, economic and ecological consequences of its design, use, and disposal (ISO, 2008). In real estate, the sustainability aspect of a property encompasses a range of attributes such as location, access to public transport, structural flexibility, that are already factored into a conventional valuation as well as the social, economic and environmental attributes which have previously not been items considered in arriving at an estimate of value. Many of these items have little or no "hard" data availability – and this lack of data provides a market transparency barrier and a room for double counting. The final valuation figure should depend on the valuers' qualitative judgment.

3.3.4.2(b). The Lump-Sum Adjustments on the Preliminary Valuation Result

The second approach is the additive approach of applying lump-sum end-adjustments to the preliminary valuation result regards sustainability as a capital sum and allows for such lump-sum adjustments to modify the preliminary valuation result to be consistent with current market conditions. Although the studies of market participants show willingness to pay (WTP) for sustainability credentials, but the potency of the lump sum approach can be criticised for treating sustainability issues as a capital expenditure whereas it is of a recurrent nature. Furthermore, the approach seems to isolate sustainability from other value influencing variables. If it is the case, sustainability issues may not be evaluated and priced adequately (Lorenz & Lützkendorf, 2011). Michl *et al.* (2016) argues that to simply take a lump-sum approach could be considered to conflict with good practice, especially as some sustainability attributes (such as location, functionality, flexibility, and distance to public transport nodes) are already routinely factored into the valuations whereas others such as energy efficiency, water conservation and health and wellbeing may not. Besides, Muldavin (2009, 2010b) insists that the treatment of sustainability in isolation can be advanced. Lorenz and Lützkendorf (2011) further states that if lump-sum adjustments are applied to incorporate sustainability issues within the valuation process, the issue of sustainability is separated from the many other value-influencing variables. Only by ensuring that factors are explicitly accounted for can transparency of computation be achieved (Michl *et al*., 2016). Lump sum allowance for sustainability ignores certification and weighting differences in the market place (Muldavin, 2010b).

3.3.4.2(c) The Calculation of a Sustainability-Correction Factor to Adjust the Preliminary Valuation Result

The third approach suggests the calculating a sustainability correction factor to adjust the preliminary valuation result. The approach seems logical given the appropriate scoring model and abundant comparable transactions. However, it might not be completely free from the criticisms of double counting. This approach also leads to the question of whether the valuation community would widely accept and adopt an additional step of calculation within the DCF method. In addition to each of Approaches 1, 2, 3, Lorenz and Lützkendorf (2011) proposes the inclusion of the Sensitivity analysis, Monte-Carlo simulation and risk documentation within the report. Sensitivity analysis, Monte-Carlo simulation and sustainability-related risk documentation are to account for uncertainties and the impact of changing conditions.

In the aggregate of all the studies above, it could be possible to value properties in sustainable properties markets with the use of either modern or conventional methods. In carrying out valuation using any of the approaches, the environmental, social and economic features indicating sustainability are to be identified and applied in the manner suitable for each method. However, it is noticeable that development of indicators to capture each feature could be quite problematic if sought by quantitative means. It is also apparent that the dearth of property transaction databases could impede the valuation process, besides, in the current small size of the sustainable market, there are other constraints related to the practice particularly in an evolving market like Nigeria. For instance, there exists the problem of appropriately adjusting discount or capitalisation rates to account for sustainability features in an environment that lacks comparative financial data, associated information on building performance and guidance and other essential data sources. Overall, the neglect of finding an approach for sustainability integration into process industries necessitated the search for an appropriate methodological approach within the five (5) valuation methods.

3.4 Developing the Valuation Approach for Process Industries

This section considers the development of the valuation approach to integrate sustainability into process industries. First, it discusses the valuers' role, industrial sustainability and some relevant aspects of asset valuation in the following sub-sections.

3.4.1 The Role of the Valuer

The key role of the valuer in response to the climate change and related issues would be to encourage and embrace measures that can incorporate sustainability adjustments into valuation calculations. Runde and Thoyre (2010) avers that sustainability discounts could reflect the avoidance and minimisation of adverse current and future impacts. The extent to which the subject property features meet sustainability criteria as a measure of sustainability compliance was put forward by Ibiyemi (2004) and RICS (2014). In the case of investment value, it suggests that relevant sustainability indicators could be incorporated even when the property market does not directly evidence their impact values. The valuation approach sought in this study is non-market because invest investment value is a non-market value basis of valuation. Hence, the valuers should:

(1) Collect sufficient quantitative or qualitative sustainability data,

(2) Identify the indicators that can influence sustainable investment and development decision making and assess the extent to which properties meet prescribed sustainability criteria as a professional and social responsibility (Runde & Thoyre, 2010; RICS, 2014,

2016). In fulfilment of this role, the study collects the information about the sustainability indicators from the literature for the Delphi experts to identify the relevant ones for scoring the extent of industry's sustainability compliance and assuage the potential social and environmental costs which are often underestimated.

With respect to market properties, the valuer reflects the market and should proceed to inform the client on sustainable design, the wider environmental and social impacts of the conventional design and the implications on development value even if sustainability aspects are not yet fully reflected in today's market prices (Lorenz, 2011)

3.4.2 Nature of Process Industries

Process industries are those concerns where the primary production processes are either sequence or follow on a batch of materials that is indistinguishable. They are used for manufacturing products or to store raw materials, and can be classified into factory-office multiuse, factory-warehouse multiuse, heavy manufacturing buildings, industrial parks, light manufacturing buildings, and research and development parks (Ibiyemi *et al.,* 2015). Industries differ from office, and residential buildings by their having special purpose designs and construction, complex nature, relatively shorter physical life spans due to the intensity of use, difficulty in adapting to new uses, dependability on trade conditions, and faster physical deterioration. Cameron *et al*. (2007) states that items of property, plant, and equipment of process industries are specialised properties. They are seldom if ever sold except by way of a sale of the business of which they are a part; due to their uniqueness, specific nature, the design of the buildings, configuration, size or location or other factors. Other main features are (i) usefulness to a limited number of users or uses (ii) They earn revenues not derived from open market transactions, and for which market-based evidence for the same or a similar asset does not exist. (iii) They have to be sold together with their tangible and intangible assets and liabilities, and they offer little utility for any purpose other than that for which they were originally designed (Maninggo, 2010; Brown, 1991; IVSC, 2010).

3.4.3 Industrial Sustainability

The concept of industry as an edaphic ecosystem that operates like the natural ecosystems where the by-product of one process is a resource to another process is the crux of sustainability. Process industries, from extraction to product disposal, impact upon the environment adversely. Sustainability aims to reduce environmental stress caused by industry while encouraging innovation, resource efficiency and sustained growth. Even so, it acknowledges that industry will continue to operate and expand, it supports the environment-conscious industry that places less burden on human and material resources. Hence, industrial sites are part of a wider ecology rather than an external, separate entity. Tibbs (1992), Tonnelli *et al.* (2013), Herrmann *et al*. (2015) describe the principles of industrial sustainability features as:

- Create industrial ecosystems of industries that partner with other industries to trade in the by-products of one another.
- Find equilibrium between industrial inputs and outputs to natural levels with profound knowledge of pro-environment activities, and their limitations.
- Materials and energy resource efficiency; reuse materials or substituting with more environment-friendly materials to do more with less, such as the use of ODS and bio-removal of air pollutants..
- Redesign products, processes, equipment; recycling, recovery of materials to conserve resources and improve the efficiency of industrial processes –
- Use of renewable sources of energy as an alternative to fossil fuels or other high impact materials, pollution control devices and waste disposal technologies, noise, fire and other safety equipments.

- Imbibe sustainability-driven policies by incorporating environment and economics into organisational, national and international policies, and the internalisation of the externalities.

- The positive impact factory integrates into its surroundings just as other critical infrastructure like water supply and elecricity, roads and public transport thus embedding into the local biota

Industrial sustainability include cost savings (materials purchasing, licensing fees, disposal costs, and so forth); increased protection of the environment protection; income generation through selling waste or by products; enhanced corporate image; improved relations with other manufacturers and organizations and market advantages (Addae-Dapaah *et al.,* 2009: Alvarez, 2011). Cannon and Vyas (2008) views the paucity of markets for materials; lackluster support from government and industry; the reluctance of industry to invest in appropriate technology uptake; and retrofitting costs could undermine the perceived successes.

3.4.4 Sustainability and Behaviour of Industrial Firms

Industrial sustainability is complex and unique: Investors are reluctant or not prepared, to invest in sustainability because they are uncertain about immediate returns on retrofitting costs or other additional costs required in embracing sustainability initiatives (Myers, 2009; NESREA, 2011). Second, they require an inducement to do so (Ibiyemi *et al*, 2015). However, sustainability may not be determined without the presence of a sustainability market, and the available market information requisite to it. Where no market exists, the valuation principles of substitution and expectation could be applied to estimate the industrial sustainability-related obsolescence (ISRO). It has been observed that, so long as the ISRO is not measured and underwritten by the investors, they would not be induced to invest in sustainability (Ibiyemi *et al.*, 2015). Industrial firms are sensitive to their internal financial control by often seeking to minimse costs inputs and maximise returns

(Wheeler, 1992; Starvins, 2001). Thus, the study of Ibiyemi *et al. (2015)* asserts that the impact-compliance perspective to the study of sustainability in process industries where no market exists be explored. It is environmentally, socially, and economically sound, and responsible valuation principle for process industries and their owners to *rationally expect t*o account for the external costs that they create through unsustainable production processes. Currently, the investors' idea about sustainability appears to be restricted to factory planning, whereas industrial sustainability issues requires attention explicitly, from the wider environmental, economic, and the socio-cultural standpoints, as advocated by Keeney *et al.* (2001). Stakeholders are usually more interested in the benefits they would receive from adopting more sustainable practices and implementing sustainability initiatives in their portfolios. The uncertainty about the perceived benefits impedes their willingness to retrofit and the lack of the keenness of industries to certify their buildings as well as invest in other sustainability initiatives (JLL, 2007).

3.4.5 Industrial Sustainability Factory Assessment Methods and Scoring

The type of tools for factory sustainability assessment is growing consistently in accordance with society's needs. Tools and indicators have their own focuses, purposes, strengths, weaknesses, and drawbacks. Existing tools often involve drawbacks such as a time-consuming assessment due to tool complexity or lacking applicability to companies from other industrial sectors. The assessment tools are evaluated and described with respect to their specific focus, that is, for use in factory planning; and benefits as well as drawbacks (Chen *et al.,* 2012). .

Factory planning has an essential role regarding the sustainability of a factory. Already during the factory planning stage, all of the facets of sustainability must be considered to build a sustainable factory in the future. In the phase of factory planning, factory planners need to contemplate the various aspects during different planning phases. In the initial planning phase, phase, the factory's location is considered. Aspects related to the location can be personnel availability, general environmental impact, economic impacts and more. In the later planning phase, planners need to emphasize details in the factory floor such as personnel safety around each machine, each machines energy consumption, and availability for personnel (VDI 5200 Blatt 1, 2009; Chen, 2012). This means factory planners need a tool showing what sustainability indicators and aspects they need to consider during the factory development phase. A holistic tool will guide factory planner to plan in a more systematic way and minimize the planning complexity related to sustainability. Actual tools are developed to assess existing factories for further improvements and not for building a new factory. However, this kind of sustainability assessment tools can also be used as a guideline for factory planners when they plan a factory from beginning or re-design a factory if the detail level and complexity level is right. The sustainability assessment tools support factory planners in order to think in the right direction. This work aims to clarify the difference between various existing sustainability assessment tools to raise the factory planners' awareness for a better planed or improved factory.

Chen, *et al*. (2012) selects 50 tools from more than 100 papers but find twelve (12) tools that scale through the criteria of cross-industry applicability, ease of use, whole factory level application and holistic TBL view of sustainability. The summary, uses and applications of the selected tools are attached as Appendix N. Further critical evaluation of the properties of the twelve (12) tools are based on the 4 criteria: (A). Rapid assessment, (B) Application on factory level, (C) Generic applicability and (D) Coverage of sustainability dimensions reveals (Table 3.12):

Table 3.12: Evaluation of tools for criteria not fulfilled (Chen *et al.*, 2012)

Year	Assessment tools	Criteria not fulfilled
1997	Barometer of Sustainability	B, C, D
1999	Dow Jones Sustainability Index	A, C, D
1999	GRI Reporting Framework	A, C
2002	IChemE Sustainability Metrics	A, C
2002	Rapid Plant Assessment Tool	C
2004	Sustainability Assessment in Mining and Minerals Industry.	A, B, C
2005	Composite Sustainable Development Index, CDSI	C
2006	ITT Flygt Sustainability Index	C
2007	Ford of Europe's Product Sustainability Index	A, B, C
2009	GM Metrics for Sustainable Manufacturing	C
2009	Sustainable Development Framework (SDF)	A, B
2010	Rapid Basin-wide Hydropower Sustainability Assessment Tool	B, C, D

As in Table 3.12, it appears clear that a proper assessment tool fulfilling all criteria to support factory planning for sustainability could not be identified. CSDI, ITT Flygt and the GM MSM could be used for specific planning purposes but not for cross factory boundaries. Future research could analyse and modify the three best tools for cross boundary use for factory planning. However, not one of the tools would meet the considerations for inclusion for valuation purposes with regards to the following aspects:

(i) The tools are factory-specific. Two similar factories need to adapt the assessment criteria for use.
(ii) The tools could provide a useful guide to sustainable manufacturing but offers no explicit inducement to sustain compliance.
(iii) Evaluation of sustainability initiatives and retrofitting are not translated to money values for industry's internal financial control.
(iv) The uses of the tools are limited to factory planning

3.4.6 Process Industry Assets and Real Estate Valuation

An asset is an object upon which ownership rights can be exercised. Assets generally can be classified by use, and purpose (Ifediora, 2004): By use, we can have specialised and non-specialised assets.

(1) Non-Specialised assets are real and personal properties which are held for investment, or owner-occupation. They are assets in general demand which can be easily bought, sold, or leased in the market place. Non-specialised assets are made up of non-specialised Land and Buildings, such as residential buildings, shops, office buildings, and warehouses. Non-specialised Plant, Machinery and Equipment include Boilers and Compressors, Generators, Transformers, and switchgear, Pipes and Cables above and underground, Computers, Telephone and other communication installations, Office and Laboratory Equipment, and Motor Vehicles.

(2) Specialised assets are properties designed and used to perform special services and functions. They are not generally in demand in the market. Their demand is usually on special order for special specifications. Therefore, no market evidence may be available for such properties. Specialised Properties include specialized Trading Properties (Hotels, Petrol Filling Stations, and Restaurants) Businesses (Manufacturing/Factory buildings) Extractive Industries, Oil Refineries, Power Stations, Chemical Works, Schools, Colleges, Universities, Hospitals and Health Care premises, Museum, Temples and Libraries. Specialised Plant and Machinery include Process Plant and Machinery, Surplus Plant and Machinery, Damaged Plant and Machinery, Power Station Plant, Maintenance Plant, Water and Effluent Treatment Plant, Ships, Aeroplanes, and helicopters.

By Purpose there can be the following categories of valuation: Valuation for Financial Reporting/Statement, Business Valuation, Going Concern Valuation, Gone Concern Valuation, Valuation of Intangible Assets, Insurance Valuation, PME (a) As part of an operational concern, and (b) As operational surplus or for sales and purchases (Ifediora, 2004).

3.4.6.1 Classification of Assets

Assets are classified as tangible and intangible assets. The tangible assets are definite, touchable and visible. The tangible assets are:

(i) The fixed assets (land, buildings and structures, PME, vehicles, furniture, and other chattels).

(ii) The current assets or floating or circulating assets, that is, assets held for a short period, not anticipated for use on a continuous basis in the activities of an enterprise. Such assets include cash in hand, cash at bank, stocks, the stock of raw materials, short-term investments (marketable securities, and bills) work in progress, finished products, trade debtors, call up share capital not paid, prepayments and accrued income (Ezeudu, 2003).

The intangible assets are not visible. However, they are long-lived assets which are suitable for the operations of an enterprise. They are not held for sale and have no physical qualities, such as, goodwill, ownership of various legal rights and instruments (patents, copyrights, franchises, contracts, and trademarks) marketing know-how, management skill, credit rating, and an assembled workforce. The components of company assets are shown in Figure 3.6.

The assets are satisfying an economic demand for the service it provides or which it houses. Ifediora (2004) enumerates the qualities of intangible assets as: *(1)* The assets have a significant remaining useful life expectancy. *(2)* Responsible ownership and competent management are expected *(3)* Continuance of the existing use by present or similar users is practical *(4)* Functional utility of the assets for their current use is given, and *(5*) Economic utility of the assets is given due consideration.

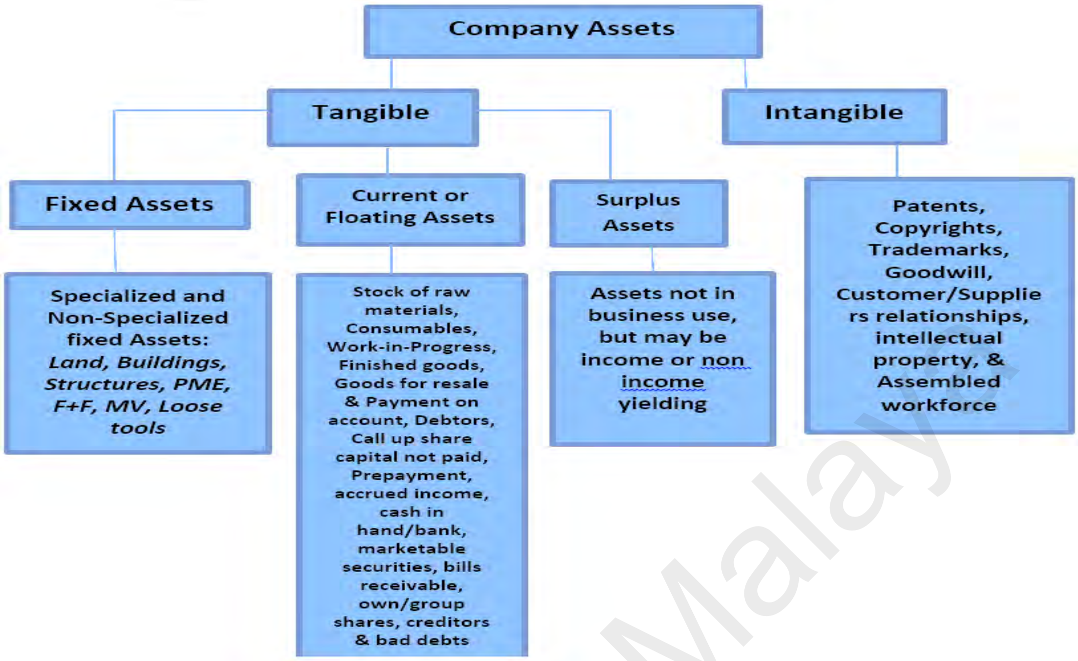


Figure 3.6: Components of Company Assets (Adapted from Ogunba, 2013)

Net tangible assets refer to tangible fixed and current assets, less liabilities (or fixed tangible assets plus working capital, while working capital is current assets minus current liabilities.

3.4.6.2 Value Bases and Methods of Asset Valuation – Value basis and Methods.

The Company Assets Valuation is required for various general purposes as follows: Business and Finance*:* Sale and Purchase of Asset, Take-overs, Mergers, Partnerships, Privatization and exchanges, mortgage, Debenture and Stock Financing, Sale and Leaseback transactions as categorised by Ifediora (2004) and Ogunba (2013) in Appendix A1.

For asset valuation purposes, valuers must clearly state whether market value or non-market value bases is used and the reason for the selection of any of the bases. Market value based valuation adopts market-based information and comparative data while non market based valuation distinctly applies within the enterprise that owns the asset or adopt some statutory provisions. However, at some points, in a market value valuation, the type and nature of the asset may dictate the uses of a non-market value approach (such as the Depreciated Replacement Cost-DRC), especially where there is no market comparable. Familiarity with the summary of purposes, bases and methods of valuation presented as Appendix A2 is essential in order to distinguish between market value valuation and non-market value valuations. The basis and methods of valuation of assets would vary according to the purpose of valuation, as shown in Appendix A3

The market value and non-market value bases valuation are determined by the application of the following basic approaches to valuation; (a) Investment/Income Capitalisation, (b) Market Comparison, (c) Cost, and (d) Profit Test /Accounts. The theory, principle, and practice of these methods in asset valuation are similar as in real property valuation, but there are some critical aspects peculiar to asset valuation. These aspects are elaborated in the following sub-sections:

3.4.6.2(a) Income capitalisation/Investment

The income approach determines the present worth of the future economic benefits of ownership. This approach is generally applied to investment properties, general use properties where there is an established and identifiable rental market or to a combination of assets that consists of all assets of a business enterprise including working capital and tangible and intangible assets (Maninggo, 2010, Ifediora, 2004). Many assets, particularly tangible, have capacity for yielding benefits and returns, which can be expressed in money terms. The capacity of assets to provide present and future benefits/income is an essential feature of investment. The approach involves the determination of the present value (PV) of the rights to future benefits derivable from the ownership of a specific asset under given market conditions. The income from an asset (actual or potential) can be derived in these ways:

(i) On the basis of amount (rent) actually received.

(ii) On the basis of comparison of market transactions on similar asset.

(iii) As a proportion of the undertaking in which the asset is an agent in the business.

(iv) In relation to cost of replacing, acquiring or constructing of the asset as a cognate substitute.

The valuer when determining the income flow is to be concerned, not only with the quantum, but also with its quality and durability. The quantity of income refers to the amount earned in a given period. The projection estimates reflect a consideration of the letting and hiring history and terms of existing lease tenancy, a review by rent paid for similar assets in similar location and uses and the existing general and local economic, social and environmental trends, as well as physical conditions peculiar to the asset which can exert influence on security and regularity of projected incomes. The quality of income from the asset is measured by the nature of the asset, type of use or business for which the asset is used, the nature of the products of the enterprise and the type of lessee or tenant using the asset. For example, if the asset is marketable, producing a product that is of great demand, and the lessee or user of the asset is one with strong financial backing and responsibility, the income from such asset has good quality as it is apparent that the investor has less risks to contend with, hence more security. The durability of income is measured regarding the economic, physical, legal and functional life of the asset. The probability of durable income is enhanced with a well-written lease agreement signed by the parties.

Operational expenses - Company assets also have incidence of expenses required to enable the assets stay in the condition of providing services and earning the income whether directly or through the earnings of the business in which the asset is involved. Expenses of ownership of assets, for which allowances must be made are as follows: fire and other insurance, tenement rates, water and other rates, repairs and maintenance, payment to superior landlord, management and landlord's services. For asset used in business operations particularly, assets/property fully equipped as an operational entity, the operational expenses would include purchases, administrative and interest expenses. Reserve for replacement of items such as PME, real estate and fittings that have limited life have to be made for the end of the lives of those assets or components. Provision for replacement is made by estimating the total cost of replacement and dividing by the average useful life of the appliance and equipment. For buildings, and PME, the various rates of depreciation are used. Reserve for replacement is an expense chargeable to the gross income/earnings. Other charges may include charges on the particular type of asset or real estate or some charges imposed by statute. However, the valuer should ignore extra ordinary occurrence in the earning profile, such as sale of real estate resulting in huge profits, huge amount involving settlement of law suits. All these expenses have to be deducted from the gross income to determine net income for capitalisation. The capitalisation or discount rate is a market-derived rate since it has to be derived from market transactions in similar assets. The valuer must determine the rate or yield that is appropriate to the class of investment in which the asset is employed, the risks involved as viewed by investors and the market factors for consideration in the choice of yield include security and regularity of income, security or safety of capital, reliability of yield, marketability denomination, that is, the scale of operation that can be handled by investors (smaller denominations improve liquidity, acceptability as collateral, suitable duration, freedom from care), that is, preference for reduced attention, cost of transfer, potential appreciation and tax advantages. The income approach/investment method is applicable to the valuation of tangible and intangible fixed assets that generate income or have income potential.

3.4.6.2(b) Comparison Method

This approach reflects prices recently paid for similar assets in the used market, with adjustments made to the indicated market prices to capture the condition and utility of the appraised asset about the market comparative (Maninggo, 2010). The rationality of the approach is that a prudent investor can go to a marketplace and purchase an existing facility or purchase individual pieces of equipment in the used market to assemble an operating package. Market comparisons are in two categories: Direct and Indirect Market Comparison. Direct Comparison (Sales Comparison) is when the value of an asset is determined by direct reference to the prices paid for a similar asset either in the first hand (if new) or second-hand markets. The indirect comparison is when the unit data from an analysis of market transactions is used to determine the value of similar assets. The comparison method is a reliable indicator of individual items of asset particularly non-specialised assets, being market oriented, and its having inbuilt direct measurement of the depreciation of the asset. The valuation process has the following steps: (1) Collection of comparable market data (2) Verification and analysis of market data, and (3) Application of data through direct or indirect market comparison. The comparison method is used in the valuation of marketable tangible and intangible fixed assets as well as current assets, provided that the amount of available data is adequate and the relative advantages and deficiencies of the asset being appraised and the comparable assets are correctly weighted.

Having examined the three approaches, Manningo (2010) highlights the strengths and weaknesses as in Table 3.13.

Table 3.13: Strengths and Weaknesses of the Main Valuation approaches. (Adapted from Maninggo, 2010)

Valuation Methods	Strengths	Weaknesses
The Income Approach	• Best measurement of total depreciation of all assets • Recognition of economics • Reflection of the logic and rational used in virtually all business decisions	• Cannot segregate specific assets • Subjectivity of income projections and rates of return
The Cost Approach	• Its best use on special purpose or newer asset • Its use for asset identification • Isolation of specific elements of depreciation • Basis for allocating functional or economic properties	• Its inability to measure the full amount of economic obsolescence • The subjective nature of estimating depreciation • It is often very detailed and time-consuming
The Market Approach	• Most reliable indicator of market value for individual item • Direct measures of depreciation for individual items of PME.	• Lack of comparable sales • Subjectivity of comparison • Timeliness of data

In all situations, all approaches to value must be considered, as one or more may apply to the subject asset. In some cases, elements of the three approaches may be combined to reach a value conclusion. Nevertheless, the relative strength, applicability, and significance of the approaches and their resulting values must be analysed and reconciled.

3.4.6.2(c) Cost Method

The cost approach is grounded on the economic principle of substitution. By this principle, an investor will pay no more for real and personal property than the cost to obtain property of the same or similar utility. The cost approach furnishes the most reliable indication of value for assets without a known used market (Maninggo, 2010). It is a method of determining the value of an asset by reference to the cost of reproducing the asset or procuring an acceptable substitute. Reproduction cost is the cost of creating a replica tangible fixed asset, building, PME or improvement, by current prices, using the same or closely similar materials. Replacement cost is the cost of creating a tangible fixed asset, building, PME or improvement having the same or equivalent utility (economic satisfaction) by current prices and using current prices and using current standards of materials and design. The reinstatement cost of an asset consists of (i) Direct asset costs (materials, labour and profit) and, (ii) Indirect asset costs (professional fees, installation costs and other expenses of an installed asset). Replacement cost new relies on the theory that an item is worth no more than the replacement cost new and may often be less. It represents the upper limit of surrogate MV, particularly for PME. The replacement method applies to all tangible fixed assets, LBS, PME, FandF. However, its application to different types of assets may require minor variations in basic theme (NIESV, 2006).

Depreciation: Depreciation, in asset valuation term, is defined as the loss in value from any cause as measured in money terms by the difference between replacement cost new of the asset and the actual or estimated market value of the same asset in its current condition. More appropriately defined for asset valuation, it is the measure of wearing out by lessening in the valuable economic life of a fixed asset whether arising from use, effluxion of time or obsolescence (functional, technical and technological or external obsolescence)

Physical deterioration: Wear and tear through use, the action of the elements such as storms, extreme temperatures, age, and destruction by termites and others, the poor construction, materials components, poor structural quality of components, structural impairment through neglect arising from lack of maintenance, fire, water, explosion, vandalisation, and lack of replacement parts. Technically, physical deterioration consists of curable (a form of depreciation in which capital investment can bring about the reduction of the degree of building obsolescence. For instance, the degradation of floor finishes and services); and incurable physical obsolescence (a form of depreciation for which no amount of capital investment can rectify).

Estimation: For curable, the costs to cure is estimated and deducted. For the incurable, any of the following age life methods may be used:

(I) The straight line depreciation – Accrued depreciation over *n* years = N(100/total useful life)% x (replacement cost) x (y years).

(II) Accelerated methods which accelerate the depreciation in the earlier years of the useful life of the latter years. It is considered that those such methods give a truer reflection of depreciation than the straight line methods (Ogunba, 2013). The two main methods are the declining balance depreciation and the sum of years digits.

Declining balance depreciation after n years of the N years of useful life (S= salvage value, P=replacement cost) is: Accumulated depreciation = P $[1 - (S/P)^{n/N}]$

Sum of years digit after n years of N years of useful life is:

$$D = \frac{(P - S)(2N + 1 - n)n}{N(N + 1)}$$

(III) Decelerated methods which write off more the value of the asset in the latter years than the earlier years. The sinking fund is one of such methods. Sinking fund depreciation after n years of the N years of useful life is:

Accumulated depreciation = $i / (1 + i)^N - 1$ x P x Amt. N1 p.a for n years @ i%

(IV) The S curve where the pattern of depreciation follows an S shape

(b). Economic obsolescence - This obsolescence is outside the control of asset ownership. Its causes include changing economic conditions resulting from neighborhood hazards and nuisances (such as heavy traffic flow, smoke, dust, noise, offensive odors and other inharmonious use). Change in zoning and Highest and Best Use (HABU) classification (lower land uses and less stringent zoning or building regulations); Infiltration of less desirable neighbors; over or under improvement by land (violation of prevailing land use order); Decreasing demand (population shifts, depression); finite material supply (leading to stoppage of production for PME); Finite market (creating less or no demand for the product); Product obsolescence (leading to less or no demand for the product); Legislation and byelaws (leading to stringent condition for production). These factors affect supply and demand for goods and services, also increase costs of operation.

Estimation: Economic obsolescence is measured through and assessment of capacity utilization because when the operating level of an asset is less than its rated capacity, inutility exists. Inutility is calculated on a percentage basis as follows:

Inutility as a Percent= $[1 - (\text{Capacity B}/\text{Capacity A})^n \times 100]$

Where capacity A = rated or design capacity

Capacity B = actual production

n = exponent scale factor, which can range between 0.4 to 1 depending on the type of equipment and labour/material ratios

Functional and Technical Obsolescence: Functional obsolescence is the loss in value or usefulness of an asset caused by inefficiencies or inadequacies of the asset itself when compared to a more efficient or less costly replacement asset that new technology has developed (Manningo, 2010). Functional obsolescence develops when an asset no longer functionally satisfies the existing use for which it was designed as a result of faulty design (wasted space, improper location of facilities, ceilings too high or too low and poor floor planning) inadequacy of structural. facilities (e.g. external walls not water resistant, ceilings and walls not insulated, inadequate electrical wiring), super adequacy of structural installations (oversized plumbing and electrical wiring, excessive no of wardrobes, bathrooms and so on). Outmoded equipment, imbalance of PME assets, incompatibility of installed PME assets, poor plant layout, poor location and communication, and changes in technology that create new assets capable of more efficient delivery of goods and services. These factors will affect demand for goods and services and the profitability of business entities. The valuer estimates rates of depreciation and remaining economic life in comparison with new and recent replacements. Advances in technology that have resulted into existing assets incapable of rendering efficient delivery of services is the source of partial or full functional obsolescence.

Estimation: The methods of measurement are by reference to excess capital costs, or excess operating costs of the assets relative to modern assets.

> Excess capital costs are calculated as the difference between reproduction costs and replacement cost.
>
> Excess operating cost is calculated as future excess operating costs multiplied by the years purchase.

3.4.7 The Valuation basis and Method used in the study

The various valuation bases and methods in asset valuation have been mentioned and discussed in sections 3.3.2 and 3.4.6.2. They include:

(i) Market bases – Market value (MV), value *of* the business, and business value.

(ii) Non-market bases – Investment value [that is, worth or value to the owner (VTTO)], Going concern value [that is, value-in-use or value *to* the business

(VTTB)]

Ogunba (2013) notes that these bases of valuation can certainly converge in a perfect market. In such a market, both buyers and sellers are well informed, as a result, buyers would pay no more, and sellers accept no less, than the MV of the expected future benefits discounted at market rates. Thus, transaction prices would be same across boundaries. However, it is not often the case due to the real market imperfections.

In this study, it is the industry owners or investors that are to be induced to initiate sustainability compliant programmes through the valuation approach. Hence, the business valuation principles, customer and user satisfaction, profits and accounts, adequate potential profitability possibilities are not within the research scope: They are market-based. Since it is the industry owners or investors that is to be induced to initiate sustainability-compliant programmes, not the industry as a going concern, value-in-use/value to the business (even as non-market value basis, have not been considered). Investment value (same as worth or value to the owner) would then be the appropriate basis of valuation for the case industry. It is the non-market value basis that addresses the issue. According to Derry (2008) and Budhbhatti, 2002), the DRC approach would be preferred in this case.

3.4.8 Theory of Externalities

The theory of externalities has been discussed in sub-sections 3.4.8.1 and 3.4.8.2 from the microeconomic and the internalisation perspectives as follows:

3.4.8.1 The Microeconomics

Wheeler (1992) submits the simple analytical model of optimal pollution control that provides a good conceptual starting point because it highlights two logical principles as follows: *(1)* Pollution should be reduced until the damage from the last unit removed is just equal to the cost of removing it *(2)* The polluting firm should pay for the damage which it causes. When differentially polluting companies have to absorb the cost of the environmental services they use, suitable information about the scarcity value of these services transmits into the economy through differential product prices. The principles of Wheeler (1992) are instructive for the following reasons:

(i) From the perspective of the industries, they pollute when it is more profitable to dispose harmful products than to recycle and market them. To them the environment is a medium of disposal. The society, on the other hand, views the environment as a form of social capital whose services are used by the industries. Hence, when the "use of environmental services" is interpreted to mean pollution, the use becomes an additional factor to the traditional factors of production (Land, labour, entrepreneurial skills, capital, materials and energy.

(ii) The calculus of profit miximisation or output constrained cost minimisation then leads to a derived demand function which relates the utilisation of environmental services to their unit price. To that extent, if the price of environmental services rises, the industry may susbstitute towards capital by increasing the use pollution control equipment; or towards labour by intensifying recycling. The industry may also move away from the use of complementary inputs, such as high polluting fuels. These, in turn, provide incentives for industries and households to shift their activities in environment-protecting ways (Wheeler, 1992. Starvins, 2001).

The principles of Wheeler (1992) provide the basis for the study valuation approach to stimulate incentives for industries to adopt sustainability initiatives through the correction factor-cost internalisation. In addition, Runde and Thoyre (2010) describes externality as a sustainability-related social risk to community's health, safety and property which should attract a dimunition in value due to stigma and property marketability.

3.4.8.2 Externalities, Market Failure, Cost Internalisation and Inducement

An externality occurs because the person or resource impacted is not part of the industrial firm's decision-making operation (World Bank, 1997). In economic science, an externality is a cost or benefit that bears upon a party who did not select to incur that cost or benefit (Buchanan & Stubblebine, 1962). Manufacturing processes that induce air pollution impose health and clean-up costs on the entire society, and if external costs subsist for pollution, the manufacturer may elect to produce more than would be manufactured if the producer were requested to pay all linked up environmental costs. If there are external benefits, as in public safety, fewer goods may be manufactured than would be if the producer were to be paid for the external benefits to others. It is all a function of inducement to produce more or less. Laffont (2008) and Vatni and Bromley (1997) sums up cost and benefit to society, as the aggregate of the imputed monetary value of benefits and costs to all parties concerned. Furthermore, for goods with externalities, the unregulated market prices do not reflect the total social costs or benefit of the transaction, except by internalisation, otherwise, the market not efficient. For market efficiency, each component of industrial processes - Land, Buildings and Structures, PME, user satisfaction, pollution control measures and other components would have to be examined in the light of all relevant sustainability indicators. It could be done by relating their levels of compliance to established Command and Control (CAC) and Technology standards (Starvins, 2001). The measure of the degree of non-compliance in monetary terms stabilises the pollution market. Market failure can occur in a variety of ways. The failure exists when the social optimum diverges from the private optimum. For example, the price mechanics may neglect to take into account the effects of negative consumption and production externalities.

The concept of cost internalisation was first enunciated by Pigou (1920, 1952). Pigou argues that industrialists look for their own marginal private interest. When the marginal social interest diverges from the marginal private interest, the industrialist has no incentive to internalise the cost of the marginal social cost. On the other side, Pigou contends that if an industry produces a marginal social benefit, the individuals getting the benefit have no inducement to pay for that service. The variance between the marginal private interest and the marginal social interest produces two basic results: First, as already noted, the party getting the social benefit does not pay for it, and the one producing the social harm does not pay for it. Second, when the marginal social cost exceeds the private marginal benefit, the cost-creator over-produces the product. Ultimately, because non-pecuniary externalities overrun the social value, they are over-produced. To deal with over-production, Pigou advocates an incentive or tax placed on the transgressing producer. Pigou (1952) delivers an authoritative view that keeping the economy cost and benefit-efficient, business should be induced by taxation, regulation or the operation of tort system, to "internalise" the costs they inflict on other activities (externalities). The contention is grounded on the theme that the neglect of sustainability initiatives is a cost of the industry involved and that, for that cost to be paid up for by other people using the public taxes paid is to create a subsidy for that industry. Therefore, for the "market" to come back to being dependable and impartial, these externalities ought to be internalised. That is, the industry should pay the equivalent of the costs its activity has imposed on other actors. In this circumstance, compensation offers the appropriate incentive for these decision makers to reconsider their activities. (Buchanan & Stubblebine, 1962; Barthold, 1994; Fullerton & Metcalf, 1998).

3.4.8.3 The Relevance of Externalities to Real Estate Sustainability and Valuation

With respect to property valuation and the environment, Meyer (2008) proposes a definition of sustainability based on economic externalities as those impacts, positive or negative, not anticipated or paid for at the time of the event can be useful when identifying off-site impacts of real estate activities and the risks posed to property value. Meyer (2008) explains that if neither an industry nor the industry customer paid nothing to restore the toxicity of an industrial material purchased, the cost to society of dealing with it—whether counted as health care for people receiving heavy metal poisoning or their harder-to-measure suffering were deemed externalities because neither the customer nor the industry paid this cost. Meyer (2008) goes on to define activities as sustainable ‘‘...when all costs are internalised because if the costs are very high, the activities stop”. As pollution control is one of the major challenges to climate change, Runde and Thoyre (2010), drawing upon the pollution theory, express that sustainability for applied real estate valuation would be seeking to avoid, minimise, and mitigate adverse current and future social, environmental and economic impacts (externalities) through sustainability compliance. In theory, a sustainable land use would avoid any current and future adverse social, environmental, and economic impacts (externalities), including those that extend beyond the property line. In practice, a land use moving toward sustainability status would first seek to avoid adverse externalities, then minimise, and finally mitigate what could not be avoided or minimised. Land uses that do not are at greater risk that sooner or later the cost will be internalised, and that they will obsolesce faster (Runde & Thoyre, 2010; Ibiyemi *et al.* 2015)

3.4.9 The Impact of Paint Manufacturing on Health and the Environment

Paint include pigment delivered by a resin and binder, a solvent to aid the paint application, and a dryer. In vinyl and acrylic paints, there would also be plastics compounds, formaldehyde, arsenic, thinners, and foamers. The pigment provides the colour. The resin is the binder that provides adhesion and grips the pigment particles together, and solvents act as a carrier for the pigments and resin. The additives boost brushing, mould and scuff resistance, drying and sag resistance (Porwal, 2015). Stratford (2016) reiterates that prolonged exposure to paint and paint fumes can cause headaches, triggering allergies, and asthmatic tendencies, irritate skin, eyes, and airways, and put increased stress on vital organs such as the heart. The World Health Organisation (WHO) reports a 20%-40% increased risk of certain types of cancer (specifically, lung cancer) for those who come into regular contact with or work with paint. Danish researchers point to the added possibility of neurological damage. The greatest environmental impact from paints is the release of volatile organic compounds (VOCs) in the drying process after applying the coating. VOC exposure to the air participates in the formation of ozone and smog when interracting with nitrogen oxides (NOx) and sunlight. Lead in house paint, and ozone attacks the tissue of the lungs (Minchin *et al.,* 1996). Porwal (2015) and Golder (2015) state that the greatest environmental impact is derived from the manufacture of Titanium Dioxide (TiO_2). TiO_2 has the following characteristics: (i) High embodied energy (54-76 MJ/kg) (ii) Emissions during manufacture include CO_2, N_2O, SO_2, NO_x CH_4 and VOCs (iii) The waste streams, including spent acid and metal sulfates, arise from the manufacturing process, each of which carries their environmental impacts. Some European Union directives seek to reduce and eliminate the pollution caused. (iv) Raw materials are derived from scarce resources.

Golder (2015) affirms that the environmental impacts associated with coloured pigments are similar, though not as intense in their effects as those for TiO2. One of the chemicals linked to illness is propane sulfone, which is widely used in paints and is a known carcinogen. The respiratory system and skin are the most significant routes for poisoning from chemicals in paints and stains. However, low-VOC or no-VOC paints and stains are becoming more widely available to the consumer. The use of products containing toxic chemicals should be done in well-ventilated areas and avoid prolonged exposure.

The main environmental impacts is derived from the manufacture of Titanium Dioxide (TiO_2). TiO_2 consists of high embodied energy (54-76 MJ/kg) [9] and the emissions of CO_2, N_2O, SO_2. (Consumpedia, 2016). Epidemiologic data and animal studies on polyvinyl acetate are very limited to allow the assessment of its possible carcinogenic risks in humans. Nevertheless, styrene has been classified as carcinogenic to humans, and several studies have reported increased risks of lymphatic and hematopoietic neoplasms in workers exposed to paints product (IARC Monograph Working Group 2002), Domestic exposure to VOCs at levels below currently accepted recommendations may increase the risk of childhood asthma.

3.4.10 Environmental Laws and Regulations in Nigeria

Nigeria uses the Command and Control (CAC) approaches that find expression in the precautionary measures; the polluter pays principle, pollution prevention technologies and control organisation system, safety measures and risk control, enforcements, offences and penalties for environmental regulations (Amokaye, 2012; Okenabirhie, 2014).

The environmental protection authorities in Nigeria comprise of the Federal Ministry of Environment (FME). FME coordinates all environment protection actions in Nigeria. Prior to FME, the Federal Environmental Protection Agency (FEPA) was the main coordinator to agencies. Others are : * Federal Ministry of Health • Federal Ministry of Labour & Productivity • Federal Ministry of Solid Minerals • The 36 States Ministries of Environment, the 36 States Ministries of Physical Planning and Urban Development • The 36 States Ministries of Health • Waste Management Authorities • Local Government

Authorities • National Environmental Standards and Regulations Enforcement Agency (NESREA) • Energy Commission of Nigeria • National Oil Spill Detection and Response Agency • Nigerian Nuclear Regulatory Authority • Department of Petroleum Resources • Nigerian Maritime Administration and Safety Agency • Nigerian Ports Authority • Environmental Health Officers Council • Standards Organisation of Nigeria, and the National Food & Drugs Administration Control Bureau.

The environmental pollution control laws in Nigeria, according to the Environmental Law Research Institute (2011) can be categorised into: (1) The Constitution of Nigeria (1999) (2) National Environmental Standards and Regulations Enforcement Agency (NESREA) Act (2007) (3) Others. The agency of the FME tasked with the functions of technical/environmental regulation of all activities of the oil and gas sector of Nigeria is the Department of Petroleum Resources (DPR). It issues guidelines to modulate the impact of such industries on the environment.

The NESREA Act, 2007 became the main statutory regulating instrument guiding environmental matters in Nigeria after the revocation of the Federal Environmental Protection (FEPA) Act of 1988. It especially makes provision for solid waste management and its administration and prescribes sanction for offences or acts which run contrary to decent and adequate waste disposal operations and practices. NESREA (2011) indicates that the following 24 other environmental regulations were issued in the Federal Government official gazette (1-24) as CAC approach paths. These regulations are to assure that the national development agenda is not at variance with the carrying capacity of the fragile environment (NESREA, 2011). The Constitution of the Republic of Nigeria (1999), as the public legal order, recognises the importance of improving and protecting the environment and lays down provisions for it. Section 20 promotes and protect the air, land, water, forest and wildlife. Part of Section 12 encourages the ratification of international environmental treaties. Sections 33 and 34 guarantee the basic human rights to live and human self-esteem as these have been linked to the need for a healthy and safe environment to feed these rights. The National Environmental Standards and Regulation Enforcement Agency (NESREA) Act 2007 administered by the Ministry of Environment. NESREA) Act of 2007 replaced the FEPA Act of 1988. NESREA is the embodiment of laws and regulations focused on the protection and sustainable development of the environment and its natural resources. The main sections which are of important consideration are sections 7, 8 and 27 which offers authority to ensure compliance with local, national and international environmental standards, pollution prevention, air and water quality and environmental sanitation. Violation is punishable under the relevant sections with a fines and imprisonment terms. Regulations (Under NESREA) National Effluent Limitation Regulations (section 1 (1) requires industries to possess anti-pollution equipment for the handling of effluent. Section 3 (2) compels a submission to the agency of a composition of the industry's treated effluents.

3.4.10.1 Assessment of Existing Instruments in Nigeria

According to World Bank (1990), Nigeria does not have well established regulatory systems. Various ministries have fragmented responsibilities for pollution. Where pollution regulation has been completed in response to local crises, it has almost always been quite belated. There has been no effective use of pollution control instruments in the absence of an appropriate regulatory apparatus. However, a traditional corpus of laws have given local authorities the right to take gross polluters to court and the right to sue for damages under tort laws, although many attempts are reported to be ineffective (Ossae-Addo, 1990; Olokesusi (1987). There are no market-based instruments and polluter-pay charges that have been statutorily authorised. Okenabirhie (2014) queries that, although the PPP has been taken into the local laws and interpreted to mean that the polluter must pay for any clean-up exercise as well as compensate those who suffer as a result of the consequences of the oil pollution, records indicate that the ultimate cry for cleanup, compensation and full application of the principle have largely been neglected.

3.5 State of Knowledge and Literature Mapping

The state of knowledge and the mapping of literature for research gaps identification are discussed in sections 3.5.1 and 3.5.2 as follows.

3.5.1 State of Knowledge

Muldavin (2009) and Lützkendorf and Lorenz (2011) report that there is no robotic formula to integrate sustainability issues into the property valuation process but the principal focus would be on the technical and functional aspects of the building under investigation, and the evaluation of its sustainability performance. Nonetheless, no new valuation methods are needed, and no fundamental change in the traditional valuation principles and practice is required to value sustainable properties. (RICS, 2009, Muldavin, 2009; Lützkendorf and Lorenz, 2011) However, valuers need to develop methods of collecting, processing, presenting new information and employing new analytic techniques to address the special considerations of sustainable properties that affect financial performance and value. Lützkendorf and Lorenz (2011) points the realisations that buildings have a central role to play in climate change policy. They also highlighted that the valuers are in a position to influence and raise awareness to help markets movements towards reflecting sustainability in property valuation. However, the 2016 progress report on the integration of sustainability aspects into real estate valuation emphasised commercial properties (Michl *et al.*, 2016). Australia is one of the leading countries with high profile researchers in the study of sustainability and real estate valuation.

In Australia, Warren-Myers (2016) investigates aspects in relation to the level of valuers' knowledge of sustainability, the mandatory rating systems and the value relationships in the property. Other studies were conducted in Germany, Switzerland and the Netherlands. The studies show that valuers associate a relationship between sustainability and value and that there is a positive suggestion in their responses of sustainability having a positive correlation with value. However, few valuers report on sustainability in every level of detail (Michl *et al.*, 2016; Warren-Myers, 2016). There was an increase in knowledge of certain elements and clearer perspectives regarding assessment processes, value relationships, and issues of energy efficiency in 2015. Nonetheless, knowledge of guidance is lacking (Michl *et al*., 2016). The numbers of sustainability-rated buildings are growing in Germany, Australia, and Malaysia, but valuers are still in the process of evolving strategic knowledge, indicating the requirement for further professional development and experience. The value relationships between sustainability and value have come to be more evident although yet to be rooted in asset ownership, real estate business and management. Test questions on sustainability rating tools (SRTs) show the possibilities of ill-informed judgement due to the discrepancies in the level of understanding the sustainability/value subject and the pintsized guidance. Warren-Warren-Myers (2016) claims that the ability of valuers to recognise change, comprehend and answer to the evolution in the market, and then reflect the change in valuations is at a low ebb. Moreso, clients, seldom request sustainability reporting within valuations (Michl *et al*., 2016). Muldavin (2010a) argues that the failure of property investors and their advisors to integrate income and risk concerns into sustainable investment decisions has led to an under-investment in sustainability.

The ethics of the valuation profession and the consequential obligation towards society imply that valuers proceed to integrate sustainability within the valuation process.

Researchers agree that energy-efficiency features have a direct, measurable impact on observed commercial and residential property prices. On the other hand, issues such as employees' and user comfort and health aspects of occupying sustainable buildings could also impact on value but have an insufficient database from which conclusions can be drawn. Building or owner image and reputation-enhancing qualities could have indirect price effects but still, lacks observed market evidence. Sustainable buildings with green building label or sustainable building assessment certificates achieve market price premiums and conventional buildings will depreciate much faster and may have to accept price discounts when sold in the market (Salvi *et al*., 2010; Muldavin, 2010a, Michl *et al.*, 2016).

The integration of sustainability into the valuation process reveals that the prime value-influencing factors be made explicit so that the clients understand the related risks and opportunities informing the opinion of value. The market value of sustainability is difficult to assess. Jasimin and Ali (2014) and Moran (2010) explain that it is because market value is just one part. Sustainability offers health values, work efficiency workers' productivity values and monetary savings that can impact on values. This is the case where the financial benefits of long-term savings in energy costs, repairs and wastes reduction and operating costs can induce tenants' to a willingness-to-pay (WTP) special rent. In addition, intangible benefits of a change in constructions and user costs and other soft gains, such as healthier employees, improved IEQ and productivity, socially responsible image, meeting corporate responsibility targets, are hard to assess.

3.5.2 Literature mapping: A way to identify research gaps

Literature mapping of previous studies supports the identification of research gaps and state of knowledge relating to sustainability and property value. Creswell (2012) suggests the adoption of literature mapping to establish the themes and patterns available in the literature. In this study, the objective of the literature mapping is to show the scope and the types of property focused upon in literature. Hence the extent of mapping is limited to the studies undertaken and types of properties covered. In a broad sense, the existing literature on sustainable buildings and valuation can be classified into: *(1)*. The sustainable design, planning and construction process; *(2)*. The methodological basics of sustainability assessments of buildings, and the development and application of certification systems; *(3)*. The methods, instruments, and processes of sustainable property investment. Nevertheless, the various methods used in literature depicted the relationships between sustainability and property values for the normative studies which include life cycle and benefits analysis, traditional valuation analysis, quantitative analysis, hypothetical analysis, case study and actual market analysis, hedonic price regression and the Delphi method. Evidence-based approaches utilised the conventional methods of valuation. Table 3.14 summarises the main studies in sustainability and property values.

Table 3.14 A Summary of the Main Studies in Sustainability and Property Values (Source: this study, 2016)

Authors	Objectives of study	Property Perspectives & Focus
NORMATIVE STUDIES		
Boughey (2000),	Theoretical analysis of real estate markets, value, and sustainability.	Property market
Boyd (2005) and Robinson (2006)	Application of real estate valuation to environmentally sustainable development	Commercial real estate
Easterbrook (2000), RICS (2007) Warren-Myers (2009)	Economic theory and sustainability, definitions and guides to valuing sustainability and probable challenges.	Education and awareness
Muldavin (2008), Reed *et al.* (2006, 2007)	Sustainability analysis and incorporation within valuation practice	Investment properties
Sayce and Sundberg (2009)	Examination of body of research and the quest to find business case for sustainability	Education and awareness
RICS (2009) (e.g. Pivo and McNamara (2005); Rapson *et al*.(2007); UNEP FI, 2007, 2008; Jones and White (2008); Lützkendorf *et al*.(2008); Kriese	Statement of norms, guidance, principles for sustainable property investment, caution in valuing sustainability.	Education and awareness

(2009); Lützkendorf and Lorenz (2009a, 2012); RICS, 2009a, b, c; UNEP FI and RPIC, (2009)		
Reed (2009); Warren-Myers (2012)	Normative analysis of drivers of value in the valuation process and sustainability	Residential and commercial real estates
Boyd (2005), Lützkendorf and Lorenz (2005, 2006), Robinson (2005), Sayce, Ellison and Smith (2004), Kimmet (2006), Runde and Thoyre, (2010)	Debate on appropriate valuation methodologies for sustainability	Residential and commercial real estates
Kohler and Lützkendorf (2002); Sayce and Ellison (2003); Kimmet and Boyd (2004); Cole (2006); Lützkendorf and Lorenz (2006, 2009b); Ellison and Sayce (2007); Newell (2009); Pivo, 2009).	Performance measurement and reporting. Publications on the development of criteria, indicators, and benchmarks for sustainability assessment, reporting purposes and performance measurement of buildings, portfolios and property investment products	Commercial real estates
Pivo, 2007; Sayce *et al.*, 2007; CoreNet and JLL, 2008; Myers *et al.*, 2008; Bügl *et al.*, 2009; Rohde and Lützkendorf, 2009).	Investor behaviour and attitudes. Analyses and surveys of investor demand and behaviour as well as of investor attitudes regarding sustainable buildings and property-investment products	Commercial real estates
Chao and Parker (2000), Kats (2003), David Langdon Consultancy (2004, 2007), JLL (2004, 2006), Robinson, 2006), Miller *et al.* (2007, 2008), Fuerst and McAllister (2008), Eichholtz *et al.* (2008, 2009), Pivo and Fischer (2008, 2009) Warren-Myers (2012)	Investigation of the value of sustainability in commercial real estate	Commercial and Residential real estates
Lützkendorf & Lorenz, 2007; CMP, 2008; Rhode *et al.*, 2010).	Sustainability and risk analysis. Publications on approaches for integrating sustainability issues into property risk	Commercial and Residential real estates
(e.g. Kats *et al.*, 2003; Morris Hargreaves McIntyre, 2006; Matthiessen and Morris, 2007; Kibert, 2008; Miller *et al.*, 2009)	Analyses and case studies on the costs and benefits of sustainable building and management of property assets. .	Commercial real estates
EVIDENCE-BASED APPROACHES		
Australian Department of the Environment (2008), Wiley *et al*. (2009), Griffin *et al.* (2009), Salvi *et al.* (2009), Wameling (2009), City of Denmark Rental Index (2010), Fuerst and McAllister (2010), Pivo and Fischer (2010, 2011), Yoshida and Sugiura (2010), Brounen and Kok (2010)	Evidence of linkages between sustainability and property values and the empirical analyses of realised sale prices, investment returns, vacancy rates, and so on	Commercial and Residential real estates

Table 3.14, continued: A Summary of the Main Studies in Sustainability and Property Values (Source: this study, 2016).		
Luetkendorf and Lorenz (2011) Warren-Myers (2016), Michl *et al*. (2016)	Nature and structure of information for sustainability valuation. Adaptation of valuation methods to sustainability, knowledge, and perception of valuers	Commercial properties

The literature review provides the overview of what the state of knowledge is on sustainability and real estate valuation; examining their relevance to the problem being investigated, and information on techniques to be used. There is agreement with their proposition to integrate sustainability into existing methods of valuation. Nonetheless, evidence from the literature review and the mapping in Table 3.14 has shown that the studies of the relationship between sustainability and real estate have not provided a defined theory and principle for incorporating sustainability issues into non-market value valuations, particularly for non-market industrial properties. The researchers focused on income yielding residential and commercial properties, and recently, on retrofits for owner-occupied properties, whereas sustainability is critical for industries in less developed countries where corporate industrial sustainability is non-existent. The researchers' methods are all market-based. The studies span many countries including Australia, Germany, Netherlands, Switzerland, Malaysia, Czechoslovakia, and UK. There were debates on appropriate valuation methodologies for sustainability and reporting. Publications also abound on the development of criteria, indicators, and benchmarks for sustainability assessment, reporting purposes and performance measurement of buildings, portfolios and property investment products. Investigation of the value of sustainability in commercial real estate formed the basis of the evidence of linkages between sustainability and property values, risk analysis and the empirical analyses of realised sale prices, investment returns, and vacancy rates.

This study recognises the gap and seeks to bridge it by providing the platform for valuing industrial properties using a non-market internalisation base for incorporating sustainability to drive a sustainability market. It would seem from the literature that the industrial organisational awareness is circumscribed to factory planning due to their restricted consideration of the broader dimensions of sustainability that often extend beyond their factory sites.

3.6 Theoretical Framework

The theoretical framework is the blueprint that holds the theory of the entire study. For this, it serves to connect to relevant theories which support the study rationale, purpose, problem statement, significance, methods and the research questions. USC Libraries, (2015) states that the research problem under study is the basis for the construction of the theoretical framework and the theory or theories may be tested. The key variables in the research and the assumptions were obtained from diverse theories in the related areas of study from the literature. The variables, which are grouped into dependent and independent variables, form a network connection of theory-based variables that justify the study research questions and address the research problem (Rocco and Plakhotnik, 2009; Grant and Osanloo, 2014). Rocco and Plakhotnik (2009) affirms that the framework demonstrates how a study advances knowledge and provides a reference point for the interpretation of study findings and implications. The researcher views the world through lense of interconnectedness, hence, the use of the social network theory approach to the theoretical framework might be justified.

The framework was grounded in the work of Runde and Thoyre (2010) and Lektauers *et al.* (2010) who first established coherent relationships between the value of sustainability in relation to market-based (commercial) properties as well as the dynamic modelling of sustainable development for governments. Runde and Thoyre (2010) endorses valuation based on the conventional method of valuation, with the cost of externalities internalised. That is, deducting cost of externalities by a direct or an indirect approach of factoring. From the theoretical orientation, the relationships are set to assess qualitatively, 'sustainability obsolescence' as a depreciation allowance for valuation of non-market industrial properties by scoring in relation to acceptable local sustainability indicators and rating guidelines. Some of the major international sustainability indicators adapted from RICS (2009), Boyd (2005) and Lütkendorf, and Lorenz (2012). Qualitative assessment of sustainability issues is in agreement with the RICS Valuation Information Papers No. 13 (2009) and IP 22 (2011) and the submissions of Lütkendorf and Lorenz (2012). Scoring is adapted from the sustainability rating tools of BREEAM (2011), Green Star (2003) and CASBEE (2004). Ahlroth (2014) agrees with the scoring and weighting method for eliciting judgments on resources, conservation and other environmental issues, but insists that the panel must consist of experts and stakeholders, and that the values and methods are consistent, and transparent. Panel of experts conducts an industrial survey as was suggested by Green Star (2003). Alhroth (2014) indicates that the direct observation, document review of environmental audit report to be used by the panel members to facilitate scoring. Scoring is by open consultation and consensus was acclaimed by BREEAM (2011). Weighting maximum scores/items upon which scoring is to be based and that value be dependent on final score (Green Star, 2003, CASBEE, 2004)

This section presents the theoretical framework of the integration of the sustainability dimensions issues into the valuation of the process industry under study. The dependent variable is the sustainability-corrected value and the independent variables are the sustainability assessment and valuation variables. The framework agenda agrees with the research scope which specifies a non-market basis – Investment value or Worth. It examines the models used in the previous study of Lektauers *et al.* (2010), Greenstar (2003), Runde and Thoyre (2010) as well as Lützkendorf and Lorenz (2012) to give direction to the study, clarify and show the relationships of the constructs in this investigation. The valuation principles of substitution and expectation explained by Wyatt (2007) and Scarret (2008) were employed. The work utilises theories of externality and inducement in environmental economics. The theory was put forward by Wheeler (1992), Starvins (2001) and Birnie and Boyle (2002). The purpose is to internalise the estimated costs of unsustainable practices to:

(i) To ensure that the government and the society did not subsidise those costs (Runde and Thoyre, 2010).

(ii) To induce process firms to invest in sustainability so long as retrofitting or uptake costs remain below cost attributable to ISRO (Wheeler, 1992; Starvins (2001).

(iii) To capture the impact perspective to the study of sustainability in industrial real estate valuations (Ibiyemi *et al.,* 2015).

In consideration of real estate valuation and industrial sustainability, the theoretical specification for a system dynamics for sustainability in real estate valuation for non-market industrial properties is presented in Figure 3.7.

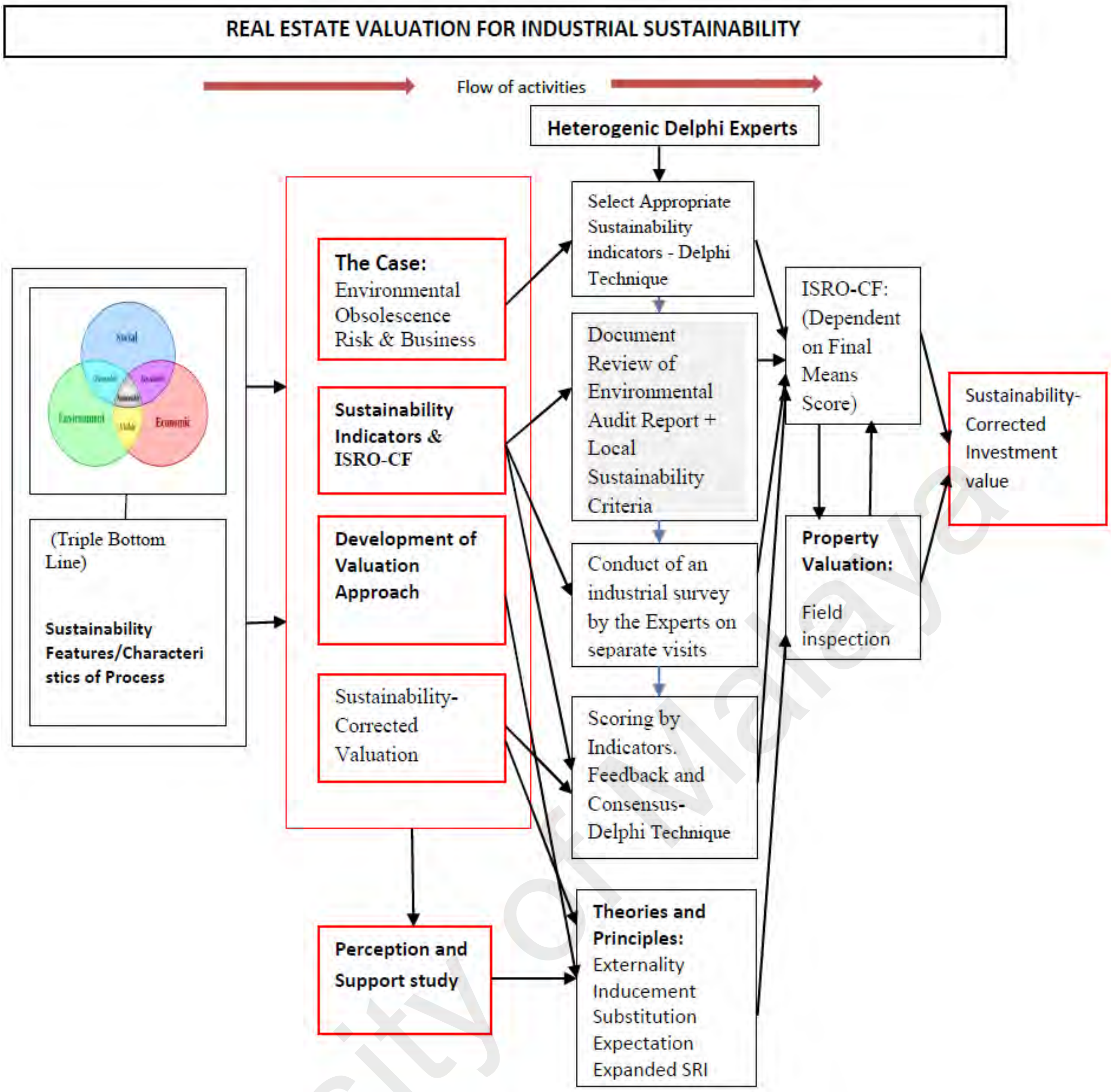


Figure 3.7: Theoretical Framework for integration of sustainability into process industries (Souce: this study, 2016).

The real goal of sustainability is improving the quality of human life by securing economic development, social equity and justice, and environmental protection. It can be achieved while living within the carrying capacity of the supporting ecosystems (IUCN/UNDP/WWF, 1991; Cavangnaro & Curiel, 2012). The framework is considered as a prescriptive support for legislative and other institutional frameworks to encourage compliance with sustainability criteria and metrics so that corporate industrial sustainability markets can evolve speedily and index sustainability issues for valuation in Nigeria. The basic thrust is that manufacturing activities cause environmental media pollution that imposes health and cleanup costs on the whole society, and if external costs exist, the producer may choose to produce more of the products than would be produced if the producer were required to bear all associated environmental costs.

By applying a sustainability obsolescence factor to the Owner's value, the producer either produces less or complies with the metrics. According to Pearse (2005), fair pricing of externalities will have an impact on both people's behaviour and the improvement of the environment. Prescriptive valuation approach that seeks to internalise costs could be a catalyst for remarkable compliance that would be able to redefine corporate industrial sustainability issues in emerging markets of the future. The TBL dimensions to sustainability requires strong human participation in identifying relevant sustainability indicators that are to be presented. Sustainability characteristics would need to be measured against the criteria or metrics to make up a reference sheet. A multi-scale model is borrowed from international rating tools of BREEAM (BRE Environmental Assessment Method), Green Star and CASBEE (Comprehensive Assessment System for Built Environment Efficiency). This framework is expected to provide a better understanding of the stakeholders about their roles and expose them to the approaches for integrating sustainability issues into non-market industrial real estates. The principal actors are the stakeholders, the local sustainability rating authority, and the valuers (Runde & Thorye, 2010).

There is abundant theoretical evidence that sustainability obsolescence would lead to a fall in market value. The fall in value even where there is a market, reflects a lack of compliance with the prescribed green building features. In the absence of a market, the framework develops a correction factor to actualise the externality theory and the expectation principle from a substituted market. In a broad sense, the purpose is to internalise the estimated costs of unsustainable practices so that the government and the society did not subsidies those costs; induce process firms to invest in sustainability so long as retrofitting or uptake costs remain below cost attributable to ISRO and to capture the impact perspective to the study of sustainability in industrial real estate valuations. The need for expanded SRI information has been justified.

The theoretical framework is relevant to this study as the sustainability corrected value is derived for the industry owner through the connection of the variables (sustainability indicators, sustainability metrics or requirements, sustainability features, value indices and judgments. In addition, it provides justification for the research questions.
Further theoretical considerations are discussed in section 5.2.3.1.

3.7 Summary

In this chapter, sustainability and property values have been discussed to ascertain the dimensions of sustainability, the appropriate sustainability indicators, existing approaches, bases and methods of valuation for industry assets. These prepare the grounds for the development of a sustainability-incorporated approach suitable for the valuation of process industries based on the existing theories of externalities and valuation. The information for sustainability integration takes the structure that transcends the traditional valuation-related information on functionality, serviceability and useful economic life. It redefines the concept of utility from the perspective of sustainability. The chapter identifies knowledge based information for valuers as important driver for sustainability inclusion into real estate valuation. The development of the theoretical framework would represent the researcher's position on the research problem and clarify the relationships among the constructs. Having identified the sustainability indicators in the literature, the selection of the appropriate sustainability indicators for a selected case industry could then be presented before a panel of experts for alterations, validation, and scoring.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

Research can be described as a systematic and organised effort to investigate an area-specific problem that needs a solution (Sekaran, 2006). The methodology is the study of how research is done, how to find out about things, and how knowledge is gained. In other words, the methodology is about the principles that guide research practices. Furthermore, it explains why certain methods or tools in research are in use, and the justification for using each of the research methods and a critical evaluation of the method (Gabriel, 2011; Cram, 2013; Regoniel, 2015). This chapter addresses the research methodology in achieving the objectives of the study through a methodological investigation of the subjects relating to the research questions and associated variables. The methodology in this study involves several stages of data collection dealing with a Delphi method for determining the ISRO correction factor, questionnaire survey towards assessing the perception and valuers' support for the integration of sustainability aspects into the valuation of process industries.

Research methods are the implements, techniques or processes by which researchers obtain data that is usde in research. Sarantakos (1998) classifies research methodology into the quantitative and qualitative traditions. However, this study employs the quantitative method because it relates to the quantitative approaches such as the use of structured survey questionnaires, defined research questions, the valuation of real estate, predictions and causal relationships, non-abstract and numeric data which are analysed by statistical procedures. Furthermore, it is deduced from available related theories and the researcher gathers scoring data by objective methods to provide information about scoring of the sustainability features, and also seems to be removed from the investigation. Nevertheless, it contains a qualitative element of gathering data from an open-ended question posed in the selection of sustainability indicators. The survey research design is adopted to identify the relevant sustainability indicators and predict the ISRO correction factor for valuation purposes. A perceptive and support study was performed for verification and validation of the main study.

The study is structured into two (2) parts: The primary study (Part I) involves a Delphi Method to uncover the important and relevant industrial sustainability indicators from the viewpoints of the experts from two panels: Environmental Managers and Consultants, and Academics and Professionals. This study formulates two Delphi research questions to find the relevant sustainability indicators and their scoring. It uses the descriptive statistics and the prescribed inferential W statistics to analyse the responses from the experts.

The second part of the research, that is, the perceptive and support study provides sub-sections on sampling, the design of questionnaire, instruments, data collection procedure, validity and method of analysis. The modelling section describes the valuers' perceptions and support for the valuation approach, the characteristics of the survey population of valuers and the relationships among the theoretical support factors. This part II study complements the Part I study so as to provide end-users' support, acceptance and the suitability of the valuation approach based on the valuers'perceptions and the causal relationships investigated. Sections 4.4.2.2(a) – (d) undertake the face, content and the reliability tests from a pilot survey for content area coverage and internal consistencies of the data. As discussed in section 4.2.2.2(m) – (o), the factor analysis is used to derive valuers' perception and support for the valuation approach.

The design in undertaking this study is outlined in section 4.2. The indicators for industrial sustainability are first selected and validated by the Delphi experts in section 4.4.1.2(k). Section 4.4.1.2(a) provides a brief overview of the Delphi Method, while section 4.4.1.2(n) provides the study outlines. The validity considerations are contained in sections 4.4.1.2(p and q). In section 4.4.1.2(s), the alternative approaches to the Delphi were discussed in conjunction with the justifications for CDM in section 4.4.1.2(t). The description for the development of sustainability integrated approach is provided in section 4.4.1.3. Sections 4.4.2.1 and 4.4.2.2 examine the conceptual framework and the field data regarding its reliability, face and content validity respectively. The method of factor reduction is through the EFA for the factor loadings and other psychometric properties including the tests of the hypotheses for the predictions of the causal relationships. Section 4.5 examines the validation of the study. The selection and location of the case study industry was reported in section 4.6. Section 4.7 provides the summary.

4.2 Research Design

Rani (2004) describes a research design as the overall strategy chosen to integrate the different components of a study in a coherent and logical way, thereby, ensuring that the research problem is effectively addressed. It constitutes the action plan or blueprint stating the methods and procedures for collecting, measuring and analysis of data needed to fulfill the research objectives and finding the solutions to the research problem. Chaudhary (1991) notes that a research design is the organisation of settings for the collection and analysis of data such that it combined relevance to the research problem and purpose. Likewise, research design is the procedural plan or framework that has specifies the type of evidence needed to seek answers to research questions objectively, accurately, parsimoniously and validly (Muaz, 2013). A traditional research design is a detailed plan on how a research study is to be completed wich includes the operative variables for measurement, choosing a sample, gathering data and analysing the results of interest to study and testing the hypotheses (Tyher, 1993). Bryman and Bell (2003) stress that research design ought to deliver the overall structure and direction of an investigation as well as the framework within which data can be collected and analysed. The outlined objectives and research questions are answered through the blueprint known as research design (Cavana *et al*., 2001; Creswell, 2012).

The study research design is the survey research design. The survey research designs are procedures in quantitative research in which a survey or questionnaire is administered to a sample to identify trends in attitude, opinions, behaviours or characteristics of a large group. (Creswell, 2012). Miller and Lessard (2001) offer a detailed descriptions of what are important concerns in designing the research thesis. Based on their recommendations, the components of this research design would cover: (i) The research problem and question(s) (ii) Sampling procedures and (iii) Methods of data collection

This research design process for this study is as shown in Figure 4.1.

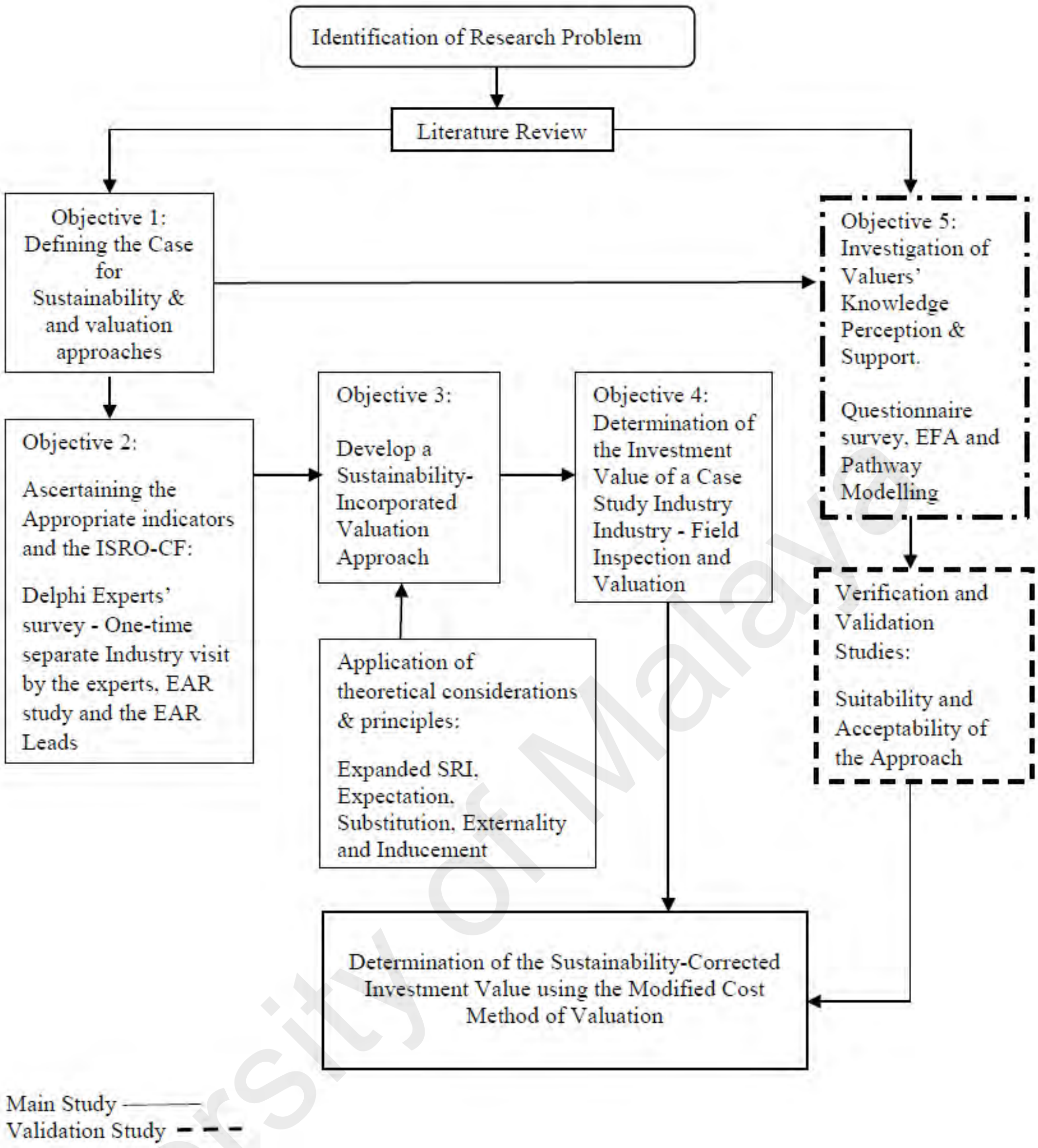


Figure 4.1: Research Design Process [Adapted and modified from Davies (2013) and Chih-Chao Chung *et al.* (2016)]

The study adopts the quantitative approach to address the integration of sustainability into real estate valuation. The first part, which is the main study, aims to develop a valuation approach for process industries on the basis of investment value. In this part, the research draws upon existing literature to generate a list of factors that relate to industrial sustainability criteria, other sustainability-related information, the principles of valuation and the theory of externalities. The research develops the sustainability impact-compliance valuation approach based on existing valuation concept of the depreciated replacement cost and modified the cost method of valuation. The identification of the industrial sustainability indicators is done during the first stage of the fieldwork which involves the use of Delphi Technique to achieve research objective 1. The list obtained from literature is exposed to a selection procedure to extract out those that are less important or include the more important criteria or factors to the case study industry. The Delphi panellists identified the sustainability indicators relevant to the industry. The scoring of the relevant indicators identified by the experts is done at the second stage of the fieldwork after the experts had carried individual industrial surveys and read the environmental audit report. A questionnaire comprising the selected criteria were given to the panellists to score the extent to which the sustainability features comply with the sustainability requirements for the industry. The correction factor was provided by the aggregated responses of the two-panel Delphi survey through a series of questionnaires, reiterations, validations and feedbacks to collect the necessary data. Afterward, an Industrial Sustainability-related Obsolescence–Correction Factor (ISRO-CF) was then derived and applied to the valuation figure. Field inspection and valuation updating constitute the third stage of the fieldwork. The industry management advances security reasons for disallowing new measurements to be taken. Therefore, all measurements are approximate estimates.

The second part constitutes the Valuers' perception of industrial sustainability integration into real estate valuation, their knowledge-base of the potential benefits and support components for the valuation approach of the research. The derived model examines the characteristics of the population of the valuers to explain the support causal factor relationships.

The initial fieldwork in the Part II (validation study) of the research is the fourth stage of fieldwork. It consists of a pilot survey aimed at pre-testing the questionnaire with a few randomly selected valuers from the sample population. The researcher requests the valuers to examine the diction and to verify whether or not the questionnaire contains all the criteria that they regard as essential to the study of perception, knowledge base and support. The pilot study is also to gauge the likelihood of the questionnaire passing the test on the actual run. Feedback also sought the relevance, accuracy, planning, sequencing and layout of the questionnaire. After the pilot study and a five (5) expert-content validity study, the attributes are revised and the questionnaire refined. Then, the fifth stage of the field work administers a questionnaire instrument on the valuers, having obtained the sampling frame and contact information from the Valuers' Register of Firms.

4.3 Research Process

The description of the stages of the research design has been discussed in section 4.2 with schematic representation shown in Figure 4.1 and the research plan in Table 4.1. It is the two-part approach towards the integration of industrial sustainability into real estate valuation. In using the Delphi study to provide a list of sustainability indicators and scoring, Heravi *et al*. (2015) had initially employed the Delphi study to identify sustainability indicators of industrial buildings in the petrochemical industry. Pivo and Fisher (2008, 2009) applied a hybrid of the Delphi and the regression model for the valuation of sustainable buildings in the commercial sector. Also, Valenzuela-Venegas *et al.* (2016) utilised it to the classification of variables according to their impacts in the valuation of eco-industrial parks. Nonetheless, it has been employed in the real estate research by Black *et al.*, (2003); Adnan and Daud (2010) and Liang and Lin (2014) to select factors that influence office occupation decisions, the prediction of the model for mortgage prepayments and management, and behavioural studies in real estate respectively.

The different phases of data collection are incorporated with literature reviews/ research questions to be answered, the research methods that are adopted and the major activities that are involved. The research plan is depicted in Table 4.1

Table 4.1. The research overall plan and approach to the study (this study, 2016)

Research Question	Objectives	Research Techniques	Major Activities
RQ 1. What would be the case for integrating sustainability into real estate valuation and the emerging normative and evidence-based valuation approaches?	1. To establish the case for incorporating sustainability into real estate valuation methodology in the context of the emerging normative and evidence-based valuation approaches.	• Desk Study + internet search. • Literature Review	• Literature Review from books and research databases such as Thompson Reuters, Scopus, Google Scholar, Springer-Link, et al • Participation in sustainability-related conferences.
RQ 2. What are the appropriate industrial sustainability indicators and the ISRO-CF?	2. To ascertain the indicators that are applicable for industrial sustainability and the ISRO-CF.	• Delphi Experts' selection of indicators and scoring. • Literature selection study.	• Identifying industrial sustainability indicators from the literature and responses to the Delphi research question 1. • Mean Scores, RII, Mean rank scores, and rating.
RQ 3. What would be the sustainability-corrected approach to value process industries by the investment value to the owner?	3. To develop a sustainability-incorporated approach suitable for the valuation of process industries on the investment value basis.	• The cost approaches property valuation. • Assessment of compliance levels. • ISRO-Correction Factor results from the Delphi experts.	• Industrial visits, direct observation, review of EAR document by experts. • Delphi scoring of sustainability indicators on the extent to which the property meets the sustainability criteria-Delphi questionnaire 2. • Delphi validations, reiterations and Analyses for consensus. • Mean Scores, RII, Mean rank scores, and rating. Kendall's W
RQ 4. What is the sustainability-corrected investment value to the owner?	4. To determine the sustainability-corrected investment value to the owner of a case study industry in Nigeria as a test of the extent to which the industry currently meets local sustainability requirements.	• Valuation update. • Application of externality theory and valuation principles of substitution and expectation.	• Reconnaissance survey • Measurements checking. • Calculations and determination of the value to the owner.

Table 4.1 continued: The research overall plan and approach to the study (this study, 2016)			
RQ 5. What are the perceptions and the support of the Valuers concerning the industrial sustainability integration into real estate valuation, the sustainability-corrected valuation approach and what model describes the characteristics of the population of valuers under study?	5. To investigate the Nigerian valuers' perception regarding the integration of industrial sustainability into real estate valuation, support for the sustainability-corrected valuation approach, the causal linkages between factors and the applicable model for the population of valuers	• Pilot Study Questionnaire survey. • Factor structure, and Identification of endogenous and exogenous variables. • Missing values replacements & Outlier identification. • PLS Model Specification and analysis.	• Questionnaire survey to elicit Perception of valuers - • Reliability and validity tests • Exploratory & Confirmatory Factor Analysis • Structural equation modeling with reflective indicators.

4.3.1 Part 1: Main Study

As explained earlier in Section 4.1, this main study seeks to investigate the relevant industrial sustainability indicators for a case study industry and obtain experts' scorings that reflect the extent to which `the industry sustainability features comply with the applicable sustainability metrics for the industry. The purpose is to enable the consideration of the primary sustainability elements in the valuation of the industry based on the adjusted cost valuation model. The factors identified from the literature are subjected to experts review through a Delphi procedure. The experts are those who have been involved in environmental and sustainability issues in the area of study and beyond. The procedure and criteria adopted for the selection of the experts are explained in section 4.4.1.2 (g). This part of the study will focus directly on the case study industry and the valuation purpose and basis.

4.3.2 Part II: Perceptive and Valuers' Support Studies – End Users

This part concerns the knowledge perception of sustainability integration and the suitability of the valuation approach and support of the main study by the potential end users (the valuers). The primary objectives of the study are to:

(1) Examine the perception of valuers about the integration of industrial sustainability into real estate valuation theory, based on their knowledge of the potential benefits of High Building Value, Cost Savings, Lowering Risks, Productivity Gains and Quality of Life.

(2) Determine the acceptance and suitability of the ISRO-CF valuation approach for assessing the extent to which industrial building features comply with sustainability requirements.

(3) Investigate the support systems and causal relationships between (1) and (2) for modelling of the valuers' population characteristics. It provides the answer to the causes of the Valuers' support for sustainability integration.

(4) The appraisal of the characteristics of the Valuers' population of study as a base for future study.

Part II is tangential to the main study that has used the modified cost approach to valuation in an industrial sustainability setting. The Part II study established the grounds for the validation of the main study. It applies the data triangulation method to validate the valuation approach for its suitability and acceptability by the potential end-users as suggested by Lisa *et al*. (2013). It also adduces causal reasons for the valuers' support for sustainability integration and the ISRO-CF valuation approach. These help to strengthen the research outcome of the main study and gain insight into the valuers' perspectives. It could help to identify areas of agreement as well as divergence. This creates innovative ways of understanding the causal-support characteristics and provide a clearer understanding of the valuers' choices. The Delphi scores of the experts in the main study have been construct-validated at two levels: The Mann-Whitney U test of significant difference in the aggregate scores of the two Delphi panels as suggested by Refaeilzadeh *et al.* (2008) [section 4.4.1.2 (o)] and the W statistics of experts' ranking >.70 [section 4.4.1.2 (n)].

4.4 Research Methodology

4.4.1 Part I – Main Study

The methods are presented according to the objectives that they seek to fulfill.

4.4.1.1 Methods for the First Objective: Review of the Existing Literature

The method used for the achievement of the first Objective is a review of relevant literature that elicits the concept of sustainability and the case for its inclusion into real estate valuation. Normative and evidence-based valuation approaches for sustainability are examined and highlighted through the prism of the available literature. Some of these approaches include those contained in RICS (2009); Lützkendorf and Lorenz (2012); Runde and Thoyre (2010); Lützkendorf and Lorenz (2010); Boyd and Kimmet (2005); Lützkendorf and Lorenz (2005); Boyd (2006); Reed (2009); Myers *et al.* (2007); and Muldavin (2010b).

4.4.1.2 Methods for the Second Objective: The Delphi Method

The Delphi process is utilised for forecasting the ISRO-CF, that is, obsolescence due to non-compliance with local sustainability requirements. The Delphi questions and strategy provide a template for predicting the obsolescence factor. It formulates appropriate Delphi questions from the objective of assessing ISRO. Specifically, the Delphi process for industrial sustainability comprises of two stages: The preliminary and the main stage, rounds, analyses and reporting steps. A description of the Delphi Method has been elaborated in the following sub-sections:

4.4.1.2(a) Overview of the Delphi Method

The Delphi Method (DM), as a research strategy, was developed by the RAND Corporation in the 1950s to obtain the most reliable consensus of a group of experts (Dalkey and Helmer, 1963). It is a method, according to Linstone and Turoff (1975) for constructing a group communication procedure so that the process is operative in letting a group of individuals, as a whole, deal with a composite problem. The "structured communication" involves with provisions for *(i)* some individual contribution of information and knowledge (feedback) *(ii)*. Some evaluation of the group judgment or view *(iii)* some opportunity for individuals to revise views; and *(iv)* some degree of anonymity for the individual responses. Schmidt (1997) provides a comprehensive description of how to conduct this type of Delphi survey, including guidelines for data collection, data analysis (based on non-parametric statistical techniques), and reporting of results. The Delphi method is a need-based instrument, designed for qualitative prediction within a diverse group of experts. The experts make their predictions, and a facilitator controls these forecasts until the point of consensus is reached. The survey gathers input without expecting the experts to work face to face. The goal of this critique is to seek operational effectiveness through an evaluation of the method. According to Turoff (1970), four possible objectives or ancillary goals of any Delphi exercise are as follows: *(1)* To explore or expose underlying assumptions or information leading to differing judgments; *(2).* To seek out information that may produce a consensus of judgment on the part of the expert group; *(3).* To compare informed judgments on a subject covering a broad range of disciplines; *(4)* To inform the respondent group about the diverse and interconnected aspects of the subject.

A high volume of literature surrounding the Delphi as an iterative multi-stage process contrived to transform opinion into group consensus exists. The literature also documents the foresightful accuracy of the method by many studies in information systems and management, public relations, real estate, nursing and general medicine. Sekker (2015) proposes an Argument Delphi built on the contradictions of the ideas of the experts during the survey. Research work relating to a critical review was carried out by Keeney *et al.* (2001). The study of Balasubramanian and Agarwal (2012) was a narrative review of the Delphi process in which selected studies were compared and summarised. The Delphi considers the use of expert participants, the size of the panel, anonymity, Delhi rounds, analysis of sampling, reliability, and validity, and technique applications. Sackman (1975) and Keeney *et al.* (2001) hint about the alterations in the conventional Delphi process. Moreover, the application in diverse fields of research and the various modifications may mean compromising the rigour associated with its validity. Arguably, this might raise methodological issues with implications for the reliability of findings. The fundamental issue is how to strengthen the Delphi Method, with adequate consideration of the consequences.

There are four diverse forms in existence: The traditional, conventional or classical Delphi (Dalkey and Helmer, 1963; Balasubramanian and Agarwal, 2012). The real-time or modified Delphi exists when the traditional model is adapted (Beretta, 1996). For instance, when close-ended queries are used, and it takes place during the run of an organised meeting that uses mechanisms to aggregate the experts' responses immediately. The selected experts know each other from the outset, but their questionnaire responses are anonymous (Hanafin, 2004; De Villiers *et al*., 2005). Others are the policy Delphi and the decision or focus Delphi (Crisp *et al.*, 1997). Hanafin (2004) restates that the classical Delphi prioritises facts and forecasts future events, using a set of first round open-ended questionnaires sent out to a group of experts, with a second questionnaire grounded in the results of the first. The following questionnaires refine and specify the facts or proposals, estimating their accuracy from the participating members. Forecasting of technological developments is the most popular implementation. The open endedness of the classical Delphi questionnaire suggests openness to reiterations and feedbacks (Halal, 2013). In a policy Delphi, the intent is not to attain consensus or stability in responses among those with expertise but to generate a range of alternative options on the potential resolutions of a major policy issue. It applies the structured public dialogue. Here, the Delphi is a tool for policy development that advances participation by capturing as many unique views as possible (Linstone & Turoff, 2002). The decision Delphi obtains a joint decision by consensus from a diverse group of experts with different opinions (Nielsen & Thangadurai, 2007). In the policy and decision, Hanafin (2004) states that the panellists often come up together to a group meeting to debate differing views and conflicting answers.

The Classical Delphi Method (CDM) uniquely provides for the reiterations and feedback mechanisms, and it is adoptable for the selection of relevant factors, components or indicators. The other Delphi models lack these qualities.

4.4.1.2 (b) The Classical Delphi Study Context

Industrial sustainability is complex and unique: First, investors are not prepared or often reluctant to invest in sustainability because they are not certain about immediate returns on retrofitting costs or other additional costs required in embracing sustainability initiatives (Myers, 2009; NESREA, 2011). Second, they need an inducement to do so. (Ibiyemi *et al*., 2015). However, the presence of a sustainability market and the available market information requisite to it is a requirement for sustainability valuation. Where no market exists, the valuation principles of substitution and expectation could apply to estimate the industrial sustainability-related obsolescence (ISRO). The measurement and underwriting of the ISRO by the investors would induce them to invest in sustainability initiatives (Ibiyemi *et al*., 2015). The CDM is best suited to provide an expert judgment estimate of a correction factor which estimates the extent to which the sustainability features of a process industry meet the local sustainability requirements. Once done, it answers the age-long question about how to do so. A discussion on the justification centres on the multi-disciplinary dimensions of sustainability and resonates with the multidisciplinary nature of the CDM. In addition, each dimension of sustainability can be priced and the extent to which each indicator meets the local sustainability requirements determined. The work is intended to contribute to the real estate sustainability body of knowledge by reviewing the CDM as a viable option for capturing industrial sustainability issues explicitly, from the environmental, economic, and the socio-cultural standpoints. The goal of this Delphi application is to seek operational effectiveness in the use of the CDM for predicting the obsolescence correction factor due to non-compliance with local industrial sustainability requirements.

4.4.1.2 (c) Key components of the Classical Delphi Method

The essential elements of the Classical Delphi Method (CDM) used in this study with reference to panel composition and expertise, number of rounds, outcomes and a graphical overview of the elements of the study are shown in Figure 4.2

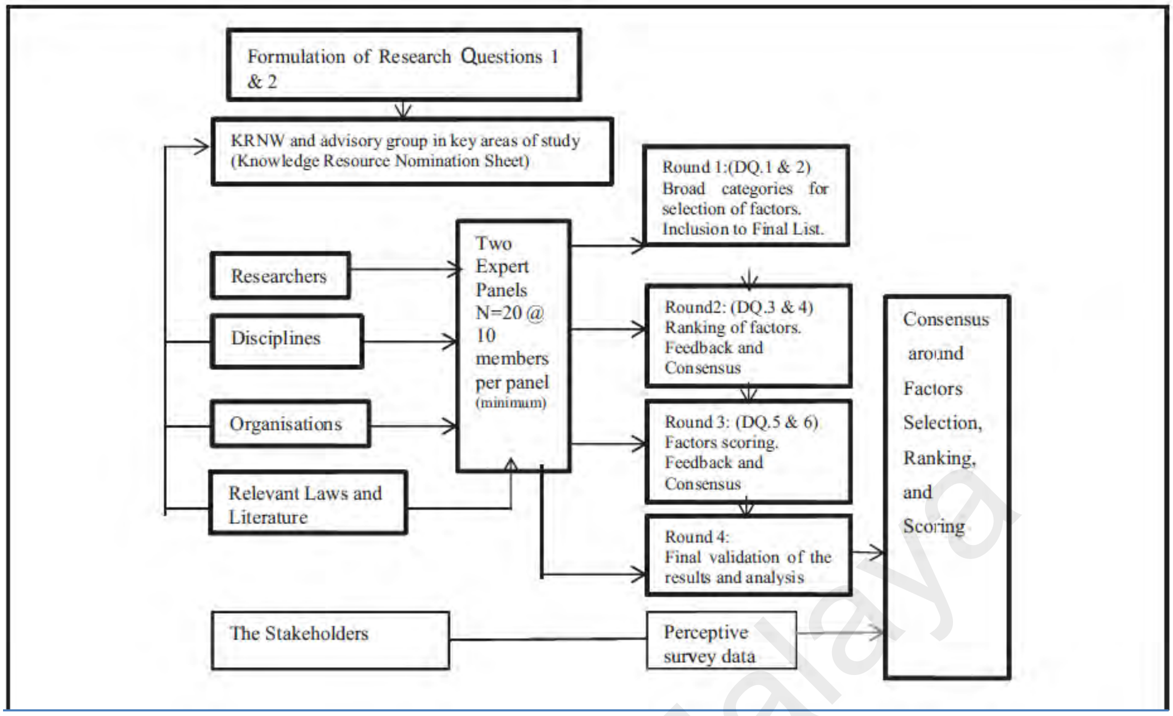


Figure 4.2: Key components of the Classical Delphi study (Hanafin, 2004; Ibiyemi *et al.* 2015)

In the CDM, each expert is asked to reconsider his response in the light of other panellists' responses. The feedback session continues for subsequent rounds until achieving consensus. The procedure is best described as multistage where each phase builds upon the outcomes of the earlier one (Nworie, 2011; Green, 2014). Lang (1995). Somerville (2008) provides the list of the process in the CDM as follows: *(1)* use of expert participants *(2)* size of the panel. *(3)* Heterogeneity (4) anonymity (5) two or more Delhi rounds, (6) controlled feedbacks from each rung with some measure of statistics, and textual information (7) analysis of data (8) consensus. The modified models are restricted to close-ended questions with experts interacting among themselves. On the other hand, the policy model can be considered inappropriate for selection of factors when the model is designed for general options on an issue in an open dialogue. The decision model uses a group debate. Overall, three other Delphi models lack the richness of the CDM when considered along with the lines of (3), (4), (6) and (8) above.

4.4.1.2 (d) Administration and Implementation

The classical form of Delphi sets out with the selection of the knowledge resource for the identification of disciplines, relevant organisations, literature, and laws. Then, the initial questionnaire (round one) acts as an idea-generation scheme to reveal the issues within the area of study. The respondents referred to as panellists bring up as many relevant issues as possible in round one. Feedback presented from round one responses complements the course of a second questionnaire which seeks an opinion on the subjects brought up. The following series provide each panel member (expert) with his or her responses as well as those of the other panelists. The procedure of reiterations and validations are continued for several rounds until a degree of concordance is reached, or the experts are no longer able to modify their previous estimates or are fatigued (Adler & Ziglio, 1996; Delbeq *et al*., 1975; Linstone & Turoff, 1975; Okoli & Pawlowski, 2004).

Selecting research experts is a vital module of Delphi research since the output of the Delphi is based the expert opinions (Bolger & Wright, 1994). Moreover, some of the experts elicit the reliability of the components. The works of Delbecq *et al.* (1975) and Okoli and Powloski (2004) describe a rigorous procedure whose purpose was to ascertain the identification of relevant experts and grant them the opportunity to be involved in the survey. A Delphi study is not reliant on a statistical sample that tries to meet the representativeness of any population. Rather, it is a group decision instrument requiring qualified experts who have a thorough understanding of the issues as one critical requirement in the selection of qualified experts.

There are discrepancies about what makes a suitable panel size. Clayton (1997) contends that, as a thumb rule, 15 to 30 people would suffice for homogenous; for instance, professors from the same subject areas. However, Ziglio (1996) accounts that ten (10) to fifteen (15) people could bring forth sound outcomes in a homogeneous panel. For groups of individuals with expertise from different social or professional areas, but in the research area, Clayton (1997) reports that four (4) to ten (10) experts are needed. Gordon (1994) points that most Delphi studies use panels of 15-35 people. Even so, in two separate studies, looking at the size of Delphi panels, no significant relationship between the panel size and effectiveness criterion was found (Rowe & Wright, 1999). In series of other literature on aggregating group judgments, groups of 6-12 members were given to be optimum (Hogarth, 1978; Mitchell, 1991). Moreover, it was ascertained that all things being equal, the bigger the group, the more powerful the aggregate assessment will be. Beyond group sizes of 20, there were marginal improvements to both reliability and validity (Hogarth, 1978). Nonetheless, the Delphi grounded on two panels might have minimum of eight (8) to ten (10) members on each of the panels (Okoli and Pawlowski, 2004). To date, there is no concordance on the panel size, the relationship of the group to neither other experts not chosen nor the sampling method expended to select such experts (Green *et al.*, 1999, Green, 2014). Also, there is no 'typical' classical Delphi; rather the method is modified to suit the circumstances and the research questions (Skumoski *et al*., 2009).

The study Delphi procedures comprise of the formulation of the Delphi research questions (DRQ), Rounds 1-3, and 6 Delphi questionnaires, 4 Reiterations and validations. The Delphi process consists of the two stages: The preliminary and the main stages, as in Figure 4.3.

The preliminary stage considers the formulation of two (2) DRQ, the content area identification, selection of expert participants, pre-test of questions and the invitation of the experts to the study. It is explained in sections 4.4.1.2 (e) to 4.4.1.2 (k) as follows:

4.4.1.2 (e) The Formulation of the Delphi Research Questions

The work employs the classical Delphi method for data collection and analysis. The Delphi method in this study was used for the following purposes:

(i) To select appropriate sustainability indicators (SIs) for the case study industry.

(iii) To obtain Actual Sustainability Compliance Scores (ASCS) for transformation to Mean ASCS for each expert and the weighted mean Industrial Sustainability-related Obsolescence Correction Factor (ISRO-CF)

The research questions are stated as follows:

DRQ. 1: What are the appropriate sustainability indicators for the case study industry?

DRQ. 2: What are the scores that indicate the extent to which the industrial sustainability features meet the requirements?

4.4.1.2(f) Selection of the Knowledge Resource Nomination Worksheet Reseach Team

Okoli and Pawloski (2004) suggests that the Knowledge Resource Nomination Worksheet (KRNW) research team consist of two (2) academics and one (1) consultant selected by the researcher purposively. These team members are those that are familiar with issues concerning industrial sustainability and are required to fill the knowledge nomination worksheet. The team has the following responsibilities:

(1) To define the content area by selecting the significant set of experts' disciplines, related organisations and applicable laws for the study (as in Table 5.1) that would be most fruitful in the identification of the industrial sustainability in the paints industry for valuation purposes (Okoli & Pawloski, 2004).

(2) To help certify the list of experts and categorise them into into two panels or groups, to prevent overlooking any important class of experts (as in Tables 5.1 and 5.6).

(3) To ascertain that the selected experts are representative of the area of knowledge (Goodman, 1987; Winkler & Poses, 1993).

(4) To examine the round one questions/instructions given and the response formats for diction difficulties, clarity and ease of understanding (Holsapple & Joshi, 2002).

In addition to the KRNW certification about (4) above (section 5.2.2.8b), the Mann-Whitney U test reports on the reliability test outcome (section 5.2.2.8d). The team members' role in (1) and (3) above help to achieve content validity (Burns & Grove, 1993, Haynes *et al*., 1995; Yaghmale, 2003).

4.4.1.2 (g) Procedure and Criteria for Selecting the Experts

The selection of the Delphi experts complies with the required basic skills and competencies in the disciplines, and the organisations specified by the three (3) member KRNW Team. The instrument used is attached as Appendix N as the KRNW worksheet. The nominated experts are specified as informed individuals (McKenna, 1994) and as specialists in their domain (Linstone & Turoff, 2002) or someone who delivers knowledge about a particular subject (Green *et al.*, 1999). Panel members were chosen purposively, founded on cognition on the issue and diversity of views (Lang, 1995; Linstone & Turoff, 2002; Garrod, 2004).

Each heading (disciplines, and organisations) represents a different lens for identifying and considering experts. However, the multiple lens perspective is necessary to identify as many experts as possible. For each category, the personal list of contacts is examined to fit the names into the appropriate categories. This is the baseline procedure detailed by Jairath and Weinsten (1994) and Gibbs *et al*. (2001) to ensure identification of the qualified experts. The list should then be populated according to the categories, after the personal contacts with them.

Disciplines or skills: Each category may require a different approach for identifying experts:

1. *Academics*: The list be populated almost entirely with experts from the academia – universities, polytechnics, and research institutes.
2. *Environmental Units*: This list involve officers of the environmental units in the industry. They are the custodians of environmental performance, audit and safety reports
3. *Government*: The regulatory agencies (NESREA and LASEPA), for persons who are considered knowledgeable experts in standards, monitoring and enforcements of industrial sustainability requirements or metrics.
4. *Estate Valuers and other professionals*: Numerous Estate Valuers and other selected professionals that are active on sustainability issues are found through the directory of registered surveyors, planners, their biodata, and the websites of their published works.

5. *Organisations*: The web, e-mail, phone, or other methods are used to contact the identified organisations (NESREA and LASEPA). The objective is to contact people in these organisations who are experts in the study area.

6. Related laws: Laws relating to green property rating and sustainability.

The expert panel is therefore designed to have expert representatives from the academia, professions in the built environment, environmental health, safety and consultancies

4.4.1.2 (h) Sampling Design

There is no concordance on the size of the expert panel, the relationship of the panel to the larger population of experts and the probabilistic sampling method expended to select such experts (Green *et al.,* 1999). Sample sizes and heterogeneity hinge upon the project design, the design selected and the time frame for data assemblage. Nonetheless, the literature admits an abundant range of possibilities in this regard (Goodman, 1987; McKenna, 1994; Green *et al.,* 1999). For the CDM, the design mode is purposive (Okoli & Powloski, 2004; Ibiyemi *et al.,* 2015) and a heterogeneous sample is carried out to assure that the entire spectrum of opinion is specified (Green *et al.,* 1999; Green, 2014). Moreover, experts must be dispassionate so that the information obtained from them reflects current knowledge and perceptions in the research area (Goodman, 1987; Nworie, 2011). However, the balance is precarious to reach and justify. Still, the Delphi panellists need to be proficient in the area of concern. Nonetheless, Chia-Chen & Sandford (2007) emphasise that the results of Delphi studies are not subject to generalisation

4.4.1.2 (i) Selection and Invitation of the Experts to the Study

First-round contacts is made with the identified experts and if necessary, the researcher may have additional experts included on the list. A brief description and explanation of the Delphi study is provided to the experts (Appendix B4). Biographical information on experts about the qualifications they possess to make them experts were gathered. These included the length of years of environmental and related exposures and their current positions. The experts are invited to participate in the study, stopping at two to four rounds (Young & Hogben, 1978; Proctor & Hunt, 1994; Beech, 1997). Choosing the maximum number of experts provides a buffer in case of attrition, even though, according to Green *et al*., (1999) participant drop-out tends to be very low when respondents have verbally assured that they are willing to participate, and the appropriate incentives are given. Each expert or panellist is contacted and the subject of the study explained to him as well as the procedures and the commitment required. Each panellist could commit up to 15 minutes to complete a questionnaire, and return each within three days over a period of 1–3 months. A limit of six questionnaires is given so as not to overburden the participants. The specimen of the permission to seek information, the researcher's profile and an invitation letter to participate in the study are attached as Appendix B1-B3.

Based on the specified guidelines, 45 Experts were invited to participate in the Delphi study, but 37 agreed to participate. 23 experts responded to all the three rounds, while 13 experts withdrew voluntarily (Table 5.2). The profile of the respondents are listed as in Table 5.3

4.4.1.2 (j) Incentives

There are incentives that may influence experts to participate in a Delphi study, such as: *(1)* being chosen in a diverse but selective group; *(2)* the opportunity to learn from the consensus building; and *(3)* increasing their visibility to local and international organisations. Okoli and Pawlowski (2004) insists that these incentives can provide the strong inducement needed to attract busy experts. Incentives (rechargeable lamps and mobile phone chargers) were given to facilitate quick responses and sustain the participation of the experts.

4.4.1.2 (k) Questionnaires Design and Administration

Mechanism: The questionnaires were administered using e-mail, and the web. The panellists are free to use any of these media as found suitable. These media have the advantage of reducing turnaround time between questionnaires. Delbecq *et al*. (1975) estimates that the average Delphi study could take 45 days to 5 months where the panellists are all in one country. However, the Delphi exercise is expected to take up to six (6) months, given the terrain and the requirement for extensive information.

Procedure: Administration of the questionnaires follows the procedure for ''ranking-type'' Delphi studies as outlined by Schmidt (1997) and discussed by Schmit *et al*. (2001). This should involve three general steps: *(1)* brainstorming for important factors; *(2)* narrowing down the original list of the most important ones; and (3) ranking the list of important factors.

Questionnaire Design: Design follows the guidelines put forth by Delbecq *et al*. (1975) and Dillman (2000). The CDM has multiple steps and reiterations that make it more time-intensive for the respondents when compared to a traditional survey. One way could be to ensure that no single questionnaire takes more than 15 minutes to complete. Second, considering the administrative mechanism of employing e-mail, and web versions of the survey, it is critical that the design formats were the same for all experts.

The preliminary study utilises the CDM in which thirty-four (34) criteria/indicators/factors derived from the literature and past studies are put forward for selection and prioritisation according to the dimensions (Appendix E).

The experts' demographic profile and the KRNW classification into two panels are presented in sections 5.2.2.3 and 5.2.2.6. Okoli and Pawlowski (2004) state that two or more Delphi panels explore the diversities on informed opinions and present more robust outcomes. The experts' demographic profile provides the insight into the type of experts who participated in the main study (section 5.2.2.6). The indicators (variables) are measured on a 5-point Likert scale (1-not important – 5 very important). The questionnaire for scoring of the sustainability features range from 1-Very poor compliance of the industrial sustainability features with the sustainability requirements to 10-Very Good compliance of the industrial sustainability features with the sustainability requirements (Appendix F1).

Experts are assigned to the two-panel structures A and B. Their size and constitution depend on the nature of the Delphi questions and the dimensions along which the experts would probably vary. For instance, the research team may identify that five relevant categories of experts have important and valuable knowledge about industrial sustainability issues in Nigeria: The Environmental Units of the industry, The National Environmental Standards and Regulations Enforcement Agency (NESREA), the State Environmental Protection Agency (LASEPA), Academics, and Estate Valuers. Following recommendations from Delphi literature, there are ten (10) to fifteen (15) people in each panel. Panel A consists of Environmental Managers and Consultants, and Panel B, Academics, and Professionals. The two panels are therefore distinct, and heterogeneity is preserved (section 5.2.2.6)

The main stage involves the data collection through the three (3) rounds as explained in sections 4.4.1.2 (l) to 4.4.1.2 (o) as follows:

4.4.1.2 (l) Delphi Data Collection:The Rounds

The main stage of the Delphi data collection consists of the three rounds analyses and the reporting steps following the preliminary stage as stated in sections 4.4.1.2 (d) to 4.4.1.2 (o) in succession. Figure 4.3 outlines the process of administering the study. They are:

Round 1: *Administration and brainstorming:* Questionnaires 1-3: Collection of factors (as individual expert)

The initial questionnaire consists of solicitation of ideas from the experts. The questionnaire asks basic questions, to answer the three Delphi questions. To address the first research question (DQ1), questionnaires 1-3 (Table 4.2) ask experts to identify the sustainability indicators (SI) from each of the four (4) SI categories in literature that can affect the use value of the industry (Note: They could also delete from or add to the literature list). The question seeks to generate a list of the sustainability indicators. The experts are then asked to offer a one-two sentence explanation as feedbacks to justify their choice. The consolidated list is sent to them again for validation. A specimen questionnaire for identification and listing is attached as Appendix E, but no scoring is expected at this stage.

Round 2: *Narrowing Down and Scoring*

In analysing the responses from the first two questionnaires, the identical responses are first removed. At this time, the number of panellists that initially suggest each item is recorded, the indicators are grouped conceptually into categories to make it easier for panellists to comprehend each list when returned to the next step. This grouping is for presentation purposes and not for analysis, and the categorisations are based on literature knowledge of the issues concerning sustainability (such as environmental, socio-cultural, and economic indicators).

The researcher, rather than the experts, performed the consolidation of the selected lists, grouping into categories, and rating of the importance of the sustainability indicators. Questionnaire 4 is to validate the consolidated lists and ranks. This questionnaire lists all the consolidated factors obtained from the first questionnaire, grouped into categories. In addition to one-sentence explanation of each factor, an explanatory glossary is included to define and explain each factor, based on information provided by the experts in the first questionnaire. Furthermore, the experts each receives an exact copy of their responses to the first questionnaire.

The questionnaire asks experts to: (a) verify that the researchers have correctly interpreted their responses and placed them in an appropriate category; (b) verify and refine the categorisations of the factors, and (c) validate the rankings or alter them with a one or two-sentence justification. According to Schmidt, *''without this step, there is no basis to claim that a valid, consolidated list has been produced*.'' At this time also, experts could suggest additional items that they might not have considered initially. Based on their responses, the two lists and categorisations are further refined.

In addressing the second research question (DQ2), the questionnaires 4 and 5 (Table 4.2) ask the experts to attach a maximum score to each of the SIs. This question seeks to generate the maximum score upon which individual scoring of the items can be based. The experts, thereafter, were asked to score the items in relation to the local sustainability requirements, and verified with a one-time individual and separate visits to the industry by the experts. They are asked to offer a two-three sentence explanation to justify their scoring. These explanations serve the dual purpose of providing a subjective empirical basis, and help to understand and reconcile the various experts' factors. Moreover, the explanations aid to classify the factors into categories (Okoli & Pawlowski, 2004). All the scorings are made available to the experts.

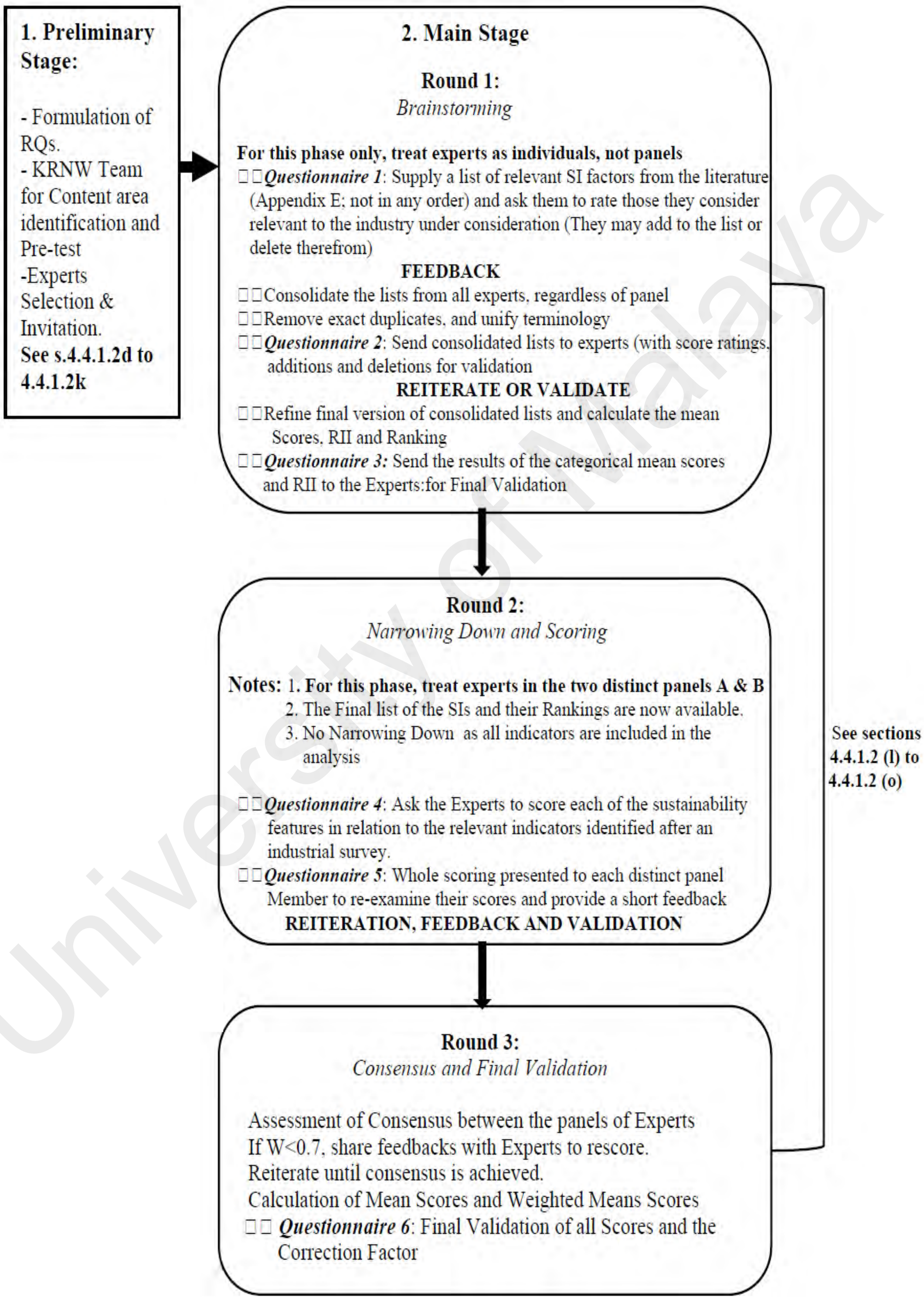


Figure 4.3. Outlines of the Delphi process of administering the study. (Adapted for this study from: Schmidt, 1997) and Okoli & Powloski, 2004).

Round 3: *Consensus*

The phase accesses the consensus between the panels of Experts. If W<0.7, share feedbacks with experts to rescore. The reiteration continues until consensus is achieved through the calculation of Mean Scores and Weighted Means Scores. Questionnaire 6 then requests for the final validation of all scores and the correction factor as in Table 4.2.

4.4.1.2 (m) The Delphi Questionnaires

The experts respond to queries in two or three rounds. After each round, the facilitator provides an anonymous summary of the experts' forecasts from the previous round as well as short reasons given for their judgments. Thus, the experts are encouraged to revise their earlier answers in the light of the responses by the other members of their panel. It is believed that during the process, the range of the answers will decrease and the group will converge towards the "correct" answer. Table 4.2 shows the list of the six (6) Delphi questionnaires that are used over the three rounds.

Table 4.2: A Summary of the Six (6) Delphi questionnaires with the Three Rounds (this study, 2016)

	Questions/Requests	Response Format	ROUNDS
Q-No.	**SELECTION STAGE**		
1	What sustainability indicators are relevant to the Paints Industry in Nigeria and how would you rate their importance? (Short feedback required)	Likert's Scales (1-5; not important to very important	ONE
2	Examine the consolidated list of the sustainability indicators by other experts and indicate changes that you would like to your initial score rating in the light of the additions and modifications (Reiterations may be required).	Open ended	
3	Verify and validate the Final Version of the consolidated list of the sustainability indicators, the mean scores, ranking and the Importance Indices	Validated/Not validated	

Table 4.2, continued: A Summary of the Six (6) Delphi questionnaires with the Three Rounds (this study, 2016)			
	SCORING STAGE		
4	What score would you attach to each of the sustainability features in relation to how it meets your perception of the sustainability criteria? (1=minimum score to 10=max.) (Short feedback required).	Scoring on 10 score points. (1-10; very poor compliance to very good compliance	TWO
5	Examine the scoring of each of the sustainability features by other experts and revise your own scoring if you wish. (Reiterations and Short feedbacks required).	Revision/No Revision	
	FINAL VALIDATION STAGE		
6	Verify and validate the computed mean scores, weighted mean scores and the derived correction factor	Yes/No	THREE

The experts were advised to type their responses directly into the word document and kindly requested them to respond as thoughtfully and comprehensively as they could. The responses were analysed (sections 5.2.2.4 – 5.2.2.7). The result from the questionnaire administration is attached as Appendix G

4.4.1.2 (n) Delphi Experts Scoring Outlines Summary

The Delphi technique provided consensus opinion from the panels about selection of indicators and the scoring of industry sustainability features (Linstone & Turoff. 2002; Worrell *et al.,* 2013). The Delphi experts scoring outlines can be summarised as follows: *(1)* An industrial survey to be conducted by the panel of experts (Green Star, 2003) *(2)* Direct observation, document review of environmental audit reports and impact statements to facilitate scoring by the experts (Ahlroth, 2014). *(3)* Scoring of the extent to which the industrial sustainability features meet the sustainability requirements is by reference to the qualitative judgment of each expert on their perceived sustainability requirements (BREEAM, 2011) *(5)* Weighting Maximum Scores/item upon which scoring is to be based, or as appraised by the individual expert or accredited Sustainable

Building Rating Tool (Green Star, 2003; Ahlroth, 2014) *(6)* Sustainability-related obsolescence correction factor is to be dependent on the final score (CASBEE, 2004) *(7)* Multiplication of the corrected factor with the valuation figure *(8)* The perception and validation study. The technique is used to provide consensus opinion at two levels from a group perspective:

Level 1: Selection and ranking of sustainability Indicators relevant to the industry in Nigeria.

Level 2: Scoring of sustainability features/characteristics based on the qualitative judgement of the experts in relation to compliance of the features with the sustainability requirements.

Consensus or convergence of opinion is established if ≥ 70% of the panel members give the same response on an item (Stitt-Gohdes & Crews, 2004). Results is computed using mean scores for each item, and relative importance index (RII). Sustainability Obsolescence Correction Factor is the factor based on aggregate scoring of the sustainability compliance level attributable to the industry under study for correcting the cost valuation figure. Taking account of the discussions, the outline study has summarised the basic concepts and the valuation process in Figure 4.4 for the assessment of the sustainability-corrected investment value.

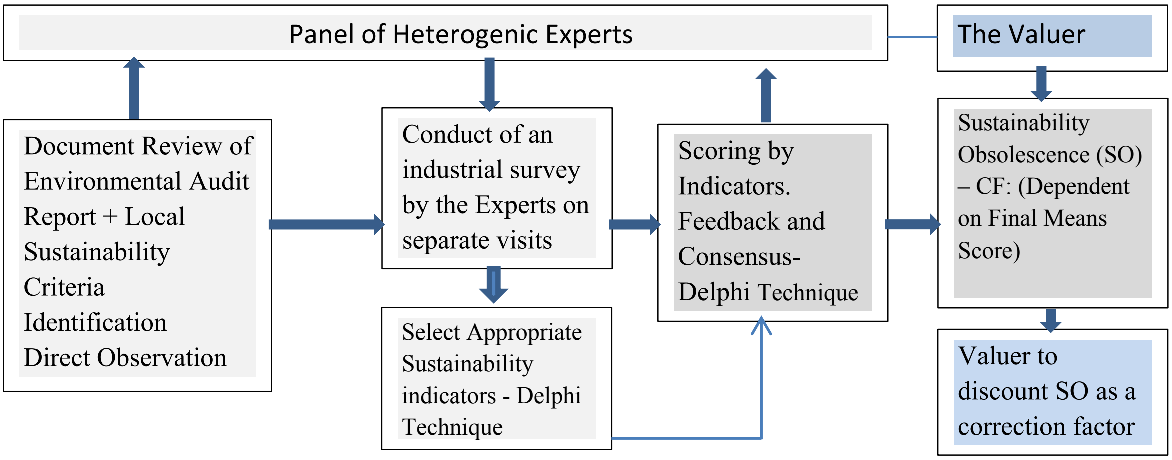


Figure 4.4: Summary of the sustainability obsolescence evaluation process: The ISRO Sustainability process. (this study, 2016).

4.4.1.2 (o) Method of Analysis and Consensus

Selection and Ranking of the Sustainability Indicators: The data collected in the field was analysed using SPSS (Statistical Package for the Social Sciences) Version 22. Descriptive statistics were used to calculate each of the factors' mean rating scores or values. Following El-Haram and Horner (2002), the factors were ranked using an importance index and calculated as follows:

$$\text{Importance index} = \left\{\sum_{i=1}^{5}(w_i \times f_{w_i})\right\} \times \frac{100}{5n}$$

Where w_i is scale given to the response *i*; *i* =1, 2, 3, 4, or 5 is the level of importance; fw_i is the frequency for each scale ranging from fw_i = not very important to fw_5 = very important, and n is the total number of responses. All the factors were listed in descending rank order based on the importance index, and none of the initial 34 factors was removed. Five (5) other indicators were added during the feedback process to bring the total number of indicators used in the study to thirty-nine (39) [sections 4.4.1.2(k) and 5.2.2.4]. This takes into consideration the adequate number of factors which are mutually interdependent to be considered as indicators. This is then followed by assessing the consensus between the two panels of experts using Kendall's W based on each panel's mean score ranks ($W \geq 0.70$).

Experts' Consensus:

There are some different metrics for measuring non-parametric rankings. Siegel and Castellan Jr (1988) consider the Kendall's W coefficient of concordance. The value of W ranges from 0 to 1, with 0 indicating no consensus, and 1 indicating perfect consensus between lists. Schmidt (1997) provides a table for interpreting different values of W, with 0.70 indicating strong agreement. After calculating concordance within each panel, the W value suggests how to proceed in the ranking. The W value of 0.70 or greater would indicate satisfactory agreement and should consider the ranking phase completed. Relative Importance Index (RII) could be used, or the mean rankings for each item may be used to compute the final ranking. However, if W is less than 0.70, questionnaire 5 is repackaged and extended as questionnaire 6, 7, 8 as the case may be. Each of the questionnaires 6, 7, 8 helps to revise their scores. The process should be reiterated until one of the three stopping criteria is reached. The criteria are as follows:

(1) When the W statistics reaches a value of 0.7, indicating a satisfactory level of concordance.

(2) If the statistic is still not at 0.7 level in the third reiteration, which would be the eighth questionnaire that a panellist received for this study, the panellists are asked if they were willing to continue iterating until they reached consensus. If the panellists agree, the process continues until W rises to the desired level.

(3) If they are fatigued, then the differences in the mean ranks could be measured using the McNemar test, which is typically used in a repeated measures situation in which each subject's response is elicited twice (pre-post test).

At the end of the ranking phase, the two ranked lists would be available—one from each of the two panels A and B - representing the priorities that each of the panels placed on various SI indicators or factors in affecting the investment value of the process industry. This rigorous process assures that the factors in the list are the most important and that the rankings are a valid indicator of the relative importance of the various factors. Based on these results, researchers could assess ISRO for the process industry and elicit determinant SI factors.

Treatment of scoring: The difference of the scorings from the maximum score allowed are aggregated to a percentage or a lump-sum deductible from the final value-in-use figure, as a correction allowance for ISRO.

4.4.1.2 (p) **Assessment of Reliability of the Expert Responses and the Validity of the Delphi Instrument**

The conditions for reliability and validity in a Delphi method have been summarised as follows:

(1) Pre-testing for the reliability of the first round questionnaires for diction difficulties, ease of understanding and the internal consistencies of the survey (Jairath & Weinstein, 1994; Holsapple & Joshi, 2002).

(2) Content validity: The research team defines the content area i.e. the disciplines, laws and organisations, response format and questionnaire items (Okoli & Pawloski, 2004). The selection of diverse experts from the knowledge area (Goodman, 1987; Winkler & Poses, 1993).

(3) Construct validity: Feedbacks based on preliminary data, reiterations, validations, number and heterogeneity of experts, anonymity, consensus and voluntary participation, stability of the group answer, W-statistics @ >0.7 for consensus based on equality of rankings, and the equality of the median scores by the two independent panels (Landeta, 2006; Cuhls, 2014).

(4) Social validity – Successful use and satisfaction by the originators and stakeholders (Landeta, 2006).

It was crucial to check the reliability of the CDM of the instruments before the actual measurement of the construct of the ISRO-CF was conducted. The Delphi process itself elicits the validity check (Landeta, 2006; Ibiyemi *et al*., 2016). Lack of validity and reliability could result in measurement error, a situation whereby the degree of the observed variable does not represent the actual data (Hair *et al*., 2010). Research projects must stick to certain ethical rules to maintain the dignity and privacy of the participants. In sum, the primary ethical considerations in a Delphi that should consolidate the integrity of the data are anonymity and confidentiality. That is, their involvement remains confidential. The confidentiality factor is of specific importance for a Delphi study for the reason that when certain panellists hold the opportunity to the flavours of the other panellists, it could skew their results. While the researcher knows the participants, it is important during the response gathering and analysis phases to learn ways to split up the data from panellists as much as possible, so interpretation of the data is not skewed by such knowledge of whom responded in what manner. Voluntary participation is a requisite of social inquiry. Advance instructions to respondents should state that any data or opinions they provide will be utilised for research purposes and publication. Also, the researcher should always protect the individual responses, turning out information only as aggregate data. Another concern in research projects is the ability to pick up the data without undue influence on the data collected. If the researcher influences the data in any manner that may hint at the respondents to share similarities and biased opinions, a skew outcome might also result (Somerville, 2008).

(i) Assessment of the Reliability of the Expert Responses

Critics of the Delphi harp on the CDM as having no grounds of reliability. That is, when the same data points for two or more panels are constructed, there is no confidence that the identical results would be received (Walker & Selfe, 1996). Jairath and Weinstein (1994) had earlier pointed out the importance of pilot testing for identifying diction difficulties and also to improve the internal consistencies of the survey. However, few Delphi researchers reported that pilot tests are required before implementation. Pilot testing of the first round Delphi questionnaires is recommended as the ground for reliability in a CDM (Holsapple & Joshi, 2002).

The preliminary reliability test of the Delphi study responses uses the KRNW team to examine the round one questions/instructions given by pilot-testing the first-round three Delphi questionnaires in Table 4.2 and resolved all diction difficulties and response formats for clarity and ease of understanding. It, therefore, disagrees with Sackman (1975) that Delphi studies are often not concerned about reliability measurements and scientific validation of the findings. In addition, three (3) Delphi experts examined the questionnaire and the response formats. The findings are reported in section 5.4.1.2(c). The second level of reliability is confirmed by the Whitney-U test of significant difference in median scores of the two panels [section 5.2.2.8 (d) and Table 5.10) as suggested by Welty (1972) and Refaeilzadeh *et al.* (2008).

(ii) Assessment of the Validity of the Classical Delphi Method

Nworie (2011) cautions critics that the Delphi method could not be subjected to the same quantitative validation criteria as the hard scientific disciplines. Moreover, content validity is of critical concern in many recent Delphi studies. The power of establishing face and content validity at the introductory and Round I can be considered an essential methodological improvement for a Delphi study. In this study, the research team defines the content area, that is, the disciplines, laws, literature and relevant organisations involved, the questionnaire items, response format and the diverse expertise selected in the knowledge area. The Delphi instrument is therefore responsive to content-validation. Gomez (2009) and Hueso and Cascant (2012) insist that a content-valid assessment instrument could duly influence the validity of research results. Content validation also provides evidence about the construct validity of an assessment instrument (Gomez, 2003).

In the views of Messick (1993) and Sireci (1998), content validity is a major component of construct validity because the evidence of the elements' relevance and representativeness is inherent in construct validity. Nonetheless, other Delphi users have found that the technique was valid. Goodman (1987) expounds that if the panellists taking part in the study are representative of the group or the area of knowledge, the content validity can be accepted. The report of Ono and Wedemeyer (1994) describes the results from a survey designed to replicate a Delphi study 16 years after in which the findings about forecasting communication developments 16 years earlier reflected present findings as instructive for construct validity. Construct validity was proven at the levels of expert consensus at $W \geq 0.70$ [section 4.4.1.2(o)] and the validation of the Delphi scores [section 4.4.1.2(q)].

Ibiyemi *et al.* (2015) agrees with Linstone and Turoff (2002) in re-echoing that the Delphi ought not to be judged using the quantitative criteria developed for the administration and interpretation of positivistic tests. Other measures such as transferability, sincerity, the number of experts, applicability or comparability of results, number of rounds, feedbacks, anonymity, consensus, reiterations, and response validations may be more appropriate for its construct validity. Nworie (2011) further explains that the technique is merely intended to recompense for lack of definitive data and share the knowledge and experience of experts. The Delphi technique and other consensus development methods are not strict scientific methods for creating new knowledge, but as a theory-building process established for the best exercise of available data, be that scientific or the collective wisdom of the participants (Murphy *et al.*, 1998). In addition, validity judgment parameters should focus on: *(1)* the quality and stability of the participating panel members; *(2)* the time between rounds; *(3)* feedbacks and sound comments; *(4)* stability of the expert answer and the frequency of modifying their answers and; *(5)* consensus; and *(6)* social validity after implementation (Landeta, 2006)

Landeta (2006) insists on judging the study against the six (6) additional parameters to strengthen the validity of the survey (section 5.2.2.8). The high quality of experts was selected from the academics, professional and consultancy units. Only about 6 per cent of the experts modified their answers thus indicating the group answer stability. The time between the three (3) rounds was six (6) weeks on the average and completion time was about five (5) months. Feedbacks and comments were based on records of the environmental audit reports and one-time industrial site visit. The second round feedbacks from experts compelled the conversion of the total score from five to ten/two. All the experts are participating voluntarily. However, the social validity proposed by Landeta (2006) could not be proven until the result of the study has been successfully implemented by the originators and accepted by the stakeholders

4.4.1.2 (q) Construct validation of the Delphi Scores

Refaeilzadeh *et al.* (2008) express the validation as a statistical method of evaluating and comparing learning algorithms by having the data into two identical segments. This method would be suitable for this study. In this case, responses to the scoring of the thirty-nine (39) sustainability indicators by (1) Panel A, and (2) Panel B. In typical validation, the training and validation sets must cross-over in successive rounds such that each data point has a chance of being validated against.

Validation of models conveys the intent to generalise results for external validity. However, the Delphi applications and results may not be generalised. So, each Delphi panel is not bound to have a similar aggregate opinion expressed by the other, either at the same time or at different times (Chia Chen & Sanford, 2007). Landeta (2006) reassures that the Delphi is a method of foresight with default construct validation procedures. Although it could be replicated, each outcome is the perceived 'truth' of the time and under the prevailing circumstances. The Delphi is based on the assumption of safety in numbers; that several experts are less likely to arrive at a wrong decision at any time than a single individual. Based on the concept, the Delphi method requires panellists from diverse sustainability-related backgrounds achieving consensus (Hassen *et al.*, 2000). Hence, it is a rigorous method of comparing the outcome of an independent measurement with the answer given by the model (in this case, the ISRO-CF) seems to be an inappropriate proposition. In this wise, Landeta (2006) suggests that the accuracy of the CDM be checked with its social validity. Nevertheless, here lies the great advantage of having two (2) or more independent panels rather than one panel so that the outcomes of each panel can be tested against each other. Following Refaeilzadeh *et al.* (2008), the scores outcome of the Panel A was used to validate Panel B by testing the equality of the two means for significant difference using the two independent samples tests (Mann Whitney U). If there is no significant difference in the two independent samples sets of scores, this would mean that the two sets of scores are the same, and the outcome scores would reflect the ISRO-CF, calculated as the sum of weighted ISRO divided by 2 (see Table 5.9). With construct validity at two levels, there would then be the assurance that the ISRO-CF is reliable and able to measure what it sets out to measure; that is, the extent to which the industry sustainability features can meet the sustainability indicators identified by the Delphi experts. The implication would be that the valuation approach could be an appropriate proposition for the valuation of process industries for sustainability based on investment value. Sangiovanni *et al.* (2007) submits that upon the validity, there is assurance that the construct would measure what it is meant to measure for the researcher.

4.4.1.2 (r) Strength and Weaknesses of the CDM

Dalkey and Helmer (1963) argue that the CDM avoids confrontation of the experts, more conducive to independent thought on the part of the experts with the prospect of an eventually considered opinion. However, it permits the researcher to obtain an objective consensus of expert judgment on study subject. They concluded that confrontation induces hasty formulation of preconceived notions, and a predisposition to be swayed by the strong opinion of others. In the view of Jaiarth and Weistein (1994) and Critcher and Gladstone (1998), a specific expert might dominate the consensus process, advertently or inadvertently, in a face to face meeting. The Delphi method has been used as a tool to uncover underlying issues and make specific predictions. Recent studies using the Delphi method have addressed diverse topics such as post-mortem evaluation of failed projects (Kasi *et al.,* 2008), information assurance (McFadzeen *et al*., 2011), offshoring and outsourcing, impact and adoption of XBRL (Bonson *et al.,* 2009; Baldwin & Trinkle, 2011) and the adoption of expert systems in auditing (Baldwin- Morgan, 1993). These studies commonly potrayed the focal topics that were directly applicable to pressing research and industry concerns. Furthermore, the use of experts, both academic and practitioner, to reach consensus suggests that an applied solution towards identifying issues facing scholars and industry can provide valuable insight to both.

The CDM employs an abductive approach to theory development in that theory is derived from the outcome of a discussion and results from experts with direct experience of a focal topic. The brainstorming phase along with the refinement in producing the finalised list of issues represents an abductive approach toward construct reduction which is vital to creating a parsimonious theoretical model (Greenstein & Hamilton, 1997; Dubois & Gadde, 2002). The strength of the Delphi method is that researchers do not begin a priori with a set of expectations about the underlying causes or drivers of a particular phenomenon. Instead, the Delphi method allows the researcher to uncover the reasons are driving the phenomenon, and then use those insights to inform further inquiry much like a grounded theory approach to theory development (Okoli & Pawlowski, 2004). Furthermore, the qualitative comments and justifications made by panelists provide researchers with the ability to judge causality which is crucial for theory development. Thus, the Delphi method can be an excellent approach towards theory development and refinement, and a stepping stone for theory testing (De Haes & Van Grembergen, 2009; McFadzeen *et al.,* 2011; Nevo & Chan, 2007). Nonetheless, the Delphi is most useful in answering the single dimensional question. Therefore, there is less support for its role to determine long range complicated forecasts and policy issues regarding multiple factors. Such complex model building is more appropriate for quantitative models with Delphi results serving as inputs or a form of cross validation.

The method provides a unique opportunity to balance the much-debated topic of rigor versus relevance (Benbasat & Zmud, 1999; Straub & Ang, 2008). It affords researchers an opportunity to engage practitioners on timely issues directly and pressing concerns while using a set of standardised statistical techniques to assess when consensus is achieved. This rigorous process ensures that research informs pressing needs facing practitioners and organisations — thus bringing academia and practice closer together. Given these benefits and considering the historical uses of the Delphi method as a tool for forecasting, issue analysis, and framework specification, this method has the potential to make significant contributions to the broader literature. A great volume of literature surrounding the Delphi as an iterative multi stage process, designed to transform opinion into group consensus exists, but it is recent to industrial sustainability and real estate valuation.

The main limitations of the CDM involve the participant's high dropout and attrition rates before completion. Even when all of the respondents begin with honorable intentions, unforeseen changes in priorities, illnesses or even deaths can occur over time. Such losses from round to round can skew the results (Babbie, 1989). Therefore, it is important to try to keep all participants committed until the end. Rieger (1986) and Landeta (2006) have explained that the length of time required to complete a Delphi can be anywhere from several weeks to months. An inadequate first-round instrument is potentially problematic, Rowe *et al.* (1991) criticised the vast majority of studies that used structured first-round instruments instead of open-ended questionnaires. They contended that the structured questionnaire does not necessarily guarantee a poor Delphi, but it does limit the involvement of the panellists in constructing the parameters for study, thus possibly negating the very purpose for including experts in the Delphi. One of the more severe limitations of the Delphi method is the amount of administrative effort re-quired to effectively execute the study (Van de Ven and Delbecq, 1974; Delbecq *et al.,* 1975; Malhotra *et al*., 1994). The Delphi method requires a significant time commitment from both the researcher and the expert panel. Most Delphi studies continue for three or more rounds (initial round for brainstorming, with subsequent rounds for narrowing and ranking items or factors), requiring the researcher to manage and modify subsequent surveys with feedback (justifications, mean ranks, the degree of consensus) from the expert panel. On the panelist's side, while each survey may require a nominal amount of time to complete, the time between subsequent rounds is often two (2) to three (3) weeks, thereby requiring a significant commitment.

The real and perceived weaknesses of the CDM over the years have included: The credibility of the experts (Sackman, 1974); convergence of opinion as the concept of the truth. (Sackman, 1974); the limitation of the interaction to controlled feedback (Milkovich *et al*, 1972; Sackman, 1974); the impracticality of anonymity (Milkovich *et al*., 1972); the ease of bias by the coordinator for private interests (Welty, 1971), the difficulty of checking the method's accuracy and reliability (Martino, 1993); the time required (Huckfeldt and Judd, 1974); the time and effort input from the participants and the non-consideration of possible interrelations between the forecast incidents (Gordon, 1994); improper application by researchers (Landeta, 2006); high drop-out rates (Rieger, 1986; Babbie, 1989); Questionnaires not actually completed by the experts (Martino, 1993): “Experts” may not truly be experts (Grunig, 1992) . These weaknesses, including the huge time inputs, are overcome through the diligence, sincerity, and competence of the research coordinator. The assessment of the validity of the Delphi applications in section 5.2.2.8 explains the default mechanisms that enabled the curtailment of the weaknesses.

4.4.1.2(s) Exploring Alternative Methods to the CDM

The alternative methods to the CDM could be the traditional survey, nominal group technique, social judgment analysis, and the predictive markets. Table 4.3 compares and contrasts the strength and weakness of the CDM with the alternative methods. The evaluation criteria includes the following: *(a)* Summary of Procedures *(b)* Representativeness of Data and Statistical Techniques *(c)* Richness of Data *(d)* Quality of Response *(e)* Reliability, Reiteration and Feedbacks *(f)* Anonymity *(g)* Non-Response issues *(h)* Construct Validity

Table 4.3: Comparison of the CDM and the Alternative Methods (this study, 2016)

Evaluation Criteria	Classical Delphi	Predictive Markets (PM)	Social Judgment Analysis	Nominal group Technique	Traditional Survey
Summary of Procedures	All the questionnaire design issues of a survey also apply to a Delphi study. After the researchers design the questionnaire, they select an appropriate group of experts who are qualified to answer the questions. The researchers then administer the survey and analyse the responses. Next, they design another survey based on the responses to the first one and re-administers it, asking respondents to revise their original responses and/or answer other questions based on group feedback from the first survey. The researchers reiterate this process until the respondents reach a satisfactory degree of consensus. The respondents are kept anonymous to each other (though not to the researcher) throughout the process. The design is flexible. (Hasson,	PM utilises human judgment in translating market price system into a numerical estimate. Prediction markets adopt the structured approaches that converge diverse opinions from groups. Similar to the Delphi. However, members need not be experts	Social Judgement Analysis is a theory that solely focuses on the internal processes of a person's judgment in regards to the relation within a communicated message. The approach is psychological. It requires psychologists (Rohrbaugh, 1979)	Group Facilitations (GF) is a critical discussion about a particular or a range of subjects. First, group members work independently and generate individual estimates on a problem. Then, the group enters unstructured discussion to deliberate on the problem. Finally, group members work again independently and provide their final individual estimates. The group result is the aggregated outcome of these final individual estimates (Wolfers and Zitzewitz, 2004)	The researchers design a good questionnaire with questions relevant to the issue of study. The questionnaire can include questions that solicit quantitative or qualitative data, or both. The researchers decide on the population that the hypotheses apply to, and selects a random sample of this population on whom to administer the survey. The respondents (who are a fraction of the selected random sample due to non-response by some) fill out the survey and return it. The researchers then analyse the usable responses to investigate the research questions.

	Keeney and Mckenna, 2000)				
Representativeness of Data and Statistical Techniques	The questions that a Delphi study investigates are those of high uncertainty and speculation. Thus, a general population, or even a narrow subset of a general population, might not be sufficiently knowledgeable to answer the questions accurately. A Delphi study is a virtual panel of experts gathered to arrive at an answer to a difficult question.	The price system of the market aggregates qualitative information of the kind which by its nature cannot enter into statistics	It requires people who are verse in cognitive logic and psycho-analyses (Doherty and Kurz, 2010)	When the group numbers eight or more, a leader or facilitator is appointed among them. Members need not be experts	Using statistical sampling techniques, the researchers randomly select a sample that is representative of the population of interest (Hasson, Keeney and Mckenna, 2000)
Richness of Data	In addition to the richness issues in other alternatives, the Delphi studies inherently provide richer data because of their multiple reiterations and their response revision due to feedbacks. Moreover, Delphi participants tend to be open to follow-up interviews.	Market data are used. Available studies are limited and often small scale.	Fair level- Follow-up interviews	Fair level. Validation of data is optional	The richness of data depends on the form and depth of the questions, and on the possibility of follow-up, such as interviews. Follow-up is often limited when the researchers are unable to track respondents.
Individual vs Group Response	Studies have consistently shown that for questions requiring expert judgment, the average of individual responses is inferior to the averages produced by group decision processes; research has	Group response	Group response	Individual and Group response	The researchers average out individuals' responses to determine the average response for the sample, which they generalise to the relevant population.

	explicitly shown that the Delphi method bears this out.				
Reliability, Reiteration and Feedbacks	Pretesting is an important reliability assurance for the Delphi method. However, test-retest reliability is not relevant, since researchers expect respondents to revise their responses. Reiteration and feedbacks are indispensable	PM are for predicting the outcome of elections, awards, sporting events and some business forecasts.	Re-questioning	No specific method of checking reliability. No feedbacks (Schwarz, 2015)	An important criterion for evaluating surveys is the reliability of the measures. Researchers typically assure this by pretesting and by retesting to assure test-retest reliability.
Anonymity	Respondents are always anonymous to each other, but never anonymous to the researcher. This gives the researchers more opportunity to follow up for clarifications and further qualitative data.	The predictive markets requires no confidentiality	Group meetings	Group meetings	Respondents are almost always anonymous to each other, and often anonymous to the researcher.
Non-Response Issues	Non-response is typically low in Delphi surveys, since most researchers have personally obtained assurances of participation (Green *et al.,* 2007).	No. of participants are not regulated and no facilitator	Not Known	Not proven	Researchers need to investigate the possibility of non-response bias and missing values to ensure that the sample remains representative of the population

Table 4.3, continued: Comparison of the CDM and the Alternative Methods (this study, 2016)

Construct Validity	In addition to what is required of a survey, the Delphi method can employ further construct validation by asking experts to validate the researcher's interpretation and categorisation of the variables. Also, a reassessment of steps, statistical validation of concordance and Whitney U test of difference in median scores are used	The mean absolute percentage error (MAPE) was used as a measure for the deviation of the results of each market	Not proven	Not Known	Construct validity is assured by careful survey design and by pretesting. Factor analysis may be used

As in Table 4.3, a traditional survey would be less appropriate because *(i)* The assessment of sustainability obsolescence does not lend itself to correct analytical techniques since no sustainability market exists for comparative analysis. Sustainability issues can benefit from subjective judgments on a common basis from experts in the field. *(ii)* Empirical evidence data is not often available for process industries regarding their valuation, hence judgmental information is indispensable *(iii)* A panel study most appropriately answers the research questions to selection and scoring of indicators. *(iv)* The issue is complex, multi-disciplinary and multi-dimensional, so requires from people who know the social, economic and environmental parameters of industrial sustainability *(v)* The CDM is flexible in its design and open to follow-up interviews that permit the collection of richer data for deeper understanding, and serves the dual purpose of soliciting opinions from experts and having them rank them according to their importance.

Prediction markets and the CDM have similar characteristics as both adopt the structured approaches that converge diverse opinions from groups. Furthermore, evidence of historical data is not available to both upon which to construct quantitative models. However, they are contrastive in their relative applicability to different problems (Green *et al.,* 2007). For instance, Green *et al*. (2007) stresses the advantages over prediction markets as the ease to maintain confidentiality, and quicker forecasts and feedbacks. On the other hand, predictive markets are based on the collective wisdom of people who do not have to be experts in the study area (Wolfers & Zitzewitz, 2004). Sustainability research requires specific expertise in the related disciplines and portends risks if left to the whims of non-experts in the study context.

Social Judgement Analysis (SJA) is a theory that solely focuses on the internal processes of a person's judgment in regards to the relation within a communicated message (Doherty

& Kurz, 2010). The work of Rohrbaugh (1979) explores the methods of group judgment making that have been developed to lessen the discrepancy between potential and actual team performance: social judgment analysis and the Delphi technique. The methods are compared in a controlled experimental setting about their potential to reduce group disagreement and to provide accurate judgments. Social judgment analysis, however, was a significantly better method of reducing disagreement than the Delphi technique. The approach is psychological, for which one has to be versed in thinking and reasoning-cognition theories. The SJA seems to be outside the purview of this thesis.

Group Facilitations (GF) is a critical discussion about a particular or a range of subjects, conducted in a group that permits involvement by all members. When the group numbers eight or more, a leader or facilitator is appointed. The facilitator is the "moderator or discussion leader" since the practice of facilitation itself provides direction without taking over the control. Schwarz (2015) views a facilitator's job as getting others to assume responsibility and take the lead. The facilitative leader centres on the content and process that is, what tasks, subjects, problems are being addressed. That includes how things are discussed, including the methods, procedures, format, tools, style of interaction, group norms, group dynamics and group climate. The GF is facilitator-dependent. The group members know and see themselves at all group discussions. There is wide scope for manipulation, group influence, and helpful responses. An opinion once expressed may not be reversible. They are also not experts.

The Nominal Group Technique (NGT) is a group process involving problem identification, solution generation, and decision making (Delbecq and VandeVen, 1971). It could be used in groups of many sizes for quick decision making, such as by votes, but want everyone's opinions taken into account, as opposed to traditional voting, where only the largest group is considered (Dunnette *et al.,* 1963). First, every member of the group gives their view of the solution, with a brief explanation. After that, duplicate solutions are removed from the list of all the solutions, and the members progress to rank the solutions as 1st, 2nd, 3rd, 4th, and so on. Facilitators may encourage the sharing of reasons and further discussion on the choices made by each group member, thereby ascertaining common ground and a variety of ideas and approaches. This diversity often allows the creation of hybrid ideas, that is, blend of two or more ideas which are often better than some ideas that were earlier deliberated upon. The numbers each solution receives are aggregated, and the solution with the highest total ranking is considered as the final decision.

Rohrbaugh (1981) study explores, by comparison, the SJA and the NGT group judgment methods which have been developed to reduce the inconsistency between potential and actual group performance. The two approaches were found to be likewise robust in the quality of judgments produced; both sets of groups performed at a level of accuracy equal to that of the most proficient member. Social Judgment Analysis, however, was found to be a significantly better method of developing consensus among group members than the Nominal Group Technique. The counting method is basic and non-probabilistic.

However, the CDM proved to be the strongest methodology for a rigorous query of experts (Rohrbaugh, 1981).

4.4.1.2(t) Other Justifications for Using the Classical Delphi Method.

Following the comparison of the CDM with the alternative methods and the subsequent analysis in section 4.4.1.2 (s) and the context of the classical Delphi discussed in section 4.4.1.2 (b), the following additional justifications are advanced for the use of the CDM for the study.

(1) The CDM as a forecasting procedure is of significant use in the area of identification, selection, and prioritisation of critical factors where there is a lack of objective data. The richness of its subjective data lends credence to its use, in preference to the others, in real estate research for the identification and selection of critical factors.

(2) This CDM study identifies critical sustainability indicators that would support the integration of sustainability to property valuation. The complex issue requires knowledge from people who have independent opinions and understand the different economic, social, and environmental issues involved in sustainability. Thus, CDM would more appropriately provide answers to the study questions from a researched viewpoint. The nature of sustainability and the CDM are both multi-disciplinary. Arguably, it could stimulate a substituted market for sustainability (Ibiyemi *et al*., 2015).

(3) The CDM is an appropriate group method among high-performing group decision analysis methods such as nominal group technique and social judgment analysis. (Rohrbaugh, 1979, Landeta, 2006). Other social judgments analyses neither use reiterations, heterogenic experts nor have a KNRW team to verify the content validity of their studies.

(4) This Delphi is desirable in that it does not require the experts to meet physically, as it would have been impractical for the two international expert participants in the study. Other methods lack the confidentiality and feedback requirements that enrich the subjective data. In the Delphi, expert opinions converged as evidence of reality and are measured statistically. The panel size requirements are also more modest (Paliwoda, 1983).

(5) The Delphi study is flexible in its design for the reason that it could use "open" and close-ended questionnaires with follow-up interviews which permit the collection of richer data for the deeper understanding of the research questions. The ranking of a CDM study can be of value in the initial stages of theory development by helping researchers to identify and prioritise the variables of interest according to their impacts.

(6) The CDM has been used by real estate sustainability researchers as Pivo (2008) in the development of responsible property investment criteria; Pivo and Fisher (2009), for the selection of property attributes in a regression analysis to extrapolate the value of sustainability; and by Valenzuela-venagas *et al.* (2016) to select sustainability indicators for the assessment of eco-industrial parks.

4.4.1.3 Methods for the Third Objective - Developing a sustainability-incorporated valuation approach

The approach used to achieve the third objective is the modified cost approach to real estate valuation in which the indicated ISRO-CF was applied to correct the valuation figure. The sequence of the cost valuation approach as indicated by Ogunba (2013) and Maninggo (2010) are:

Step 1: Reproduction Cost New/Replacement Cost New (RCN)

Step 2: (RCN) less Physical Deterioration =RCNLPD

Step 3: RCNLPD less Functional Obsolescence = RCNLPDFO

Step 4: RCNLPDFO less economic obsolescence = RCNLPDFOEO

It is the sustainability-related obsolescence CF that the CDM seeks to determine in step 5

Step 5: Determine the ISRO-CF from the Delphi study

Step 6: RCNLPDFOEO multiplied with the ISRO-CF

=Depreciated Replacement Cost (DRC)

= VALUE TO THE OWNER (investment value)

ISRO-CF derived from the responses to Delphi survey research question 2 was incorporated into the Depreciated Replacement Cost approach to property valuation on the basis of investment value.

In assessing the value of process industries as a going concern for value-in-use, Brown (1991) and ANZ (2010) report that the sales comparison, income and cost approaches could be used depending on the nature of the assets and information available. However, that in the unlikely event that comparable sales evidence exists, the value to the owner may be determined. Income capitalisation and the discounted cash flow analysis have the same constraint of comparable evidence (RICS, 2008; ANZ, 2010). Brown (1991); ANZ (2010); Maninggo (2010); and RICS (2014) thereafter concludes that the cost approach is the most commonly used valuation approach, with a statement incorporated within the valuation report that the indicated value is, either subject to a test of adequate potential profitability, or service potential for private and public sector entities respectively.

The approach of Ibiyemi *et al* (2015) assesses the "sustainability obsolescence CF" as a correction allowance for valuation of non-market industrial properties by scoring the industrial sustainability compliance in relation to the local sustainability indicators and rating guidelines of GreenstarSA SBAT. Some of the major international sustainability indicators are also adapted from RICS (2009); Boyd (2005) and Lützkendorf and Lorenz, (2012) and listed for assessment by the Delphi experts. The approach deals with process industries for investment value. The approach regards sustainability as an obsolescence which ought to be discounted from valuation result as a correction factor to reflect a fair value to the owner, the propable externalities and the level of non- compliance with local sustainability metrics.

4.4.1.4 Method for the Fourth Objective – Field Valuation and Reporting

To achieve Objective 4, the updated valuation of the selected non-market industrial real estate was carried out for the purpose of determining the investment value of the industrial real estate. The Modified Cost Method of Valuation was used to accomplish the task. The method has been discussed extensively in sections 3.3.2 and 3.4.6.2.

4.4.2 Part II: Perception and Support Studies

4.4.2.1 Conceptual Approach to the Valuers' Perception, Support, and Causal Relationships

The conceptual framework is the researcher's conceptual understanding of how the particular variables in perception and support study connect with each other following the synthesis of the literature. Thus, it identifies the dependent and independent variables required in the research investigation and maps them in pursuing the investigation (Regoniel, 2015). The overall conceptual underpinning of the perspective and support study is conjectured that the knowledge about the potential sustainability benefits summarised in literature could build up the valuers' support system for sustainability integration into industrial real estate evaluation. Addae-Dapah *et al.* (2009) and Babawale and Oyalowo (2011) describe the benefits as high building value (HBV), cost savings (CS), lower risks (LR), productivity gains (PG), and impact minimisation (IM). Figure 4.5 below illustrates the conceptual framework. Valuers' support could then be validated with their agreement to have green industrial rating tools, pay a premium for green features and recommending green features to other users.

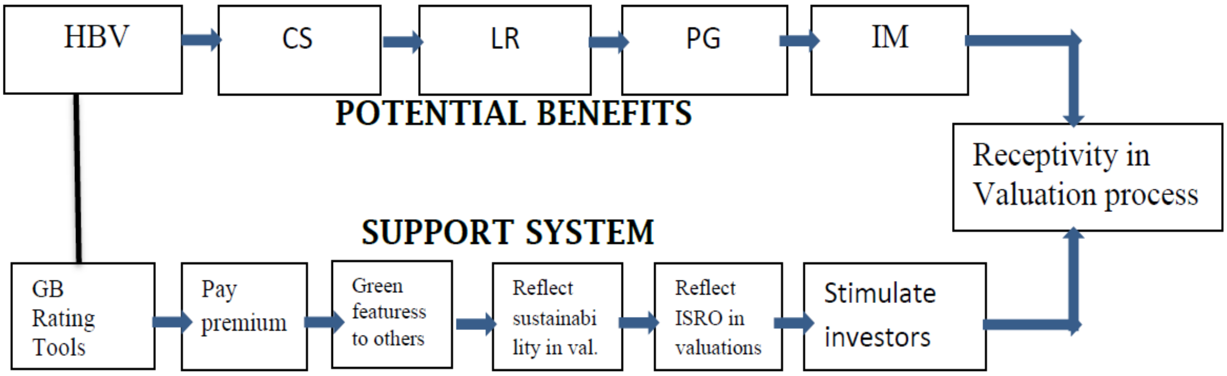


Figure 4.5. Conceptual Framework for appreciation of benefits and support for industrial sustainability valuation (Researcher's C-Model)

Other indications would be that industrial valuation should reflect sustainability; that ISRO approach would be appropriate; and that it could induce support for integration and compliance with local sustainability requirements. The Researcher's conceptual model shown as Fig.4.5 was modified from Babawale and Oyalowo (2011); Addae-Dapaah *et al.* (2009) for use in this study. This concept was also part of the postulations of Gloet (2006) and Petrini and Pozzeboh (2009) who developed support systems based on knowledge and business intelligence (BI)

Knowledge integrates, applies and extends insights to the study of sustainability systems and programmes that prompts SD actions. Linking knowledge for action requires the understanding of open channels for communication between stakeholders. Cash (2001) emphasise that mutual understanding is often hindered by jargon language and lack of persuasive argument. Therefore, NRC (1999) advocates sustained transition to sustainability to be structured through scholarly research, practical experimentation and comparative learning. The view that was supported by Cash *et al.* (2002). In series of case studies, the relevance of KM and information systems (IS) in sustainability has been demonstrated. Cash *et al.* (2003) reveals that large systems of research information, innovations and applications evolve to correct past shortcomings in the sustainability systems. For instance, as Guston (1999) states that it is recently known that organisation structures can support or block the construction of credible and legitimate information for a range of decision makers. Also forecasting systems from KM strives to produce timely information allowing identification of those system features that promote effective use of predictive information (Cash, 2000). Even so, Alcock, (2001) reiterates that it is KM that explains how sustainability characteristics influence political, economic and natural systems outcomes. Active, iterative and inclusive communication between experts, decision makers and the community proves crucial to systems that mobilise knowledge in the world of action.

Warren-Myers (2016) classifies Valuers' knowledge requirements for sustainability and perception into two categories:

(1) Perception of the relationships between sustainability and property values and the perception of sustainability for inclusion into real estate valuation.

(2) The knowledge management and understanding of the potential benefits by the valuers

It became apparent that after 2007, additional investigation was required to know how valuers considered sustainability credentials in the valuation process. In particular, when literature reveals that valuers' knowledge of sustainability could be a potential source of results bias (Warren-Myers, 2016). Surveys in 2011 and 2015 obtain knowledge rating from valuers including a series of test questions about key property market-based sustainability concepts such as GBRTs, building codes, and indicators. Knowledge levels changed marginally between 2011 and 2015, but professional knowledge about GBRTs improved in 2015. Warren-Myers (2016) insists that the knowledge levels of these sustainability concepts and tools could correlate with how valuers assess the sustainability metrics of a building in the valuation process. In Australia, 35-39% of valuers have knowledge about the mandatory systems of the Building Energy Efficiency Certificate (BEEC) and NABERS. Bias is therefore expected to some extent. Even so, valuers would rely on the rating schemes for sustainability assessment and performance. The ability of the valuer to understand sustainability issues sufficiently for reflection in valuation would function on considerable experience, heuristic qualities, the knowledge of the prerequisite sustainability factors, tools and the marketplace (Michl *et al*., 2016). Valuers overall have a good knowledge of sustainability in the property market and are relatively educated on the rating tools and the concepts of sustainability in the property. Warren-Myers (2016) tells that the knowledge is growing based on valuers' survey responses and the test questions.

The investigation of valuers' viewpoint and opinion of the market about the differential influences that sustainability might have upon specific valuation variables and the elements of sustainability that might affect value: Valuers identify the uneven effect of sustainability on valuation variables such as yields, risks, rental growth, vacancy rate and operational expenses. Also, evidence of retrofitting costs and benefits might prove significant in measuring effect sizes. Nevertheless, valuers perceived positive relationships across all the relevant variables and the paramount indicators are energy efficiency, IEQ and water conservation. Valuers reached consensus on the positive correlation between sustainability and value with 80% concordance in 2007, 60% in 2011 and 77% in 2015 (Warren-Myers, 2016). RICS (2014) and Warren-Myers (2016) prescribe that valuers should continually seek to enhance their knowledge of sustainability in the following areas:

(i) The assessment of values in the light of evidence obtained through market analysis.

(ii) The assessment of the extent to which properties currently meet sustainability requirements where no market analysis is possible, and arrive at an informed view on the likely impacts on non-market values.

(iii) Documentation of relationships between sustainability features and attributes, benefits, risks and property values.

(iv) Inclusion of sustainability into property valuation theory.

(v) Knowledge integration about GBRTs for assessment and influeces on sustainability compliance of real estates

(vi) Improved heuristic qualities and the identification of sustainability indicators.

(vii) Valuation variables such as risks, yields, rental growth, vacancy rates and operational expenses requisite to sustainability.

The conceptual framework gives the direction of study.

4.4.2.2 Method for the Fifth Objective - Valuers' Survey Questionnaire for Perception, Knowledge-based Support and Modelling Relationships for the Valuers' Population

This part supports the findings of the main study. It is structured to gain insight into the perceptions of the valuers (the end-users) regarding sustainability integration into property valuation, enhance their understanding, and to identify their knowledge-based support or disagreements with the valuation approach as well as quantifying the structural relationsships among the underlining constructs.

A questionnaire survey was carried out using the Nigeria Directory of Licensed Real Estate Firms (2009 Edition) as the sampling frame to elicit the perception. The sample was drawn from each of the following three chief administrative, commercial and industrial cities of Nigeria – Port Harcourt, Lagos, and Abuja. For the purpose of this study, following Falade (2005) and Ibiyemi and Tella (2013), three three cities in Nigeria - Lagos, Abuja and Port-Harcourt, are representative of the Nigerian real estate valuers' clusters. Over 72% of registered firms have either their principal offices or branch offices in the three cities covered by the study. The distribution of offices comprises 52% in Lagos, 13% in Port Harcourt, and 7% in Abuja, the Federal Capital Territory (Babawale and Oyalowo, 2011). There are 28% offices in other areas.

A face, content validity and pilot study precedes the full questionnaire survey. The pilot study is required to test the reliability of the instrument (i.e. whether the instrument gives a consistent and similar result). The validity of the constructs (that is, whether it measures the variable that it is supposed to measure) is ascertained. The dominant factors and perceptions of support are also determined. Finally, the causal linkages was established so that a useable model is derived. The questionnaire is close-ended and sought responses from the Real Estate Valuers in the selected areas as to whether sustainability should be reflected for valuation purposes. The questionnaire also asks them to predict the significance of the sustainability indicators of the reliability-tested twenty-six (26) variables (as in Table 4.5) on the value of a non-market industrial real estate and the acceptance and suitability of the valuation approach. Two 5-point Likert scales ranging from [Not Significant (1) to Very Significant (5)] and [Strongly Disagree (1) to Strongly Agree (5)] are used.

The structural equation or regression modelling (SEM) used at this stage describes a family of statistical methods designed to test a conceptual, or theoretical causal relationships or interrelationships among variables *and make predictions* (Ho, 2006). The relevance of SEM to this sustainability research lies in the understanding that sustainability is a key concept used in interactions between human society and the environment. Even so, sustainable development discusses methodologies aimed at the investigation of attitudes and behaviour observable (Fahy and Rau, 2013). With regard to selecting a model fit statistics to predict relationships, several opinions exist. The variance-based partial least squares (PLS-SEM) was used to test the three (3) hypotheses stated in section 4.4.2.2 (s) post.

4.4.2.2 (a) Face and Content validity for the Fifth Objective

Bryman and Cramer (2003) explains that a researcher who advances a new measure should ensure that there is face validity, that is, that the measure reflects the genuiness of the questions in relation to the concept in question. This can be actualised in four (4) ways as follows: (1) Having a good reason for every question asked and keeping the questions simple and precise (2) avoiding lead questions (3) Making responses mutually exclusive and exhaustive, and (4) using the measurement scale. Face validity involves looking at the questions to understand if they are genuinely asking for ratings of the factors. Content validity (CV), also known as relevance or representative validity, reports the relevance and representativeness of elements in a measurement procedure to the construct that they will be used to measure (Haynes *et al.,* 1995). The scope of content area measurement concerns creating reliable operational definitions for complex constructs like support and knowledge related to industrial sustainability benefits.

The tasks include: *(1)* The examination of the relevance, clarity, simplicity, and non-ambiguity of the questions used for each dimension of a construct *(2)* The coding criteria, that is, the measures used and the variables formats - nominal and ordinal variables. *(3)* The scales used - continuous scales, Likert scales). (4) The number of dimensions and measures of a construct (5) The number of ways constructs can be operationally defined, and (6) The potential for constructs to overlap and become indiscriminate. Therefore, establishing content validity is a necessary initial task in the construction of a new measurement procedure or the revision of the existing one.

4.4.2.2 (b) Conducting the Face and Content validity

Content validity (CV) involves requesting experts in the field of study to fit the substance of the questionnaire to discover how accurately, it measures, for instance, knowledge of the potential benefits and support for incorporating industrial sustainability. The measures reflecting the content of the concept in question was examined. Yaghmale (2009) and Waltz *et al.* (2005) provide the table of assessment of the content validity index (CVI). The items were given to five (5) experts (Appendix I). A literature study was used to generate a representative sample of items for the knowledge-based valuers' support for industrial sustainability integration into property valuation. At this stage, the scale was developed with thirty-four (34) items and six (6) constructs as in Table 4.4. No item was removed from the thirty-four (34) items after the face validity. The five (5) experts are selected from the National Environmental Standards Regulations Agency (2), State Environment Protection Agency (1), Professional valuer (1) and a University's Faculty of Environmental Sciences (1). The participants have knowledge about sustainability and property valuation. The researcher gave a copy of the questionnaire scale to the experts (Table 4.4) and explained the aim and purposes of the study to them individually. The CVI developed by Waltz and Bausell (1981) was used. The 5 experts were then asked to rate each item based on relevance, clarity, simplicity and ambiguity on the four-point scale. (Appendix J). The CVI would be in two stages:

(1) CV of the individual items, i-CVI.

(2) CV of the overall scale, s-CVI.

Questions with more than 0.75 i-CVI remained. Six (6) items were slightly modified but no question was removed. Two (2) of the five (5) experts handled the s-CVI for the overall scale. The most often reported in scale development studies is the s-CVI. s-CVI relies on the ratings by two experts. The s-CVI expresses the proportion of items given a rating of 3 or 4 (quite/highly relevant) by the two expert raters using the 4-point scales of item relevance. In the study, both judges first agreed that any individual item is relevant for it to count toward the s-CVI. All the 34 items in Table 4.4 were judged to be either quite or highly relevant, and so the s-CVI is then computed to be 0.807 > 0.80. An s-CVI of .80 or higher is acceptable (Grant and Davis, 1997; Polit and Beck, 2004).

Literature summary was used to provide a checklist of issues involved in content validity and the guidelines. For i-CVI, the computation is the number of experts giving a rating of 3 or 4 (relevant/very relevant). Ratings 1 or 2 (not relevant/somewhat relevant) are ignored for the purpose of computing the i-CVI. The results of the thirty-four (34) variables were put in the final variation of the questionnaire as suggested by Yaghmale (2009). In other words, thirty-four (34) variables across six factors were tested for reliability

4.4.2.2(c) Pilot Study

Reliability of measurement scales elicits the level to which measures are free from error and, therefore, can generate consistent results. That is, how well the instrument measures what it supposedly puts out to measure (Thorndike *et al.* 1991). The test developer, Crocker and Algina (1986) asserts, has a duty to identify the measurement error sources that would be most detrimental to helpful score interpretation and design a pilot questionnaire-based reliability study that allows such errors to occur so that their effects can be measured. Pilot testing requires samples not less than 15, complimented with a discussion of questions with respondents to remove ambiguities and to fine-tune answer options (Kimberlain and Winterstein, 2008). Refinement of the instrument then centres on minimising measurement error. The researcher, through reliability analysis, examines the properties of measurement scales and the items that frame the scales, by working out some commonly used measures of scale reliability that provide information about the relationships between individual items in the scale. The estimates are used to evaluate stability, internal consistency, and inter-rater reliability.

4.4.2.2 (d) Conducting the Pilot Test

A randomly selected pilot sample size of forty-six (46) valuers was first taken from the survey population across three cities (section.4.4.2.2) for the purpose of the reliability testing. The questionnaires distributed to the respondents were self-administered. Table 4.4 presents the factors and the variables derived from the literature in sections 2.3.2 and 4.4.2.1of this study.

Table 4.4: Factors and variables of study and their codes (34 variables)

Latent Variables (Factors)	Items (Observed Variables)		
POTENTIAL BENEFITS		CODE	Type
1. High Building Value (BHBV)	o Siting and structure design efficiency o Faster tenants' lease up o Valuation premium o Better market distinction o Higher prestige	a1 a2 a3 a4 a5	Dummy
2. Cost Savings (BCS)	o Water conservation o Energy efficiency o Lower services maintenance costs o Secure grants and subsides o Reduced societal costs of landfill creation. o Less claims on medical costs	b1 b2 b3 b4 b5 b6	Dummy all
3. Lower Risks (BLR)	o Reduced waste water pollution and degradation o Lower risk of unsustainable resource use o Reduced liability risks o Reduced health and safety risks o Less complaints about comfort and related problems	c1 c2 c3 c4 c5	Dummy all
4. Productivity Gains (BPG)	o Boosts creativity o Higher morale o Improved employee productivity o Improved indoor quality for staff welfare o User satisfaction o User having more control over the environment	d1 d2 d3 d4 d5 d6	Dummy all
5. Quality of Life (BQL)	o Sustainability provides future generation needs o Less pollution o Fight global warming o Minimise wastes o Minimise site impact	f1 f2 f3 f4 f5	Dummy all

Table 4.4, continued: Factors and variables of study and their codes (34 variables)			
SUPPORT			
6. Support (SUP)	o Invest in Green industrial building rating tools	s1	Dummy all
	o Pay premium for green features	s2	
	o Recommend green features to others	s3	
	o Relationship between sustainability and industrial building obsolescence	s4	
	o Industrial valuation to reflect sustainability	s5	
	o Industrial sustainability-related obsolescence would induce firms to comply with metrics and invest in further initiative.	s6	
	o Would support the cost/ISRO approach where no market exists	s7	

Tests of reliability for internal consistency are reported to be as follows:

The number of pilot test samples, n, is 46. The knowledge-based potential benefits are represented by constructs, High Building Value (BHBV), Cost Savings (BCS), Lowering Risks (BLR), Productivity Gains (BPG) and Quality of Life (BQL). The valuers' support variables, s1-s7, reflect the Support (SUP) construct. Therefore, as in Table 4.4, BHBV has observed variables a1-a5; BCS and observed variables b1-b6; BLR and observed variables c1-c5; BPG and observed variables, d1-d6, BQL and observed variables f1-f5: and SUP support variables s1-s7. The reliability test was run factor by factor.

BHBV: On the first SPSS 22 run, Cronbach alpha value showed .696, with inter-item correlation matrices less than 0.3 at a1/a3, a1/a4, a3/a5. It indicates that a1 correlated with a3, a4, and a5 inadequately. Furthermore, a1 has the lowest corrected item-Total correlation of .229. Hence, a1 was dropped, and a rerun showed an improved Cronbach alpha of .717. BCS: The first run showed a Cronbach alpha value of .772, with inter-item correlation matrices less than 0.3 at b1/b5, b2/b4, b2/b5, b3/b4, b3/b5, b4/b5, b5/b6, b6/b4, and b6/b5. It indicates that b4 and b5 correlated inadequately with items b1-b3 and b6. Furthermore, b4 and b5 have the lowest corrected item-Total correlations of .051 and .099 respectively. Hence, b4 and b5 were dropped, and a rerun showed an improved Cronbach alpha of .913.

BLR: On the first run, Cronbach alpha value showed .815, with inter-item correlation matrices less than 0.3 at c1/c5, c2/c5, c3/c4, and c5/c3. It indicates that c5 correlated with c1-3 inadequately. Furthermore, c5 has the lowest corrected item-Total correlation of .236. Hence, c5 was dropped, and a rerun showed an improved Cronbach alpha of .858.

BPG: On the first run, Cronbach alpha value showed .698. d6 has inter-item correlation matrices less than 0.3 with all other items d1-d5. It indicates that item d6 correlated with items d1-d5 inadequately. Furthermore, d6 has the lowest corrected item-Total correlation of .169. Hence, d6 was dropped, and a rerun showed an improved Cronbach alpha of .765.

BQL: The first run showed a Cronbach alpha value of .737, with inter-item correlation matrices less than 0.3 at f1/f5, f4/f5, and f5/f3. It indicates that f5 correlated inadequately with f1, f3-4. Furthermore, f5 has the lowest corrected item-Total correlations of .313 respectively. Hence, f5 was dropped, and a rerun showed an improved Cronbach alpha of .761

SUP: The first run showed a Cronbach alpha value of .698, with inter-item correlation matrices less than 0.3 at s2/s3-5, s2/s7, s3/s6, s4/s2 s4/s6, s5/s6, s7/s4, and s7/s6. It indicates that s2 and s6 correlated most inadequately with items s3-5, 7. Furthermore, s2 and s6 have the lowest corrected item-Total correlations of .301 and .302 respectively. Hence, s2 and s6 were dropped, and a rerun showed an improved Cronbach alpha of .819.

Section 4.4.2.2(e) reports the summary of findings at this stage.

The reliability test confirms that there is internal consistencies of responses, interrelatedness and unidimensionality in the sample of test items. It implies that the measurement errors are minimal and the assessment of the accuracy of the questionnaires are enhanced since Cronbach alpha >0.70.

4.4.2.2 (e) Modification of the Questionnaire

The result of the reliability test in section 4.4.2.2(d) indicates that the under-listed eight (8) items be dropped out of the thirty-four (34) items, having established statistically significant internal consistencies for twenty-six (26) variables across the six factors at Cronbach alpha >0.7

- Siting and structure design efficiency a1
- Secure grants and subsides b4
- Reduced societal costs of landfill creation. b5
- Fewer complaints about comfort and related problems c5
- User having more control over the environment d6
- Minimise site impact f5
- Pay a premium for green features s2
- Industrial sustainability-related obsolescence would induce firms to comply with metrics and invest in further initiative.s6

The pilot test was the way in which the questionnaires survey could be redesigned to ensure questions were clear and that the respondents have consistent comprehension of the questions with no diction difficulty in answering the questionnaire (Jang and Lee, 2001). After the pilot test, the total number of constructs/factors for the entire questionnaire is six (6) and the variables were reduced to twenty-six (26) as in Table 4.5. It was expected that by redesigning the questionnaire, errors in the data collection could be avoided. The reliability-tested questionnaire survey having the twenty-six (26) variables is shown in Appendix H.

4.4.2.2 (f) Sampling Design

The section adopts the survey approach using the questionnaire surveys. Therefore, the sample selected should be representative of the population under investigation to enable generalisations and conclusions of the population. This sample provides a robust and valid justification (Cooper and Schindler, 2008). The survey research offered the scope for a large representative sampling of real estate valuers from where reliable information can be extracted about perceived benefits of industrial sustainability and their support for integration into real estate valuation. Interviews and observations have limited scope in this scheme. The secondary information was gathered from related literature sources.

The sample population is taken from the three (3) cities randomly using the 2009 Register of Estate Firms as the sampling frame. The register has 847 registered firms. Out of which 650 were randomly selected. Table 5.12 shows the reliability tested closed-ended responses with the 26 variables/items. The table provided the main data which was retrieved from 267 randomly selected real estate valuers who were either Heads of Firms or the Staff Partners. The distribution is as follows: Lagos (102), Port-Harcourt (76) and Abuja (89). This represents a response rate of 41%. The study explored the factor structure of the responses with the field data. The sample size for factor analysis used for data reduction could be at least five times as many observations as there are variables to be analysed, with the acceptable range up to a ten-to-one ratio (Hair *et al.,* 1998). As there is a total of 26 items on benefits and support scales in the questionnaire, and a ten-to-one ratio gives a maximum sample size of 260. The sample size was also established, based on the criterion of at least 200 subjects' observations by Boomsma and Hoogland

(2012). The study sample size of 267 satisfies the minimum size of 200 specified by Kline (1994) and Osborne and Castello (2003).

4.4.2.2 (g) Questionnaire Design

The design of the questionnaire survey was directed towards investigating the perception of the valuers for sustainability integration, support factors, and their relationships. The questionnaire comprises of three (3) sections as described below:

Section One concerns the demographic and professional data of the respondents. Questions also relate to the number of years the firm is established, the size of the firm, and a number of staff. The years of operation was requested to see if the valuers had the relevant exposure knowledge and experience to accurately answer the questionnaire relating to industrial sustainability to give credence to the data collected.

In section two, the questionnaire sought to ascertain the respondents' knowledge base about potential benefits and support for integrating sustainability into industrial real estate valuation, given that ISRO could induce industries to invest in sustainability initiatives that can assure all the advantages that the respondents considered to be of importance. This section has 21 items. A 5-point Likert scale (1-not important, 2-not so important, 3-moderately important, 4-important, 5-very important) was applied (see Appendix H)

Section three has 5 items, including 2 remaining new concepts (s4 and s5). The questionnaire sought to ascertain the necessity for sustainability integration, the suitability and acceptability of the valuation approach. The answers were notched on a 5-point Likert scales (1-strongly disagree, 2-disagree, 3-undecided, 4-agree, 5-strongly agree). These scales are considered appropriate having being used in similar studies by Addae-Dapaah *et al.* (2009); Babawale and Oyalowo (2011).

The respondents were asked to rate the twenty-six (26) reliability-tested variables made up of the twenty-one (21) potential sustainability benefits and five (5) support subscales based on their knowledge of sustainability. Eight (8) variables were removed from the intial thirty-four variables (section 4.4.2.2e)

4.4.2.2 (h) Instrument

The questionnaire survey was used as an instrument to ascertain the respondents' knowledge and perception about potential benefits, support for integrating sustainability into industrial real estate valuation and the suitability, useability and acceptability of the ISRO-CF valuation approach. These instruments originate from the study of potential sustainability benefits, perceptive and support systems that were derived from the previous literature (sections 2.3, 3.2.1.4, 4.4.2.1). In the study, the factors for knowledge-based potential benefits and support were presented under the six (6) main factors as in Table 4.5.

Table 4.5: Summary of the Main Area and Factors used for the Valuers' perception and support (before EFA) (this study, 2016)

Latent Variables (Factors)	Items (Observed Variables)	Total
POTENTIAL BENEFITS		
1. High Building Value (BHBV)	o Faster tenants' lease up a2 o Valuation premium a3 o Better market distinction a4 o Higher prestige a5	4
2. Cost Savings (BCS)	o Water conservation b1 o Energy efficiency b2 o Lower services maintenance costs b3 o Less claims on medical costs b6	4
3. Lower Risks (BLR)	o Reduced wastewater pollution and degradation c1 o Lower risk of unsustainable resource use c2 o Reduced liability risks c3 o Reduced health and safety risks c4	4
4. Productivity Gains (BPG)	o Boosts creativity d1 o Higher morale d2 o Improved employee productivity d3 o Improved indoor quality for staff welfare d4 o User satisfaction - d5	5

Table 4.5, continued: Summary of the Main Area and Factors used for the Valuers' perception and support (before EFA) (this study, 2016)		
5. Quality of Life (BQL)	o Sustainability provides future generation needs - f1 o Less pollution - f2 o Fight global warming - f3 o Minimise wastes - f4	4
SUPPORT		
6. Support (SUP)	o Invest in Green industrial building rating tools s1 o Recommend green features to others s3 o Relationship between sustainability and industrial building obsolescence s4 o Industrial valuation to reflect sustainability s5 o Would support the cost/ISRO-CF approach where no market exists s7	5
	Total number of variables	26

4.4.2.2 (i) Data Collection and Procedures

The questionnaire survey was used to collect the data for this study. The questionnaire forms were self-administered to ensure that an adequate amount of data was collected through the various ways of distribution (Sierks, 2003). The self-administered survey was preferred by the researcher to ensure the questionnaire can be distributed to the respondents within a reasonable time period at a lower cost (Trochim *et al*., 2016). The 650 questionnaires were self-delivered or emailed to the Estate Firms. The questionnaire was accompanied with a covering letter addressed to the Heads of Firms, and the narrative of the valuation approach. It introduced the theme of the research and guaranteed respondents' anonymity. The complete survey materials also included pre-stamped and self-addressed envelope. The survey gave the respondents one month to reply.

The mail survey is suitable where the sample size is large, a major drawback is its low response rate. To ease this problem, some incentive measures were implemented. First, the questionnaire was limited to three (3) pages and fashioned in such a way that it was easy to complete. Second, the questionnaires were personally addressed to the Heads of Firms to convey the importance of the survey. At the same time, the advantage of addressing the questionnaire to the Heads of Firms is that they may effectively identify and delegate the task of completing the questionnaire to responsible and proficient real estate personnel in the firms. Third, the questionnaires were sent out in three waves. Two weeks after the first batch of questionnaires was sent, a reminder postcard followed together with a personal phone call. Where they had not responded, another set of questionnaires was dispatched two weeks later via email or a telephone follow-up was conducted. Fourth, the survey pack comprising the cover letter explaining the rationale and scope of research, the survey questionnaire and the self-addressed pre-paid envelope. The data set was collected between January 2016 and August 2016. This period covers data gathering for both the pilot test and the data collection for the first phase of the main study. The data collection for the pilot study took about one (1) month, July 2015.

For the study, a total of 267 responses were received out of six hundred and fifty (650) which gives a response rate of 41%, which were then selected for the analysis. However, there were no responses to some questions, indicating missing values.

4.4.2.2 (j) Missing Values

Missing data occurs when a variable of observation has no data value. They are a common occurrence and can have a significant effect on the inferences and outcomes. IBM (2012) iterates that there are two sets of methods for handling missing values: (1) The Multiple Imputation methods that provide analysis of patterns of missing data. That is, the production of multiple versions of the dataset, each containing its set of imputed values. The execution of the statistical analyses, the parameter estimates for all of the imputed datasets are pooled, allowing estimates that are more accurate than they would be with only one imputation. (2) The missing value analysis provides a slightly different set of descriptive tools for analysing missing data (especially the Little's MCAR test) and includes a variety of single imputation methods. Multiple imputations are conceived to be superior to single imputations (IBM, 2013). Gaskins (2012) summarises that missing values can be handled listwise, pairwise, or replaced with mean, or median for continuous and interval, including the Likert scale responses. The data are checked for outliers and missing values replaced median values.

4.4.2.2 (k) Conducting the Missing Values test

Missing values ranged from 0.4% - for BLR, BCS, BHBV to 3.7% of data for, the professional qualifications and age group of respondents. The pattern of missing values takes on a regular diagonal path, with more residents failing to respond to reduced waste water pollution and degradation, fewer claims on medical costs, and faster tenants' lease up. The indication is that, with missing values <15% of a particular variable or respondent, adequate data points would be available to run analysis, and the data could be less problematic for causal models in particular (Gaskins, 2012). The missing values was replaced with median values for the purpose of modelling.

4.4.2.2(l) Methods of Analysis

There are two phases involved in the analyses of the data for the achievement of Objective 5.

In the first phase, the data set collected in the study was exposed to the outlier, missing value and missing value replacement procedures before it could be analysed. The coding was prepared first and then the data file structure was developed. Subsequently the data set was entered in the SPSS Version 22 where screening and cleaning of data was performed. The data set was analysed according to the way the questionnaire was designed to match with the appropriate application of statistical analysis.

For the second phase, four sets of statistical methods were used to analyse the subjective data set in this study: First, the descriptive statistics was used to analyse the background or profile of respondents (Section 5.3.1.2). Then, reliability uses the inter-item correlation and the Cronbach alpha coefficient [Section 4.4.2.2 (d)]. It checks the data integrity for missing values, outliers and the composite reliability, convergent and divergent validity of the 3 factors (after the EFA). Subsequently, the factor loadings for the perceptive study and identification of dominant factors were obtained from the EFA (section 5.3.1.3). Confirmatory factor analysis elicits the factor structure and the construct validity (Figure 4.6). Finally, the SmartPLS 2.0 partial least squares was used to investigate the causal linkages and relationships among the constructs for the given population of valuers [section 5.3.1.3(b)]. The Perceptive and Support Studies are considered in two phases which are discussed in the subsequent sections.

4.4.2.2(m) Phase 1 of the Perceptive and Support Studies – Perception, Support and Evaluation of Valuation Approach.

This phase of the study involves the reduction of the theoretical factors indicating knowledge-based on potential industrial sustainability and valuers' support for the integration of sustainability into real estate valuation and the ISRO-CF valuation approach. The study uses the EFA, exploratory factor analysis (following Hair *et al*., 2006; Tabachnick and Fidell, 2007). Drawing upon the 6 factors and the 26 variables identified after the reliability test in section 4.4.2.2(d), the EFA Principal Axis Factoring (PAF) extraction and the Promax rotation methods were used to reduce the initial six (6) factors to three (3).

4.4.2.2 (n) Reliability of factor loadings

The reduction relies on the factor loadings. The unstandardised regression coefficient signifies the quantity of change in the dependent or intervening variable for each single unit change in the variable predicting it. Whereas standardised regression coefficients link the predictors to the dependent variable, and the R^2 value for the dependent variable appears above its rectangle in path diagrams. The standardised regression weights are less sensitive to model constraints. They represent the measure of change in the dependent variable that is attributable to a single standard deviation unit's worth of change in the predictor variable (UniTexas, 2012). A range of factor loadings from .3 (sample size ≥350) to .75, .70, .65, .60, .55, .50, .45, .40 for sample sizes, 50, 60, 70, 85, 100, 120, 150, 200, and 250 respectively was highlighted by Gaskins (2012)

4.4.2.2 (o) Reduction in the Number of Factors – Exploratory Factor Analysis

The data sets in section 5.3.1.2 were gathered to reduce the variables to a number acceptable for further analysis through the use of the PAF to extract the number of factors. The advantage of the PAF is that it can be used when the assumption of normality has been violated (Fabrigar *et al.,* 1999). Second, the PAF is less likely to produce improper solutions than Maximum Likelihood (ML) (Finch & West, 1997). Moreover, following Ho (2006) and Chinna and Yuen (2016), the PAF is the extraction method for reflective (related or correlated) indicators (indicators that seem to measure the corresponding latent variables or onstructs. The Principal Component Analysis (PCA), on the other hand, is used where indicators seem to form the corresponding latent variables (formative). The factors are then rotated to interprete the factor matrixes. There are an infinite number of orientations of the factors that will explain the data equally well for any solution with two or more factors, Oblique rotations permit correlations among factors, though the factors thus identified may not correlate. It is envisaged that rotation should produce strong loadings (>0.3) so the Promax rotation strain is used. The advantage of oblique rotation is that it yields solutions with improved modest structure for the reason that it allows factors to correlate, and produces estimates of correlations among factors (Finch & West, 1997).

The Bartlett's test of sphericity and Kaiser-Meyer-Okin (KMO) are employed to determine the appropriateness of the dataset for treatment with factor analysis and the PAF. A high value of between 0.5 and 1.0 on any of these tests indicates that the factor analysis is appropriate. A value below 0.5 implies that the use of factor analysis may be inappropriate (Kline, 1994; Malhotra, 1996). Kaiser (1974) and Kinnear and Gray (1994) suggest that a KMO value of less than 0.5 should be considered as insufficient and unacceptable for the application of this technique. For reliability, measurement, Cronbach Alpha is one of the most common tools to use, with scores (alpha) that lie in the range of 0 to 1 (Cronbach, 1951). In this study, an alpha score of 0.7 has been imposed as the minimum acceptable.

EFA has a parsimony principle, such that the resulting number of factors should be considerably less than the number it starts with. The result of the EFA studies are used for the evaluation of the valuers' perception of sustainability integration and their knowledge-based potential industrial sustainability benefits.

4.4.2.2(p) Phase 2 of the Perceptive and Support Studies – Relationships between Constructs and the Modelling of the Valuers' population

This phase of the study involves the use of the extracted factors to model the relationships and elicit the knowledge-based characteristics of the population of valuers under study in relation to industrial sustainability. The first stage comprises of the Partial Least Squaress (PLS) confirmatory tests. This part of the study attempts to evaluate the causal relationship between valuers' support for integration of industrial sustainability into property valuation and the knowledge about the perceived sustainability benefits. It compares the results of the respondents' evaluation of the theory-driven models and indicators for applicability to the study population. The current investigation was hinged on the theories of Addae-Dapaah *et al.* (2009), Gloet (2006) and Petrini and Pozzeboh

(2009) on the scale validating knowledge-support systems in sustainability and property valuation.

4.4.2.2 (q) Convergent, Discriminant, Construct Validity and Factor Structure

The three constructs, SUP, BLR and BCS were then tested for convergent, discriminant and construct validities and subsequently, the factor structure. The convergent, discriminant and construct validities are essential to ascertain the following:

(i) That each reflective variable measures and harmonises with another measure within a construct/factor.

(ii) That a construct or concept does not show high correlation with other constructs intended to measure concepts that are theoretically different.

(iii) The extent to which each construct measures the reflective variables

Validities are observations of the degree to which an instrument measures what it purports to evaluate or to which interpretations of the results of a survey are warranted (Kimberlain & Winterstein, 2008; Ibiyemi, 2009). Validities are sort into internal and external. Internal validity is the approximate truth about the inferences regarding cause-effect, or causal relationships between the theoretical independent and dependent variable and the researcher's ability to relate to the research outcome and affirm that no other variables except the study variables caused the result (McLeord, 2013; Trochim *et al.,* 2016). External validity concerns the issue of representation and the degree to which research results are generalisable or cross the boundaries of the outside group not involved in the experiment or study (Mohammed *et al.,* 2015). Cronbach and Meehl (1955) describes the construct validity as the extent to which a test measures a hypothetical statement. To validate a test of a construct, the researcher deduces hypotheses from a theory that is relevant to the concept, and after that checks the construct (McLeord, 2013). Campbell and Fiske (1959) demonstrates convergent validity when the measure harmonises with another measure within a factor. It would entail showing convergence between the two measures. Discriminant validity tests whether concepts or measurements that are not expected to be related are, in fact, not related. Campbell and Fiske (1959) stresses the significance of using both discriminant and convergent validation techniques when assessing new tests. Bryman and Crammer (2003) asserts that a favourable assessment of discriminant validity indicates that a concept does not show high correlation with other tests intended to measure concepts that are theoretically different. The inference is that the two scales measure different factors (or constructs) if the output value is less than 0.85 (John and Bennet-Martinez, 2000). Discriminant validity is evaluated by comparing the shared variance (squared correlation) between each pair of constructs against the average of the AVEs of the constructs (Bove *et al.,* 2009). Discriminant validity exists if the output value is less than 0.85 (John & Bennet-Martinez, 2000: Domino & Domino, 2006).

The target of confirmatory factor analysis (CFA) for construct validity is to examine whether the hypothesised measurement model is fitted by the observed data. The blueprint identifies the factor structure (Hair *et al.,* 2006). CFA engages in understanding shared variance or correlation of variables measured and conceived to belong to a factor. The researcher hypothesises in advance, the number of factors, and which items/measures load onto and reflect which factors, by permitting the constraint of certain weights to be zero (Gatignon, 2010).

4.4.2.2(r) Conducting the Convergent, Discriminant, Construct Validity and Factor Structure tests

The constructs are reflective. The SmartPLS 2.0 has been used to conduct the convergent, discriminant, construct validity and factor structure tests. Table 4.6 indicate the outputs.

Table 4.6 – Quality criteria of model adjustments – SEM specification – Rates of average variance extracted (AVE), compound reliability, R and Cronbach´s Alpha of Constructs – *Overview* (this study, 2016).

	AVE	Composite reliability	R Square	Cronbach's Alpha	Communality
BCS	0.7644	0.9285	0	0.9006	0.7644
BLR	0.6059	0.7446	0	0.4062	0.6059
SUP	0.4798	0.8456	0.4615	0.7933	0.4798

Reference value: AVE>0.5; CR>0.7, Cronbach alpha >0.7; communality>0.40. Convergent validity is achieved (AVE>0.5 across constructs), composite reliability achieved at >0.7. Internal consistency is not proven for BLR (0.4062<0.7). Communality is achieved across all constructs (>0.4). Latent variable correlations viewed from *outer loadings* are <0.9. Discriminant validity is thus achieved by showing that all constructs are independent. The outputs reported about missing values <15%, absence of outliers, replacement of the missing values with median values, convergent and discriminant validity verify the integrity of the data for its useability.

Construct validity and factor structure exploration could lead to new data collection, review of questionnaire scale and the development of more valid hypotheses if found inadequate. The confirmatory factor analysis (CFA) verifies that measures of a construct are consistent with a researcher's understanding of the ontology of that construct. In other words, it builds the factor structures of a set of observed variables and tests the hypothesis that a relationship exists between observed variables and their underlying latent constructs (Suhr & Shay, 2010; Ibiyemi *et al.,* 2014). The knowledge of the theory, empirical research, or both, postulates the relationship pattern a priori is applied and the hypothesis is tested statistically. The researcher hypothesises in advance, the number of factors, and which items/measures load onto and reflect which factors, by allowing for the explicit constraint of certain loadings to be zero (Gatignon, 2010). Even so, where some questions do not measure what they should, then, the factor structure is not substantiated. In this case, Exploratory Factor Analysis (EFA) is the next step (Suhr & Shay, 2010). EFA helps to ascertain what the factor structure looks like according to participants' responses.

The construct validity uses Analysis of Moment Structures (AMOS.22) to indicate a two (2) factor structure as shown in Figure 4.6.

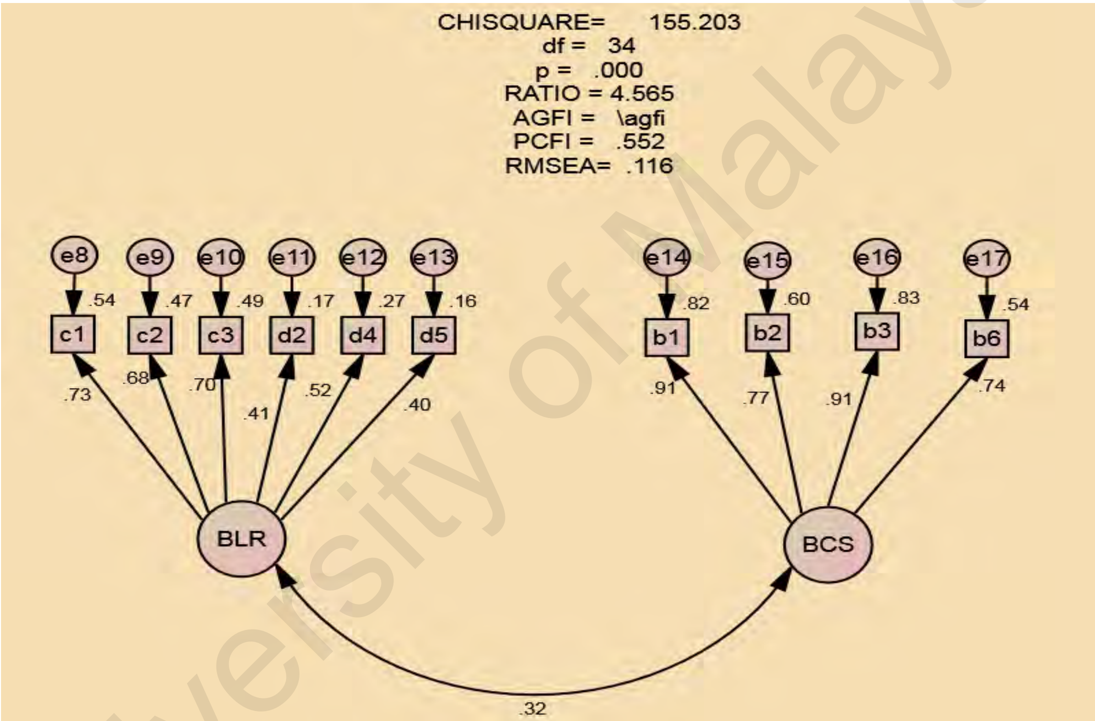


Figure 4.6: CFA Path Diagram showing construct valididty of constructs and their underlying variables (this study, 2016)

With respect to the industrial sustainability benefits and support scale, the CFA yielded an acceptable test of model discrepancy, CMIN/df < 5 = 4.565, although it could not be adequate with other fit indices such as RAMSEA < .08 and PCFI >0.9. The factor loading ranged between 0.40 to 0.91 in standardised units. The correlation between BLR and BCS was r=0.32. The 2-factor model marginally fits the data upon the exclusion of certain items with factor loadings less than 0.4. The correlation matrix is 0.32 (< 0.9). Even so, modification could have improved the fit but this was not provided by the system for this analysis. The findings show a two-factor structure comprising of two constructs BLR and BCS.

4.4.2.2 (s) Predictions and Test of Hypotheses

The hypotheses proceed with the concept that the support effectiveness for industrial sustainability integration into real estate valuation would be a function of knowledge-base of the valuers about the potential benefits (sections 3.2.1.4; 4.4.2.1). In support, Lorenz (2006) accords that success in achieving more sustainable development in property and construction would depend on progress in integrating sustainability issues into property valuation theory and practice. The success may not be actualised in the industrial real estate sector unless valuers are knowledgeable about potential sustainability benefits and need-based support for its inclusion into the real estate valuation body of knowledge (Warren-Myers, 2016). It is imperative that valuers appreciate the benefits of sustainability in property and also attain the skill to report them in their valuations. Their knowledge, skills, and attitude could bring about a change in the behavior of industrial firms by providing an integrated basis for industrial sustainability-related obsolescence (ISRO). This study promotes a new understanding that leverages on engendering support for industrial sustainability initiatives through the valuers' knowledge linkages with the potential benefits of sustainability. The part of the study aims to test the theoretical relationships concerning industrial sustainability and valuers' support system. The following three (3) hypotheses were tested and evaluated:

H1: Cost savings (BCS) predicts Support (SUP), that is, that SUP is influenced by BCS
H2: Prospects of lowering risks (BLS) influence SUP
H3: Support depends on the expectation of high building value (BHBV) by valuers.

4.5 Validating the Main Study

4.5.1 Purpose of Validating the Main Study

Triangulation was initially conceptualised by Webb *et al.* (1966) as a method for the improvement of concepts measurement, whereby more than one method would be employed in the development of measures, resulting in broader understanding of the phenomenon of interest and greater confidence in research findings. Triangulation was initially associated with a quantitative research strategy, where, it is primarily used to assess the predictive performance of the models and to judge how they perform outside the sample to a new data set (test data). Ideally, any researcher would like to see how the model performs with new data to verify the accuracy of its predictions. In science, theories are judged by its predictive performance. However, triangulation can also take place within a qualitative research strategy (Bryman, 2012). Lisa *et al.* (2013) discusses the different methods in triangulation as: data triangulation, investigator triangulation, theory triangulation, methodological triangulation, and environmental triangulation. They all have their different purposes of checking the validity and seeing the differences of opinion about their phenomena (section 4.5.2).

Following Schoenberger (1991), queries were raised as to why opinions differed to those from other respondents. This permitted a cross-checking of data supplied from different sources and allowed the build up an image, not only of the various positions of actors but also of their perceptions of each other. Data was then compared with evidence from other shareholder sources, including evidence from other research methods as well as company documentation, trade journals, and research reports

4.5.2 Validating methods used by researchers

The examination of the validating methods enables the understanding of their applications and appropriatenessness in the various research environments. Lisa *et al.* (2013) discusses the methods as follows:

Investigator triangulation concerns using several investigators in the evaluation process. The assessment team consisting of researchers in the field of study and each investigator studies the program with the other qualitative method (interview, observation, case study, or focus groups). Then, the findings from each evaluator would be matched to develop a broader understanding of how the various investigators view the issue. If they arrive at the similar conclusion, then the confidence in the findings would be heightened.

Theory triangulation uses multiple perspectives to interpret a single set of data. It uses professionals outside of the field of study. A popular approach is to bring together people from different disciplines. Sometimes, individuals within disciplines may be used as long as they do not have the same status positions. In theory, it is assumed that people from different disciplines and positions would interpretes the information, in a similar way, then validity is established.

Data triangulation begins by identifying the stakeholder groups for in-depth interviews. , It uses different sources of information to improve the validity of a study. These sources are expected to be stakeholders in the program, participants, other researchers, staff, or other community members. The in-depth interviews could be done with each of the groups to gain insight into their viewpoints on research outcomes. At the analysis stage, feedback from the stakeholder or end user groups would be compared to determine areas of agreement, support, suitability, as well as areas of divergence.

Environmental triangulation involves the use of different locations, settings, and other key factors related to the environment that the study took place: the time, day, or season. The key is identifying which environmental factors if any, might influence the information that is received during the study. These environmental factors are changed to see if the findings are the same across settings. If the findings remain the same under varying environmental conditions, then validity has been established.

Methodological triangulationis is the fifth type of triangulation mentioned by Lisa *et al*. (2013). The triangulation uses the *"within-method studies"*, that is, multiple qualitative or multiple quantitative methods or both to examine the study. For example, surveys, focus groups, or interviews results could be compared to see if similar results have been found. Second, survey questionnaire and pre-existing database could also be compared. If the inferences from each of the methods are the same, then validity is established (Casey & Murphy, 2009; Bekhet & Zausnieski, 2012)

Based on the preceding discussion of the methods, models have been validated to various degrees of rigour. At the less laborious end, experts are invited to comment on the models. Tam and Harris (1996) validates their model for assessing building contractors project performance by conducting three interviews with potential model users. Potter and Sanvido (1995) validates their Design and Build (DB) prequalification system by conducting telephone surveys with four experts to obtain their general views on the model. A more rigorous method compares the outcome of an independent measurement with the answer given by the model. This is to determine the model's ability to arrive at a similar conclusion. Liston (1994) tests his model by working with some owners to evaluate eleven (11) classified contractors.

4.5.3 The Study Validation

Methodological triangulation appears to be best suited to the study. The research process in a methodological triangulation permits the use of the survey method from which a wider spectrum of data can be gathered and subjected to various psychometric tests to improve outcome confidence and feedbacks. In application to this study, triangulation information would be from the perspectives of the valuers regarding their agreement, support, suitability of the valuation approach. This type of triangulation is considered the preferred choice due to its ease to implementation within the study.

Nevertheless, Sangiovanni *et al.* (2007) and Singha (2015) contend that cross-validation comprises of verification and validation. Verification and validation are self-governing procedures that are used together for checking that product, service, or system compliance with requirements, regulation, and specifications, and that it fulfills its intended purpose regarding its suitability and acceptability by a third party. Verification is an internal process that envisions to check that a service, or system meets a set of specifications (Sangiovanni *et al.,* 2007). The study complies with the professional requirements of restricting research investigations to the five methods of valuation, and the specifications of the Royal Institution of Chartered Surveyors as contained in the RICS Redbook, Section 2.5g:3-4 which states as follows:

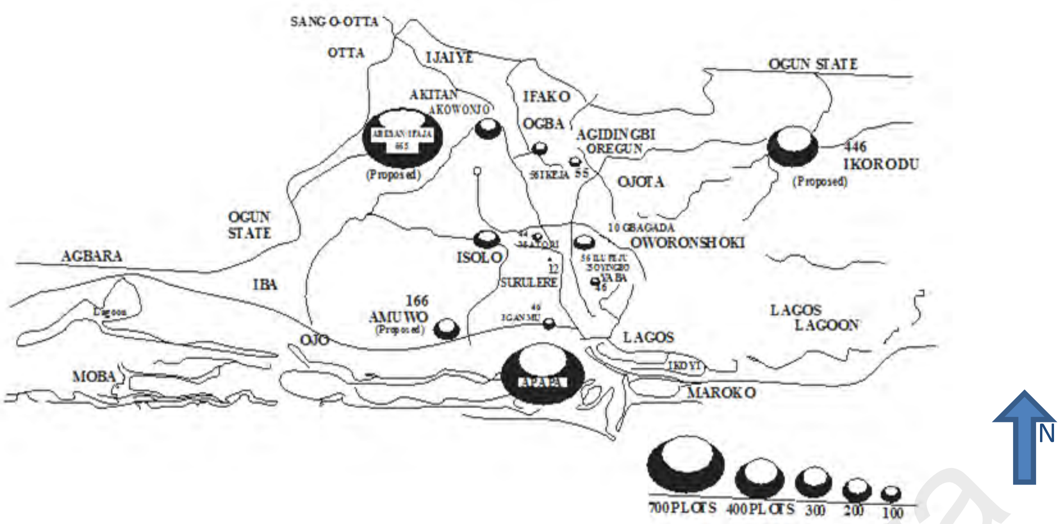
When preparing investment values, sustainability factors that could influence investment decision-making may properly be incorporated, even though they are not directly evidenced through market transactions (RICS, 2014). Valuers are recommended to assess the extent to which the subject property currently meets sustainability criteria to arrive at a knowledgeable (informed) view on the likelihood of these impacting on value

On the validation front, this study sets the investigation of the Valuers' perception and support studies to verify whether there is statistical justification for integrating industrial sustainability into property valuation in the case study area. Furthermore, whether the valuation approach fulfills it intended purpose regarding its suitability and acceptability by the end-users (Altrichter *et al*., 2008; Lisa *et al.,* 2013). The suitability and acceptability of the valuation approach was verified in section 5.3.1.3.

4.6 The Case Study Industry: Location

4.6.1 Regional Location

Nigeria situates in the West of the African continent. The coastal boundary is bordered by the Gulf of Guinea in the south, and Cameroon and Chad share the land boundaries in the east, Niger in the north and Benin in the west. It covers an area of 923,768 sq. km. and Abuja is the capital city. The latitudinal and longitudinal degree of the country is 4° to 14°N and 2° to 15°E respectively. Lagos is the commercial capital of Federal Republic of Nigeria with over 70% of industries situated there. Also, it is also the fastest growing city in Nigeria regarding development and industrial infrastructure. The rapid growth and unplanned urbanisation have led to an increase in environmental pollution and waste generation. Lagos has over 7,000 medium and large scale manufacturing facilities without many environmental considerations (Oketola and Osibanjo, 2011). Pollution reduction technologies are generally absent, and the consequence is a gross pollution of natural resources and environmental media. The main industrial estates in Lagos are at Ikeja, Amuwo-Odofin (industrial), Apapa area, Gbagada, Iganmu, Ijora, Ilupeju, Matori, Ogba, Oregun, Oshodi/Isolo/Ilasamaja, Surulere (light industrial) and Yaba (Ogungbuyi and Osho, 2005) as shown in Fig. 4.7



City of Lagos: Main Urban Area, Lagoon, Harbour and Port. Scale:
10km

Figure 4.7 - Map of Industrial Estates in Lagos (Oketola & Osibanjo, 2011)

The wide ranges of industries and the pollutants introduced largely depend on the class of industry, raw material characteristics, specific process methods, the facilities, operation techniques, the grades of products and climate conditions. (Onianwa, 1985). MAN (The Manufacturers Association of Nigeria) groups the industries as food, beverage, and tobacco; textiles, wearing attire; paper and pulp products; pharmaceutical and chemical and; wood and wood products; nonmetallic mineral products; basic metal; electrical and electronic; motor vehicle and miscellaneous; and domestic and industrial plastics (M.A.N, 1991). The Chemical and Pharmaceutical sectors are the greatest polluting industry based on the final ranking of IPPS pollution loads. (Oketola & Osibanjo, 2011). The chemical manufacturing facilities in the sector include the paint manufacturing industries, soap, and detergents, pharmaceuticals, domestic insecticides and aerosol, petroleum products, toiletries and cosmetics, basic industrial chemicals. Tthe core metal manufacturing facilities are steel manufacturing, metal fabrication, and aluminum extrusion.

4.6.2 Location of the Case study Industry.

The case study industry is located at Oba Akran Road, Ikeja industrial estate in Lagos. The company situates within an area delineated by Ladipo Oluwole street, GEMCO road and Sapara avenue. It is a paints manufacturing industry that commenced operations in January 1959. The selection of the industry for the sustainability and real estate valuation studies is based on the following considerations:

(1) The chemical paints industry is the third most polluting industries in Nigeria behind the cement and asbestos industries (Oketola & Osibanjo, 2011). The cement industries are located in the vulnerable areas while the asbestos industry are not willing to participate in the study.

KPMG (2015) reports on the case-study that:

(i) The company is the oldest and largest paints industry with 16 depots spread all over Nigeria.

(ii) It is the first of the two paints companies quoted on the Nigerian Stock Exchange (NSE) and a reference point in the Nigerian paints industry.

(iii) It is the only paints company that operates the five (5) key segments: Decorative/architectural finishes, marine and protection coatings including KCC heavy duty coating, automotive/vehicle finishes, industrial coatings, wood finishes and preservers.

(iv). The total company assets (current and non-current) is in the region of N4billion (RM58million).

(v) The company has won the NSE Merit and SON Awards and the National Merit Award for local raw materials utilisation in the paints industry.

(vi) Overall, the company was chosen for their willingness to participate in the study, the applicability to the study's objectives, and the potential usefulness of the resulting data to the industry as a whole.

(vii) The first to deliver tropicalised and environment-friendly paint products to the Nigeria market.

Figure 4.8 shows the aerial view of the case study industry within the Ikeja Industrial Estate.

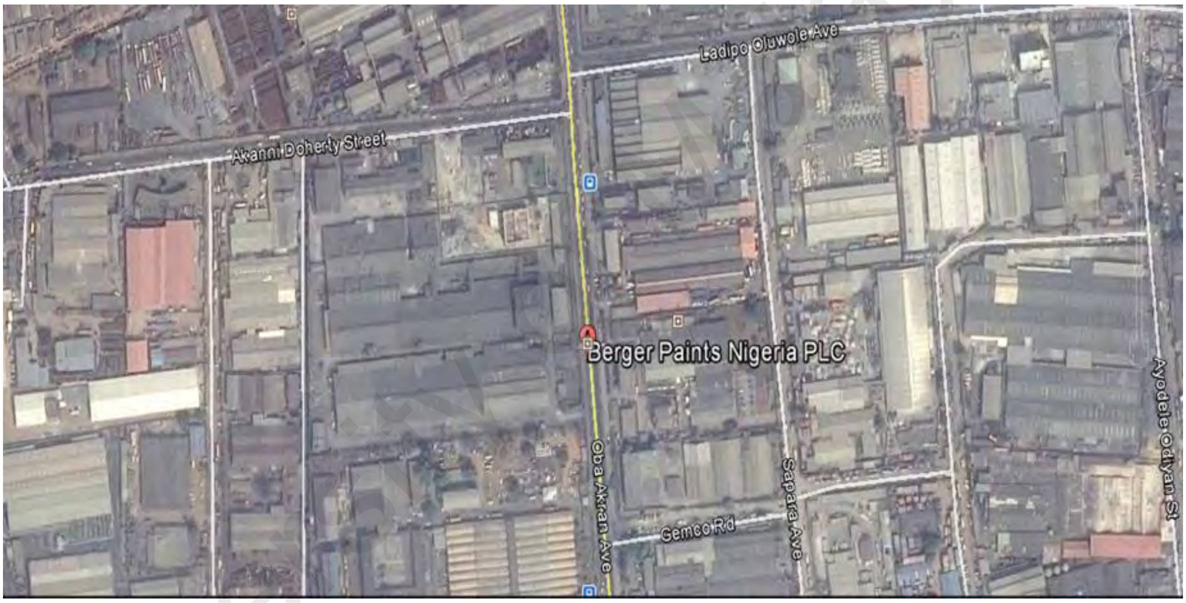


Figure 4.8: The aerial view of the case study industry. (Google Earth, 2016)

The situation of the industry along Oba Akran Road is shown as Figures 4.9 and 4.10 (East and West Wings)

Figure 4.9 Frontage of the Industry at Oba Akran Road (East Wing)

Figure 4.10 shows a large portion of West Wing of the frontage unto the main Oba Akran Avenue, Ikeja, Lagos, Lagos State of Nigeria

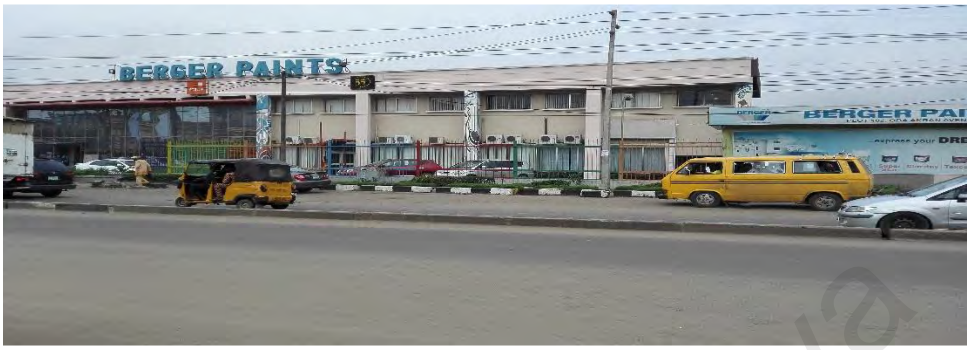


Figure 4.10. Frontage of the Industry at Oba Akran Road (West Wing)

Figures 4.11 and 4.12 show a large portion of rear West and East Wings entrances to the industry from Sapara street, which runs parallel to Oba Akran Avenue

Figure 4.11. Rear Entrance to the Industry at Sapara street (East Wing)

Figure 4.12. Rear Entrance to the Industry at Sapara street (West Wing)

The company has a full time staff strength of two hundred and twenty seven (227). It operates a single 8-hour work schedule per day and 5-working days per week from Monday to Friday giving a total of forty (40) hours per week. It has the Water and the Solvent-based production lines.

4.7 Summary

In this chapter, research designs and methods used for the development of the valuation approach for integrating industrial sustainability into property valuation were discussed. The chapter began with the discussion of the main part of the study. It discussed the Delphi Method, the steps which were used to identify the relevant sustainability indicators (SI) for industrial sustainability in the case study industry and the sustainability indicator scores. The reliability and validity considerations of the Delphi instruments were then discussed which led to the development of the valuation approach. Then the perceptive-support study for the adopted valuation approach by the valuers was discussed. First, the extraction method adopted to reduce the number of factors, which are the Principal Axis Factoring (PAF) and the Promax rotation method described. Second, the chapter described the PLS confirmatory tests and the AMOS-CFA that were used to test the data integrity and the factor structure. Also, it mentions the test of the relationships among the factors to set the character of the valuers' population in perspective for future related studies.

CHAPTER 5

RESULT AND ANALYSES

5.1 Introduction

This chapter presents the data analysis and results for the main and perceptive studies. In the main study, the result entails the case for sustainability and the use of Delphi method to establish experts' selection of relevant sustainability indicators for the paints industry, with reference to the case study industry.

The experts' survey had resulted in the selection of thirty-nine (39) industrial sustainability indicators. The study worked with all the indicators as the nature of sustainability indicators is their mutual inclusiveness and interdepedence. In other words, an exclusion of one could have considerable effect on some or all of the others. Sustainability research is inter and multi-disciplinary with its uniqueness in being globally interlinked (Siebenhuner, 2004, Schäfer *et al,* 2010; Fahy & Rau, 2013). It is a public-shared mission, a survival issue, a value-driver, and a requirement of clients and society for ecological integrity, social equity, and economic security (Weber, 2005, Lorenz, 2006). Accordingly, the 'Narrowing Down' [section 4.4.1.2(l) and Figure 4.3] was skipped and the study selected all the 39 indicators for analysis. In pursuing the aim of factor reduction, the perceptive and support study drew from the findings of an earlier work of Addae-Dapaah *et al.* (2009) on the sustainability of sustainable real property development in Singapore and the matrix measurement of the constructs for the support and benefits scale. This work also employed the techniques of principal axis factoring and the partial least squares for the factor reduction and the pathway modelling for the perceptive study.

From the Delphi results of the ISRO-CF, the appropriate valuation figure was calculated using the cost approach. The figure reflects the extent to which the sustainability features of the industry meet the sustainability requirements based on the qualitative judgment of the Delphi experts. This valuation approach conforms to the valuation approach prescribed by the RICS (2014, 2016). The work serves as a guide to integrate sustainability features into the valuation of process industries on the investment value basis. It also adopts a new methodological approach to fulfil the RICS requirements.

This chapter is structured as follows. Section 5.2 reports the result and the analysis of the main study in accordance with each of the objectives 1 to 4. Section 5.3 presents the results and the analyses of the perceptive study which was used as the data validation. In particular, section 5.2.1 presents the report on the establishment of the case for sustainability inclusion. The survey for the selection of the relevant sustainability indicators, analyses of the statistical inputs, scoring and the analysis of the scoring was presented in section 5.2.2. Section 5.2.3 addresses the valuation approach in relation to the theoretical framework development. Section 5.2.4 provides the factory description, production sequence and the valuation analysis. The perceptive and support studies were examined and reported upon to ascertain the suitability and acceptability of the valuation approach in section 5.3. The research findings following the presentation of the field data and the analysis are shown in section 5.4. The summary of the chapter is provided in section 5.5

5.2 Result and Analyses of the Main Study

This section presents the results of the main study which deals with the research objectives 1 to 4. It reviews and establishes the case for incorporating sustainability into real estate valuation methodology in the context of the emerging valuation approaches; reveals the relevant sustainability indicators within the paint manufacturing industry; develops and applies a sustainability-incorporated methodological approach as a test of the extent to which process industry sustainability features meet local sustainability criteria on an investment value basis. Finally, the developed valuation approach was operationalised.

5.2.1 Data Analysis of the Main Study: The First Objective

5.2.1.1 The Case for Sustainability Integration and the Valuation Approaches

The case for sustainability are based on the theoretical evidence and the literature findings in sections 2.2.2 and 3.3.4. The review on the literature found the business and socio-environmental cases for the integration of sustainability into real estate valuation and the three major evidence-based valuation approaches.

In recognition of the significance of sustainability, the RICS VVA in 2007 declared the evolving importance of sustainability and mandated its integration into real estate valuation and appraisals. However, implications must be understood in the light of the valuers' standards and practices with the aim of improving understanding of their relationship. It imposes a social and professional responsibility on the Valuers in accordance the Royal Charter of 1881, IVS and other recognised standards. A clear distinction was established between green buildings and sustainable buildings. The concept of green building does not fully explore the social and the economic dimensions of sustainability in a building. It was found that sustainabity in buildings also looks at the whole life cycle of the building including demolition or 'deconstruction'. In other words, it means that organisations or individuals should operate in a financially sound framework but as well be socially and financially responsible in their activities and operations.

The business case for sustainability creates a progressive business result and marks the intelligent design of voluntary but distinct social and environmental management. The idea of the business case for sustainability helps researchers and practitioners alike to find answers to the key question. These are conscious actions for the society not just a reaction to legal enforcement and regulations or which would be expected for economic reasons as part of common business behaviour. Companies are facing a more complex array of trade-offs and risks across their value chains, so sustainability has become an important feature in business strategies. Large multinationals and mid-sized companies are increasingly taking a long-standing view toward managing environmental and social risks. Therefore, many companies recognise that by attending to ecological and social issues can they achieve healthier progress and cost savings, reputational gains, strengthen stakeholder relations, and boost their line of customers and external interested parties. Climate change now matter to business success The understanding of climate risks and adaptation is critical to supporting business clients for the reason that the long-term impact of climate change such as changes in temperature, rainfall patterns, sea level, and storm conditions require new business adaptation strategies. Moreover, there is also public pressure for companies to decrease their greenhouse gas emissions, which rose to an all-time high of 6 percent in 2010.

The key challenge of identifying, creating and managing business cases for sustainability is about incorporating the three dimensions of sustainability with market-oriented business activities, both on the level of corporate visions and strategies as well as operational management. The "sustainability triangle" benefits in the understanding that the business case for sustainability is embedded within the wider notion of corporate sustainability. Corporate sustainability can be viewed as the result of management attempts to tackle challenges posed by the need for corporations to move towards the goal of sustainability which can be interpreted in the marketplace for property valuation purposes. Information is another key to supporting decision making. The identification, creation and managing business cases for sustainability leads to expansion of information requirements. Traditional information management systems do not meet the expansion. Firstly, sustainability-related decision situations and information needs have to be identified. Secondly, according to sustainability accounting and reporting frameworks are required to be integrated into information management. The heuristic of a sustainability triangle helps to structure the information needs for managing corporate sustainability and business cases for sustainability.

The social case for sustainability integration borders on the quest for the enhancement of the quality of life. The expectation of high quality of life are reflective in the increase in health status, comfort and safety, high morale of company and staff, reduction in health symptoms and health cost claims, employee and tenant retention.

Lorenz (2006) accords that success in achieving more sustainable development in property and construction largely depends on progress in integrating sustainability issues into property valuation theory and practice. The success may not be actualised in the industrial real estate sector unless valuers are knowledgeable about potential sustainability benefits and support its inclusion into the property valuation body of knowledge. To this end, it is imperative that valuers appreciate the benefits of sustainability in property and also secure the skill to account for them in their valuations. Expectedly, their knowledge, expertise and attitude could bring about a change in the behaviour of industrial process firms by providing an integrated basis for industrial sustainability-related obsolescence (ISRO). It is, in part, an answer to the sustainable development goals' (SDG) global call for improved links between property investment, social responsibility, and sustainability.

The main findings are highlighted in section 5.4.1.1

5.2.2 Result and Data Analysis of the Delphi Study: The Second Objective

This sub-section presents the result of the primary study which reveals the sustainability indicators for industrial sustainability within the paints industry context. The sub-sections cover the data analysis of the results and the selection of the factors and scoring through the application of Delphi Method. The Delphi study took six and a half months to complete. The study identified thirty-nine (39) industrial sustainability indicators and the ISRO-CF

The CDM method employed consists of two (2) Research Questions answered in three (3) rounds, six (6) Delphi Questionnaires, four (4) Reiterations and four (4) Validations

5.2.2.1 The KRNW Team Nomination

The initial process of the CDM captured the essence of the experts' survey. Through the three (3) KRNW research team that has the periods of experiences ranging from twenty-two (22) to thirty-five (35) years, the identication of the main experts were made. They were asked to identify individually, the most appropriate disciplines, organisations and literature/laws that would be most useful in evaluating sustainability issues in process industries for valuation purposes.

The labels, qualifications and experience of the KRNW team members are contained in Appendix N. The list assembled from the disciplines and organisations related to the selected sustainability indicators was provided and spaces were made available for them to input additional disciplines, organisations and laws as deemed necessary (Appendix N). Table 5.1 presents the selection made by the KRNW team. As in the Table, the asterisked items indicate the additional inputs made by the team.

Table 5.1: Results of KRNW Team on Selection of Disciplines, Organisations and Laws (Source: this study, 2016)

	KRNW TEAM MEMBER No.1	KRNW TEAM MEMBER No.2	KRNW TEAM MEMBER No.3	Frequencies
Disciplines and Skills	Real Estate Valuation, Environmental Management	Real Estate Valuation, Environmental Management Academics Land Use Econmics Urban & Regional Planning Building* Industrial Pollution* Chemical and Allied Processing	Real Estate Valuation, Environmental Management Academics Land Use Econmics Urban & Regional Planning Soil Science* Forestry & Wildlife* Plants & Animal Taxonomy* Chemical/Process Engineering*.	3 (S) 3 (S) 2 (S) 2 (S) 2 (S) 1 (S) 1 1 (S) 1 1 2 (S)
Organisations	NESREA	NESREA LASEPA	NESREA LASEPA FME* DPR* National Park Management Agency*	3 (S) 2 (S) 1 1 1
Laws/Literature	NESREA Act of 2007 ELRI of 2011	NESREA Act of 2007 ELRI of 2011	NESREA Act of 2007 ELRI of 2011 Environmental Audit Report* EIA Act No.86 of 1992* National Parks Act of 1999* Natural Resources Conservation Act of 1989* Endangered Species Act No.11 of 1985)*	3 (S) 3 (S) 1 (S) 1 1 1 1

*New Additions by KNRW Members; (S)-Selected discipline, organization or law

Disciplines and Skills: Building* Industrial Pollution* Soil Science* Forestry & Wildlife*Plants & Animal Taxonomy*Chemical/Process Engineering*

Organisations: FME* DPR* National Park Management Agency*
Laws/Literature: Environmental Audit Report* EIA Act No.86 of 1992*National Parks Act of 1999* Natural Resources Conservation Act of 1989* Endangered Species Act No.11 of 1985)*

5.2.2.2 Selection and Participation of the Experts

The selection of the experts complies with the required basic skills and competencies in the disciplines and organisations specified by the 3-member KRNW Team. (Table 5.1). The selection mode is the number of occurrences, which can be once, twice or thrice. The items occurring thrice or twice are automatically selected. Items selected only once may be included based on the logic and good judgment of the investigator. Forestry and Wildlife, Plant and Animal Taxonomy, National Park Management Agency, National Parks Act of 1999, Endangered Species Act No.11 of 1985 were, therefore, excluded from the disciplines, organisations and laws considered to have significant influences on industrial sustainability and real estate valuation. The KRNW Team's selection of disciplines formed the basis for the purposive selection of the experts.

Forty-five (45) Experts were invited to participate in the Delphi study, but thirty-six (36) agreed to participate (see the letter of invitation and other introductory materials in Appendix A1-A4. Twenty-three (23) experts responded to all the three (3) rounds, while thirteen (13) experts withdrew voluntarily before the commencement of the survey. Table 5.2 shows the participation and returns by the disciplines of the respondents.

Table 5.2: Participation and Returns by Categories of Respondent-Experts (Source: this study, 2016)

Categories	Invited	Agreed to Participate	Formally withdrew	Delphi Panel	Completed Round 1	Completed Round 2	Completed Round 3
Professional Valuers	6	3	1	2	2	2	2
Professional Urban Planners	5	3	1	2	2	2	2
Professional Builders	3	3	2	1	1	1	1
Pollution Experts	5	3	2	1	1	1	1
Soil Scientist	2	2	1	1	1	1	1
Process/Chemical Engineers	2	1	1	1	1	1	1
Academics	6	6	1	5	5	5	5
Land Economist	2	2	1	1	1	1	1
Environmental Consultants	3	3	1	1	1	1	1
The Case Study Industry	2	2	0	2	2	2	2
NESREA	5	5	1	4	4	4	4
LASEPA	4	3	1	2	2	2	2
TOTAL	45	36	13	23	23	23	23

The twenty-three (23) Delphi Experts are to provide answers to the two Delphi research questions relating to the following:

(1) Identifying and Listing of the appropriate industrial sustainability indicators for the case study industry in Nigeria.

(2) Scoring of each component of the indicators after their industrial visit, direct observation and a study of the EAR.

5.2.2.3 Profile of the Delphi Experts

The experts comprise of the following:

Academics and Professionals: University Lecturers (4), Professional Estate Valuers (4), Urban Planners (1), Builders (1), Land Economists (1); and Environmental Managers and Consultants: Environment and Safety Officers (8), Private Consultants (1), Pollution

Experts (1), Process Engineers (1) Soil Scientists (1). Table 5.3 shows the experts' qualifications and experience.

Table 5.3: Profile of the Delphi Experts (this study, 2016)

No.	Qualifications, Experience & Designations
1.	Professional Valuer M. Tech Real Estate, MURP Urban & Regional Planning + 27yrs experience
2.	Academic PhD Environmental Valuation + 21yrs experience
3.	Professional Valuer MSc (Housing), ANIVS, RSV + 28yrs experience
4.	Academic PhD Urban, Regional Planning & Environment + 31yrs experience
5.	Professional Builder PhD Building Maintenance + 20yrs experience
6.	Academic PhD Real Estate Valuation & Sustainability + 31yrs experience
7.	Professional Valuer PhD Real Estate Valuation + 28yrs experience
8.	Academic PhD Wetland Valuation + 24yrs experience
9.	Land Economist PhD Land Economics + 33yrs experience
10.	Professional Urban Planner MSc Urban & Professional Planning + 24yrs experience.
11.	Professional Estate Valuer MSc (Est.Mgt), RSV + 17yrs experience.
12.	Enforcement Officer - Government Official MSc (Env. Science) + 15yrs experience
13.	Government Official, LASEPA. MSc (Env. Magt) + 22yrs experience
14.	Chemical/Process Engineer MSc (Chemical Engineering) + 26yrs experience
15.	Enforcement Officer, Government Official, NESREA MSc (Environmental Studies) + 17yrs experience.
16.	Pollution Expert, MSc (Pollution Chemistry) + 16yrs experience
17.	Snr Enforcement Officer Government Official, NESREA + 21yrs experience.
18.	Government Official, Director, MSc (Env Mgt) + 32yrs experience
19.	CEO, Environmental Consultant MSc (Env. Mgt), MNES + 23yrs experience.
20.	Environmental Officer Environmental Unit & Safety Officer, 19yrs experience
21.	Environmental Officer Environmental Unit & Safety Officer, 17yrs experience.
22.	Soil Science Expert (MSc Soil Science) University Putra Malaysia + 17yrs experience
23.	Senior Enforcement Officer, NESREA MSc (Safety Engineering) + 18yrs experience

The experts are highly qualified personnel in the relevant fields with periods of experience ranging from fifteen (15) to thirty-three (33) years. The list of the Delphi experts, their labels and panel classifications according to core competences is shown in Table 5.6.

5.2.2.4 Identification and Listing of Sustainability Indicators

The Delphi method sets out to find an answer to the Delphi Research Question 1 as in section 5.2.2.2. A list of sustainability indicators was provided in the Delphi questionnaire based on the literature findings.

As a single group, the expert is empowered to remove any item from the list or add, alter or amend any item in the list as deemed appropriate to the potential local sustainability metrics (Appendix N). The responses from the Delphi Questionnaire (DQ) 1 returned with the following feedback as new additions and modifications to the sustainability indicators:

1. "Updates" added to "Compliance with Fire and Safety Regulations" [section 1(I) of Table 5.4].
2. "Chemicals and Materials Storage, including Warehousing" added to "Lifts and Escalators" under "Factory Facilities" [section 1(K) of Table 5.4]
3. "Technical Skills of Workers and Reward Systems"; "Facilities Maintenance Management" and "Intermittent Environmental Analyses" are added [section 1(L) of Table 5.4]
4. "Restrictions, Appropriate Signage and Guides" are added to "Social Aspects" [section 2(I) of Table 5.4]

5. “Provisions of Reserves for possible remediation” are added to “Economic Aspects” [section 3(G) of Table 5.4]

The DQ. 2, including the above additions and modifications indicated in the responses to DQ.1 were sent back to the Delphi experts asking them to indicate the changes (if they wish) to their intial score in the light of the additions and modifications (1) to (5) above. There were no changes to the intial scores. DQ.3 attaches the responses from DQ.2 and permits the experts to verify and validate the final version of the consolidated list of the indicators together with the mean scores and the RIIs. The indicators, including the additions were validated without further alterations.

Table 5.4 presents the final rating responses of the Delphi experts.

Table 5.4 – Delphi Experts' Responses to Selection of Sustainability Indicators (Source: this study, 2016)

Dimensions	Sustainability Issues/Indicators	EXPERTS																					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1. Environmental (Building and Process– Related or the Green Features) (Boyd, 2005; Madew, 2006; RICS, 2009: Addae-Dappah *et al.*, 2009, Cheng and Venkataraman, 2013; Von Thilo Elbert *et al.,* 2013)	*A. Consumption of non-renewable energies* (e.g. coal, oil and gas) / Evidence of alternative energy supplies	5	5	4	5	5	4	4	5	4	4	5	5	3	4	5	4	5	5	4	5	3	4
	B. Water Consumption – Portable, hygiene and cooling towers, water recycling, recovery, reuse, and capture measures + waste water reduction	4	5	4	5	5	3	5	5	4	4	4	5	4	5	2	5	3	5	5	5	5	5
	C. Materials Consumption - Ecological impacts of materials used for construction	5	4	4	5	5	3	3	5	4	5	5	4	4	4	5	5	5	2	5	5	4	4
	D. Green House Gas (GHG) emission – Pollution control devices, regulation compliances, effluent treatments, recycling and removal, use of ODS	5	5	5	5	5	3	4	5	4	5	5	5	4	5	5	5	5	5	5	5	4	5
	E. Other atmospheric emissions – Condition of air conditioning plants, refrigerants, and presence of plants that remove air pollutants.	3	5	4	5	5	2	3	5	4	3	4	5	3	5	5	5	5	3	3	4	4	5
	F. Solid and liquid waste – Waste disposal technologies	4	5	4	5	5	4	5	5	5		4	5	4	5	4	5	3	5	5	5	4	5
	G. Indoor air quality – Absence of indoor pollution nets, ventilation, natural lighting and acoustics, noise abatement	3	4	4	3	1	3	4	4	4	5	5	1	5	5	4	5	3	3	5	4	5	5
	H. Durability, Adaptability and Flexibility – Suitability of building materials for refurbishment.	2	5	3	3	5	2	2	4	4	5	5	4	4	4	3	4	3	5	5	5	4	4
	*I. Compliance with Fire, and other safety regulations and *updates*	4	5	5	5	5	3	3	4	5	4	5	5	5	5	3	5	5	5	5	4	5	5
	J. Factory facilities – Lifts and escalators	3	5	3	4	4	2	1	3	3	4	5	4	4	5	2	4	2	2		4	2	3
	*K. Chemicals and Materials Storage,including Warehousing**		4	3	5	3	3		4	4	5	5							4	2			
	*L. Technical Skills of Workers and Reward Systems**		3	2	2	5		2				5		5		5			3	4		3	
	*M. Facilities Maintenance Management**	3	2	2	3		2					4							2			3	
	*N. Intermittent Environmental Analyses**	4		4	3	5			5	4	3			4	4		5	4		4		3	
	A. Public transport availability	1	3	3		5	4	3	3	3	2		4	4	5	4	4	2	1	3	4	5	3

2. Social aspects (Boyd, 2005; Madew, 2006; RICS, 2009: Addae-Dappah *et al.*, 2009, Cheng and Venkataraman, 2013; Von Thilo Elbert *et al.,* 2013)	B. Compliance with health and safety regulations	5	5	4	5	4	3	3	5	5	4	5	5	5	5	4	4	5	5	5	5	5	5
	C. Quality of communal service areas	2	4	3	4	5	3	2	5	3	2	4	5	4	4		4	3	4	4	5	5	5
	D. Awareness and training in emergency response	5	4	4	4	5	3	3	5	4	2	5	5	4	3	4	4	5	4	5	5	5	5
	E. Appropriate training for Security Personnel4	4	3	3	4	5	4	2	5	4	2	5	5	4	2	3	4	5	3	5	5	5	5
	F. Appropriate training for Public Relations personnel	3	4	3	4	5	4	2	5	3	2	5	5	3	3	3	4	4	3	4	4	3	5
	G. Accident First aid facilities and procedures	4	5	3	4	5	2	3	5	5	2	5	5	4	4	4	5	5	5	5	5	5	5
	H. Wheelchair access		3	4	3	4	1	2	5	3	2	4	4	2	3	3	4	4	3		4	4	5
	I. Restrictions, Appropriate Signage and Guides*											5											
3. Economic Aspects (Boyd, 2005; Madew, 2006; RICS, 2009: Addae-Dappah *et al.*, 2009, Cheng and Venkataraman, 2013; Von Thilo Elbert *et al.,* 2013)	A. Standard of service delivery	3	4	4	4	5	3	4	5	5	4	5	5	4	5	4	4	5	5	5	5	4	5
	B. Savings from reduced energy, water and wastes.		4	3	4	5	3	3	5	4	5	5	2	5	4	5	4	4	3	4	5	4	5
	C. Adequate public liability and service provider insurance	2	5	4	4	4	4	2	5	5	3	5	4	3	3	4	4	2	3	5	4	5	5
	D. Workers' productivity and health	5	4	4	4	5	4	3	5	5	3	5	5	4	5	5	5	5	5	5	5	5	5
	E. Transparency of marketing agreements	3	4	3	3		3	2	4	4	3	5		3	4	4	4	3	4	4	4	5	4
	F. Monitoring stakeholders' concerns	3	5	4	3	5	3	3	4	4	3	5	3	4	4	4	4	5	3	5	4	5	4
	G. Provisions of Reserves for possible remediation*								5	4													
4. Cultural, Location and Urban Planning Related. (Boyd, 2005; RICS, 2009: Lützkendorf and Lorenz (2012)	A. Proximity to town centres and malls	1	2	3	3	3	4	1	4	2		5		3	2	4	3	3	5	2	4	3	3
	B. Availability of appropriate internal circulation	3	3	3	3	4	4	2	4	4	4	5	3	5	4	4	4	3	3	3	4	3	3
	C. Compliance with space standards	3	5	4	5	5	3	3	4	4	5	5	4	5	3	5	4	5	3	4	4	3	2
	D. Proximity to child care facilities	5	1	3	3	1	3	4	4	3	3	4	4	3	2	5	4	3	1	1	4	5	
	E. Connection with designated green space	1	3	4	3	2	2	4	4	3	4	5	4	4	3	5	4	5	1	4	4	4	4
	Land use – F. Quality of overall built environment	5	3	4	5	4	3	3	4	4	5	5	5	5	4	4	3	5	4	5	5	4	5
	G. Recognition of indigenous people through cultural space.	4	3	4	3	5	3	3	4	3	3	4	4	3	3	5	3	5	2	4	2	3	3
	H. Preservation of heritage values	4	4	4	3	4	4	3	4	3	4	5	4	3	3	5	3	3	3	5	4	4	3
	I. Corporate Social Responsibility	4		5		5	4	3	4	3	4	5		3	4	5	4	5	3	5	4	5	5

The four sustainability dimensions (1-4 in Table 5.4) are the paths depicting the linkages and interactions among the pillars of sustainable development.

The new additions mentioned in section 5.2.2.4 are 1(l), (K), (L): 2(I) and 3(G). The findings indicate thirty-nine (39) sustainability indicators. The distribution of the indicators across the dimensions of sustainability are as follows: Green features/Environmental (14); Social (9); Economic (7); Planning/Cultural (9) (Table 5.4). Further analysis with regard to the relative importance and the ranking of the indicators within each dimension is contained in section 5.2.2.5.

5.2.2.5 Analysis of the Relative Importance and Group Ranking of the Indicators

This study adopted the descriptive importance index rating to arrive at an ordered comprehensive array of factors in the selection list. The importance index scores were determined from the experts' selection list. The experts identified 39 indicators 1-A to 1-1N, 2A-2I, 3A-3F and 4A-4I (Table 5.4). Table 5.5 also depicts the thirty-nine (39) relevant sustainability indicators. These selections illustrate the outcomes of the indicators selected by the Experts in the first round of the exercise. During the first round, the Experts were asked to rate the importance of SIs in each of the 4 dimensions on the Likert scales, including the additions and modifications. The additions and modifications were maintained since no further changes were noted in experts' responses. The importance index score was determined from the aggregated experts' ratings in Table 5.4 for the group ranking. Table 5.5 presents the 39 indicators, their RIIs, and RII-based group rankings

Table 5.5 - RIIs and Group ranking of indicators by Experts (Source: this study, 2016)

Dimensions	Sustainability Issues/Indicators	RII	R
1. Environmental Building and Process – Related (Green Features) [14]	*A. Consumption of non-renewable energies* (e.g. coal, oil, and gas) / Evidence of alternative energy supplies	89.1	4
	B. Water Consumption – Portable, hygiene and cooling towers, water recycling, recovery, reuse, and capture measures + waste water reduction	87.0	5
	C. Materials Consumption - Ecological impacts of materials used for construction	85.2	6
	D. Green House Gas (GHG) emission – Pollution control devices, regulation compliances, effluent treatments, recycling and removal, use of ODS	90.4	2
	E. Other atmospheric emissions – Condition of air conditioning plants, refrigerants, and the presence of plants that remove air pollutants.	80.9	7
	F. Solid and liquid waste – Waste disposal technologies	90.0	3
	G. Indoor air quality – Absence of indoor pollution nets, ventilation, natural lighting and acoustics, noise abatement	76.4	8
	Durability, Adaptability, and Flexibility – H. Suitability of building materials for refurbishment.	75.5	9
	I. Compliance with Fire, and other regulations and updates	90.9	1
	Factory facilities – J. Lifts and escalators	64.8	12
	K. Chemicals and Materials Storage, including Warehousing	73.3	10
	L. Technical Skills of Workers and Reward Systems	73.3	10
	M. Facilities Maintenance Management	85.0	8
	N. Intermittent Environmental Analyses	86.7	6
2. Social aspects [9]	A. Public transport availability	70.5	9
	B. Compliance with health and safety regulations	91.8	2
	C. Quality of communal service areas	74.3	6
	D. Awareness and training in emergency response	86.4	3
	E. Appropriate training for Security Personnel	80.0	5
	F. Appropriate training for Public Relations personnel	70.4	8
	G. Accident First aid facilities and procedures	83.5	4
	H. Wheelchair access	67.0	7
	I. Restrictions, Appropriate Signage and Guides	93.3	1
3. Economic Aspects [7]	A. Standard of service delivery	84.3	4
	B. Savings from reduced energy, water and wastes.	77.1	6
	C. Adequate public liability and service provider insurance	86.4	3
	D. Workers' productivity and health	90.9	2
	E. Transparency of marketing agreements	72.0	7
	F. Monitoring stakeholders' concerns	79.1	5
	G. Provisions for Reserves for possible remediation	93.3	1
4. Cultural, Location and Urban Planning-Related [9]	A. Proximity to town centres and malls	60.0	9
	B. Availability of appropriate internal circulation	70.0	5
	C. Compliance with space standards	74.4	3
	D. Proximity to child care facilities	61.9	8
	E. Connection with designated green space	70.0	5
	Land use – F. Quality of overall built environment	86.0	1
	G. Recognition of indigenous people through cultural space.	68.7	7
	H. Preservation of heritage values	73.3	4
	I. Corporate Social Responsibility	83.2	2

$$RII = \frac{\sum W}{A*N}$$

Where W - weighting given to each statement by the respondent ranging from 1-5
N-Total number of respondents; A-Higher Response Integer (5)

The following observations can be made about the results of findings in Table 5.5. It is revealed that there are varying degrees of importance placed on the various identified factors or indicators. However, all the indicators are either very important or of secondary mportance in so far as they are mutually interdependent and closely confined to their groups

Environmental Indicators (Building and Process-Related or Green Features) - Compliance with fire and other safety regulations and updates, pollution control devices, regulation compliances, effluent treatments, recycling and removal, use of ozone depleting substances (ODS), waste disposal technologies and evidence of renewable alternative energy supplies are the very important factors in this dimension. On the other end, the factors of secondary importance are water and materials consumption, indoor air quality and materials storage. Considering the prevalence of fire disasters across the classes of properties, it is to be expected the observation that the responses by panels are in tandem with the ground reality.

Social indicators: Restrictions, Appropriate Signage and Guides, compliance with health and safety regulations, awareness and training in emergency response, and accident first aid facilities are the very important factors in the social dimension. This finding hinges on health and safety and provides specific support for fire and other regulations that can enhance workers' productivity and customers' patronage. The secondary important factors are the availability of public transport and appropriate training for security and public relations personnel.

Economic indicators: Provisions of reserves for possible remediation, workers' productivity and health, adequate public liability, and service provider insurance and standard of service delivery are the most important factors. Of secondary importance are monitoring stakeholders' concerns, savings from reduced energy, water and wastes, and transparency of marketing agreements. It is important to have reserves for immediate remediation as most LDCs lack the appropriate pollution prevention technologies. Remediation measures regarding life premium and work in progress insurance might be the prime considerations

Cultural, Location and Urban Planning Related indicator: Quality of overall built environment, corporate social responsibility, compliance with space standards and preservation of heritage values are the most important factors in this dimension. Planning and cultural heritage preservations are indispensable in the scheme of socio-cultural sustainability. CSR and compliance with site area ratio and other planning regulations and are essential components of sustainability.

Many GBRTs present differing scores to reflect the weights attached to each indicator according to the ground realities of the regions they cover. In the view of South Africa's SBAT theory of balance, all the sustainability indicators are equally important and carry the same weight of 10/2=5. This study aligns with the equal scoring system of the GreenstarSA (2007, 2014) because of its comprehensiveness. Besides, the reality of the indicators is that they are mutually complementary and negatively correlated (A small variation could lead to significant consequences). Equal importance is attached to all the indicators

5.2.2.6 Analysis of the Sustainability Indicators Scoring and Ranking by Panels A and B

The Delphi method seeks the answers to the Delphi Research Question 2. At this stage, the experts are assigned into two panels A and B by the KRNW Team according to the experts' core competences (Table 5.6) as follows:

PANEL A: Academics and Professionals
(University Lecturers (4), Professional Estate Valuers (4), Urban Planners (1), Builders (1), Land Economists (1),

PANEL B: Environmental Managers and Consultants
Environment and Safety Officers (8), Private Consultants (1), Pollution Experts (1), Process Engineers (1) Soil Scientists (1).

Table 5.6. Labelling of Delphi Experts into Panels A and B (this study, 2016)

EXPERTS' LABELS	GROUP A: Qualifications, Experience & Designations (ACADEMICS & PROFESSIONALS)
EXP-A1	Professional Valuer *(R.13)* M. Tech Real Estate, MURP Urban & Regional Planning + 27yrs experience
EXP-A2	Academic *R1* PhD Environmental Valuation + 21yrs experience
EXP-A3	Professional Valuer *R.23* MSc (Housing), ANIVS, RSV + 28yrs experience
EXP-A4	Academic *R.3* PhD Urban, Regional Planning & Environment. + 31yrs experience

EXPERTS' LABELS	GROUP B: Qualifications, Experience & Designations (ENVIRONMENTAL MANAGERS & CONSULTANTS)
EXP-B1	Enforcement Officer - Government Official (*R.15)* MSc (Env. Science) + 15yrs experience
EXP-B2	Government Official, LASEPA. R3 MSc (Env. Magt) + 22yrs experience
EXP-B3	Chemical/Process Engineer *R.19* MSc (Chemical Engineering) + 26years experience.
EXP-B4	Enforcement Officer Government Official, NESREA *R.17* MSc (Environmental Studies) 17yrs experience

EXP-A5	Professional Builder *R.9* PhD Building Maintenance) + 20yrs experience
EXP-A6	Academic *R.6* PhD Real Estate Valuation & Sustainability + 31yrs experience
EXP-A7	*Professional Valuer R.12* PhD Real Estate Valuation, + 28yrs experience
EXP-A8	Academic *R.1* PhD Wetland Valuation + 24yrs experience
EXP-A9	Land Economist R.3 PhD Land Economics +33yrs experience
EXP-A10	Professional Urban Planner MSc Urban & Professional Planning + 24yrs experience. *R.21*
EXP-A11	*Professional Estate Valuer* MSc Est.Mgt), RSV + 17yrs experience. *R.18*

EXP-B5	Pollution Expert, *R.7* MSc Pollution Chemistry + 16yrs experience
EXP-B6	Snr Enforcement Officer Government Official, NESREA + 21yrs experience. *R.16*
EXP-B7	Government Official, Director, LASEPA R.13 MSc (Env Mgt) + 32yrs experience
EXP-B8	CEO, *Environmental Consultant* MSc (Env. Mgt), MNES + 23yrs experience. *R.10*
EXP-B9	Environmental Officer Environmental Unit & Safety Officer, BP R.3 19yrs experience
EXP-B10	Environmental Officer Environmental Unit & Safety Officer, BP 17yrs experience. *R.11*
EXP-B11	Soil Science Expert *R.22* (MSc Soil Science) University Putra Malaysia 17yrs experience
EXP-B12	Senior Enforcement Officer, NESREA MSc (Safety Engineering) *R.19* 18yrs experience

The Delphi questionnaire 4 lists the thirty-nine (39) items for scoring and distributes the same questionnaire to them. The experts, as two panels, score the extent to which the industrial sustainability features meet the perceived requirements, that is, the sustainability capacity of the industry. The scoring is based on the outlines presented in section 4.4.1.2(n):

(1) A one-time individual visit to the industry by the experts

(2) Direct observation by the experts

(3) Individual study of the Environmental Audit Report (EAR)

(4) EAR leads provided by the researcher

(5) GreenstarSA (2007, 2014) equal scoring weight of 5 (i.e. 10/2) for each of the indicators.

The score sheet and guides are attached as Appendix F1

5.2.2.7 Analysis of the Consensus between Panels A and B Ranks: The First Level of Construct Validity

The score ranks ® is based on the means of all ISRO-CF indicated as the mean of all the ASCS scoring by each expert. The results of the industrial sustainability scoring are presented in Tables 5.7 and 5.8 as follows:

Table 5.7 Experts' Scores: Panel A – Academics and Professionals (this study, 2016)

		ENVIRONMENTAL ASPECTS														SOCIAL ASPECTS							
EXPERTS		1I	1D	1F	1A	1B	1N	1C	1M	1E	1G	1H	1K	1L	1J	2I	2B	2D	2G	2E	2C	2H	2F
	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
*EXP-A1	ASCS	7	8	7	8	8	8	6	6	7	7	8	7	9	9	9	8	8	7	7	7	6	7
	ISRO	*0.3*	*0.2*	*0.3*	*0.2*	*0.2*	*0.2*	*0.4*	*0.4*	*0.3*	*0.3*	*0.2*	*0.3*	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.3*	*0.3*	*0.3*	*0.4*	*0.3*
	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
*EXP-A2	ASCS	10	8	9	8	7	8	8	7	7	8	9	6	10	9	10	7	9	9	9	9	7	9
	ISRO	*0.0*	*0.2*	*0.1*	*0.2*	*0.3*	*0.2*	*0.2*	*0.3*	*0.3*	*0.2*	*0.1*	*0.4*	*0.0*	*0.1*	*0.0*	*0.3*	*0.1*	*0.1*	*0.1*	*0.1*	*0.3*	*0.1*
*EXP-A3	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	7	7	6	6	7	4	5	5	7	5	6	4	6	4	8	5	6	7	7	5	4	6
	ISRO	*0.3*	*0.3*	*0.4*	*0.4*	*0.3*	*0.6*	*0.5*	*0.5*	*0.3*	*0.5*	*0.4*	*0.6*	*0.4*	*0.6*	*0.2*	*0.5*	*0.4*	*0.3*	*0.3*	*0.5*	*0.6*	*0.4*
*EXP-A4	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	8	9	7	9	9	9	9	7	7	8	8	8	9	9	9	9	10	9	9	9	8	8
	ISRO	*0.2*	*0.1*	*0.3*	*0.1*	*0.1*	*0.1*	*0.1*	*0.3*	*0.3*	*0.2*	*0.2*	*0.2*	*0.1*	*0.1*	*0.1*	*0.1*	*0.0*	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*
*EXP-A5	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	8	8	6	8	8	5	7	6	6	5	4	6	9	9	9	9	9	9	8	8	6	9
	ISRO	*0.2*	*0.2*	*0.4*	*0.2*	*0.2*	*0.5*	*0.3*	*0.4*	*0.4*	*0.5*	*0.6*	*0.3*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.2*	*0.2*	*0.4*	*0.1*
*EXP-A6	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	9	9	9	8	8	7	7	7	8	7	9	4	9	9	10	9	8	9	9	10	7	8
	ISRO	*0.3*	*0.2*	*0.3*	*0.2*	*0.2*	*0.2*	*0.4*	*0.4*	*0.3*	*0.3*	*0.2*	*0.3*	*0.1*	*0.1*	*0.0*	*0.1*	*0.2*	*0.1*	*0.1*	*0.0*	*0.3*	*0.2*
*EXP-A7	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	7	7	6	5	7	4	5	6	7	6	6	5	6	4	8	5	7	7	6	5	6	6
	ISRO	*0.3*	*0.3*	*0.4*	*0.5*	*0.3*	*0.6*	*0.5*	*0.4*	*0.3*	*0.4*	*0.4*	*0.5*	*0.4*	*0.6*	*0.2*	*0.5*	*0.3*	*0.3*	*0.4*	*0.5*	*0.4*	*0.4*
*EXP-A8	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	6	7	7	6	7	7	6	6	7	6	6	8	7	5	6	6	5	5	7	5	4	3
	ISRO	*0.4*	*0.3*	*0.3*	*0.4*	*0.3*	*0.3*	*0.4*	*0.4*	*0.3*	*0.4*	*0.4*	*0.2*	*0.3*	*0.5*	*0.4*	*0.4*	*0.5*	*0.5*	*0.3*	*0.5*	*0.6*	*0.7*

Table 5.7, continued: Experts' Scores: Panel A – Academics and Professionals (this study, 2016)

*EXP-A9	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	7	5	5	5	4	6	5	6	5	7	7	5	7	6	5	8	6	6	5	7	6	7
	ISRO	*0.3*	*0.5*	*0.5*	*0..5*	*0.6*	*0.4*	*0.5*	*0.4*	*0.5*	*0.3*	*0.3*	*0.5*	*0.3*	*0.4*	*0.5*	*0.4*	*0.4*	*0.4*	*0.5*	*0.3*	*0.4*	*0.3*
*EXP-A10	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	6	7	6	7	7	7	5	5	6	6	7	7	7	7	7	7	6	6	6	6	6	6
	ISRO	*0.4*	*0.3*	*0.4*	*0.3*	*0.3*	*0.3*	*0.5*	*0.5*	*0.4*	*0.4*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*	*0.4*
*EXP-A11	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	10	8	8	8	8	6	8	5	6	5	5	9	8	6	5	5	7	3	8	7	7	9
	ISRO	*0.0*	*0.2*	*0.2*	*0.2*	*0.2*	*0.4*	*0.2*	*0.5*	*0.4*	*0.5*	*0.5*	*0.1*	*0.2*	*0.4*	*0.5*	*0.5*	*0.3*	*0.5*	*0.2*	*0.3*	*0.3*	*0.1*

Table 5.7 continued: Experts' Scores: Panel A – Academics and Professionals (this study, 2016)

		ECONOMIC ASPECTS								PLANNING/CULTURAL												
EXPERTS		2A	3G	3D	3C	3A	3F	3B	3E	4F	4I	4C	4H	4E	4B	4G	4D	4A	∑ASCS	N	M	R
	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
*EXP-A1	ASCS	7	6	5	7	7	6	7	6	7	7	6	6	7	9	9	6	8	281	39	7.21	3
	ISRO	*0.3*	*0.4*	*0.5*	*0.3*	*0.3*	*0.4*	*0.3*	*0.4*	*0.3*	*0.3*	*0.4*	*0.4*	*0.3*	*0.1*	*0.1*	*0.4*	*0.2*				
	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
*EXP-A2	ASCS	9	7	2	4	9	8	2	2	8	6	6	2	7	*8*	2	2	8	273	39	7.00	4
	ISRO	*0.1*	*0.3*	*0.8*	*0.6*	*0.1*	*0.2*	*0.8*	*0.8*	*0.2*	*0.4*	*0.4*	*0.8*	*0.3*	*0.2*	*0.8*	*0.8*	*0.2*				
*EXP-A3	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	6	6	3	6	8	8	3	3	7	5	5	3	6	8	3	3	7	217	39	5.56	11
	ISRO	*0.4*	*0.4*	*0.7*	*0.4*	*0.2*	*0.2*	*0.7*	*0.7*	*0.3*	*0.5*	*0.5*	*0.7*	*0.4*	*0.2*	*0.7*	*0.7*	*0.3*				
*EXP-A4	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	9	8	6	8	9	6	8	6	9	8	8	7	7	10	8	7	9	322	39	8.26	1
	ISRO	*0.1*	*0.2*	*0.4*	*0.2*	*0.3*	*0.4*	0.2	*0.4*	*0.1*	*0.2*	*0.2*	*0.3*	*0.3*	*0.0*	*0.2*	*0.3*	*0.1*				
*EXP-A5	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	9	5	4	8	8	9	4	4	8	7	5	5	8	9	4	4	9	272	39	6.97	6
	ISRO	*0.1*	*0.5*	*0.6*	*0.2*	*0.2*	*0.1*	*0.6*	*0.6*	*0.2*	*0.3*	*0.5*	*0.5*	*0.2*	*0.1*	*0.6*	*0.6*	*0.1*				
*EXP-A6	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	8	8	7	6	8	9	9	7	9	7	7	6	8	9	7	7	8	310	39	7.95	2
	ISRO	*0.2*	*0.2*	*0.3*	*0.4*	*0.2*	*0.1*	*0.1*	*0.3*	*0.1*	*0.3*	*0.3*	*0.4*	*0.2*	*0.1*	*0.3*	*0.3*	*0.2*				
*EXP-A7	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	7	6	4	5	7	8	4	5	8	6	6	4	7	7	5	5	6	231	39	5.92	9
	ISRO	*0.3*	*0.4*	*0.6*	*0.5*	*0.3*	*0.2*	*0.6*	*0.5*	*0.2*	*0.4*	*0.4*	*0.6*	*0.3*	*0.3*	*0.5*	*0.5*	*0.4*				
*EXP-A8	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	7	5	6	5	6	6	5	5	7	6	5	5	6	6	7	8	9	238	39	6.11	8
	ISRO	*0.3*	*0.5*	*0.4*	*0.5*	*0.4*	*0.4*	*0.5*	*0.5*	*0.3*	*0.4*	*0.5*	*0.5*	*0.4*	*0.4*	*0.3*	*0.2*	*0.1*				
*EXP-A9	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	6	5	5	5	6	6	5	6	7	6	6	6	4	5	5	5	5	223	39	5.72	10
	ISRO	*0.4*	*0.5*	*0.5*	*0.5*	*0.4*	*0.4*	*0.5*	*0.4*	*0.3*	*0.4*	*0.4*	*0.4*	*0.6*	*0.5*	*0.5*	*0.5*	*0.5*				
EXP-A10	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	7	5	7	4	6	4	5	4	6	6	6	7	7	8	7	5	7	241	39	6.12	7
	ISRO	*0.3*	*0.5*	*0.3*	*0.6*	*0.4*	*0.6*	*0.5*	*0.6*	*0.4*	*0.4*	*0.4*	*0.5*	*0.3*	*0.2*	*0.3*	*0.5*	*0.3*				
EXP-A11	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	9	7	6	6	10	10	5	7	8	8	5	5	10	8	9	7	8	273	39	7.00	4
	ISRO	*0.1*	*0.3*	*0.4*	*0.4*	*0.0*	*0.0*	*0.5*	*0.3*	*0.2*	*0.2*	*0.5*	*0.5*	*0.0*	*0.2*	*0.1*	*0.3*	*0.2*				

Table 5.8 Experts' Scores: Group B – Environmental Managers & Consultants (this study, 2016)

		ENVIRONMENTAL ASPECTS														SOCIAL ASPECTS							
EXPERTS		1I	1D	1F	1A	1B	1N	1C	1M	1E	1G	1H	1K	1L	1J	2I	2B	2D	2G	2E	2C	2H	2F
	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
EXP-B1	ASCS	10	10	5	8	10	8	8	8	8	6	10	6	10	10	10	8	10	10	10	10	10	10
	ISRO	*0.0*	*0.0*	*0.5*	*0.2*	*0.0*	*0.2*	*0.2*	*0.2*	*0.2*	*0.4*	*0.0*	*0.4*	*0.0*	*0.0*	*0.0*	*0.2*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
EXP-B2	ASCS	*9*	*7*	*7*	*7*	*8*	*6*	*7*	*8*	*7*	*6*	*8*	*7*	*9*	*7*	*9*	*9*	*9*	*8*	*9*	*8*	*7*	*8*
	ISRO	0.1	0.3	0.3	0.3	0.2	0.4	0.3	0.2	0.3	0.4	02	0.3	0.1	0.3	0.1	0.1	0.1	0.2	0.1	0.2	0.3	0.2
EXP-B3	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	*10*	*10*	*6*	*8*	8	5	7	5	5	5	10	5	10	10	10	10	5	9	7	5	5	9
	ISRO	0.0	0.0	0.4	0.2	0.2	0.5	0.3	0.5	0.5	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.1	0.3	0.5	0.5	0.1
EXP-B4	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	*7*	*5*	6	6	7	6	7	8	7	6	8	7	9	7	8	9	7	8	7	8	7	8
	ISRO	0.1	0.3	0.4	0.4	0.3	0.4	0.3	0.2	0.3	0.4	02	0.3	0.1	0.3	0.1	0.1	0.1	0.2	0.3	0.2	0.3	0.2
EXP-B5	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	*10*	*8*	*7*	*10*	*6*	*9*	8	6	6	10	10	8	9	9	9	9	9	9	7	7	6	7
	ISRO	0.0	0.2	0.3	0.0	0.4	0.1	0.2	0.4	0.4	0.0	0.0	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.3	0.3	0.4	0.0
EXP-B6	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	9	9	9	8	8	7	7	7	8	7	9	4	9	9	10	9	8	9	9	10	7	8
	ISRO	*0.3*	*0.2*	*0.3*	*0.2*	*0.2*	*0.2*	*0.4*	*0.4*	*0.3*	*0.3*	*0.2*	*0.3*	*0.1*	*0.1*	*0.0*	*0.1*	*0.2*	*0.1*	*0.1*	*0.0*	*0.3*	*0.2*
EXP-B7	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	7	7	6	5	7	4	5	6	7	6	6	5	6	4	8	5	7	7	6	5	6	6
	ISRO	*0.3*	*0.3*	*0.4*	*0.5*	*0.3*	*0.6*	*0.5*	*0.4*	*0.3*	*0.4*	*0.4*	*0.5*	*0.4*	*0.6*	*0.2*	*0.5*	*0.3*	*0.3*	*0.4*	*0.5*	*0.4*	*0.4*
EXP-B8	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	6	7	7	6	7	7	6	6	7	6	6	8	7	5	6	6	5	5	7	5	4	3
	ISRO	*0.4*	*0.3*	*0.3*	*0.4*	*0.3*	*0.3*	*0.4*	*0.4*	*0.3*	*0.4*	*0.4*	*0.2*	*0.3*	*0.5*	*0.4*	*0.4*	*0.5*	*0.5*	*0.3*	*0.5*	*0.6*	*0.7*
EXP-B9	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	ASCS	7	5	5	5	4	6	5	6	5	7	7	5	7	6	5	8	6	6	5	7	6	7
	ISRO	*0.3*	*0.5*	*0.5*	*0..5*	*0.6*	*0.4*	*0.5*	*0.4*	*0.5*	*0.3*	*0.3*	*0.5*	*0.3*	*0.4*	*0.5*	*0.4*	*0.4*	*0.4*	*0.5*	*0.3*	*0.4*	*0.3*

Table 5.8, continued: Experts' Scores: Group B – Environmental Managers & Consultants (this study, 2016)

EXP- B10	TSCS ASCS ISRO	10 6 0.4	10 7 0.3	10 6 0.4	10 7 0.3	10 7 0.3	10 7 0.3	10 5 0.5	10 5 0.5	10 6 0.4	10 6 0.4	10 7 0.3	10 7 0.3	10 7 0.3	10 7 0.3	10 7 0.3	10 7 0.3	10 6 0.4	10 6 0.4	10 6 0.4	10 6 0.4	10 6 0.4	10 6 0.4
EXP- B11	TSCS ASCS ISRO	10 6 0.4	10 7 0.3	10 5 0.5	10 6 0.4	10 10 0.0	10 8 0.2	10 8 0.2	10 8 0.2	10 8 0.2	10 6 0.4	10 9 0.1	10 6 0.4	10 9 0.0	10 9 0.0	10 10 0.0	10 8 0.2	10 10 0.0	10 9 0.1	10 10 0.0	10 10 0.0	10 9 0.1	10 10 0.0
EXP- B12	TSCS ASCS ISRO	10 7 0.3	10 5 0.5	10 5 0.5	10 5 0.5	10 5 0.5	10 4 0.6	10 6 0.4	10 5 0.5	10 6 0.4	10 5 0.5	10 5 0.5	10 5 0.5	10 5 0.5	10 5 0.5	10 5 0.5	10 6 0.4	10 5 0.5	10 5 0.5	10 7 0.5	10 3 0.7	10 6 0.4	10 7 0.3
EXP- B4	TSCS ASCS ISRO	10 7 0.1	10 5 0.3	10 6 0.4	10 6 0.4	10 7 0.3	10 6 0.4	10 7 0.3	10 8 0.2	10 7 0.3	10 6 0.4	10 8 02	10 7 0.3	10 9 0.1	10 7 0.3	10 8 0.1	10 9 0.1	10 7 0.1	10 8 0.2	10 7 0.3	10 8 0.2	10 7 0.3	10 8 0.2

Table 5.8, continued: Experts' Scores: Group B – Environmental Managers & Consultants (this study, 2016)

		ECONOMIC ASPECTS								PLANNING/CULTURAL												
EXPERTS		2A	3G	3D	3C	3A	3F	3B	3E	4F	4I	4C	4H	4E	4B	4G	4D	4A	∑ASCS	*N*	M	R
EXP-B1	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	10	8	6	10	10	5	10	5	8	4	4	9	9	3	4	10	6	316	39	8.10	1
	ISRO	0.0	0.2	0.4	0.0	0.0	0.5	0.0	0.5	0.2	0.6	0.6	0.1	0.1	0.7	0.6	0.0	0.4				
EXP-B2	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	9	8	7	8	8	8	6	7	9	6	5	5	5	5	5	5	6	285	39	7.31	6
	ISRO	0.1	0.2	0.3	0.2	0.2	0.2	0.4	0.3	0.1	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.4				
EXP-B3	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	10	5	4	10	10	9	6	6	8	8	5	7	9	9	8	8	9	231	39	5.92	10
	ISRO	0.0	0.5	0.6	0.0	0.0	0.1	0.4	0.4	0.2	0.2	0.5	0.5	0.1	0.1	0.2	0.2	0.1				
EXP-B4	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	4	6	6	5	5	4	5	5	4	3	4	5	6	5	6	6	5	301	39	7.95	2
	ISRO	0.6	0.4	0.4	0.5	0.5	0.6	0.5	0.5	0.6	0.7	0.6	0.5	0.4	0.5	0.4	0.4	0.5				
EXP-B5	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	7	8	7	8	8	8	6	6	7	7	8	7	9	9	5	5	5	295	39	7.56	4
	ISRO	0.0	0.6	0.5	0.6	0.1	0.1	0.8	0.8	0.0	0.4	0.6	0.7	0.1	0.0	0.5	0.5	0.5				
EXP-B6	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	8	8	7	6	8	9	9	7	9	7	7	6	8	9	7	7	8	288	39	7.38	5
	ISRO	0.2	0.2	0.3	0.4	0.2	0.1	0.1	0.3	0.1	0.3	0.3	0.4	0.2	0.1	0.3	0.3	0.2				
EXP-B7	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	7	6	4	5	7	8	4	5	8	6	6	4	7	7	5	5	6	242	39	6.21	8
	ISRO	0.3	0.4	0.6	0.5	0.3	0.2	0.6	0.5	0.2	0.4	0.4	0.6	0.3	0.3	0.5	0.5	0.4				
EXP-B8	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	7	5	6	5	6	6	5	5	7	6	5	5	6	6	7	6	9	244	39	6.26	7
	ISRO	0.3	0.5	0.4	0.5	0.4	0.4	0.5	0.5	0.3	0.4	0.5	0.5	0.4	0.4	0.3	0.4	0.1				
EXP-B9	TSCS	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10				
	ASCS	6	5	5	5	6	6	5	6	7	6	6	6	4	5	5	5	5	231	39	5.92	10
	ISRO	0.4	0.5	0.5	0.5	0.4	0.4	0.5	0.4	0.3	0.4	0.4	0.4	0.6	0.5	0.5	0.5	0.5				

Table 5.8, continued: Experts' Scores: Group B – Environmental Managers & Consultants (this study, 2016)

		ECONOMIC ASPECTS								PLANNING/CULTURAL													
EXP-B10	TSCS ASCS ISRO	10 *7* 0.3	10 *5* 0.5	10 *7* 0.3	10 5 0.5	10 6 0.4	10 4 0.6	10 5 0.5	10 4 0.6	10 6 0.4	10 6 0.4	10 6 0.4	10 7 0.5	10 7 0.3	10 8 0.2	10 7 0.3	10 5 0.5	10 7 0.3	242	39	6.21	8	
EXP-B11	TSCS ASCS ISRO	10 *5* 0.5	10 *7* 0.3	10 *6* 0.4	10 *7* 0.3	10 7 0.3	10 8 0.2	10 6 0.4	10 6 0.4	10 8 0.2	10 8 0.2	10 5 0.5	10 7 0.3	10 9 0.1	10 9 0.1	10 8 0.2	10 8 0.2	10 7 0.3	310	39	7.95	2	
EXP-B12	TSCS ASCS ISRO	10 *4* 0.6	10 *5* 0.5	10 *5* 0.5	10 5 0.5	10 5 0.5	10 5 0.5	10 5 0.5	10 5 0.5	10 5 0.5	10 3 0.7	10 3 0.7	10 5 0.5	10 3 0.7	10 5 0.5	10 6 0.4	10 6 0.4	10 5 0.5	197	39	5.05	12	

Legend of the Thirty-nine (39) Sustainability Issues/Indicators

1. ENVIRONMENTAL ASPECTS
A. Consumption of non-renewable energies (e.g. coal, oil and gas) / Evidence of alternative energy supplies
B. Water Consumption – Portable, hygiene and cooling towers, water recycling, recovery, reuse, and capture measures + waste water reduction
C. Materials Consumption - Ecological impacts of materials used for construction
D. Green House Gas (GHG) emission – Pollution control devices, regulation compliances, effluent treatments, recycling and removal, use of ODS
E. Other atmospheric emissions – Condition of air conditioning plants, refrigerants, and the presence of plants that remove air pollutants.
F. Solid and liquid waste – Waste disposal technologies
G. Indoor air quality – Absence of indoor pollution nets, ventilation, natural lighting and acoustics, noise abatement
H. Suitability of building materials for refurbishment.
I. Compliance with Fire, and other safety regulations and updates
Factory facilities –
J. Lifts and escalators
K. Chemicals and Materials Storage, including Warehousing
L. Technical Skills of Workers and Reward Systems*
M. Facilities Maintenance Management
N. Intermittent Environmental Analyses

2. SOCIAL ASPECTS
A. Public transport availability
B. Compliance with health and safety regulations
C. Quality of communal service areas
D. Awareness and training in emergency response
E. Appropriate training for Security Personnel4
F. Appropriate training for Public Relations personnel
G. Accident First aid facilities and procedures
H. Wheelchair access
I. Restrictions, Appropriate Signage and Guides

3. ECONOMIC ASPECTS
A. Standard of service delivery
B. Savings from reduced energy, water and wastes.
C. Adequate public liability and service provider insurance
D. Workers' productivity and health
E. Transparency of marketing agreements
F. Monitoring stakeholders' concerns
G. Provisions for Reserves for possible remediation.

4. PLANNING/CULTURAL
A. Proximity to town centres and malls.
B. Availability of appropriate internal circulation.
C. Compliance with space standards
D. Proximity to child care facilities
E. Connection with designated green space
F. Quality of overall built environment
G. Recognition of indigenous people through cultural space.
H. Preservation of heritage values

Notes:

EAR – Environmental Audit Report
TSCS – Total Sustainability Compliance Score (10)
ASCS - Actual Sustainability Compliance Score (1 to 10)
ISRO – Industrial-related Sustainability Obsolescence
Index (TSCS – ASCS) / 10

The results of the mean ASCS ranking of Panels A and B is presented in Table 5.9

Table 5.9: Mean ASCS Score Ranks for Panels A and B as converted from ASCS mean scores (this study, 2016)

PANEL A (EXPERTS)	MEAN =∑ASCS / 39	PANEL A (ASCS SCORE RANKS)
*EXP-A1	7.21	3
*EXP-A2	7.00	4
*EXP-A3	5.56	11
*EXP-A4	8.26	1
*EXP-A5	6.97	6
*EXP-A6	7.95	2
*EXP-A7	5.92	9
*EXP-A8	6.11	8
*EXP-A9	5.72	10
EXP-A10	6.12	7
EXP-A11	7.00	4
SUM OF RANKS		62
Weighted Mean ISRO-CF	73.82/11 = 6.64	

PANEL B (EXPERTS)	MEAN =∑ASCS / 39	PANEL B (ASCS SCORE RANKS)
EXP-B1	8.01	1
EXP-B2	7.31	6
EXP-B3	5.92	10
EXP-B4	7.95	2
EXP-B5	7.56	4
EXP-B6	7.20	5
EXP-B7	6.21	8
EXP-B8	6.26	7
EXP-B9	5.92	10
EXP-B10	6.21	8
EXP-B11	7.95	2
EXP-B12	5.05	12
SUM OF RANKS		75
Weighted Mean ISRO-CF	81.55/12= 6.80	

The table of the mean ASCS Score Ranks for Panels A and B presents absolute differential sums of ranks of 62 and 75 respectively. The indication is that Panel B experts, that is, the environmental managers and consultants, seem to score the sustainability sub-indicators lower than the academics, real estate, and other professionals. Furthermore, Figure 5.1 shows the comparative mean ASCS ranks distribution of the two panels. A tied rank can be observed between EXP-A9 (10) and EXP-B9 (10). Close agreements are also observed between EXP-A3/EXP-B3, EXP-A4/EXP-B4, EXP-A8/EXP-B8, EXP-A10/EXP-B10. However, the descriptive analysis seems to be indicative of some degrees of agreements between the panels. Nevertheless, an inference could not draw on the descriptive basis. The Kendall's W uses the coefficient of concordance ≥ 0.70 to validate statistical concordance between two or more panels (Sumsion, 1998: Green *et al*., 1999)

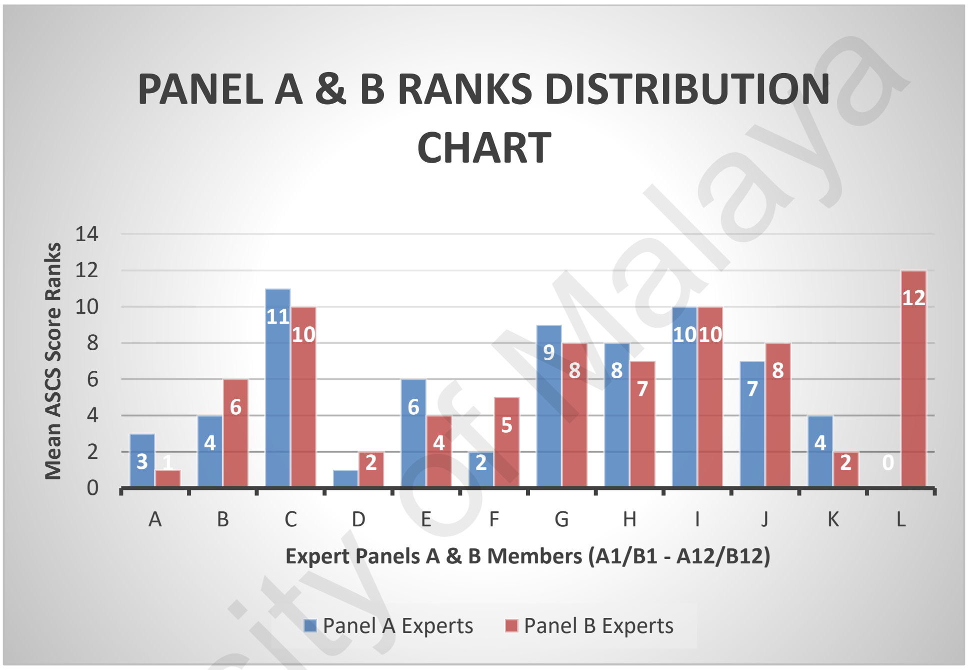


Figure 5.1: Distribution chart showing Panels A & B ranks of mean ASCS Scores (Source: this study, 2016)

Kendall's coefficient of concordance (Kendall's *W*) is a measure of agreement among raters. Kendall's W statistics gives the coefficient of concordance among the ranks assigned by different experts on the different sub-indictors. The analysis uses the mean ASCS ranked score obtained from each expert. Where more than two panels are used, the significance of the W could also be tested through either critical X^2 or F values. The null hypothesis would then be: There is no significant agreement among the two panels of Experts in the ranking of different sub-indicators (Legedre, 2010). The Kendall's W (B1: M3) returns the output presented in Figure 5.2. The RealStats.Xlam EXCEL

Supplemental Function was used and the Coefficient of Concordance, W= 0.711 was obtained.

Kendall's W

W	0.710664
r	0.421329
chi-sq	15.63462
df	11
p-value	0.155247

Fig 5.2 Kendall W Output for Consensus

As in the Table 5.9, the overall weighted ISRO-CF is (6.64 + 6.80) / 2 = 6.71/10=0.671. The ISRO index would then be 3.29/10=0.329

Feedbacks from panellisits in the frame of reasons for their rating of sustainability indicators and the evaluation of sustainability sub-indicator scores rests on the following:

(1) The study of the EAR report and the EAR leads provided by the researcher.

(2) The onsite observation of operations and site facilities during their industrial visits.

(3) Experience in environmental scoring in factory planning consultancies.

(4) To provide basis for the identification of sustainability indicators for priortisation of attention.

The feedback that has been found relate to the reallocation of maximum score from 5 to 10/2.

The main findings are highlighted in sections 5.4.1.2 (a), (b)

5.2.2.8 Analysis of the Validity Considerations of the Delphi Applications

The reliability and validity considerations of the Delphi method in this study rely on the conditions of preliminary validity in the literature. The conditions for the preliminary validity have been presented in section 4.4.1.2(p), (3). These considerations have implications for the validity of the Delphi overall results.

5.2.2.8(a) Content area identification, selection of expert participants and reliability test.

A knowledge resource nomination worksheet (KRNW) research team of two academics and one consultant defined the content area by selecting the important set of experts' disciplines related organisations and applicable laws for the study. The team also ascertains that the selected experts are representative of the area of knowledge, organisations and disciplines (Goodman, 1987; Winkler and Poses, 1993). The study selection complies with the required core competencies in the disciplines and organisations specified by the three-member KRNW Team.

The Delphi study invited forty-five (45) experts to participate out of which thirty-six (36) agreed; Twenty-three (23) experts responded to all the three (3) rounds, whereas 13 experts withdrew voluntarily. The KRNW team certified the list of the experts shown in Table 5.3.

5.2.2.8(b) Delphi First Round Questionnaire Pre-test

In addition to the KRNWs vetting the first round questionnaires for clarity, three (3) experts within the selected group of experts also examined the questions/requests for diction difficulties. Minor revisions were made and the revisions were reflected in the questions. The result is shown in Appendix F2

5.2.2.8 (c) Consensus

There are no agreed proportion of statistics for the CDM, as the level used depemds on the sample numbers, the aim of the research and resources. McKenna (1994), relying on Loughlin and Moore (1979) suggests that consensus which is 51 percent agreement validate the score ranking. Sumsion (1998) insists on 70 percent, whereas Green *et al.* (1999) opts for about 80 percent. However, for the study, the Kendalls W (B1:M3) on the RealStats.Xlam EXCEL Supplimental Function indicated the Coefficient of Concordance to be W=0.711>0.70, at p>0.05

5.2.2.8 (d) Delphi Scores Validation: The Second Level of Construct Validity

The first level of the construct validity test of ranks uses the W Statistic of 0.711>0.70 (section 5.2.2.7). Following Refaeilzadeh *et al.* (2008), the Delphi scores of each panel were tested for significant difference between the scores. The Mann-Whitney U test is a non-parametric test for a between–subjects design using two levels of an independent variable (that is, two panels of experts) and scores that are measured at least at the ordinal level. Ho (2006) states that it is often used in place of the *t*-test for two different groups where there is a violation of the normality requirement or when the data are scaled at a level that is not suitable for the *t*-test. The data set for this analysis is a maximum of 12 such that a normality assumption cannot be made.

The total actual sustainability compliance (ASCS) scoring for Panels A and B Experts is shown in Table 5.10

Table 5.10: The total actual sustainability compliance (ASCS) scoring for Panels A and B Experts (Source: this study, 2016)

PANEL A (EXPERTS)	∑ASCS
*EXP-A1	281
*EXP-A2	273
*EXP-A3	217
*EXP-A4	322
*EXP-A5	272
*EXP-A6	310
*EXP-A7	231
*EXP-A8	238
*EXP-A9	233
EXP-A10	241
EXP-A11	273
	-

PANEL B (EXPERTS)	∑ASCS
EXP-B1	316
EXP-B2	285
EXP-B3	231
EXP-B4	301
EXP-B5	295
EXP-B6	288
EXP-B7	242
EXP-B8	244
EXP-B9	231
EXP-B10	242
EXP-B11	310
EXP-B12	197

Ho (2006) lists the statistical assumptions for a Mann-Whitney U test as follows:

(1) The data must be independent

(2) The data must be measured at least at the ordinal level

(3) The underlying dimension of the dependent variable (that is, the scores) is continuous in nature, even though the actual measurements may be ordinal in nature.

The scores are independent and are measured on the metric scale. Therefore, the data meets the underlying statistical assumptions for a Mann-Whitney U test. The test output is contained in Appendix F2 (1).

The hypothesis tested by the Mann-Whitney U analysis is that the medians of the two panels are equal. The obtained Mann-Whitney U statistic is 58.5. This value, when corrected for tied rankings and converted to a z-score (critical ratio test) is significant at the .644 level. This means that the probability of the two medians being the same is high.

Thus, it can be concluded that there is no significant difference in the median scores of the Delphi Panels A and B at p (.644) >.05.

The findings relating to the reliability, content and construct validity of the Delphi consensus and scores presented in sections 5.2.2.8 (a), (b), (c), (d) can be found in section 5.4.1.2(c)

5.2.3 Development of the Valuation Approach for sustainability integration into Real Estate valuation.

For the development of the valuation approach for the integration of industrial sustainability, some theoretical considerations were explored in section 5.2.3.1.

5.2.3.1 The Theoretical Considerations

The theoretical framework has been discussed in section 3.6. Nevertheless, this section offers an explicit statement of the theoretical assumptions which gives the basis for the research questions, choice of research methods and the specification of the variables involved,

The valuation approach is based on the following theoretical considerations and principles: Externality theory from environmental economics, expectation, industry behaviour and the substituted market principle for the cost method of valuation. The expanded expectation principle of valuation, the inducement theory from environmental economics, the expanded SRI base and the obsolescence-based correction factor.

The theory of externality and its application to real estate valuation and sustainability have been discussed in section 3.4.9. When possible costs are internalised through the use of the ISRO-CF to correct the valuation figure downwards, the non-sustainable activities could grind gradually to a stop. This way, it is possible to avoid, minimise, or mitigate adverse current and future social, environmental and economic impacts on the society. Notional risks of faster obsolescence and fall in value are also imposed on non-sustainability compliant properties.

The valuation principle of expectation has been discussed in section 3.3.1.2. The expectation of future benefits from proprietary rights creates the present value of such rights to be aggregated as the opinion of value. However, the approach expands the scope of expectation in two rational directions: (i) That valuers' expect industries to behave in sustainability ways; and (ii) the expectation of the industry's willingness to internalise external costs as discussed in section 3.4.4.

The principle of substitution has been discussed in section 3.3.1.3. A rational person will pay no more for a property than that amount by which he can obtain, by the purchase of a site and construction of a building, without undue delay, a property of the similar utility. The application of this principle about the cost method of valuation presupposes the absence of a market-based sustainability. Therefore, a substituted market that could provide the extent of sustainability compliance with the metrics would be an appropriate proposition to measure the correction factor.

The behaviour of industries has also been discussed in section 3.4.4. Industrial firms are sensitive to their internal financial control by often seeking to minimise costs inputs and maximise returns. The correction factor is measured and discounted from the investors' value as an indirect inducement for them to invest in sustainability.

The SRI have been discussed in section 3.3.3. Conventional valuation information base has been expanded to capture SRI. The coverage is provided by the thirty-nine (39) sustainability indicators identified by the Delphi experts without consideration for those elements that already form part of the conventional value influencing components.

Obsolescence and sustainability were discussed in section 2.2.2.2. Obsolescence and sustainability are negatively correlated. In that wise, the fair value to the Owner relies on the corrected valuation figure.

From a logical viewpoint, the extent to which industrial sustainability features meet local sustainability metrics assumption suggests sustainability compliance. It seems to imply that 100% sustainability compliance by the industry would mitigate all impacts to 0%. While the assumption may not always be true in real terms, it may be logical to generalise that the more the sustainability compliance level, the less would be the expected operational impacts of the industry, and the higher the corrected value. Theoretically, the valuation approach is impact-sustainability compliance based.

5.2.3.2 The Valuation Approach

The study developed a modified cost approach. The approach is derived from the cost method of valuation where ISRO-CF is factored into the DRC valuation calculation to explain the extent to which industrial sustainability features meet local sustainability metrics. It is a modified cost approach to the valuation of process industries. The ISRO-CF-derived from the consensus of the Delphi study is incorporated into the Depreciated Replacement Cost approach to property valuation on the investment value basis.

From the theoretical framework for the integration of sustainability into process industries in Figure 3.8, the overall approach is to assess “sustainability obsolescence” as a correction factor allowance for valuation of non-market industrial properties by scoring in relation to acceptable local sustainability indicators and rating guidelines of GreenstarSA (2007) and Cheng and Venkataraman (2013). Figure 4.4 explains the sustainability obsolescence evaluation process through the value judgment of the experts in relation to the industry's sustainability requirements.

Major international sustainability indicators are taken from the industrial sustainability literature in section 3.4.3 and specific selections guided by RICS (2009); Boyd (2005) and Lützkendorf and Lorenz, (2012). The experts included five (5) additional indicators (section 5.2.2.4) for assessment. The approach regards sustainability as an obsolescence which ought to be discounted from valuation result as a correction factor to reflect a fair value to the owner, capture externalities, reflect the level of non-compliance with local sustainability requirements and induce industries to adopt green initiatives.

The sequence of the cost valuation approach as indicated by Ogunba (2013) and Maninggo (2010) are:

Step 1: Reproduction Cost New/Replacement Cost New (RCN)
Step 2: (RCN) less Physical Deterioration =RCNLPD
Step 3: RCNLPD less Functional Obsolescence = RCNLPDFO
Step 4: RCNLPDFO less economic obsolescence = RCNLPDFOEO
It is the sustainability-related obsolescence correction factor that the DS determined in step5

Step 5: Determine the ISRO-CF from the Delphi study
Step 6: Multiply RCNLPDFOEO with the ISRO-CF
=Depreciated Replacement Cost (DRC)
= Value to the Owner (Investment value)

The findings relating to the development of the modified cost approach are presented in section 5.4.1.3

5.2.4 Valuation of the Case Study Industry – The Fourth Objective

This subsection undertakes the valuation of the case industry in fulfilment of the fourth objective. The valuation determines the fair investment value based on the industry's sustainability compliance and reports its findings from site inspections, financial statements and other information provided by the company.

5.2.4.1 Site, Buildings and Structures, Plant, Machinery and Equipment

Site coverage is approximately 3.12 hectares of rectangular-shaped land. It appears level and not susceptible to flooding. The site measures approximately 75 metres at the frontage. Site development comprises of the Administration block, Finished Products' store, and Gatehouse; Production Section. Structures consist of the- Generator and Transformer house and Oil Reservoir, Materials & Products Storage area, Chemical Tank Farm, Waste Storage area Bore-hole and, Water Storage Area, Transformer; PME, Diesel Tanks, 5 Generating sets, Parking lots and the Effluent Treatment Area, Motor Vehicles, Furniture, Fittings and Office Equipment. The information extracted from the Valuers' Report are as follows:

Gatehouse-42.84m2, Factory block (Factory Area – 297m2, Central Factory area-594m2), Computer/measurement block-37.8m2, Administration block-705.6m2, Finished Products Store-396m2, Generator house-68.97m2, Transformer house-41.15m2.
*Industry profit rate is given ast 15% (i.e. Interest on capital, 10%; Proprietor's remuneration @ 5% of net tangible assets)
*Economic obsolescence is represented by the 75% capacity utilisation. Scale factor could range from 0.4 to 1. (We could use a scale factor of 0.7)
*Salvage value of the PME is estimated at N2,500,000
*Remainder useful life is estimated to be 40 years while total economic life span is 50 years

*No allowance is made for functional obsolescence because there is neither excess capital, nor excess operational costs of the operation from which it can be calculated.
*Test of adequate profitability and goodwill value are not reflected due to their speculative nature for sustainability purpose.
*The land element is subject to degradation resulting from the operations.
*Reducing balance after n years of the N years of useful life has been used: S=salvage value, P=Replacement cost. Capacity utilisation is estimated at 75%.

Other factory information regarding the facilities description such as raw materials management, production processes, services, environmental compliance status, physical condition of assets and tenure are contained in Appendix Q as attached.

5.2.4.2 Basis and Method of Valuation

The purpose of valuation is for individual investment or operational objectives of the industry owner. The method of valuation is the cost, based on the concept of Depreciated Replacement Cost. The basis of valuation is investment value (worth or value to the owner). The study addresses the value of the asset to the owner or class of investors with regard to the extent to which the property assets currently meet the local sustainability requirements. The valuation has not adopted the IFRS 13 approach because IFRS strictly applies to value of the business for financial statements with fair value as its basis of valuation. Besides IFRS does not currently apply in Nigeria. Value of the business indicates the business value, MV or the fair value of the business.

The justification for the valuation basis and method used in the study are explained in s.3.4.7

5.2.4.3 The Valuation Calculations:

			N’000
Land Area in use – 4.682m2			324,612
DRC of Buildings and Structures:			
Factory Area 297m2	128,580		
Central Factory Area 594m2	230,722		
Administration Block 705.6m2	121,279		
Computer Block 37.8m2	9,800		
Finished Products block 396m2	11,710		
Generator House 68.97m2	650		
Transformer House 41.15m2	1,500		
Gate House 42.84m2	1,230		505,469
RC of Plant and Machinery		199,700	
Less:			
Incurable physical deterioration			
$P [1 – (S/P)^{n/N}]$			
$199{,}700 [1 – (2{,}500{,}000/199{,}700{,}000)^{10/50}]$			
$199{,}700 [1 – (0.0125)^{0.2}]$			
199,700 [1 – 0.416]			
199,700 [0.584]			
=	116,624		
Economic obsolescence (inutility)			
$[1 – (75/100)^{0.7}] \times 199{,}700{,}000$			
[1 - 0.1876] x 199,700,000			
0.1824 x 199,700,000			
=	36,425	153,049	
Plant Depreciated Replacement Cost:			
= 199,700 – (153,049)			46,651
Functional obsolescence There are no excess capital costs or Excess operational costs arising from functional obsolescence.			
Value of Equipment & Tools (DRC)			88,779
Motor Vehicles (DRC)			31,960
Furniture & Fittings (DRC)			29,388
			1,026, 859
ISRO as obsolescence and correction factor			0.67
Value of tangible assets to the Owner			687,995

Say, N688,000,000 (RM 9.2million)

Note: The scale factor (0.4 to 1) depending on the type of equipment and labour/material ratios. A range of 10-15% can be added to the ISRO index to account for double counting

The findings relating to the valuation of the case study industry can be found in sub-section 5.4.1.4

5.3 Result and Analysis of the Perceptive and Support Studies: The Fifth Objective

5.3.1 The Perceptive and Support Studies

This section of the chapter presents and discusses the data analysis and results of the perceptive and support studies of the end users. The first phase discusses the data analysis and results of the EFA methods adopted to reduce the factors and evaluate the valuers' perceptions. First, the dataset was treated using the Principal Axis Factoring to select the factors.

Section 5.3.1.1 presents the data collection results while the respondent valuers' profile is examined in Section 5.3.1.2

5.3.1.1 Data Collection Results

A total of 650 questionnaires were distributed. Table 5.11 shows the breakdown of the number of respondents who completed the questionnaire based on the data for the various collection approaches.

Table 5.11: Response Rate of Useable answered Questionnaires

Method of Data Collection	Total No. Distributed	Received	Useable	Response Rate-Useable Questionnaire (%)
Enumerators	150	87	56	8.6
Direct Mail	400	179	148	22.8
Self-Delivered	100	73	63	9.7
	650	339	267	41.1%

Out of the original total survey forms of six hundred and fifty (650) distributed, some were returned undelivered for failing to reach the target respondents. Possible causes were incorrect email addresses or that the respondents changed their email addresses. The respondents lists gathered from the Register of Surveying firms was further updated since some firms were noted to have merged and monitored for the responses to be used in the survey. In all, there are seven hundred and seventy nine (779) registered firms. Table 5.11. shows that the direct mail data collection mode yielded the highest response rate at 22.8%. The self delivery method produced a comparatively lower response rate of 9.7%. In all, two hundred and sixty-seven (267) useable questionnaires were received out of the possible total of 650 to post a useable overall return rate of 41.1%. 72 questionnaires were unuseable due to many uncompleted sections. The response rate of 41.1% is acceptable given that some other real estate studies have responses that fall between 14% and 31.7% (McDaniel & Louargand, 1994; Seiler *et al*., 2000).

5.3.1.2 Profile of the Respondent Valuers and Frequency Distribution of Responses

80.9% of the respondents are real estate valuers having full registration status with registration Board of Valuers, 15.3% are in the final stages of full registration while 3.7% did not indicate their registration status. Although the questionnaires were given to the Heads of Firms and Staff Partners, returns showed that in some cases, the questionnaires were completed by proxy. 86.1% holds either Ph.D. and MSc degrees; 4.9% with first degrees. 56% are heads of firms, managing, and staff partners, 33.7% are personnel other than heads of firms, managing, and staff partners, while 10.3% did not indicate their personnel status. 54.6% are above fifty (50) years old. 91.4% have over 10 years' experience, while 8.6% has experience less than ten (10) years. It indicates that these respondents are core professionals, having deep experience to deliver quality responses. Of the 267 respondents firms, 43% were based in Lagos, 18% in PortHarcourt and 12% within Abuja. These are the core cluster operation areas for Valuers in Nigeria. Table 5.12. shows the frequency distribution of responses.

Table 5.12. Frequency distribution of questionnaire responses (this study, 2016)

Latent Variables (Factors)	Items (Observed Variables)	(Likert scales) *Frequencies*					Total
POTENTIAL BENEFITS		1	2	3	4	5	
1. High Building Value (BHBV)	• Faster tenants' lease up a2	39	35	13	136	53	266
	• Valuation premium a3	22	36	20	145	44	267
	• Better market distinction a4	18	35	7	153	54	267
	• Higher prestige a5	44	32	18	115	56	265
2. Cost Savings (BCS)	• Water conservation b1	56	43	29	64	75	267
	• Energy efficiency b2	53	25	40	57	82	267
	• Lower services maintenance costs b3	65	28	15	78	81	267
	• Less claims on medical costs b6	68	31	22	59	86	266
3. Lower Risks (BLR)	• Reduced wastewater pollution and degradation c1	90	23	23	29	101	266
	• Lower risk of unsustainable resource uses c2	79	46	23	75	44	267
	• Reduced liability risks c3	84	29	36	56	62	267
	• Reduced health and safety risks c4	72	28	10	57	100	267
4. Productivity Gains (BPG)	• Boosts creativity d1	81	30	21	81	54	267
	• Higher morale d2	54	53	19	67	74	267
	• Improved employee productivity d3	35	35	23	107	67	267
	• Improved indoor quality for staff welfare d4	46	43	46	62	70	267
	• User satisfaction - d5	71	11	21	119	37	267
5. Quality of Life (BQL)	• Sustainability provides the future generation needs - f1	7	-	20	101	146	267
	• Less pollution - f2	1	1	-	131	134	267
	• Fight global warming - f3	12	13	-	157	84	267
	• Minimise wastes - f4	-	24	-	164	79	267
SUPPORT							
6. Support (SUP)	• Invest in Green industrial building rating tools s1	-	-	-	147	120	267
	• Recommend green features to others s3	-	-	-	132	135	267
	• Relationship between sustainability and industrial building obsolescence s4	10	-	-	162	95	267
	• Industrial valuation to reflect sustainability s5	-	-	-	166	101	267
	• Would support the cost/ISRO approach where no market exists s7	-	-	-	153	114	267

The six (6) constructs - High Building Value (BHBV), Cost Savings (BCS), Lower Risks (BLR), Productivity Gains (BPG), Quality of Life (BQL) and Support (SUP) have been discussed in sections 2.3 and 3.2.1.4. The distribution of sampling and responses are representative for statistical analyses and inferences. Respondents were asked to rate the extent to which they consider the twenty-one (21) reliability-tested variables in factors 1-5 are contributors to potential industrial sustainability support for integration. They were also asked to indicate their support for green industrial features and sustainability based on responses to the five (5) items in factor 6. Missing values are <10% and there are no outliers

5.3.1.3 Exploratory Structure and Reliability of Factor Loadings

The fitness of the data was at first confirmed through the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, which yielded a score greater than .6 (KMO=.698) (Kaiser, 1974). Bartlett test of sphericity is significant at $p \leq .05$ ($p=.001$) (Bartlett, 1954). The indication is that factor analysis appropriate (Ho, 2006; Pallant, 2011). Eight (8) components reported eigenvalues ≥ 1, explaining a total of 70.46% of the variance (Appendix K). Table 5.13 presents the factor matrices.

Table 5.13: Valuers' Perception, Support and Knowledge-Benefit factors

Factor Matrix[a]

	Factor							
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
a2	***.489***	*.203*	*.209*	*.462*	*.123*	*.363*	*.215*	*.108*
a3	***.342***	*.062*	*.097*	*.358*	*.129*	*.263*	*.161*	*-.165*
a4	***.489***	*.113*	*.326*	*.460*	*.113*	*-.059*	*.272*	*.159*
a5	*-.038*	*.030*	*.047*	*.013*	*.128*	*.076*	*-.015*	*-.049*
b1	*-.284*	*.642*	***.855***	*-.149*	*-.146*	*-.066*	*-.036*	*-.066*
b2	*-.344*	*.578*	***.816***	*-.014*	*-.100*	*-.116*	*-.057*	*-.098*
b3	*-.312*	*.631*	***.867***	*-.129*	*-.084*	*.003*	*-.029*	*.018*
b6	*-.299*	*.551*	***.812***	*-.036*	*-.087*	*.070*	*.137*	*.010*
c1	*.081*	***.660***	*-.206*	*.146*	*.051*	*-.065*	*-.192*	*-.165*
c2	*.119*	***.605***	*-.208*	*.303*	*.196*	*-.139*	*-.392*	*.077*
c3	*.164*	***.658***	*-.246*	*.222*	*.176*	*-.065*	*-.126*	*-.112*
c4	*.320*	***.515***	*-.204*	*.205*	*.029*	*.145*	*-.133*	*-.019*
d1	*.078*	***.400***	*-.063*	*-.136*	*.282*	*.094*	*.038*	*.116*
d2	*.102*	***.625***	*-.293*	*-.256*	*.001*	*.005*	*.389*	*-.112*
d3	*.162*	***.595***	*-.366*	*-.262*	*.222*	*-.074*	*.023*	*.012*
d4	*.090*	***.698***	*-.313*	*-.087*	*.066*	*.069*	*.088*	*.208*
d5	*-.095*	***.599***	*-.346*	*-.260*	*.154*	*.046*	*.195*	*.183*
f1	*.626*	*.145*	*.042*	*-.162*	*-.057*	*.315*	*-.142*	*.120*
f2	*.525*	*-.128*	*.113*	*.172*	*-.328*	*.157*	*-.145*	*.082*
f3	*.448*	*.151*	*-.090*	*.141*	*-.621*	*-.125*	*-.043*	*.112*
f4	*.391*	*.461*	*-.212*	*-.067*	*-.572*	*-.178*	*.159*	*.042*
s1	*.854*	*-.089*	*.448*	*-.384*	*.243*	*.045*	*-.191*	*.395*
s3	*.739*	*-.075*	*.277*	*-.029*	*.300*	*-.053*	*.008*	*-.226*
s4	***.568***	*-.081*	*.202*	*.179*	*.261*	*-.642*	*.123*	*.025*

Table 5.13, continued: Valuers' Perception, Support and Knowledge-Benefit factors.								
s5	***.794***	*-.063*	*.185*	*-.315*	*.072*	*-.140*	*.032*	*-.066*
s7	***.639***	*.053*	*.105*	*-.338*	*-.033*	*.237*	*-.054*	*-.372*

Extraction Method: Principal Axis Factoring. a. Attempted to extract 8 factors. More than 25 iterations required. (Convergence=.001). Extraction was terminated

.

5.3.1.3 (a) Analysis of the EFA

PAF factor matrix indicate 3 factors. Factor loadings from Oblique-Promax rotation relocated items a2-a4, f1-f3 to SUP: and d1-d5 to BLR. BCS remains stable (Table 5.14). The two highest ranking factors, each of which accounts for more than 10% of the variance, are Support (s1, s3-s5, s7, a2-a4, f1-3,) accounts for 17.19%. and BLR (c1-c3, d1, d2, c4, d3-d5, f4) accounts for 16.20%. BCS (b1-b3, b6) account for 9.57%. Item loadings above .4 on the components indicate strong loadings (Pallant, 2011). The factor names were derived from the dominance of the *s*, *c* and *b* variables in the factor matrix 1, 2, 3 respectively.

The support factor account for 17.19% > 10% of the variance statistically attests to the respondents' strong support for incorporating industrial sustainability into valuation (.794) by using the cost approach where no market exists (.639). The valuers support the sustainability initiatives of providing future generation needs (.626), ensuring pollution reduction (.525), and would indeed recommend green features to those who are not valuers (.739). Regarding perceived benefits, lower risks of exposure to pollution (16.20% of the variance). The benefit factor, BLR, has reduced waste pollution and degradation (.660) and lower risks of unsustainable practices (.605) as the most influential. Cost savings also account for close to 10% (9.57%) for inclusion. The underlying implication of both Factors 2 and 3 is that the respondents seem to be aware that industrial sustainability issues are not a merely responsible alternative, but could provide significant exposure to risk-lowering outcomes and save costs.

Table 5.14: Matrices for factor loadings (Source: this study, 2016)

Cronbach's Alpha: SUP = (.819); BLR = (.856); BCS = (.853)			
	FACTORS		
	1	2	3
FACTOR 1 - Support			
s5 Industrial valuation to reflect sustainability	.794		
s3 Recommend green features to others	.739		
s7 Support the cost/ISRO approach where no market exists	.639		
f1 Sustainability provides future generation needs	.626		
s1 Invest in Green industrial building rating tools	.584		
s4 Relationship between sustainability and industrial building obsolescence	.568		
f2 Less pollution	.525		
a2 Faster tenants lease up	.489		
a4 Better market distinction	.489		
f3 Fight global warming	.448		
a3 Recommend green features to others	.342		
Variance	17.19%		
FACTOR 2 – Benefit: Lower Risks (BLR)			
d4 Improved indoor quality for staff welfare		.698	
c1 Reduced wastewater pollution and degradation		.660	
c3 Reduced liability risks		.658	
d2 Higher morale		.625	
c2 Lower risk of unsustainable resource use		.605	
d5 User satisfaction		.599	
d3 Improve employee productivity		.595	
c4 Reduced health and safety risks		.515	
f4 Minimise wastes		.461	
d1 Boost creativity		.400	
Variance		16.20%	
FACTOR 3 – Benefit: Cost Savings (BCS)			
b3 Lower services maintenance costs			.867
b1 Water conservation			.855
b2 Energy efficiency			.816
b6 Less claims on medical costs			.812
Variance			9.57%

Extraction Method: Principal Axis Factoring: Rotation Method: Oblique-Promax.

Two determinant factors, which are: Perceived risks reduction (BLR) and Support for integration of sustainability by valuers (SUP) have been identified. The third factor, BCS was admitted because of its closeness to the 10% variance cut-off (9.57%). The observed variables under the three factors are statistically significant at the 0.05 level. BLR and BCS factors induce respondents to be willing to invest in and/or occupy green industrial buildings. In a logical sense, it is expected that the three factors, SUP, BLS, and BCS could be associated. SUP has 11 items, BLR has 10 items, BCS has 4 items as shown in Table 5.13. This suggests the various underlying dimensions that the factors are measuring.

The indication is that the Support from real estate valuers and knowledge about anticipated lower risks from operationalising sustainability initiatives are the determinant factors for integrating industrial sustainability into real estate valuation in Nigeria. The support variables, (s1, s3, s4, s7) for integration and the benefit variables for lowering risks, (c1, c2, c3, c4) are dominant in components 1 and 2 respectively. The *s* and *c* codes are shown in Table 4.4. The SUP, BLR, and BCS factor loadings evidenced the adoption of the three (3) factors for the analysis (Variances at 17.19%, 16.20% and 9.57% respectively). BHBV, BPG, BQL are not significant factors considered by the valuers based on factor loadings in Table 5.13.

5.3.1.3 (b) Predictions and Hypothesis Testing

The predictions relate to relationships among the three (3) factors or constructs. The conceptual framework for the linkages between knowledge-based sustainability benefits and the ensuing support for pollution and sustainability programmes was explained by Addae-Dapaah *et al* (2009). (section 4.4.2). Also, the preparatory tests for a PLS test of predicting causal relationships – missing values and outliers – have been done (section 4.4.2.1j). The factor analysis indicates factor loadings for 3 constructs: SUP, BLR, and BCS. BHBV, BPG, BQL are poorly loaded <0.40. The factors could not be included in the test they are not dominant. Therefore, they could not predict SUP. The relationship between the 3 constructs of the reflective model was estimated. (Figure 5.3.).

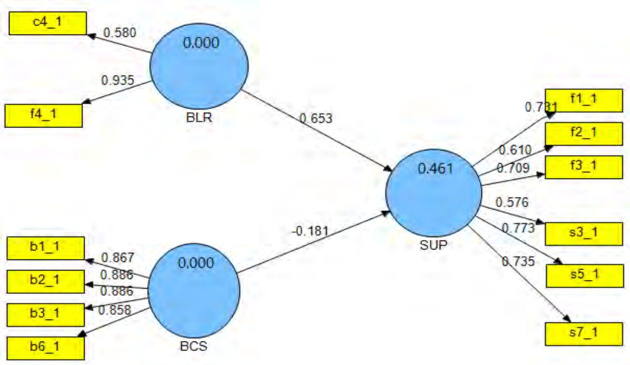


Figure 5.3: Pathway diagram specifying relationships between the constructs (this study, 2016).
=> pathway

The factor loadings ranged from 0.576 to 0.935 > 0.5. The regression weight on BCS => SUP is weak (<0.5): Strong for BLR => SUP (0.653> 0.5). BLR, BCS = *0.461SUP:* The coefficients of determination (R^2) of 0.4615 is fair. [0.19 - 0.33, *weak*; 0.34 - 0.66, *fair*; > 0.67, *strong* (Henseler *et al*, 2009).]. 41.6% of SUP is explained by BLR and BCS.

The result of the confirmatory tests are contained in Table 5.15

Table 5.15: Quality criteria of model adjustments – SEM specification – Rates of average variance extracted (AVE), composite reliability, R and Cronbach´s Alpha of Constructs – *Overview* (Source: this study, 2016)

	AVE	Composite reliability	R Square	Cronbach's Alpha	Communality
BCS	0.7644	0.9285	0	0.9006	0.7644
BLR	0.6059	0.7446	0	0.4062	0.6059
SUP	0.4798	0.8456	0.4615	0.7933	0.4798

Given the reference values as: AVE>0.5; CR>0.7, Cronbach alpha >0.7; communality>0.40. Convergent validity is achieved (AVE>0.5 across constructs), composite reliability achieved at >0.7. Internal consistency is not proven for BLR (0.4062<0.7). Communality is achieved across all constructs (>0.4). Latent variable correlations viewed from *outer loadings* are <0.9. Discriminant validity is thus achieved showing that all constructs are independent.

5000 bootstrap modules were run for the test of significance so that the t-values can be obtained. Bootstrapping result show that the regression line is significant if $t > 1.196 = p > 0.05$ (>1000) (Ringle *et al.,* 2010). Figure 5.4 indicates the significance of the prediction lines.

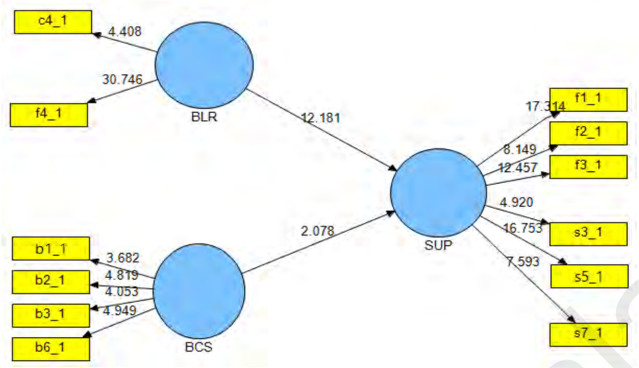


Figure 5.4: The Adjusted Research Model (this study, 2016)

As in Figure 5.14, the adjusted research model has two significant paths: BLR => SUP (t=12.181); BCS => SUP (t=2.078) > 1.196. Inference can be drawn that BLR and BCS are significant predictors of Valuers' support for the integration of industrial sustainability into real estate valuation. The adjusted research model for the population of valuers in Nigeria regarding support for industrial sustainability for inclusion into property valuation indicate that BLR and BCS factors are the causes of the Valuers' support the integration of industrial sustainability into real estate valuation and the ISRO-CF approach. . The SmartPLS blindfolding module - Stone-Geisser Indicator (Q^2) evaluates the predictive relevance, that is, how well the model predicts the data. [$Q^2 = 0.1818 > 0$] [Perfect model, $Q^2 = 1$]. The Cohen's Effect Size Indicator (f^2) estimates how useful each construct is to the derived model (≤.02, *small*; 0.15, *medium*; ≥ 0.35, *large)* (Hair *et al.*, 2013). The values of Q^2 (0.1818) and f^2 (0.5866, 0.0242, 0.2991) indicate that the model is correct, and the three constructs are important for the general adjustment of the model.

5.3.1.3 (c) Evaluation of the Hypotheses

The model´s general quality was considered by indicator GoF (Goodness-of-Fit) through the geometric mean of mean R^2 and mean AVE (Tenenhaus *et al.,* 2005). The result was given as 0.418. It shows that the model is a well-adjusted model. Rates over 0.36 were good and acceptable in the case of Applied Social Sciences (Wetzels *et al.,* 2009). Table 5.16 presents the results of the evaluation of the hypotheses.

Table 5.16: Evaluation of Hypotheses (this study, 2016)

Hypothesis	Pathway	t-value	Conclusion
H1	BCS ==>SUP	2.078	Supported
H2	BLR ==>SUP	12.181	Supported
H3	BHBV==>SUP	-	Not Supported

With the quality of the model´s adjustments confirmed, the inferences on the path coefficients and their rates could be confirmed. Since the model was adjusted, rates were employed to evaluate the research hypotheses as in Table 5.16. H_1 and H_2 are the supported hypotheses. H_3 was not supported for the reason that its factor loading is not significant.

5.4 Study Findings

The study identifies the main findings from Chapters 1 – 4 with particular emphasis on the research objectives and questions. The purpose is to link the findings to the theoretical review (theory) to confirm, extend, refute, generate a new theory. This section is divided into two parts: Part 1 identifies the main study findings and Part 2 summarises the findings that are supplementary or supportive to the main findings.

5.4.1 Part 1 – Main Findings

5.4.1.1 The Case for Integrating Sustainability and the Valuation approaches

The study found that there are business and socio-environmental cases for integration of sustainability. The rising demand by consumers and investors for sustainable products and services, tied with the increased inquiry and reporting on corporate responsibility are driving companies to pay more attention to their sustainability performance. The necessity for the integration of sustainability into real estate valuation is also underscored by the following findings that:

(1). Valuations are carried out in any phase of the building lifecycle. Moreover, in recent times, market had identified that environmental and social features of sustainable buildings would impact on costs of building, operating and capital expenses as well as rental incomes

(2). Valuers sct as information managers in highly distorted property markets for the reason that they are the sovereign axis around which property information flows.

(3). Valuers influence market outcomes. For instance, the arguments advanced in negotiations between transacting parties are often based on professional advice given on all sides.

(4). Sustainability is a potential risk factor in property investment and development. It leads to falling in values for those properties that are not complying with the sustainability initiatives.

(5) For industries, the investors have a responsibility to behave in a pro-sustainability manner and therefore expected to comply with the metrics for valuation purposes or have their value diminished for non-compliance. On the other hand, Appraiser also has a responsibility to interprete industry behavior in value terms. In other words, the appraiser

interpretes the difference between the normative and actual sustainability compliance levels.

Further valid arguments indicate that property market transactions are beginning to demand sustainability. If the demand is ignored, it could lead to misallocation of capital, mispricing of property assets and probable underinvestment in retrofitting and other initiatives.

Evidence-based approaches concern with the analysis of actual market evidence. Section 3.3.4.2 describes the approaches in the literature. The evidence-based approaches found are as follows:

(i). The use of appropriate traditional valuation approaches such as the income, cost or comparison with a single valuation input parameter that *c*onsiders of sustainability issues based on a sustainability sub-analysis.

(ii). The use of appropriate traditional valuation approaches such as the income, cost or comparison with a single valuation input parameter that does not *c*onsider the sustainability issues, and later adding of a lump sum to account for the sustainability issues based on a sustainability sub-analysis.

(iii). The use of appropriate traditional valuation approaches such as the income, cost or comparison with a single valuation input parameter that does not *c*onsider the sustainability issues, and later multiplying by a correction factor.

(iv). The hedonic price regression of sale prices using theory-based property attributes.

(v). The hedonic regression analysis using the Delphi method to select the neighbourhood relevant attributes.

However, the regression analysis approaches (4) and (5) are not within the five methods of valuation (section 3.3.4.1).

There is relatively strong support found in the literature for various environmental accountability mechanisms, environmental policy integration (EPI) and the assignment of new responsibilities to existing organisations. The idea in the approach is to make sector departments internalise the policy-making principle of EPI so that they are induced to consider the industry's sustainability capacities and to develop their scope for reducing obsolescence and risks. Moreover, environmental and social appraisal plays a key role in the investors' decision to assign capital sums to socially responsible investing (SRI) funds, which grows at an annual rate of 22 percent since 2003.

The study also found that the importance of sustainability uptake in the commercial property stock is paramount for reducing the negative impact of the built environment. It could be implied that if industrial sustainability sets the limits of production capacities for industries through internal financial control incentives, adverse impacts can be reduced. Valuation instruments can be useful in the assessment of the value of assets to reflect the extent to which properties adopt the prevailing sustainability requirements. The professional ethics and the resulting responsibility towards the society imply that valuers incorporate sustainability into real estate valuation. Other key arguments are: *(1)* Market transactions already observed are reflecting the sustainability index as a critical value driver. *(2)* Valuers take the view that valuation could not be considered rational and socially responsible if they are mere market reflectors rather than being active influencers also. *(3)* Opportunistic and the enlightened investors could monopolise the market if properties are mispriced. *(4)* There could be a misallocation of investment capital or probable underinvestment in building sustainability so it is increasing becoming important that investors and industries would behave rationally (RICS, 2009; Lorenz, 2011; Lützkendorf & Lorenz, 2012). (5) The responsibility towards society and the environment for image gains, avoidance of reputational risks, and collective conviction as a condition for economic success (Lützkendorf & Lorenz, 2012).

Valuation approaches for sustainability can be classified into: (i) The Normative and (ii) the evidence-based. The normative include the case and quantitative approaches consist of the life cycle cost and benefit analysis, hypothetical analysis, quantitative analysis, case study analysis, residual approach analysis cost analysis, sensitivity analysis with quantitative risk documentation, hedonic price regression and a hybrid of the regression analysis with the Delphi method. The evidence-based approaches are *(1)*. The use of appropriate conventional valuation approaches such as the income, cost or comparison with a single valuation input parameter such as in yields or percentage obsolescence that *c*onsiders of sustainability issues (SI) identified in a sustainability sub-analysis of risks, certification, and environmental criteria. *(2).*The use of appropriate conventional valuation approaches such as the income, cost or comparison with a single valuation input parameter that does not *c*onsider the sustainability issues (SI), and later adding a lump sum to account for SI based on a sustainability sub-analysis. *(3).*The application of the appropriate traditional valuation approaches such as the income, cost or comparison with single valuation input parameter that does not *c*onsider the sustainability issues (SI), and then multiplying by a correction factor. *(4).* Hedonic price regression of sale prices using theory-based property attributes. *(5).*Hedonic regression analysis using the Delphi method to select the appropriate neighbourhood attributes.

The majority of the research efforts found positive results indicating value premium in relation to sustainability rating (Miller *et al.,* 2008; Eichholtz *et al.,* 2010; Pivo & Fischer, 2010; Fuerst & McAllister, 2010; Michl *et al*., 2016). In consideration of the theories advanced for sustainability integration, the study seeks a progression to show how to operationalise an integrative approach for process industries that considers the use of the Delphi study-derived correction factor.

5.4.1.2 Delphi Outcomes: Relevant Industrial Sustainability indicators, Delphi Consensus and ISRO-CF.

The study findings regarding the relevant Industrial Sustainability indicators and the ISRO-CF are summarised in the following sub-section.

5.4.1.2 (a) Relevant industrial sustainability indicators for real estate valuation

The comprehensive list of the relevant sustainability indicators is shown in Table 5.5. The critical indicators are taken at a cut-off of 73.3 RII, the point at which the first four (4) indicators in each of the 4 dimensions are presented in Table 5.17.

Table 5.17 The List of Critical Sustainability Indicators (Source: this study, 2016).

Main SIs	Critical Sub-indicators
1. Environmental	▪ Compliance with Fire, and other regulations and updates (90.9) ▪ Green House Gas (GHG) emission – Pollution control devices, regulation compliances, effluent treatments, recycling and removal, use of ODS (90.4) ▪ Solid and liquid waste – Waste disposal technologies (90.0) ▪ Consumption of non-renewable energies (e.g. coal, oil, and gas) / Evidence of alternative energy supplies (89.1)
2. Social	▪ Restrictions, Appropriate Signage and Guides (93.3) ▪ Compliance with health and safety regulations (91.8) ▪ Awareness and training in emergency response (86.4) ▪ Accident First aid facilities and procedures (83.5)
3. Economic	▪ Provisions of Reserves for possible remediation (93.3) ▪ Workers' productivity and health (90.9) ▪ Adequate public liability and service provider insurance (86.4) ▪ Standard of service delivery (84.3)

Table 5.17 The List of Critical Sustainability Indicators (Source: this study, 2016).	
4. Planning/Cultural	▪ Quality of overall built environment (86.0) ▪ Corporate Social Responsibility (83.2) ▪ Compliance with space standards (74.4) ▪ Preservation of heritage values (73.3)

The list of the sustainability indicators are arranged in their order of importance, although they are mutually-inclusive.

5.4.1.2 (b) The ISRO-Correction Factor

The study found the overall Weighted Mean ISRO Correction Factor is 0.671 (section. 5.2.2.7, Table 5.9). Feedbacks from panellists in the frame of reasons for their rating of sustainability indicators and the evaluation of sustainability sub-indicator scores rests on the study of the EAR report, and the EAR leads provided by the researcher, their onsite observation of operations and site facilities during industrial visits and their experience in environmental scoring for factory planning consultancies. Industrial sustainability is outside the purview of precise quantitative studies for valuation purposes hence, the subjective judgments of a heterogenic group of experts provided the prediction of the correction factor. The study also found good compliance of the industrial sustainability features with the sustainability requirements. The expectation is that the ISRO index of 0.329 (1-0.671) would be an inducement for industries to take pro-sustainability steps to minimise current impacts and avoid future impacts.

5.4.1.2(c) The Reliabiliy and Validity of the CDM

The result in sections 5.2.2.8(a) – (d) indicate that the validity of the CDM outcome rankings, scores and the reliability of the experts' responses.

Findings show that the relevant areas of knowledge for the study of industrial sustainability and property valuation in Nigeria are as follows: Real estate valuation, environmental management, land use economics, urban and regional planning, building, soil science, chemical/process engineering. The main organisations identified are the National Environmental Standards Regulations Agency and the Lagos State Environmental Protection Agency. The applicable laws for valuation purposes are the NESREA Act of 2007 and the ELRI of 2011.

The round one questions/instructions in section 4.4.1.2(m) and the response formats to be clear and straightforward to understand.

With regard to construct validity, it can be concluded that there is no significant difference in the median scores of the Delphi Panels A and B. In addition, given W=0.711>0.70, the significant consensus among the two panels of experts at Kendall's W = 0.711 and the Mann-Whitney U test of significant difference p (0.644)>0.05 validate the Delphi scores for useability. In other words, the construct of Delphi scoring is validated by the mesures of concordance and the median scores. It implies that the industrial sustainability indicators, the overall weighted ISRO-CF of (6.64 + 6.80)/2 = 6.71/10 =0.671 and the ISRO index of 3.29/10 = 0.329 are grounded and reliable results. This is also evident in the methodological approaches that form the basis of the implementation of the study. Second, the precise results depend upon quality control throughout the organisation of the process.

The overall implication of this evaluation is that the CDM study fulfils the requirements of a reliable and valid study.

5.4.1.3 The Sustainability-Incorporated Approach

Based on literature analysis in sections 3.4.8; 4.4.1.3 and 5.2.3 and the case study operationalisation of the valuation approach in section 5.2.4.3), the modified cost method, using the ISRO-CF approach appears to express the concept of sustainability valuation for process industries on the investment value basis as "the extent to which the industrial building features meet the local sustainability requirements or metrics". The ISRO-CF corrects the valuation figure rather than take off a lump sum. Hence, it has the least flaw to treat the issue of sustainability in isolation. Moreover, its implementation recognises other value-influencing factors and can be adapted to avoid the possibilities of double counting. Double counting is a limitation that could arise because some of the prominent traditional sustainability aspects, such as building functionality (accessibility and transport, quality of layout, space efficiency, fitness for purpose, suitability for reuse, *et al*); serviceability (flexibility and adjustability, storage space, safety, comfort and health, *et al*); and useful economic life span (maintenance and repair liabilities, *et al*), which are already integral parts of the valuation traditional allowances. The limitation can be overcome by allowing an appropriate discount for the envisaged overlaps. The approach overcomes the treatment of sustainability issues in isolation. It does not attempt to separate sustainability considerations from other value-influencing factors; rather, it seeks to incorporate them through a correction factor that synthesises expanded sustainability information for valuation purposes.

The findings reflect the value to the owners upon adjustment for sustainability compliance (section 5.2.4.3). The conventional information requirements for valuers are limited to location, market, size, building types and rent levels. The need was found for expanded information base that covers energy performance in buildings, HVAC, recyclability, environmental and health impacts of buildings.

The concept was expressed by RICS Red Book (2014, 2016) in section 2.5g:3-4 (see section. 4.5.3). Moreover, the approach elicits the sustainability capacity of the industry at a particular date. It uses market substitution because no sustainability market exists for process industries from where comparable evidence can be drawn. Second, the rational theoretical principle of expectation of the approach would be: *(1)* That industries behave in sustainability ways and expect to account for external costs. (Wheeler, 1992; Starvins, 2001); *(2)* A reduction in the value to the owner because of sustainability obsolescence (Ibiyemi *et al*, 2015); *(3)* To reduce the risk of faster obsolescence (Runde and Thorye, 2010); *(4)* To avoid any current or minimise any future adverse social, environmental, and economic impacts, including those that extend beyond the property line by inducing industrial investors to choose the sustainability alternatives (Ibiyemi *et al.,* 2015)

5.4.1.4 Sustainability-Corrected Investment Value of the Case Study Industry

The indicated investment value of the industry was N689million (RM9.2million) when an ISRO correction factor of 0.671 was applied (section. 5.2.4.3). The factor is multiplied with the result of an indicated value to correct for a predictable extent of systemic obsolescence due to non-compliance with the sustainability requirements expected.

Based on the examination of the environmental compliance status 2014 report on the case study industry by section 1: (14), (23) of NESREA Act, 2011 and the Factories Act, Cap. 126, LFN 1990, the company has not complied with the following NESREA requirements:

(a) Submission of valid EAR for the current period
(b) Submission of EMP and Environmental Policy
(c) Segregation of wastes in a prescribed manner
(d) Securing permits for discharges.
(e) Effluents abatement, treatment, and monitoring.

(f) Noise abatement measures and noise level measurements.

(g) Placement of marked notices on emergency exits painted in red letters using appropriate Nigerian languages

(a) – (g) could be significant contributors to the ISRO index of 0.329

5.4.2 Part II– Perception and Support Study Findings

5.4.2.1 Perception of the valuers

The study found significant support for sustainability integration and the suitability of the valuation approach from the responses gathered. Furthermore, Valuers' support (SUP) is associated with perceived benefit-related Lower Risks (BLR) and Cost Savings (BCS). Valuers also support the inclusion of industrial sustainability into real estate valuation using the ISRO correction factor as suitable for reflecting compliance with the sustainability requirements. The support is motivated by:

(1) The perception that sustainability would provide future generational needs (f1)
(2) That there would be less pollution (f2)
(3) That industrial sustainability could help fight global warming (f3)
(4) That they could also contribute by recommending green features to others (s3)

The dominant factors in the Valuers' Support scale are SUP, BLR, and BCS as indicated in Tables 5.13 and 5.14. The s1-s5 and s7 are dominant in Factor 1 as the components of support; c1-4 in Factor 2 as components of lowering risks, and b1-3, b6 dominant in Factor 3 as components of cost savings.

5.4.2.2 Causal Relationships between Constructs and Modelling

The hypotheses have been tested, and findings have indicated relationships where significant. The path betas, β, shown on BLR => SUP (12.181); BCS => SUP (2.078) have explanatory power. The relationship of BLR and SUP has demonstrated a strong influence on SUP. The variance of 41.6% explained in SUP by BLR and BCS is fair. The unknown factors explain 58.4% of the variance in SUP. Furthermore, BLR has a stronger influence than BCS. Although the influence of BCS on SUP is also significant, the relationship is comparatively less powerful. The theoretical postulations of Addae-Dapaah *et al.* (2009) about relationships are supported in part because only BLR and BCS influence the support factor in the research model. Evidently, there is a deviation from the theoretical model that BHBV, BPG, BQL would also be significant predictors of SUP. BHBV, BPG, BQL were less considered as probable benefit nodes for industrial sustainability by the Valuers. The logical explanation would be either that valuers do not seem to have sufficient knowledge about industrial sustainability benefits being a vehicle for a higher premium, and building values, productivity gains and enhanced quality of life or knowledge management among them is ineffectual. The outcome is unexpected at this time when innovations for sustainable development are gaining more grounds. Sustainability support systems based on knowledge as developed by Gloet (2006) and Petrini and Pozzeboh (2009) are also not fully supported. This finding has diminished the internal validity of the validation study. Moreover, with the knowledge insufficiency about BQL indicators, it could not have a mediation effect on SUP and BLR. The three factors in the theoretical model not loaded could lend credence to a submission that the valuers' perception was a responsible alternative rather than one based on knowledge and industrial sustainability and sustained awareness. Nonetheless, the model can be applied to the population of valuers for the prediction of support for integration of industrial sustainability. It is correct at $Q^2 > 0$ and $f^2 > 0.15$. BLR and BCS are significant pathways to SUP.

5.5 Summary

This chapter presents the results and data analysis of the main study and the perception-support study. The result of the main study reveals the case for sustainability and identified thirty-nine (39) relevant sustainability indicators. Four (4) dominant indicators from each of the dimensions of sustainability – Environmental, Economic. Social and cultural were selected on the basis of their relative importance indices. It examines the necessities and arguments for inclusion of sustainability as a valuation consideration. The Delphi scoring results showed the correction factor and the compliance index. The valuation figure reflected the corrected factor as a measure of sustainability compliance. The expectation is that responsible and sustainability compliant valuation could induce more compliance and adoption of sustainability initiatives.

Finally, the supportive studies of valuers endorse the acceptability and the suitability of the valuation approach and this formed the basis for the data validation of the main study as suggested by Bekhet & Zausnieski (2012).

CHAPTER SIX

DISCUSSION OF FINDINGS

6.1 Introduction

This chapter discusses the findings and the outcomes of the research in relation to the results that have been obtained based on the research problem, study objectives, and research questions. Supplementary discussions of related issues, such as the theoretical framework formed the key part of the theoretical considerations already discussed in section 5.2.3.1. The Delphi method, and preliminary data evaluation outcomes are also examined. The discussion of findings, which commenced from the review of the case for sustainability integration into real estate valuation, led to the steps that provided the integration of sustainability into real estate valuation for process industries on the investment value basis. This section is divided into two parts. Part 1 discusses the main findings, and Part II discusses the findings that are supplementary and supportive to the main findings.

The valuation approach is based on the valuation principle of market substitution where no comparable market evidence exists for both property valuation and sustainability (sections 3.3.1.3; 3.4.7.3); the principle of expectation by valuers that industry investors would behave rationally, responsibly, and in sustainability ways, and also the expectation to underwrite social costs through internalisation (sections 3.3.1.2; 5.2.3.1); the theory of externality that internalisation of costs would induce investors to increase the extent to which they can comply with the prescribed sustainability requirements (section 3.4.8). The approach uses the valuation principles to consider the inducement of investors to adopt sustainability initiatives and reduce external costs to society. The underlying theories and principles are further discussed in sections 5.3.3.1 and 6.6. First, the empirical findings indicate that there is a case for sustainability integration into real estate valuation. However, where market evidence is not available to reveal the aggregate sustainability price indices, the sustainability indicators have to be identified by a group of experts versed in the subject area. Therefore, the Delphi experts revealed a list of thirty-nine (39) sustainability indicators across four (4) sustainability dimensions (Table 5.4) and the RII was used to rank in order of dimensional importance (Table 5.5). The indicators that were identified from literature and past research works were reaffirmed while also adding new ones. It was these findings which subsequently provided the basis for scoring the extent to which each industry feature meets their prescribed sustainability criteria after conducting a one-time industrial survey and studying the current EAR report. Aggregating these results led to deriving the ISRO-CF of 0.671 (section 5.3.2.7). The ISRO-CF was built into the conventional cost approach to the valuation of the case industry as a measure of its aggregate sustainability capacity (section 5.4.1.4). The ranking by the two independent panels of experts was tested for concordance using the Kendalls' W Statistics. The Kendalls' W Statistics test concordance at $W > 0.70$, $p > .05$. The main Delphi scores were also validated with scores of each of the independent panels of experts as suggested by Refaeilzadeh *et al.* (2008).

Given the findings from the main study, the perceptive and support study examined the knowledge perception of industrial sustainability benefits, the support system and the nature of the support system arising from the potential end-users and implementers of the approach. The overall purpose is to evaluate the suitability and acceptability of the approach as a data triangulation process in which the suitability of the approach was statistically proven with a factor loading of 0.696 (Table 5.16). A sample of valuers was then taken from the population of heads of firms or staff partners - valuers in the study area. The EFA was performed in section 5.3.1.3(a). This step involved subjecting the six (6) factors gathered from the literature to the data reduction techniques to assist in assessing the perception of the valuers and ascertain the dominant support factors that would be reflected for modelling.

6.2. The Case for Sustainability and the Valuation Approaches

In answering the first research question, that is, RQ 1: "What would be the case for integrating sustainability into real estate valuation and the emerging normative and evidence-based valuation approaches?" a review of the literature was made. RQ1 was answered through the examination and exploration of the concepts, importance and the necessity for sustainability integration into real estate valuation considering the socio-cultural, environmental and economic dimensions (sections 2.2 and 3.3.4). These theories and concepts were drawn from the perspective of the real estate investments, risks, obsolescence, and valuation. Identifying the cases formed the bedrock upon which the valuation approaches may proceed.

It was revealed that a sustainability framework must emphasise the theory of externality. If sustainability is to be truly recognised as a value-driver, a public-shared mission, and a survival issue, it should be a requirement of investors to comply with the local sustainabilitymetrics. The Investors' reluctance and uncertainties about returns on retrofitting costs and new initiatives necessitate the framework that could induce them to do so. For process industries, the framework could enable the measurement of ISRO and a correction factor that adjusts their cost minimisation and profit maximisation objective. Second, rationally, investors should expect a reduction in the value of properties that have not responded to market requirements for sustainability. Another revelation is that valuers will be required to broaden the range and depth of their existing expertise into some currently unfamiliar territory to interpret the valuation implications of an increasing range of triple bottom line issues and to recognise the synergies and interrelated nature of aspects previously viewed in isolation. For example, this might include the emerging influence of low carbon buildings which offer reduced operating costs (financial aspect), improved working conditions (social) and valuable carbon credits (environmental) whose traded worth is still in flux. In the context of development and investment strategies, advice which members of the property group are likely to be called upon to supply would extend to many of the issues hitherto not considered in conventional valuation reporting.

In examining the case for sustainability, several studies have highlighted that buildings are important target areas for addressing climate-related changes (Miller and Buys, 2008; Eichholz *et al.,* 2008; Michl *et al*., 2016). The achievement of SDG goals in the real estate sector is likely to lead to greater social equality, economic equilibria, and further spread of sustainable production and consumption. (Kopnina, 2016). However, the strong negative correlation between human well-being and environmental well-being noted by (Kaivo-oja *et al.,* 2013) could soon give way if all investors alter the traditional financial parameters and requirements in their investment analysis techniques to incorporate sustainability (Myers, 2009). Action should be taken for the reason that sustainability is considered a technological change affecting properties so that risks relating to demand, competition, and regulatory and legislative issues may not render properties obsolete faster than expected.

The emerging normative studies and the evidenced-based valuation approaches put the case for sustainability integration into real estate valuation into perspective for the application of the five methods. Sustainability is becoming a major issue in the present day valuation scenarios. Valuers and other Stakeholders are now increasingly aware that they must inculcate greener and responsible practices in the real estate business strategies for which developing and implementing sustainability assessment and reporting need to be emphasised (RICS, 2014). Sen (2013) argues the idea of sustainability as preserving the wealth of a nation for the present and future generation and that the need for sustainability in industrial development and green practices is compulsory. It is necessary to translate the general principles and practices of sustainable development into business. Ahmad and Suleiman (2004) and Pahuja (2009) submit that this can be done by ensuring that sustainable development becomes more institutionalised with a concrete base in the regulations concerning prime sustainability factors, such as consumption of non-renewable energies, water consumption, indoor air quality, wastes, and adaptability.

6.3 Relevant Industrial Sustainability Indicators and the ISRO-CF

The findings from the case for sustainability and the various valuation approaches covering the review of the literature and previous studies on the case and quantitative and empirical researches suggested sixteen (16) important sustainability indicators (sections 5.4.1.2a). Of those factors, the factors that relate specifically to the case study industry were determined through a Delphi experts survey. The Delphi study identified the relevant sustainability indicators. The research question RQ.2: What are the appropriate industrial sustainability indicators and the ISRO-CF Correction Factor? was answered from the findings of this part of the study

6.3.1 Selection of Sustainability Indicators

The literature and past research works provided the list of sustainability indicators and sustainability-related information for real estate information. In the current study, a rigorous review of the literature led to the identification of the sustainability dimensions (Appendix E). The studies by Boyd (2005), Gibberd (2005), Sebake (2008), RICS (2009), Lützkendorf and Lorenz (2012), Cheng and Venkataraman (2013), and Von Thilo Ebert *et al*. (2013) provide the generalised findings on the various aspects of the building and process-related (green) features, the social, economic, cultural and planning aspects of sustainability. Syed-Yahya *et al.* (2014) also enumerates the primary components of industrial green buildings as energy efficiency, use of environmentally preferable construction materials, renewable energy, quality, comfortable and healthy indoor environmental qualities

Precise results depend upon quality control throughout the organisation of the process. That includes maximising respondent motivation to participate, securing the clarity of the questions and respondent instructions, contriving a plan to follow up on non-respondents, pre-testing the questionnaire and survey operations, coding the survey information accurately, and entering the information correctly (Scheuren, 2004; Cuhls, 2014). With the Delphi method, participants present and justify their feelings about the specified subject. Likewise, they take the opportunity to consider the positions of others, reconsider their judgments, and evaluate the relative importance of each opinion presented. The utility of the method for the theory-building process for sustainability has been exposed. First, the selection and ranking of the sustainability indicators are of value at the initial stages of theory development. It helps to identify what SI factors experts perceive are important for industrial sustainability valuation where no market exists, and the ones are viewed as dominant. The reliability of the Delphi findings in research studies is contingent upon a list of relevant variables, so the experts' rankings prioritise the dominant factors and help the researchers to identify the factors with the strongest effects. It may not have been possible to validate dominant SI factors for the locality by any other method except through a CDM. The SIs, ISRO and the correction factor were the information solicited from experts who have varied exposure and experience on the subject matter. By inquiring about their opinion, the study extends the empirical observations upon which an initial concept is based—thus firming up the grounding of the theory and enhancing the likelihood that the resulting theory could hold across similar contexts and settings.

6.3.2 Experts Consensus and Feedbacks

The existence of a consensus on a Delphi process does not connote the correctness of the result. The CDM has been criticised as a method that coerces consensus because participants have no opportunity to discuss issues and elaborate on their views (Walker & Selfe,1996; Powell, 2003). Nevertheless, attainment of consensus and its utilisation in the CDM can provide valid findings for exploratory and theory development. Keeney *et al.* (2001) insist that CDM require panellists achieving consensus; even so, there is no standard method for ascertaining the consensus. Another useful method for combining the subjective but sound judgments of panellists to produce a collective impression would be to average participant responses. However, the literature supports the robustness method for aggregating a group's opinion and the CDM often utilises the Kendall's W statistics, mean ranks of factors, relative importance index, and standard deviation (Schmidt *et al.*, 2001; Winkler & Clemen, 2004; Stitt-Gohdes & Crews, 2004; Kasi *et al.*,2008).

Turoff and Hiltz (1996) conceive of feedback as an important aspect that ensures panellists feel their comments and contributions are valued. Indeed, to Rowe and Wright (1999), feedback of the reasons or rationales behind panellists' forecast is invaluable in Delphi studies. They tallied up that because it is through the medium of feedback that information is transmitted from one panel to the next; by circumscribing feedback, one also restricts the range of panellists' aggregate accuracy. Feedback to panellists in the frame of reasons for their evaluations has been proven to ameliorate the efficiency of group minds in the social sciences.

6.3.3 Sustainability Obsolescence and Correction Factor (ISRO-CF)

The inability to compare all buildings (that is, new and existing) under a single rating system and be able to analyse whether the performance of the building matches its certification has created considerable confusion and a failure to identify the market value of sustainability accurately. Even so, the current industry rating tools are not at a point where all the building stock can be compared or analysed throughout its lifecycle holistically and on performance. This makes it inherently difficult for Valuers to identify whether there is a differentiation in the market value of buildings with a higher level of sustainability (Warren-Myers & Reed, 2010). Also, the secretive nature of the property market has caused many issues and prevented the assessment and analysis of commercial property transactions. As a result, the utilisation of the comparison of transactions for sales and leasings has been hard for valuers; thus preventing the industry to accept or identify whether a differential is noted in the buildings that demonstrate an increased level of sustainability. There is likewise the potential need for the development of a medium by which valuers can use to assess the multidimensional sustainability attributes in a building precisely.

The development of the valuation approach is based on the incorporation of the ISRO-CF into the conventional cost approach. The concept of externality and the theory of pollution control by Wheeler (1992), Starvins (2001), Birnie and Boyle (2002) have been applied to sustainability in industrial real estate valuation, where no market exists to reflect the sustainability capacity of the case study industry. The purpose of externality is to internalise the social and environmental costs in relation to the industry's sustainability incapacity as expressed by the ISRO-CF. Other remote purposes are: (i) To ensure that the government and the society did not subsidise those costs extensively (ii) To induce the owners to uptake sustainability so long as retrofitting or uptake costs remain below 'costs' attributable to sustainability-related obsolescence (iii) To capture the impact perspective to the study of sustainability (iv) To assess the sustainability-corrected investment value to the owner.

In addition to what has been variously discussed in section 4.4.1.3; 5.4.1.3, further evidence was provided in support of the ISRO-CF in section 6.6.3. ISRO-CF is the assessment of the value to the owner based on the sustainability capacities of process industries. If ISRO is unaccounted for, industries would have no reason to comply with the sustainability requirements. From the sustainability impact-compliance perspective, a positive correlation could exist between compliance and value; but negative, between compliance and ISRO. The more compliant with requirements, the less the ISRO, and the more the value to the owner or business (value-in-use). ISRO scales their values-in-use to reflect sustainability capacities at the date of valuation because there are no comparable transactions to reflect it. Besides, it is environmentally, socially, and perhaps, economically sound, and responsible valuation principle for process industries and their owners to *expect t*o account for the external costs that they create through unsustainable production processes (section 5.4.1.3). The study considers a non-market based approach and explains that ISRO could relate to the extent to which industrial property features fail to conform to the demands of local sustainability.

The literature has argued that obsolescence precedes a fall in value, indicative of the necessity for the property owner/proprietor to 'comply' with certain physical, economic, functional/technological metrics, including "sustainability" metrics. It further submits that identifying sustainability obsolescence in real estate valuation would play a crucial role in redefining building life, property income cycles, and stimulate significant industrial sustainability market sensitivities over a short period of time, where such markets do not now exist. These thoughts have since been extensively shared by Myers (2009), API (2007) and Parnell and Sayce (2007). The current study emphasises these points together with the inclusion of expanded sustainability-related information which can avoid overlaps with the functionality, serviceability and the durability requirements of the traditional valuation.

It has been argued that sustainability obsolescence attempts to evaluate and price sustainability in isolation, thus becoming problematic. This is also much true for other forms of obsolescence - physical, economic, and functional (PEFO), for which research has not provided superior substitutes. PEFO do influence valuation input parameters individually and collectively in many ways as well. The point to understand is that obsolescence allowance could take account of overlaps in the various compartments in a most coherent manner. The proposition in this thesis is supported by the argument that obsolescence allowances and correction factors in property valuations are indicative of the necessity for the rational property investor to 'comply' with certain physical, economic, functional/technological metrics, and in this case "sustainability" metrics. Obsolescence is inevitable as a factor for consideration in most property valuations. The relationship and influence of obsolescence on value may well be appreciated if we consider a building that has reached total obsolescence stage in its life cycle with the prime value of the land element and its development potential. In this brief illustration, obsolescence is the chief factor that has brought the property to the end of its life cycle for which the value *rebus sic stantibus* is limited to the land element and what can be salvaged and resold. Over time, and with sufficient market sensitivity, sustainability obsolescence could play a significant role, among the other forms, in redefining building life and property income cycles. In the context of this study, Ibiyemi *et al.* (2015) insist that it be unlikely that depreciation for obsolescence could be avoided in a depreciated cost approach to non-market industrial valuations.

Doubt has been expressed as to the likeliness of the approach being adopted by valuation professionals. It may well be submitted that it is too early to predict. Besides, it must be understood that the issue of sustainability is not only a professional one but also borders on survival, for which the valuation profession has a social responsibility. The calculation of a sustainability-correction factor of 0.671 to adjust the preliminary valuation result aligns with one of the evidence-based approaches. The adoption of the correction factor has not been a common practice because all value-influencing factors are often directly considered within the determination of single valuation input. However, it is adopted for a good reason that sustainability cannot be isolated from other value–influencing variables, as could be the case if taken off as a lump sum. Indeed, sustainability-related building attributes exert influences on all the key valuation input parameters (Lorenz and Lützkendorf, 2008a). The ISRO-CF introduces an additional step of calculation into the valuation process for which the immediate end users have indicated their acceptance to adopt. Furthermore, the ISRO-CF approach could be considered as a necessary transitional intervention and practical solution for industrial sustainability accounting that can induce a change of behavior through a self-regulatory sustainability capacity building by the individual industry. For instance, industries have the additional advantage of their sustainability capacities and capabilities and can elect to improve on them, given the required ‘incentives’.

The study recognises that SD precedes sustainability itself, but tends to promote it. Conversely, non-compliance with the SD initiatives could be detrimental to sustainability. Literature also documents that a sustainability market could not probably exist without compliance (Runde & Thoyre, 2010). Then, a substituted market is desirable to assess ISRO for property valuation purposes, where no market exists. Resultantly, this study submits that non-compliance ought to be the cause of ISRO and a resultant loss in value to the business or the owner. If this is the case, the measuring standards ought to be the local sustainability metrics. Logically, if a loss in value *of* the business should be expected due to non-compliance with market demands for sustainability, where a market exists; then, a loss in value *to* the business or owner, should also be expected due to non-compliance with the local sustainability metrics where no market exists. Expectation and substitution are cardinal principles of property valuation upon which this model has been based. Adoption of sustainability initiatives is critical for process industries, and should not be ignored in property valuation. It could enhance their utility indices provided stakeholders be well informed. Future work could focus on critical review of the Delphi for industrial sustainability evaluations, and its operationalisation for effectiveness in industrial, and other classes of properties where the cost method of valuations is the most appropriate option. Also, studies on the implementation of retrofit strategies on large industrial building stocks are still limited.

6.4 Sustainability-Corrected Value to the Owner

The value of the asset to the owner or a prospective owner for individual investment or operational objectives is in the region of 9 million Malaysian Ringgit (section 5.2.4.3). The final valuation figure has integrated the extent to which the process industry currently meets prescribed sustainability criteria when not directly evidenced through market transactions. The context of investment value basically indicates worth or value to the owner. Sustainability compliance has become a value indicator as values tend to change in response to the impact considerations and sustainability uptakes, both of which are directly related to the measure of ISRO-CF.

The corrected value to the owner accords the theoretical framework to strengthen the internal validity of the study.

6.5 Perception and Support of the Sustainability-Corrected Approach by Valuers' Perception and the Relationship between Constructs

The hypotheses stated in section 4.4.2.2 (s) have been tested, and the findings reported in section 5.4.2 have indicated that the relationships of BLR and BCS to SUP were significant. The path betas, β, shown on BLR => SUP (12.181); BCS => SUP (2.078) have explanatory power. The relationship of BLR and SUP has demonstrated a strong influence on SUP. The variance of 41.6% explained in SUP by BLR and BCS is fair. Unknown factors explain 58.4% of the variance in SUP. BLR has a stronger influence than BCS. Although the influence of BCS on SUP is also significant, the relationship is comparatively less powerful. The conceptual postulations of Addae-Dapaah *et al.* (2009) about relationships are supported in part because only BLR and BCS influence the support factor in the research model. Moreover, there is a deviation from the conceptual model that BHBV, BPG, BQL would also be significant predictors of SUP. BHBV, BPG, BQL were less considered as probable benefit nodes for industrial sustainability by the valuers.

The logical explanation of these findings would be either that valuers do not seem to have sufficient knowledge about industrial sustainability benefits being a vehicle for a higher premium, and building values, productivity gains and enhanced quality of life or that knowledge management among them is ineffectual. The outcome is unexpected at the present time when innovations for sustainable development are gaining higher grounds. Sustainability support systems based on knowledge concepts developed by Gloet (2006) and Petrini & Pozzeboh (2009) are also not fully supported. With knowledge insufficiency about BQL, it could not have a mediation effect. The three factors in the conceptual model not considered because of poor factor loading (BHBV, BQL, BPG), could arguably lend credence to a submission that the valuers' perception was more of a responsible alternative rather than knowledge-based. The outcome challenges the researcher's conceptual model and those of Gloet (2006) and Petrini and Pozzeboh (2009) that sustainability in organisations can be backed up by knowledge and intelligence. Nonetheless, there is conceptual indication that valuers' specific understanding of economic and risks reduction advocacy can help achieve industrial sustainability in the long run. Since BLR is more important than BCS as dominant factors, there is evidence that SUP could improve significantly with more proof of risk lowering available to the valuers. Even so, in support of the model, BHBV, BPG, BQL are associated with SUP, but valuer's knowledge about sustainability needs to be upgraded to enhance concrete support for the implementation of valuation-based industrial sustainability initiatives.

Valuers support the inclusion of industrial sustainability into real estate valuation using the ISRO index and correction factor. However, support for industrial sustainability inclusion for investment value or value-in-use are motivated by the BLR and BCS factors, such as reduced health and safety risks (c4); reduced building obsolescence (f4), water conservation (b1), energy efficiency, lower maintenance costs(b3) and less claims on medical costs (b6).

BLR and BCS factors causally related to support. In other words, support received from valuers was dependent on the valuers' knowledge about the expected risks and cost savings benefits from the initiative of integrating sustainability footprints into real estate valuation theory and practice. The adopted concepts of Glanz (2001; Gloet (2006) and Petrini and Pozzeboh (2009) that sustainability in organisations can be backed up specifically by knowledge about productivity gains, environmental impact minimisation and the prospects of a high building value is further challenged. Addae-Dapaah *et al.* (2009) also discussed the similar framework but did not verify it. Nevertheless, the occurrence could be due to inadequate knowledge management among the valuers and within the larger society. Since the overall conceptual framework is not fully supported by the research outcomes, the observation has implications for the internal validity of this study. The valuers' support elements can be attributed to their knowledge about lowering risks and cost savings alone. However, the measure of causal relationships indicates that 41.6% of the support factor is explained.

This study needs to be differentiated from the previous ones in several aspects. One distinct way of differentiating is that most literature studies address sustainability in commercial and residential properties and the methods of valuation applied are confined to the comparative analysis of data and market transactions, and the linear hedonic model. The reason for this is that sustainability markets were identified, monitored and reflected as evidence of value differentials. The comparative method of valuation has been described (section 3.4.7.3b). The other case studies used the linear hedonic price regression (HPR). Miller *et al.* (2009). Fuesrst and McAllister (2008), Salvi *et al.* (2010), Eichholtz *et al.* (2008, 2009), Pivo and Fisher (2009) applied the hedonic regression, hedonic regression for sale and weighted least square regression, regression analysis, portfolio analysis with a hybrid of the Delphi and the regression analysis. Sopranzetti (2010) explains that the basic additive hedonic equation is one where the value of an asset is regressed against the characteristics that determine its value. Rather than pricing a given house or property directly, a researcher can deconstruct the house and property into their value-adding components, such as lot size, square feet, the number of bathrooms, and the number of bedrooms, neighborhood quality, sustainability aspects and so forth. A well-specified hedonic model will estimate the contribution to the total price of each of these features separately.

The analyses and case studies on the costs and benefits of sustainable building and management of property assets (Kats *et al*., 2003; Morris Hargreaves McIntyre, 2006; Matthiessen & Morris, 2007; Miller *et al.,* 2009) and the various publications on performance measurement. (Kohler & Lützkendorf, 2002; Sayce & Ellison, 2003b; Kimmet & Boyd, 2004; Lützkendorf & Lorenz, 2006, 2009; Ellison & Sayce, 2007; Pivo, 2008); and sustainability risks (Lützkendorf & Lorenz, 2007; CMP, 2008) are investment-related. Nonetheless, the study of Runde and Thoyre (2010) was a clear exception from the others for the reason of providing a new orientation and a re-definition of the goal of sustainability in real estate valuation. The work queried why valuers need to understand sustainability if they are only concerned with increasing the market values of real estate and wondered why they are not also focussing on the sustainability discount or adjustments that could reflect the avoidance, mitigation and minimisation of adverse current and future social, environmental and economic externalities. The aim of this research resonates with the central submissions of Runde and Thoyre (2010) but differs in applications and methodological approach. The three-step sustainability valuation model which consists of assessing the market uptake of sustainability, categorisation of the sustainability valuation matrix of the value of a property relative to its green-brown characteristics, and constant monitoring are also market-based.

The findings of this thesis relate to the results obtained as well as the research problem identified in section 1.3. The discussions have been done according to the findings. The findings show that the ISRO-CF valuation approach is an option for valuers to incorporate industrial sustainability into the valuation of process industries on the basis of investment value. The approach is adapted to capturing the dimensions of sustainability using the relevant sustainability indicators. The Delphi method and scores used were validated and a data triangulation confers the suitability and acceptability to the end-users.

6.6 The Research Claim

A claim argues, persuades, convinces proves, or provocatively suggests something to a reader who may or may not initially agree with a proposition. Weida and Stolley (2013) states that a claim defines the thesis direction, goals, scope, and exigence and is reinforced by quotations, evidence, argumentation, expert opinion, statistics, and telling details. A claim argues for a certain interpretation or understanding of the subject matter.

6.6.1 Classification

The claim relates to industrial sustainability. Sustainability is a form of obsolescence that could be handled by the use of a substituted market that scores the extent to which the industrial sustainability factors meet the prescribed sustainability criteria, where no sustainability market exists.

6.6.2 The Claim

Obsolescence and property values are interdependent. In specific terms, Obsolescence and sustainability are negatively correlated in so far as lack of prescribed initiatives lead to a loss of property values whether there is a sustainability market or not. Where no market exists, as is the case for process industries, the ISRO-Correction Factor approach should be used to value the process industries on the basis of investment value for the reason that it seems to deal more effectively with issues of double counting and does not treat sustainability in isolation of other value-influencing factors as raised in the literature.

6.6.3 Evidence to support the claim

Sustainability research is unique by its being inter and multi-disciplinary with its globally interlinked status. Siebenhuner (2004) and Fahy and Rau (2013) proclaim that because DM and sustainability have inter and multidisciplinary dimensions, it is these approaches that can provide a valid assessment of expert consensus opinion. The study asserts that the CDM reinforces the sustainability impact-compliance perspective to the study of sustainability in process industries, where no market exists by creating a platform that could raise private costs, and limit industries' productive output to a level commensurate with their sustainability-compliance capacities. Section 5.3.3.1 has further discussion on the impact-compliance considerations. The CDM, in the view of the researcher, is suited to ISRO for the reason that the assessment of ISRO is not appropriate to precise analytical techniques since no industrial sustainability market data exists for comparative analysis. The issue is complex, so requires contributions from people who are acquainted with the socio-cultural, economic and environmental dimensions of sustainability. Therefore, a panel study should most appropriately answer the research question about ISRO-CF, that is, the extent to which industrial sustainability features meet the prescribed sustainability criteria (Ibiyemi *et al*., 2015). The traditional survey would be less appropriate (Rowe *et* *al.*, 1991; Jairath & Weinsten, 1994; Linston & Turoff, 2002; Okoli & Pawlowski, 2004). The use of the correction factor is one of the sustainability-incorporated valuation approaches found in current literature. Its application in a substituted market could provide an estimate of the ISRO as a Correction Factor from which the investment value might be derived. The correction factor scales down the investment values to reflect the industry's sustainability capacities at the date of valuation because there are no comparable transactions to reflect it. Furthermore, the approach has already been accepted by the end user valuers as an appropriate valuation approach.

The ISRO-CF is a factor that is multiplied with the result of the valuation figure to correct for a known amount of systemic sustainability obsolescence due to non-compliance with the sustainability metrics. This quality by itself eliminates the arguments that it could treat sustainability in isolation, although care must be taken to prevent double counting. The single input parameter using the ARY is a heuristic approach that is subject to wide variances. The lump sum allowance relies on the valuers' inputs together with those from the Facilities Managers and Designers. However, larger assembly of expertise is required in the case of process industries.

6.6.4 Description of the evidence.

This claim relies on these principles and theories:

(a) The valuation principles regarding the substitutive market and expectation

(b) The Delphi strategy as a valid consensus of a group of experts in providing the ISRO forecasts for the correction factor

(c) The environmental economics theory of externalities and inducement.

Investors are reluctant or not prepared, to invest in sustainability because they are uncertain about immediate returns on retrofitting costs or other additional costs required in embracing sustainability initiatives (Myers, 2009; NESREA, 2011). Second, they need an inducement to do so. (Ibiyemi *et al.*, 2015). However, sustainability may not be determined without the presence of a sustainability market, and the available market information requisite to it. Where no market exists, the valuation principles of substitution and expectation are applied to estimate the ISRO. Unless the ISRO is measured in relation to sustainability capacities and underwritten by the investors, they would not be induced to invest in sustainability (Ibiyemi *et al*., 2015). Ibiyemi *et al*. (2015) argues that the Delphi forecasting technique (DT) could initiate the integration of its multidisciplinary nature to reflect the multidimensional industrial sustainability-related obsolescence for valuing process industries, where no market exists. The purpose would be to serve the aspirations of society for industrial sustainability. Besides, it is environmentally, socially, and perhaps, economically sound, and responsible valuation principle for process industries and their owners to *expect* to account for the external costs that they create through unsustainable production processes. The other theoretical considerations can be found in section 5.2.3.1

6.6.5 Interpretation of the Evidence.

Theory documents the evidence of loss in market value resulting from properties' non-compliance with requisite sustainability uptake and a corresponding decline in their utility value. Logically, ISRO-CF relates to the extent to which industrial property features fail to conform to the demands of local sustainability. First, it is evident that obsolescence precedes a fall in value; indicative of the necessity for the prudent property owner/proprietor to 'comply' with certain physical, economic, functional/technological metrics, including "sustainability" metrics. Furthermore, from the impact-compliance perspective, a positive correlation seems to exist between compliance and value; even so, negative, between compliance and ISRO (section 5.2.3.1) The more compliant with requirements, the less the ISRO, and the more the investment value. Thorough understanding of the relationships might play a relevant role in redefining building life, property income cycles, and stimulate important industrial sustainability market sensitivities over a short period where such markets do not now exist. These thoughts have been extensively shared by Myers (2009), API (2007) and Parnell and Sayce (2007). Furthermore, and to a large extent, it is the prescription of sustainability metrics by the GBRTs that drives interpretative sustainability in the property market. There appears to be high multicollinearity between prescription, compliance, and sustainability to justify the application of the ISRO-CF. If obsolescence leads to falling in the value *of* the business, it is sound and logical reasoning to expect a fall in value *to* the business. The sustainability market discounts for sustainability in market valuations, and the substituted sustainability 'market' reflects sustainability in the case of value to the business.

This work specifies reliable evidence, convincing arguments, procedural fairness and approach characterisation of issues in industrial sustainability for inclusion in property valuation that has not been previously addressed. It advances an original point of view that helps to proceed with sustainability valuation for process industries.

6.7 Summary

The study recognises that compliance with sustainability requirements precedes sustainability, but tends to promote it. Compliance is the root of sustainability. Conversely, non-compliance could be detrimental to sustainability. Hence, a viable sustainability market could not probably exist without compliance. Resultantly, this study insists that non-compliance ought to be the cause of sustainability obsolescence (SO) and the resultant loss in value. If this is the case, adoption of sustainability initiatives might enhance the utility index of process industries provided stakeholders be well informed. However, a loss in *value of the business* should be expected due to non-compliance, where a market for sustainability exists; and a loss in *value to the business or owner,* where no market exists.

- In the marketplace, obsolescence due to sustainability is reflected through evidence provided on transactions (*Indirect)*. However, where no market exists, the Owner or Business accounts for obsolescence due to sustainability through compliance – *Direct*

- Sustainability obsolescence (SO) should be assessed for property valuation purpose based on the sustainability capacity for compliance or performance of process industries relative to local sustainability requirements or metrics to leverage on industries to limit their productive capacities to a level commensurate with their sustainability compliance capabilities.

CHAPTER 7

CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

The study has shown that buildings impact negatively on our natural environment, economy, health, and productivity through high embodied and operational energy consumption, raw materials use, waste output, portable water consumption, and carbon dioxide emission. It is also noted that the negative impacts of buildings can be reduced through a synergy of such sustainability initiatives as efficiency in the siting and design of structures, efficient use of energy, water and building materials, enhancement of indoor environmental quality, optimisation of operations and maintenance, as well as waste and toxins' reduction. To achieve this state, it requires the participation of all stakeholders, including built environment professionals who are to devise strategies for SD in their fields. This work resolves for the valuer, the question of finding an appropriate approach to integrating sustainability issues into process industries where no market exists by proposing the use of the Delphi method to integrate sustainability obsolescence correction factor into investment values or values-in-use. Real estate professionals should study and interprete market behaviors and gather evidence to show that markets are indexing sustainability issues in rental and capital bids, but the same strategy is inappropriate for non-market industrial properties where there are no real market indices upon which their sustainability can be read, particularly in many less-developed countries. The viable solution is to relate their sustainability incapacity to some acceptable local sustainability requirements from where some quanta of sustainability obsolescence can be derived. Sustainability rating and certification standards play an important role in shaping decisions and choices that process industry investors would have to make, at least in the long run. Hence, it is expected that the investors have to make references to the set criteria from time to time to verify compliance if they wish to maximise profits, as their production limits would correlate with their degree of compliance with the metrics. Invariably, a kind of action and reaction comparable to those found in the regular markets may evolve, each influencing the other. Arguably, this can be regarded as a substituted market of the prescriptive order. It is clarified that there is an impact-compliance perspective to sustainability and real estate valuation of non-market industrial properties. Valuers also have a professional responsibility to drive sustainability by offering sustainability-driven advice to their clients, and social responsibility to create those incentives that can persuade industries to invest in sustainability. It is necessary because stakeholders are more interested in the immediate benefits they will receive from adopting more sustainable practices by implementing sustainability initiatives. The implication of the industry mindset is that they are unlikely to invest in sustainability voluntarily unless encouraged or persuaded to do so. Legislative changes, global reporting and focus on climate change, corporate social responsibility and good governance may assist in this regard. If these congressional, regulatory, and other incentive drivers are not explored and implemented, particularly in the industrial sector, there could be limited or no investment in industrial sustainability. The study of sustainability and real estate and the search for an integrated approach to real estate valuation is a continuum but must be expounded to cover all kinds of real estate and property types. It seems unrealistic in practice that we rely on rating codes and market-driven approaches alone to enhance sustainability. Government regulation is necessary as a framework for reducing pollution and other sustainability challenges, but stakeholders need to fashion a well-designed sustainability evaluation framework in a manner that the civil society and private firms can serve as vigilant extensions of State‘s capacity for monitoring and enforcement of sustainability regulations. A situation where there are indirect effects of consumption or production activity on agents other than the creator of such activity, which does not work through the price system is unsustainable.

7.2 Conclusion of Main Findings

The study's aim to build valuation theory and provide a valuation approach for the practice for sustainability applications to investment values of process industries has been achieved. Sections 5.2.3.1., 6.6.4 and 6.6.5 considered the theory building aspects. First, the lack of property sustainability has become a prime source of obsolescence in buildings which necessitates the use of a correction factor obtained by the CDM (sections 2.2.2.2; 5.2.1.1). Second, the expanded principles of substitution and expectation have covered the sustainability-related issues (sections 5.2.3.1; 6.6.4; 6.6.5). Third, the aspects of the sustainability impact-compliance assumption contained in section 5.2.3.1. Fourth, the theory of externality and inducement to sustainability by industries (section 3.4.9). The four theoretical considerations constitute important options for valuation theory building. The valuation approach is the modified cost approach to valuation which acounts for sustainability-impact compliance through the ISRO-CF.

All the objectives of study have been fulfilled and research questions answered. In line with the proposition of Evanschitzky and Armstrong (2010), the work can be replicated. The conclusion of the main findings connects to the research objectives and the answers provided to the research questions as considered in sections 7.2.1 to 7.2.5. The theoretical framework justifies the usefulness of the findings and conclsion.

7.2.1 Establishment of the Case for Sustainability and the Real Estate Valuation Approaches

Sustainability research is inter and multi-disciplinary. This research brand faces the challenge of integrating knowledge and methods from different scientific and social disciplines, and of integrating both real world and scientific knowledge. However, this study is intended to conclude that ISRO should be assessed for property valuation based on the sustainability compliance or performance of the process industries in relation to the local sustainability requirements. It reviews the evidence-based approaches and applies the calculation of a sustainability-correction factor to adjust the preliminary valuation result. The logical reason for the choice is that sustainability is multidisciplinary and the Delphi method provides a valid assessment of opinion from a heterogeneous and multi-disciplinary expert perspective. Besides, a correction factor seeks to induce a change of behaviour. The approach appears clear and explicit.

The first objective "To establish the case for the integration of sustainability into real estate valuation in the context of the emerging normative and evidence-based real estate valuation approaches" was achieved with the build up of the rationale of study that brought to the fore, the need for valuers to intervene through the instrumentation of valuation. Second, the literature identified specific reasons why sustainability must be integrated into real estate valuation and also the consequences of not doing so (section 2.2.2).

7.2.2 Identification of the indicators that apply to industrial sustainability and the Industrial Sustainability-correction factor.

The second objective "To find out the relevant sustainability indicators and evaluate the sustainability-related obsolescence correction factor for a process industrial real estate based on investment value" was achieved through the Delphi survey. The survey used experts in two panels, who are versed in real estate valuation, sustainability and related environmental issues. The experts include urban planners, land economists, soil and pollution scientists, academics and environmental managers. In a rigorous Delphi exercise, they selected and validated the list of relevant sustainability indicators and scored each of the indicators after their industrial visits for direct observation and through the study of the EAR, including the summaries provided by the researcher. All the indicators are mutually complementary and important for inclusion in the assessment. However, for the purpose of prioritising, a list of the first four (4) important indicators has been presented in Table 5.17 and a full list of the thirty-nine (39) indicators in Table 5.5. The experts scored the indicators as two different groups on a maximum score of 10/2 upon which the ISRO - correction factor of 0.671 was derived (Table 5.9). The aggregate consensus is achieved and based on the feedbacks, the experts are well informed. The Delphi result is valid for the following:

(1) Selected the appropriate number of qualified Experts from a diverse background as prescribed by the KNRW Team.

(2) Sufficient anonymity in the survey process to remove common biases and social interaction that normally occurs in face-to-face group communications.

(3) Validated and reiterated responses from the experts with feedbacks.

(4) Achieving statistical consensus among the two panels about the scoring of sustainability indicators.

(5) Further validation uses the Mann-Whitney U to test significant difference between the aggregate panel scores.

7.2.3 Developing a sustainability-incorporated valuation approach

The third objective of developing a sustainability-incorporated valuation approach was achieved by adding steps 5 and 6 to the valuation process (section 5.2.3.2). Step 5 assesses the ISRO-CF through the Delphi experts, and step 6 reflects the sustainability capacity of the process industry by multiplying the indicated figure with the ISRO-CF. The achievement of the findings for RQ.3 leads to the achievement of RQ.4

7.2.4 Assessment of the sustainability-corrected investment value to the industry owner, using the case study process industry.

A 2015 valuation report prepared for the case study industry by a reputable firm of Chartered Surveyors was updated, and a value-in-use of N1,027,000,000 (RM13.7 million) derived. Then, an ISRO correction factor of 0.67 discounted the valuation figure to N688,000,000 (RM9.2 million). The difference of N339,000,000 (RM4.5 million) represents the industry's sustainability incapacity from the perspective of the experts. The fourth objective of assessing the true value to the owner was realised with the provision of the corrected valuation figure.

7.2.5 Investigating Valuers' perception on the integrating sustainability into industrial real estate valuation, support for the approach and explaining the linkages between the critical factors.

A questionnaire survey was used as a method of investigating the valuers' perception on the integrating industrial sustainability into real estate valuation and verifying the acceptability and suitability of the integration approach. The overall integrity of the data is sufficient to conclude upon the data useability, the needlessness of further data collection nor a new survey. The evidence for the claim abounds in the result of a finding of the specific parameters. Real estate valuers' support both the integration and the approach. The three factors, SUP, BLR, and BCS, are associated, and causal linkages exist between them. However, the population character suggests that BLR and BCS considerations are the causes of the support for the integration of industrial sustainability and the acceptance of the approach. This information is vital to the main study for the reason that there is limited literature to support initiatives for the optimisation of industrial sustainability in real estate valuation. Meanwhile, it is known through this study that economic and risks reduction advocacy can help achieve integration of industrial sustainability into real estate valuation. The objective was fulfilled in section 5.3.1.3.

7.2.6 Methodological Triangulation

The methodological triangulation employs the survey method to perceive infer support of the valuers, the suitability and the acceptability of the valuation approach for operationalisation. The end-users have thus enhanced the validity of the study. Insights into the perception and perspectives on the valuation approach indicate its appropriateness.

The valuers, as end-users, validated the valuation approach and the Mann-Whitney U validated the useability of the Delphi scores. The indication is that the ISRO-CF is a reliable research outcome.

7.3 Contributions of the Study

This study has endeavoured to produce both theoretical and practical contributions to the integration of sustainability into property valuation. These contributions are in the context of the existing use valuation of process industries for investment and other objectives. However, theoretical contributions are primarily related to the contribution to knowledge that, aside from property and sustainability markets consideration for sustainability considerations, there is also a non-market impact-prescriptive paradigm regarding investment value assessments for industry owners. Furthermore, the viable theoretical solution is a substituted market that relates industrial sustainability capacities to established local sustainability requirements from where some form of sustainability obsolescence index and correction factor could be derived. The contributions of this study are put forward in Section 7.3.1 (theoretical contributions) and Section 7.3.2 (practical contributions).

7.3.1 Theoretical Contributions

There are two major significant theoretical contributions of this study reflected according to the findings and the adopted research method and approach:

1. The findings reveal the sustainability indicators for integrating industrial sustainability into property valuation as well as the different group weights given by the experts from heterogeneous backgrounds.

2. The strengthening of the useability of the Delphi method in real estate valuation since Pivo and Fisher (2009) first used it for the selection of property attributes and the subsequent regression analysis.

The two major contributions are incorporated in the study. The first encompassed the identification of the theoretical framework through sustainability assessment which adopted the cost valuation method. The second is the identification of the list of the sustainability indicators in each group of the mutually dependent dimensions.

Other implications of the findings for research and valuation theory are contained in section 1.7.

7.3.2 Practical Contributions

Regarding the practical contributions to the industrial property market and in particular the non-market properties:

1. This study provides an insight to the industrial and other stakeholders (Industrial investors, owners, developers, and managers) of the important sustainability indicators relevant to industrial sustainability that can complement factory planning practice.
2. This work enables valuers to proceed with the assessment of the inestment value to industry owners which was hitherto problematic.
3. The work provides a measure of industry's sustainability compliance for valuation putposes

Other implications to practice and society are contained in section 1.7

7.4 Limitations of the Study

A rigorous literature search was conducted from numerous relevant databases. However, it is possible that some sustainability indicators and benefits may have been missed out. Therefore it is expected that later studies may find other indicators as relevant to this study.

The case study was conducted on the premises of the selected process industry during the period of research from 2014 to 2016 in Lagos, Nigeria. Thus, the findings of this study should be interpreted for the period stated.

The findings should also be interpreted for the process under study as no attempt is made to generalise the ISRO Correction Factor for other process industries. There would be differences in sustainability capacities and compliance between industries, but careful comparisons could be drawn between similar industries.

There is sparse property valuation literature that deals with sustainability issues in industrial processes because it is a recent area of study. It is usual for contemporary property valuation to bear the risk of estimates of distorted value-in-use in this case.

The likelihood that a Delphi-derived ISRO correction factor could overlook the overlaps with conventional obsolescence and compound the ISRO index could be a limitation of this methodology for property valuation purposes.

There are no previous significant guidelines and models for this particular research area to study. The researcher in some cases relied on literature drawn from the field of Environmental Economics and Multivariate Statistics.

Valuation of the case study industry relies on updates from a valuation survey carried out in 2015 by a firm of Chartered Surveyors. Permission was not granted for a fresh survey. We extracted relevant measurement and other information from the valuation report. Nevertheless, cross-checking of measurements were done randomly (where possible) to prevent measurement errors. Limited information was given about their profitability indices, but we obtained a recent copy from web resources. Security was given as a dominant reason for this. We obtained the EAR report from the State Environmental Protection Agency. Notwithstanding, it is not expected that the accuracy of the value estimates would be affected adversely.

As with many research studies, the results of the cross-validation studies are based on a limited numeral of real estate valuers who are Heads of Firms. Firstly, while the respondents were chosen randomly from the sampling frame – Directory of Licensed Real Estate Firms - We might assert that the sampling is probabilistic, but no claim is made about possible errors of random sampling. We reckon that the data was handled properly. Even so, it was not possible to control missing data from the respondents. Without missing data, the research findings could have been further strengthened. Nevertheless, the sample seems relatively diverse and representative. Second, the sampling did not consider the clusters of Real Estate Valuers on a regional basis, but the random selection seem to cover the six geopolitical zones of Nigeria. However, it was difficult to know the extent to which these findings are generalisable.

The limitations of the Delphi methodology are described in section 4.4.1.2(r).

7.5 Recommendations

7.5.1 Recommendation Based on Conclusions

The recommendations based on the conclusions are:

(1). All the sustainability indicators are important and must be selected by proven methods like the Delphi, with each carrying equal scoring weight to justify their mutual dependency. This submission agrees with GreenStarSA (2007, 2014).

(2). The government should set up a Minimum Green Content in Buildings Committee of Stakeholders to work out the minimum input of sustainability issues for industrial property development using the Delphi-derived sustainability indicators as the benchmark.

(3.) Establishment of Nigeria Building Sustainability Council (NBSC) to assess the performance of the outcomes of the sustainable construction for new buildings and retrofitting existing buildings.

(4) That critical factors in industrial sustainability are associated but have petite statistical causal relationships. However, it may but require the mediating effect of knowledge acquisition among stakeholders and the general public on the potential benefits of sustainable development and sustainability. Knowledge acquisition about industrial sustainability is a basic requirement.

As a derivative from (4) above: The introduction of the concept of SD in the educational curriculum for property valuers.

7.5.2 Practical Recommendation for inclusion in Valuation Theory and Practice

The inclusion of the Delphi-driven ISRO correction factor approach to the body of knowledge for determining the investment value to the owners of process industries for investment and other objectives. In other words, the theoretical framework of this study should be fully implemented.

7.5.3 Recommendations for Future Research

This study is envisaged to provide a roadmap to five (5) potential future areas of research. The recommendations are:

(1) Future research could include the selection of three or more heterogeneous Delphi expert panels with a comparison of their degree of scoring agreements. This may help

base scoring on more reliable and valid foundations and provide conscious resolution to the double-counting issue.

(2) The test of the adequacy of the ISRO correction factor as an inducement to the pro-sustainability behavior of industries.

(3) Future work could appraise the values of industry's sustainability incapacities against costs that might be involved in retrofitting and prepare a payback schedule for decision making.

(4) The buildup of robust feedbacks from Delphi experts to justify their responses can be a valuable aid to proposing an Argument Delphi (AD) to build on the contradiction of ideas of the experts for detailed qualitative research.

(5) The examination of knowledge (KM) and human resources management (HRM) can articulate means by which valuers can grow leadership and management capabilities to support sustainability across real estate appraising and business contexts. In other words examining the mediating effect of KM and HRM on support for industrial sustainability.

(6) The exploration of security as a distinct sustainability indicator in the lless developed countries.

(7) Finally, a joint research between the Nigerian Institution of Estate Surveyors and Valuers, Ministry of Environment, Universities, Manufacturers' Association of Nigeria, NESREA could be one of the options to reach out to the industries through the findings of the study. Support from industries could initiate a change of behaviour and encourage

retrofitting activities. The involvement of the RICS would give practical value to the research. This should not only further improve and enhance the uptake of industrial sustainability but would also contribute to the knowledge systems about sustainability

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List of Publications and Papers Presented

List of Publications

1. Ibiyemi, A., Adnan, Y. Mohd & Daud, N. Md (2016) - The Validity of the Classical Delphi Applications for Assessing the Industrial Sustainability Correction Factor: An Example Study. Foresight, Vol.18, No.6 [SCOPUS CITED]

2. Ibiyemi, A., Adnan, Y. Mohd & Daud, N. Md (2016) - Pro-environmental behaviour: An incentive-based pollution charge assessment for process industries. *Pollution Research Journal.* Vol. 35, No.2, 57-68.[SCOPUS CITED].

3. Ibiyemi, A., Adnan, Y. Mohd & Daud, N. Md (2015) - Framework for integrating sustainability issues into the valuation of non-market industrial real estates. *International Journal of Environment and Sustainable Development*, Vol. 14, No.2, pp. 170-190. .[SCOPUS CITED]

List of Conferences Proceedings

1. Ibiyemi, A.O, Adnan, M.Y & Daud M. N (2015). Exploring the Delphi strategy for integrating sustainability issues into industrial real estate valuations where no market exists. 21st Annual Pacific Rim Real Estate Society (PRRES) Conference held in Kuala, Lumpur, Malaysia, 18-21 January 2015.

2. Ibiyemi, A., Adnan, Y., Daud, N. & Olanrele, O (2014). Valuation-based Approach to Sustainable Industrial Pollution Control in Nigeria: The case for compliance-related Pollution Charge. *8th ASEAN Postgraduate Seminar 2014 'Cities and Environment: Turning Challenges into Opportunities'* 12/11/2014 at the Faculty of Built Environment, University of Malaya, Kuala Lumpur, Malaysia.