MODELLING THE INTER-RELATIONSHIPS AMONGST ELEMENTS OF SUSTAINABILITY STRATEGIES FOR SUSTAINABLE MANAGEMENT OF CONSTRUCTION PROJECTS

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DECLARATION

I hereby declare that the work in this dissertation titled **"MODELLING the Inter-relationships Amongst Elements of Sustainability Strategies for Sustainable Management of Construction Projects"** has been performed by me in the Department of Quantity Surveying, Faculty of Environmental Design, Ahmadu Bello University Zaria. The information derived from literature has been duly acknowledged in the text and a list of references provided. No part of this work has been presented for another degree or diploma at any institution.

ADAMU ADAMU

…… ……...…….. …….……..

Student's name Signature Date

CERTIFICATION

This dissertation titled MODELLING THE INTER-RELATIONSHIP AMONGST ELEMENTS OF SUSTAINABILITY STRATEGIES FOR SUSTAINABLE MANAGEMENT OF CONSTRUCTION PROJECTS by ADAMU ADAMU meets the regulations governing the award of the degree of MSc Project Management of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This dissertation is dedicated to Almighty ALLAH (S.W.T) with whom all things are possible and my parents Hajiya Jummai Abdullahi and Late Alh. Tanko Adamu for their understanding, love and support during this long, tedious and on many occasions strenuous journey.

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ABSTRACT

The quest for economic growth in most developing countries has resulted in huge demand for construction projects, and this has eclipsed crucial sustainability concerns (Zhang *et al.,* 2014; Change *et al.,* 2016*).* Therefore, the governments in many countries are increasingly aware of their responsibility to ensure sustainability, leading to the identification of sustainability strategies (Aarseth et al., 2016) to improve reported lower practices in the construction industry (Zoufa & Ochieng, 2017). Because there is an existing correlation amongst the elements of the identified strategies (Aarseth et al., 2016), however, the nature of their inter-relationships is not known. By neglecting the nature of the inter-relationships, existing research has failed to identify key strategies and develop a well-structured model to work as a whole, articulated towards guiding and facilitating experts towards sustainable practices. The key objectives of the study were to identify and assess the sustainability strategies, develop a model from the resulting interrelationships and finally classify those strategies based on their level of influence. Data was collected through the use of 18 Semi-structured interviews to source the expert's opinion from industry practitioners and academics comprising architects, builders, engineers and quantity Surveyors. Interpretive Structural Modelling (ISM) methodology was used to analyse the inter-relationships amongst the elements of sustainability strategies. Using the ISM approach, the present work is able to distinguish and prioritize the strategies according to their driving power and dependencies. The result shows that "Setting sustainability policies by the government" was found to be the key factor or the high priority strategy, influencing the implementation of all the other strategies. Also, the study was able to develop the ISM model based on the resulting interrelationships among those strategies into 7 different ranks. The ISM model so formed, serves as a normative guide or action plan to construction practitioners and other key stakeholders towards sustainable management of their construction projects. Also, the eight elements of the sustainability strategies were classified into independent strategies, dependent and quadrants of MICMAC graph. None of the strategies were found in the autonomous quadrant, signifying that all of the strategies are significant in achieving sustainability in the management of construction projects. The government should therefore, develop measures to ensure that its sustainability policies are strictly adhered to, which helps in achieving organisational and project level strategies. Because the ISM model is not statistically validated, further studies should aim at validating the results of this study with use of a linear equation modeling such as structural equation modeling technique (SEM).

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GLOSSARY OF ABREVIATIONS

ANP: Analytical Network Process

FRM: Final Reachability Matrix

ISM: Interpretive Structural modeling

MICMAC: Cross Impact Matrix Multiplication Applied to Classification

PM: Project Management

RM: Reachability Matrix

SD: Sustainable Development

SEM: Structural Equation Modeling

SPSS: Statistical Package for Social Science

SSIM: Structural Self Interaction Matrix

TBL: Triple Bottom Line

WCED: World Commission on Environment and Development

CHAPTER ONE

1.0 INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The quest for economic growth in most developing countries has resulted in huge demand for construction projects, contributing significantly to the countries in which they are executed (Aarseth, Rolstadås and Andersen, 2011; Javernick-Will and Scott, 2010). On the other hand, projects also pose challenges to the local community and government such as social, economic, and environmental challenges which have become increasingly complex, forcing organisations to innovate, manage change, and adopt new activities (Pope et al., 2004; Wilkins, 2003). As a result, sustainability is increasingly perceived as necessary for understanding the social, economic, and environmental consequences associated with the way projects are designed, constructed, operated, maintained, and finally eliminated (El-Haram, Walton, and Horner 2007; Thomson, El-Haram & Emmanuel, 2011). One potential area for practical implementation of sustainability is sustainable project management (Martens & Carvalho, 2016). In project management, attention is clearly moving from focusing on the iron triangle of cost, time, and quality to broader business impacts (Atkinson, 1999; Shenhar et al., 2001; Silvius and Schipper, 2014). Recognizing sustainability is critical in delivery projects where the deliverables and processes may have a generous effect environmentally, socially and economically (Silvius & Schipper, 2017).

Because sustainability is a fairly new topic in project management literature, with the majority of publications dating from the last ten years (Martens & Carvalho, 2014), the integration of sustainability into PM practices is rarified. Hence, recent studies attempt to integrate both sustainability and project management (Silvius et al., 2013, 2017; Gareis et al., 2013; Sánchez, 2015; Marcelino, 2015; Martens & Carvalho, 2016, 2017; Silvius & Schipper, 2017; Chawla,

2018). This growing momentum shows that 76% of the total literature about sustainability and PM has been produced in the past five years (Silvius & Schipper, 2017).

Correspondingly, the governments in many countries are increasingly more mindful of their duty to ensure sustainability, at least locally (Aarseth et al., 2016). Empirical studies have demonstrated how governments necessitate that organizations executing projects develop strategies, action plans towards dealing with sustainability (Yanarella and Bartilow, 2000). While current sustainability initiatives, strategies and processes focus on wider global aspirations and strategic objectives, they are noticeably weak in addressing micro-level (project specific level) integrated decision-making (Ugwu et al., 2006; Akadiri et al., 2012). Ironically, it is precisely at the micro-levels that sustainability objectives have to be translated into concrete practical actions, by using a holistic approach to facilitate decision making (Akadiri et al., 2012).

Consequently, Aarseth et al. (2016) conducted a systematic literature review and revealed two distinct perspectives in the project sustainability research; one assumes the perspective of the project organisation delivering the asset. The other perspective is the host organisation, which is the regulating body that approves the project and governs the area where the project is located. Furthermore, they also identified and described eight elements of sustainability strategies used by project organisation, host organisation or both (mutual) in order to achieve their project sustainability goals. These so called strategies consist of concrete activities and practices through which sustainability challenges are managed in projects (Aarseth et al., 2016). The eight elements of sustainability strategies are not isolated, but rather form complex correlations towards facilitating sustainability goals (Aarseth et al., 2016). Nevertheless, there is a need to develop more effective strategies in the Nigerian construction industry, to raise awareness and increase demand for sustainable practices during construction of projects (Zoufa & Ochieng, 2017).

1.2 STATEMENT OF THE PROBLEM

Due to the growing trend at the nexus of sustainability and PM, researchers have attempted to identify practices (strategies) by previous researchers towards managing the challenges and opportunities of sustainability in projects to achieve sustainability goals.

However, according Sánchez (2017) sustainability is still a major challenge and difficult to incorporate in programs and projects. Also, Zoufa & Ochieng (2017) reported that holistic sustainability practices and initiatives during the life cycle of projects in the Nigerian construction industry have not been fully embraced. These signify low sustainable implementation practices despite the identification of these strategies to ensure sustainable practices. Therefore, identifying the elements of sustainability strategies is a necessary element although may not be enough to fully attain sustainable practice.

Although there an existing correlation amongst these elements of sustainability strategies (Aarseth et al., 2016), however, the nature of the relationships among them is not known.

By neglecting the nature of the inter-relationships among the elements of sustainability strategies, existing research has failed to identify the high priority strategies (key factors) and develop a well-structured model to work as a whole, articulated clearly towards supporting and facilitating sustainable management of construction projects.

1.3 AIM AND OBJECTIVES

1.3.1 Aim

To model the inter-relationships that exists amongst the elements of sustainability strategies for sustainable management of construction projects. By so doing, the study intends to identify the high priority strategies (key factors) and develop a well-structured model to serve as a normative guide or action plan for practitioners towards ensuring sustainable management of construction projects.

1.3.2 Objectives

1. Identify the elements of sustainability strategies from literature.
2. Assess the inter-relationships amongst elements of the strategies.
3. Develop a model of the strategies from the resulting nature of inter-relationships.
4. Classify the elements of the strategies into different categories based on their level of influence.

1.4 SIGNIFICANCE OF THE STUDY

The study adds to the current literature by proving an in-depth understanding of the interactive relationships amongst the elements of sustainability strategies towards facilitating and ensuring sustainable management of construction projects.

In practice, the result of this study will provide project managers, experts and other key stakeholders, a structured model that will ease and enable them identify the most effective and strategic guide to manage the challenges of sustainability, leading to sustainable delivery of construction projects. It is believed that such a normative (prescriptive) presentation of the framework would benefit the managers in providing proper guidance and direction during the implementation of sustainability in the management of construction projects.

The adoption of a methodology (ISM) which aids in identifying a structure within a complex system of strategies in a clearly defined fashion. This helps in giving more insights into understanding the nexus of sustainability concepts into project management practices.

By classifying the elements of the sustainability strategies into linkage, dependent and independent practices according to their dependency and driving powers, the study gives an insight to practitioners and other key stakeholders as to which set of strategies should be given more attention to in the planning and execution of their projects.

1.5 SCOPE OF THE STUDY

The study is delimited only to the eight elements of sustainability strategies identified by the previous researchers. Potential new strategies were not investigated and used for the study.

Sustainability in projects can be viewed from two perspectives: the sustainability of the project delivery and management of the project (i.e., the process) and the sustainability of the project deliverable (i.e., the product) (Gareis et al., 2013; Silivius and shcipper, 2015). The focus of this proposed study is the sustainability of the project delivery process, as these strategies applies only to sustainable project delivery process rather than the project deliverable.

The study employed interpretive structural modeling (ISM) approach for analyzing the relationships. ISM was chosen because the process is systematic; as it is designed to consider all possible pair wise relations of a system elements, directly from the responses of the participants. Moreover, it guides and records the results of the group deliberations on a complex issue in an efficient and systematic manner, and produces a structured model or a graphical representation of the original problem situation that can be communicated more effectively to others.

Other techniques such as Analytical Network Process (ANP) or structural equation modelling (SEM) can also be used. However, ANP cannot completely show all kinds of dependencies since it is generally difficult to obviate the possibility of interactions within the criteria cluster (Wu, 2008).

Both construction practitioners and industry academics were considered for the study as they have vast experience and knowledge in both sustainability and project management of building and civil engineering projects. The strategies referred to are applicable to construction projects.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 SUSTAINABLE DEVELOPMENT

The concept of sustainable development (SD) attracted wide attention following the publication of the "Brundtland Report" by the World Commission for Environment and Development in 1987. A broader accepted concept of SD is the one given by the World Commission for the Environment and Development, and it is important in order to understand and to formulate the concept of sustainability. According to the report named "Our Common Future," **SD is defined as the development that meets the needs of the actual generations without compromising the needs of future one** (WCED, World Commission on Environment and Development, 1987). A concept of SD more acceptable is the one based on the integration of economic, environmental, and social dimensions, designing the sustainability known as Triple-Bottom-Line (TBL), and it became widely known (Elkington, 1998; Knoepfel, 2010; Labuschagne et al., 2005; Carvalho and Rabechini, 2011; Gimenez et al., 2012; Talbot and Venkataraman, 2011).

The international interest in this report concluded in the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro (aka the 'Earth Summit'), where the Rio Declaration was signed by 153 nations.

Recently, in July of 2012, again in Rio de Janeiro, chairmen of countries and States (called the ONU system) and the civil society participated of the Rio +20 that discussed three main topics: the green economy in the SD context, the eradication of the poverty, and the institutional structure for the SD. This event developed a publication of an official report named "The future we want" confirming the commitment between countries to reach the SD (Rio+20, 2013).

2.1.2 Corporate social responsibility & corporate sustainability

As a concept, CSR can be defined as "Corporate social responsibility is the continuing commitment by business to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large" (WBCSD, The World Business Council for Sustainable Development, 2006, p.3). On the other hand, the Commission of European Communities describes CSR as a concept, whereby companies integrate social and environmental concerns into their business operations and interactions with their stakeholders on a voluntary basis (Commission of the European Communities, 2001).

Furthermore, the concept of corporate sustainability (CS), related to actions aimed at the business environment, which is also presented by Baumgartner and Ebner (2010, p.77) when they argue that "sustainable development when incorporated by the organisation is called corporate sustainability (CS) and it contains like sustainable development, all three pillars: economic, ecological and social."

2.2 SUSTAINABILITY

Sustainability is defined by Gladwin et al. (1995) as a process that creates a vision of community that respects the prudent use of the natural resources to ensure that the present generations achieve a high degree of economic security and can attain democracy and popular participation in the control of their communities while maintaining the integrity of the ecological systems and of life. For Gimenez et al. (2012) and Kleindorfer et al. (2005), the term of sustainability is used to include environmental management, the closed-loop supply chains and a broad perspective on the triple-bottom line, thought that is part of the profit, people, and the planet in corporate culture, strategy, and operations.

For the organisations, this macroeconomic setting, the definition of sustainability adopted and used by the WCED, World Commission on Environment and Development (1987), is difficult to apply and provides little guidance on how the current needs should be identified in relation to the future, on how to determine the technologies and resources to meet these needs and understand how to effectively balance organisational responsibilities among multiple stakeholders (Hart, 1995; Starik and Rands, 1995; Gimenez et al., 2012).

2.2.1 Distinction between SD and sustainability

According to Araújo and Mendonça (2009), the concepts of SD and sustainability are distinct: SD is commonly associated with the expectation of a country entering in a growth phase and remain so over time, and sustainability is the ability to self-sustaining itself and self-remaining. Thus, we can relate SD with public policies and sustainability with all other actions promoted by the private sector.

2.2.2 Triple bottom line

Sustainability as TBL was a phrase coined in 1994 by John Elkington with the aim of broadening the environmentalist agenda of those working in the field of sustainability so that the concept of sustainability could be more explicitly incorporated the social dimension (Elkington, 2004). He used this phrase as a basis for his book "Cannibals with Forks," in which he explains that the TBL vision comprises three components: economic prosperity, environmental quality, and social justice (Elkington, 1998). For the author, it is the dimension of social justice that completes the TBL, and this dimension is the element of sustainability that many companies still partially ignore. Sustainability is envisioned as a TBL, which Elkington refers to as "triple-P": planet, profit, and people. The idea is that the three pillars of sustainability are not stable but, rather, are in a constant

flow of movement due to social, political, economic, and environmental pressures, and its effects occur at the interface of the pillars (Elkington, 2012).

It is recognized that the broad definition of the WCED integrates economic, environmental, and social issues. The way as the definition is usually operationalized is through the triple-bottom line, a concept developed by Elkington (1998).

1. **Economic sustainability** is generally well understood and has been operationalized at the operational level, as the costs of producing or manufacturing (Cruz and Wakolbinger, 2008; Gimenez et al., 2012).
2. **Environmental sustainability** at the operational level refers to the use of energy and other resources and waste left behind as a result of its operations. Environmental sustainability is often related to waste reduction, pollution reduction, energy efficiency, emissions reduction, reduced consumption of hazardous, harmful and toxic materials, and the decrease in the frequency of environmental accidents (Gimenez et al., 2012).
3. **Social sustainability** has focused on internal communities (employees) and external (Pullman et al., 2009). Social sustainability means that organisations provide equal opportunities, encourage diversity, promote connectivity within and outside the community, ensure the quality of life, and provide democratic processes and responsible governance structures (Elkington, 1998). In fact, companies need to engage in CSR activities as a way to improve their social reputation (Fombrun, 2005; Gimenez et al., 2012).

The triple-bottom-line concept suggests that organisations do not only engage in social behavior and environmentally responsible, but also, that the positive financial gains can be obtained in the process.

2.2.3 Sustainability goals

Projects are implemented to achieve a certain goal and selected objectives. In addition to the iron triangle objectives of scope, time, and cost, companies are increasingly concerned with a project's broader benefits and value (Silvius and Schipper, 2014). The strategic value of a project can be considered in terms of various social, ecological, and economic dimensions (Martinsuo and Killen, 2014) that are featured in sustainability. Benefits, value, and value creation may imply different things to the project contractor and the customer (Winter and Szczepanek, 2008) and appear differently during the different phases of the project's and the product's life cycle (Labuschagne and Brent, 2005), thus making the specification of project goals very challenging.

2.2.4 Ways of incorporating sustainability

Moreover, organisations can incorporate principles of sustainability into their activities in the following ways (Labuschagne et al., 2005):

- by considering sustainability during the preparation and review of business strategies,
- by supporting new agreements and negotiations that promote sustainable practices, and
- by developing new projects driven by sustainability principles and
- Finally, by broadening their vision of sustainability beyond the limits of the company.

2.2.5 Importance of sustainability

Sustainability has received increasing importance since (Brundtland, 1987) on environment preservation and sustainable development. It is defined as "meeting the needs of present without compromising the ability of future generations to meet their own needs". Ever since there has been increasing concerns regarding sustainability from both public as well as private sector. A recent example is the Paris Agreement which is further elaborated in (Rogelj et al., 2016). Sustainability has thus become a need for various organisations; this can be seen in their mission and vision

statements respectively. These statements are translated from policy level to project level. In doing so, the policy of an organisation is reflected in objective(s) of an undertaken construction project. Ambitious sustainability goals of recent, current and future construction projects are not a surprise anymore. Kuhlman & Farrington (2010) conclude a need for clarifying the concept of sustainability, even though there is a large body of literature available on the concept. Sustainability and its implementation in project management practice is relatively a new phenomenon.

2.3 SUSTAINABLE PROJECT MANAGEMENT

Sustainable project management implies the use of practices that ensure social, ecological, and profitable delivery of the project so that the project deliverable is socially and environmentally acceptable throughout its life cycle (Silvius and Schipper, 2014). Sustainable project management involves and builds on stakeholder cooperation (Eskerod and Huemann, 2013), includes life cycle thinking (Labuschagne and Brent, 2005), and balances the three dimensions of sustainability (Silvius and Schipper, 2014, building on Elkington, 1997). Klakegg (2009) suggested several reasons for the lack of sustainability in project management: conflict of interest, lack of commitment from key stakeholders, low economic benefits of sustainability compared to the required investment, and changing conditions. Various practices have been introduced to characterize sustainable project management. For example, Klakegg (2009) proposed clearly expressing sustainability as an evaluation criterion, holistic planning with sustainability included in the bottom line, reviewing relevant stakeholders' concerns and expectations, and ensuring flexibility of the delivery of the project to increase the value of the investment. Saving energy during the construction phase and during the life cycle of a building helps cut greenhouse gas emissions (Zhang et al., 2015). Considering the life cycle perspective in road construction projects

helps reduce the greenhouse gas emissions involved (Barandica et al., 2013). Sustainability and project management should be integrated (Marcelino-Sádaba et al., 2015) to make sure that project management is updated and ready to face global sustainability-related problems.

Sustainability in delivery of projects can be viewed from different perspectives. Previous research has recognized four aspects of sustainability: product related, process related, organisation, and people (Marcelino-Sádaba et al., 2015). Sustainability in project business concerns the process of the project delivery and the project deliverable (Gareis et al., 2013). This study is focused on the delivery of the project i.e. how the project is delivered to the external actors in sustainable manner, to either mitigate its impacts on the environment or to promote its favorable contributions to the society.

2.3.1 Challenges for adoption of sustainability in project management practices

A wide range of challenges such as unstable economy, lack of data and transparency (Elkhalifa, 2016) and corruption affect the construction industry in developing countries (Othman and Ahmed, 2013; Perera et al., 2014). Added to these, lack of the formal education on sustainability, financial and political constraints and sociocultural challenges impede the adoption of sustainability (Hakiminejad et al., 2015; Pade et al., 2008). Furthermore, the dearth of financial incentives and obstructive policies are among the challenges inherent to developing countries when it comes to the sustainable delivery of construction projects (Chang et al., 2016; Gan et al., 2015).

According to Othman and Ahmed (2013), the main challenges influencing the sustainable delivery of projects in developing countries come under five major groups. These are technical, human development, managerial, political and triple bottom line (TBL) with TBL referring to environmental, social and economic challenges. Of these, managerial challenges have been found to be the most influential (Othman and Ahmed, 2013). Of particular interest should be

unsustainable project management practices, found to be among the major barriers to the sustainable delivery of projects (Dobrovolskienė and Tamošiūnienė, 2016; Martens and Carvalho, 2016, 2017).

Hwang and Ng (2013) obtained ten (10) challenges for sustainable construction project management in their research:

- Greater time required during the pre-construction process;
- Difficulty to select subcontractors that provide green construction services;
- Uncertainty concerning green equipment and materials;
- High cost of green materials and equipment;
- Increase in meetings and coordination required with consultants and specialist engineers;
- Most frequent design variations, emerging during the construction process;
- Difficulties to include green specifications in the contract details;
- Unexpected circumstances when completing green projects;
- Planning in a non-traditional sequence of operations;
- Planning for different construction techniques.

2.4 PROJECT SUSTAINABILITY STRATEGIES

Strategies are often described as plans and directions to succeed (Artto et al., 2008) and sustainability strategies then deal specifically with the challenges and opportunities of sustainability (Aarseth et al., 2016). In a recent study conducted by Aarseth et al. (2016) in the form of systematic literature review (SLR) across relevant journals in the field of project management and sustainability, two revealed distinct perspectives on project sustainability research were revealed.

a) The first assumes the perspective of the project organisation delivering the investment asset, to either mitigate their negative impacts on their business environment or increase their favorable contribution to the society.

b) The second assumes the perspective of the host organisation, which is the regulating body that approves the project and governs the area where the project is located.

Furthermore, eight distinct sustainability strategies used by either the project or its host or by both of them to support sustainability goals were identified. They include;

I. Setting strategic and tactical sustainability goals.
II. Emphasizing sustainability in project design.
III. Developing sustainable supplier practices.
IV. Setting sustainability policies by the government.
V. Influencing sustainability of project practices.
VI. Promoting sustainability actors in project organization.
VII. Sustainable competences and skills.
VIII. Project portfolio management.

2.4.1 Strategies for project organisation

The first group of articles described three distinct sustainability strategies adopted by project organisations to either mitigate their negative impacts on their business environment or increase their favorable contribution to the society (Aarseth et al., 2016).

2.4.1.1 Setting strategic and tactical sustainability goals

This strategy exists at the early phase of a project and is the key to aligning project and overall strategies. It means focusing explicitly on sustainability issues when developing project strategies, paying special attention to instances where sustainability issues align with other concerns (Aarseth et al., 2016).

Herazo et al. (2012) conducted a study of construction projects where the focus was on utilizing sustainable development issues to link clients' overall strategic management to project management of specific projects. They found that sustainable development was a facilitator in the alignment process between project management and business strategy. Marcelino-Sadaba et al. (2015) presents a research agenda of which transferring strategies tied to sustainability to specific projects is at the top. When sustainability goals align with overall project or business goals should be considered low-hanging fruit with regards to implementation. Example is aligning sustainability goals with lean construction which is aimed at reducing waste (Ochoa, 2014; Verrier et al., 2016). Shen et al. (2010) focus on the project feasibility study and its role for integrating sustainable and socially responsible construction practices in China. The authors look to the government as the responsible stakeholder who effectively can promote sustainability in this phase, as economic performance currently is given the most concern project feasibility studies, whilst less attention is given to the social and environmental performance.

2.4.1.2 Emphasizing sustainability in project design

This is focusing on sustainability issues extensively during the project design phase by the design team as a means to ensure sustainable practice during the execution and management of the project (Abidin and Pasquire, 2007).

Value management and life cycle management are two methods available for use in projects' design phase, and the authors claim that expanding these by adding sustainability issues can help projects improve their sustainable performance (Aarseth et al., 2016). However, they found that this potential has not been fully realized by the practitioners, and they hope to promote this by proposing a structural model that incorporates sustainability into value management and life cycle management.

The provision of sustainability indicators can be a method for emphasizing sustainability from the front-end design and planning through construction, operations and maintenance and demolition as presented by Heravi et al. (2015). Sanchez (2015) provides a method to derive sustainability indicators from a sustainability analysis, both of which are part of a larger framework for sustainability in project management.

2.4.1.3 Developing sustainable supplier practices

It normally falls to the project owner to develop such guidelines, and proactive owners could even support other actors in the project in implementing these (Aarseth et al., 2016). Some studies have looked into specific practices that could be included in sustainability guidelines. Ross et al. (2010) studied housing projects in South-Africa and found seven sustainable principles applied in these projects; minimize resource consumption, maximize resource reuse, use renewable, recyclable or recycled resources, protect the natural environment, create a healthy, non-toxic environment, pursue quality in the built environment, and promote socio-economic uplifting.

Emphasizing prefabrication as a means to improving sustainability is also an important method. Jaillon and Poon (2008) found that environmental, economic and social benefits of using prefabrication were significant when compared to conventional construction methods. Similar

findings were reported by Eriksson et al. (2013) found that industrialized construction can improve both short-term efficiency and long-term innovation and sustainability in infrastructure projects.

2.4.2 Strategies for host organisation

Here two strategies are identified through which hosts can promote sustainability in the projects implemented in their context. When using the concept of host, it refers to the actors that are linked to the geographical and/or local context of where the project is implemented (Aarseth et al., 2016). This is the context that is primarily affected by the project's execution and outcome and typically actively attempts to influence and shape the project in order to promote sustainability, to minimize the negative environmental effects and maximize the social and financial effects of the project (Aarseth et al., 2016). The identified two sustainability strategies adopted by hosts are;

2.4.2.1 Setting sustainability policies by the government

This centers on the establishment of laws, regulations, norms and guidelines that promote sustainability of the projects in the host country (Aarseth et al., 2016). A study by Bossink (2002) focusing on the sustainability of the Dutch construction sector highlighted the salience of governmental policy making and the development of environmental policy plans, laws, implementation measures, and financial incentives to realize the attainment of ambitious sustainability goals. The centrality of governmental level sustainability policies is also frequently discussed in the context of the developing countries where the challenges are oftentimes seen to lie in the actual implementation and control of the realization of the sustainability guidelines and visions in practices (Chen and Chambers, 1999; Ross et al., 2010).

Environmental impact assessments, social impact assessments and sustainability assessments (Hill and Bowen, 1997) that are typically required during the preparation and design phases of large and

complex projects that have significant impacts on their environment and society can also be considered as one important dimension of sustainable policies.

Another aspect of this strategy was found in a study by Block and Paredis (2013), who stress the need for "entrepreneurial political leadership" in developing an agenda for sustainable urban transformations. The findings, from their case projects, are rather specific, e.g., that mayors in cities must act entrepreneurially to drive sustainable urban development and the important role of "entrepreneurial political leadership" in various forms. These do offer insights into how host institutions can perform its governing role in a manner that promotes sustainability. The case study of (Block and Paredis, 2013; Meech et al., 2006) of the clean-up of the Britannia mine site also illustrates how host institutions can actively promote and help facilitate sustainable projects.

2.4.2.2 Influencing sustainability of project practices

This is about incorporating sustainability in projects through different types of technical solutions, systems and standardized practices that are promoted by the host at the industry level (Aarseth et al., 2016). Examples of such practices are specified waste management systems, required environmental management systems and different design tools that in themselves support sustainability (Bossink, 2002). The prefabrication trend within the construction industry and industry-level standardization is also an important element that improves the possibilities for more sustainable construction by alleviating some of the environmental burdens associated with conventional construction (Jaillon and Chi-Sun, 2010; Jaillon and Poon, 2008). In their study, Jaillon and Poon (2008) emphasized particularly the role of the different committees and standardization bodies in implementing changes toward prefabrication-related practices.

2.4.3 Project and host organisations mutual strategies

The strategies that ensure that both the project organisation as well as the host achieves their sustainability related project goals (Aarseth et al., 2016) falls under this category below;

2.4.3.1 Inclusion of sustainability-promoting actors in project organisation

This has been highlighted by multiple sources, particularly the engagement of local stakeholders, such as local authorities, local public and NGOs in the planning, development and execution of projects and project-related decision-making has been brought up as a relevant factor in promoting sustainability (Mathur et al., 2008; Ross et al., 2010; Yunus and Yang, 2014). Without a doubt, consensus among the key stakeholders is highly imperative for project stakeholders to fully embrace sustainability (Yunus and Yang, 2014). In practice, the project organisations and hosts can enact a number of means to promoting the active inclusion of local stakeholders (Aarseth et al., 2016). Examples of these are guidelines for setting mutually agreeable targets for sustainability and local stakeholder engagement (Yunus and Yang, 2014), creating targets and guidelines for community participation (Ross et al., 2010) and promoting the social value, improved legitimacy and opportunities for learning that the inclusion of local stakeholders brings to the project (Mathur et al., 2008).

2.4.3.2 Developing sustainability competencies

Developing the competencies and skill sets of project managers e.g. by investing in formal training programs as well as developing sustainability-related competencies of governmental/ regulatory actors/staffs (Aarseth et al., 2016).

Furthermore, a better educated general public in terms of environmental issues could facilitate more attention and pressure from NGOs and the general population in areas targeted for project development (Aarseth et al., 2016). Several authors discuss various aspects of such competence

development; Gao et al. (2006) reports from an experiment to implement training and education in various sustainability issues, covering company managers as well as government staff and the public. Genus and Theobald (2015) build on the general debate regarding the role of higher education institutions in realizing environmentally sustainable urban spaces and identify roles that may be played by academic researchers in building sustainable urban locations. Cantalapiedra et al. (2006) start their paper by stating "Education is the foundation for achieving sustainable development". Tabassi et al. (2016) focus on sustainable construction, and the importance of project manager competence and training in sustainability issues for the success of sustainable building projects. Liu et al. (2010) point out the importance of teaching project participants sustainability for them to realize the importance of the project (re-use of limited water).

While not directly focused on projects, Vezzoli (2003) argues the need for a redefinition of university level education in the field of sustainable design. Design in this context typically means industrial design of products (and services), but nonetheless represents support for a strategy of strengthening sustainability competencies.

Another aspect of this strategy is the utilization of benchmarking of project implementation practices into the strategy for building sustainability competencies (Aarseth et al., 2016). One specific approach to this discussed by Chen and Chambers (1999) is benchmarking best sustainability practices. Their studies focused on sustainability practices and policies in China and emphasized the need for the undeveloped countries to benchmark and learn from the experiences in developing countries.

2.4.3.3 Sustainability-emphasis in project portfolio management

This involves applying criteria that accentuate sustainability effects when considering which projects to approve for implementation (Aarseth et al., 2016). Portfolio selection is one of four

steps in Sanchez (2015) approach to integrating sustainability issues into project management. This relies on either using a framework for project selection or actively including sustainability as a dimension in early-phase appraisals.

2.5 PROJECT SUSTAINABILITY CONTROL

Project control is defined as "encouraging behavior that is desirable to achieving the organisation's objectives" (Cardinal et al., 2010). An organisation's objectives include the sustainable delivery of projects, and project control is a way to manage projects toward their sustainability goals (Kivila, Martinsou & Vourinen, 2017). Achieving project goals during project execution has typically been built upon the definition of clear performance measures and verified through the use of various diagnostic project control tools, such as earned value analysis (e.g., Anbari, 2003) and project health checks (e.g., Jaafari, 2007). In addition, a holistic viewpoint can be taken for project control, following a behavioral science approach and building on organisational control, rooted in permanent organisations and manager–subordinate relationships (e.g., Ouchi, 1979; Simons, 1994).

In the holistic view, control can take many forms, and it is typically divided into

- Control modes (e.g., formal and informal control) and
- Control mechanisms (e.g., rules, plans, budgets, schedules, and social control; Nieminen and Lehtonen, 2008).

Organisations employ different combinations of control modes and mechanisms in different projects (Kirsch, 1997; Liu et al., 2014; Nieminen and Lehtonen, 2008), and this combination may be referred to as a control package. For example, (Nieminen and Lehtonen, 2008), the control mode of bureaucratic control includes various;

- Boundary mechanisms (rules, directives, codes of conduct) and

- Diagnostic mechanisms (plans, budgets, resource allocation, schedules, performance measures, incentives, reports).

The control mode of clan control may feature

- belief mechanisms (mission statement, vision, values) and
- Interactive mechanisms (project manager selection, training, team control, culture).
- The control mode of self-control may include autonomy on three levels (decision power on daily matters, working methods, project goals).

The existing project control literature has focused on understanding the antecedents and the performance effects of different control package configurations in different projects (Liu, 2015). However, regarding the desirable objectives toward which project control is targeted (Cardinal et al., 2010), the existing studies have either taken a broad consideration or, at least implicitly, focused on the iron triangle objectives.

The existing project control literature has focused on understanding the antecedents and the performance effects of different control package configurations in different projects (Liu, 2015). However, regarding the desirable objectives toward which project control is targeted (Cardinal et al., 2010), the existing studies have either taken a wide thought or, at least certainly, focused on the iron triangle objectives of time, cost and quality.

According to the literature, these indicators should be case-specific (Ugwu et al., 2006), cover multiple dimensions of sustainability (Amiril et al., 2014), and meet the varying goals of different stakeholders (Fernández-Sánchez and Rodríguez-López, 2010). However, the empirical results of utilizing sustainability indicators vary (Gareis et al., 2013; Haponava and Al-Jibouri, 2010). Shen et al.'s (2011) review pointed out that, in general, the proposed indicator sets fail to meet the stated goals for the three dimensions of sustainability (economic, environmental, social).

Although indicator sets that are holistic exist (Shen et al., 2011), many of the proposed indicator sets focus on a particular dimension of sustainability, for instance, on the environmental dimension. Even if a holistic indicator set is utilized, considering the dimensions separately can lead to compromise between the dimensions (Bond et al., 2012). Thus, a systemic approach targeting net sustainability gains should be adopted (Gibson, 2006). Developing new sets of performance indicators for sustainability may be considered simply "yet another new system" by project personnel (Gareis et al., 2013). Instead of having a separate system for sustainability goals, empirical results have shown that sustainability issues and indicators should be a fundamental part of a company's existing project management model (Gareis et al., 2013).

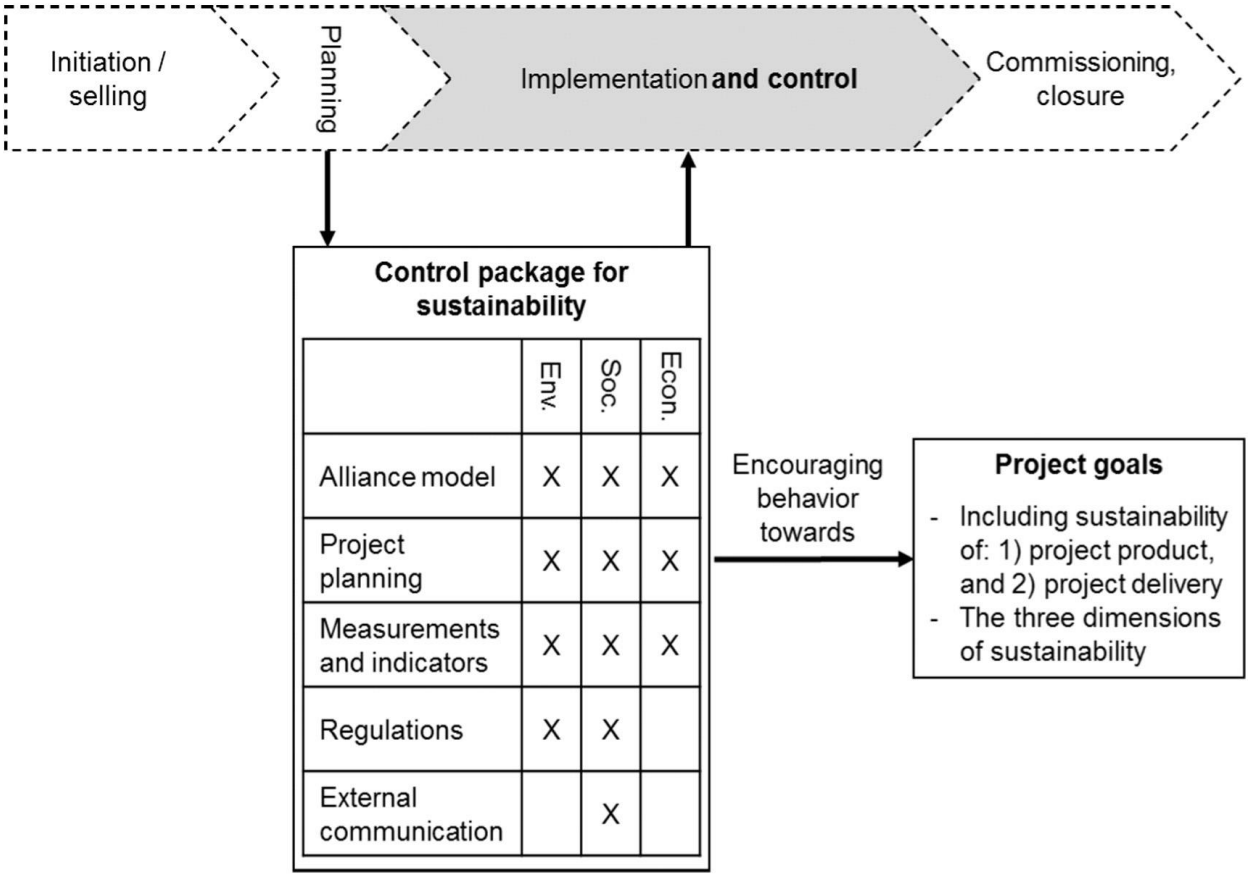


Figure 1: Control package for managing sustainability during project implementation (Kivila, Martinsou & Vourinen, 2017).

Figure 1 was developed based on a study to identify the different control practices used by project organisation in implementing sustainable project management practices in an infrastructure project by Kivila, Martinsou & Vourinen (2017). The figure 1 showed the;

1) Proof of the control package in sustainable project management in an infrastructure delivery project,

2) Interpret the use of different control mechanisms for the different dimensions of sustainability,

3) Confirm the need to integrate sustainability into the ordinary project control routines (instead of developing separate routines), and

4) Propose project sustainability governance as an innovative avenue for research.

The study by Kivila, Martinsou & Vourinen, (2017) revealed that the case project included a unique configuration of control mechanisms (i.e., a control package, cf. Malmi and Brown, 2008). In the project control literature, the variety of different control modes and control mechanisms is a widely established spectacle (Kirsch, 1997; Liu et al., 2014; Nieminen and Lehtonen, 2008). However, the literature on sustainable project management has concentrated mostly on the role of different performance indicators in controlling sustainability (Amiril et al., 2014; Fernández-Sánchez and Rodríguez-López, 2010; Haponava and Al-Jibouri, 2010; Shen et al., 2011; Ugwu et al., 2006).

The study by Kivila, Martinsou & Vourinen (2017) contributes to the literature by showing that the case project employed a wider range of different control mechanisms in controlling sustainability. It was also revealed that the mechanisms were clearly linked with each other, and particularly to the incentive model of the alliance contract. The identified control mechanisms differed from each other in their origin: some mechanisms came from outside the project organisation, whereas others were developed inside the project organisation. A clear majority of

previous research on both general organisational control and project control focuses on internal control, particularly control practiced by a director, a project manager or, as the main exception, a customer (e.g. Liu et al., 2014). The infrastructure project (Kivila, Martinsou & Vourinen, 2017) also revealed a control package involving control mechanisms from both within (internal control, e.g. project planning) and outside the project organisation (external control, e.g. regulation).

2.6 INTERPRETIVE STRUCTURAL MODELING (ISM) METHODODLOGY

It is generally felt that individuals or groups encounter difficulties in dealing with complex issues or systems. The complexity of the issues or systems is due to the presence of a large number of elements and interactions among elements in a given system. The presence of directly or indirectly related elements complicates the structure of the system which may or may not be articulated in a clear fashion. It becomes difficult to deal with such a system in which structure is not clearly defined. Hence, it necessitates the development of a methodology which aids in identifying a structure within a system. Interpretive structural modeling (ISM) is such a methodology (Rajesh, Vivek & Nikhil, 2013).

ISM is an interactive learning process. In this technique, a set of different directly and indirectly related elements are structured into a comprehensive systematic model (Sage, 1997; Warfield, 1975). The model so formed portrays the structure of a complex issue or problem in a carefully designed pattern implying graphics as well as words (Raj et al., 2007; Ravi and Shankar, 2005; Singh et al., 2003; Raj and Attri, 2011).

Interpretive structural modeling (ISM) is a well-established methodology for identifying relationships among specific items, which define a problem or an issue (Jharkharia and Shankar, 2005). For any complex problem under consideration, a number of factors may be related to an issue or problem. However, the direct and indirect relationships between the factors describe the

situation far more accurately than the individual factor taken into isolation. Therefore, ISM develops insights into collective understandings of these relationships (Rajesh, Vivek & Nikhil, 2013).

ISM starts with an identification of variables, which are relevant to the problem or issue, and then extends with a group problem solving technique. Then a contextually relevant subordinate relation is chosen. Having decided on the element set and the contextual relation, a structural self-interaction matrix (SSIM) is developed based on pairwise comparison of variables. In the next step, the SSIM is converted into a reachability matrix (RM) and its transitivity is checked. Once transitivity embedding is complete, a matrix model is obtained. Then, the partitioning of the elements and an extraction of the structural model called ISM is derived (Agarwal et al., 2007).

Interpretive Structural Modeling is a computer-aided method for developing graphical representations of system composition and structure (Rajesh, Vivek & Nikhil, 2013).

ISM had its inception in Warfield's (1974) perception of the need, when attempting to couple science to policy, for "a set of communication tools which have both a scientific and lay character serving as a linkage mechanism between science and the public, and having meaning for all who are involved" and which, in particular, are capable of communicating a holistic sense of the elements and their relations which define system structure (Rajesh, Vivek & Nikhil, 2013).

Interpretive Structural Modeling (ISM), provides an ordered, directional framework for complex problems, and gives decision makers a realistic picture of their situation and the variables involved (Rajesh, Vivek & Nikhil, 2013).

2.6.1 Steps involved in ISM methodology

The various steps, which lead to the development of an ISM model (Rajesh, Vivek & Nikhil, 2013), are illustrated below;

2.6.1.1 Step 1: Structural self-interaction matrix (SSIM):

ISM methodology suggests the use of the expert opinions based on various management techniques such as brain storming, nominal group technique, etc. in developing the contextual relationship among the variables (Ravi et al., 2005; Barve et al., 2007; Hasan et al., 2007). For this purpose, experts from the industry and academia should be consulted in identifying the nature of contextual relationship among the factors. These experts from the industry and academia should be well conversant with the problem under consideration. For analyzing the factors, a contextual relationship of 'leads to' or 'influences' type must be chosen. This means that one factor influences another factor. On the basis of this, contextual relationship between the identified factors is developed (Rajesh, Vivek & Nikhil, 2013).

Keeping in mind the contextual relationship for each factor and the existence of a relationship between any two factors (*i* and *j*), the associated direction of the relationship is questioned. The following four symbols are used to denote the direction of relationship between two factors (a) ***V*** for the relation from factor *i* to factor *j* (i.e., factor *i* will influence factor *j*). (b) ***A*** for the relation from factor *j* to factor *i* (i.e., factor *i* will be influenced by factor *j*). (c) ***X*** for both direction relations (i.e., factors *i* and *j* will influence each other). (d) **O** for no relation between the factors (i.e., barriers *i* and *j* are unrelated).

Based on the contextual relationships, the SSIM is developed. To obtain consensus, the SSIM should be further discussed by a group of experts. On the basis of their responses, SSIM must be finalized (Rajesh, Vivek & Nikhil, 2013).

2.6.1.2 Step 2: Reachability matrix

After developing the Structural self-interaction matrix in developing the contextual relationship among the variables, the next step in ISM approach is to develop an initial reachability matrix from

the SSIM. For this, SSIM is converted into the initial reachability matrix by substituting the four symbols (i.e., V, A, X or O) of SSIM by 1s or 0s in the initial reachability matrix (Rajesh, Vivek & Nikhil, 2013).

The rules for this substitution are as follows:

(a) If the (*i*, *j*) entry in the SSIM is V, then the (*i*, *j*) entry in the reachability matrix becomes 1 and the (*j*, *i*) entry becomes 0.

(b) If the (*i*, *j*) entry in the SSIM is A, then the (*i*, *j*) entry in the matrix becomes 0 and the (*j*, *i*) entry becomes 1.

(c) If the (*i*, *j*) entry in the SSIM is X, then the (*i*, *j*) entry in the matrix becomes 1 and the (*j*, *i*) entry also becomes 1.

(d) If the (*i*, *j*) entry in the SSIM is O, then the (*i*, *j*) entry in the matrix becomes 0 and the (*j*, *i*) entry also becomes 0.

Table 2.1: SSIM substitution rule

SSIM	REACHABILITY MATRIX	
(*i*, *j*)	(*i*, *j*)	(*j*, *i*)
W	1	0
X	0	1
Y	1	1
Z	0	0

Following these rules, the initial reachability matrix is prepared. 1* entries are included to incorporate transitivity to fill the gap, if any, in the opinion collected during development of

structural self-instructional matrix. After incorporating the transitivity concept as described above, the final reachability matrix is obtained.

2.6.1.3 Step 3: Level partitions

From the final reachability matrix, for each factor, reachability set and antecedent sets are derived (Rajesh, Vivek & Nikhil, 2013). The reachability set consists of the factor itself and the other factor that it may help achieve, whereas the antecedent set consists of the factor itself and the other factor that may help in achieving it. Thereafter, the intersection of these sets is derived for all the factors and levels of different factor are determined. The factors for which the reachability and the intersection sets are the same occupy the top level in the ISM hierarchy. The top-level factors are those factors that will not lead the other factors above their own level in the hierarchy. Once the top-level factor is identified, it is removed from consideration. Then, the same process is repeated to find out the factors in the next level. This process is continued until the level of each factor is found. These levels help in building the diagraph and the ISM model (Rajesh, Vivek & Nikhil, 2013).

2.6.1.4 Step 4: Conical matrix:

Conical matrix is developed by clustering factors in the same level across the rows and columns of the final reachability matrix. The drive power of a factor is derived by summing up the number of ones in the rows and its dependence power by summing up the number of ones along the columns (Raj et al., 2011; Raj et al., 2012; Attri et al., 2012a; Attri et al., 2012b). Next, drive power and dependence power ranks are calculated by giving highest ranks to the factors that have the maximum number of ones in the rows and columns, respectively.

2.6.1.5 Step 5: Diagraph

From the conical form of reachability matrix, the preliminary digraph including transitive links is obtained. It is generated by nodes and lines of edges (Raj et al., 2012; Attri et al., 2012a; Attri et al., 2012b). After removing the indirect links, a final digraph is developed. A digraph is used to represent the elements and their interdependencies in terms of nodes and edges or in other words digraph is the visual representation of the elements and their interdependence (Raj and Attri, 2010; Dev et al., 2012). In this development, the top level factor is positioned at the top of the digraph and second level factor is placed at second position and so on, until the bottom level is placed at the lowest position in the digraph.

2.6.1.6 Step 6: ISM model:

Digraph is converted into an ISM model by replacing nodes of the factors with statements (Rajesh, Vivek & Nikhil, 2013).

2.6.2 Advantages of ISM approach

The following are some of the advantages of using the ISM approach for the purpose of establishing relationships amongst complex variables (Rajesh, Vivek & Nikhil, 2013).

1. It guides and records the results of group deliberations on complex issues in an efficient and systematic manner.
2. It produces a structured model or graphical representation of the original problem situation that can be communicated more effectively to others.
3. It enhances the quality of interdisciplinary and interpersonal communication within the context of the problem situation by focusing the attention of the participants on one specific question at a time.

4. It serves as a learning tool by forcing participants to develop a deeper understanding of the meaning and significance of a specified element list and relation.
5. It permits action or policy analysis by assisting participants in identifying particular areas for policy action which offer advantages or leverage in pursuing specified objectives.

2.6.3 Limitations of ISM approach

There may be many variables to a problem or issue. Increase in the number of variables to a problem or issue increases the complexity of the ISM methodology (Rajesh, Vivek & Nikhil, 2013). So we can only consider limited number of variables in the development of ISM model. Other variables which are least affecting a problem or issue may not be taken in the development of ISM model. Further experts help are taken in analyzing the driving and dependence power of the variable of a problem or issue. These models are not statistically validated. Structural equation modeling (SEM), also commonly known as linear structural relationship approach has the capability of testing the validity of such hypothetical model.

2.6.4 MICMAC analysis

Matrice d'Impacts croises-multiplication appliqúe an classment (cross-impact matrix multiplication applied to classification) is abbreviated as MICMAC. The purpose of MICMAC analysis is to analyse the drive power and dependence power of factors. MICMAC principle is based on multiplication properties of matrices (Sharma et al., 1995). It is done to identify the key factors that drive the system in various categories. Based on their drive power and dependence power, the factors, have been classified into four categories i.e. autonomous factors, linkage factors, dependent and independent factors.

2.8.4.1 Autonomous factors

These factors have weak drive power and weak dependence power. They are relatively disconnected from the system, with which they have few links, which may be very strong.

2.6.4.2 Linkage factors

These factors have strong drive power as well as strong dependence power. These factors are unstable in the fact that any action on these factors will have an effect on others and also a feedback effect on themselves.

2.6.4.3 Dependent factors

These factors have weak drive power but strong dependence power.

2.6.4.4 Independent factors

These factors have strong drive power but weak dependence power. A factor with a very strong drive power, called the '**key factor**' falls into the category of independent or linkage factors.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter deals with the research methodology. The research methodology involves the systemic rules and procedures upon which this research agenda is based and against which the data collected are interpreted and the findings evaluated. The methodology describes the procedures in conducting research. This study was aimed at modelling the inter-relationships that exists amongst the elements of sustainability strategies towards facilitating sustainable management of construction projects. The method focuses only on those issues that are necessary in achieving the research objectives. Thus, the chapter was structured into the following sub-headings: research approach, study population, sampling design, procedure for data collection, and lastly data analysis.

3.2 RESEARCH APPROACH

As highlighted by Neuman (2005), although quantitative and qualitative research approach differ in many ways, they can still be complementary strategies. Nonetheless, the decision-making process to choose the most appropriate research approach depends upon various variables such as the purpose of the study and the type and availability of the required research information (Naoum, 2007). According to Kothari (2004), quantitative research is based on the measurement of quantity or amount and is applicable to phenomena that can be expressed in terms of quantity; while Qualitative research, on the other hand, is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind. The approach employed for this study is qualitative research approach through the use of semi-structured interviews. The interview was

selected in place of other instruments such as questionnaire as the ISM approach is an interactive learning process whereby the information added (by the process) is zero. The value added is structural (Farris & Sage, 1975).

Qualitative research is especially important in the behavioral sciences where the aim is to discover the underlying motives of human behavior concerned with subjective assessment of attitudes, opinions and behavior (Kothari, 2004). Qualitative research has to do with an understanding of human condition in varying contexts and of the idea about situation. However, there exist no perfect study design, and then unexpected events can always appear. The most important thing is how much resources, time and effort the researcher in a study is able to invest in trying to understand the concept under study (Patton,2014). Research in such a situation is a function of researcher's insights and impressions. Such an approach to research generates results either in non-quantitative form or in the form which are not subjected to rigorous quantitative analysis.

3.3 STUDY POPULATION

All the items under consideration in any field of inquiry constitute a population (Kothari, 2004). The population is the entire group whose characteristics are to be estimated (Wimmer & Dominick, 2011). A population can be defined as the universe represented in a group of interest which the researcher wishes to draw information and generalize result of a study. Also, Verma & Beard (1981) describe population as a large group from which a sample is selected for study. A population is a well-defined group (people) on which the observation can be made. The population for the study comprises of 18 practitioners from the Nigerian construction industry registered with their respected regulatory bodies. They include

I. Quantity surveyors registered by the quantity surveyors registration board of Nigeria.
II. Architects registered by the Nigerian institute of Architects (NIA).

III. Also, engineers certified by the Nigerian Institute of Civil Engineers (NICE).

IV. Builders registered by the council of registered builders of Nigeria (CORBON).

The 18 participants were considered sufficient for the interview as previous studies considers less using the ISM methodology for analysis (Gijon, Daohan, Chengshuang, and Yulong, 2019; Mahnaz, Mehdi, Moslem, Mohammad, and Alireza, 2019; Tan, Ke, Fan and Weisheng 2019; Digalwar and Ganneri, 2015; Rajesh, Ram, Gajanand and Nidhi, 2015).

Table 3.1: Background information of participants

S/N	BACKGROUND INFORMATION OF PARTICIPANTS/INTERVIEWEES				
1	**DISCIPLINE**	**ARCHITECTS**	**BUILDERS**	**ENGINEERS**	**QS**
	NUMBER	4	3	2	9
	PERCENTAGE	22%	17%	11%	50%
2	**EDUCATIONAL QUALIFICATION**	**BSc.**	**MSc.**	**PhD.**	
	NUMBER	4	5	9	
	PERCENTAGE	20%	30%	50%	
3	**PROFESSIIONAL QUALIFICATION**	**PROBATION**	**MEMBER**	**FELLOW**	**NONE**
	NUMBER	5	8	4	1
	PERCENTAGE	28%	44%	22%	6%
4	**AVRG. YEARS OF EXPERIENCE**	**0-5 YEARS**	**6-10 YEARS**	**16-20 YEARS**	**OVER 20 YEARS**
	NUMBER	3	6	2	7
	PERCENTAGE	17%	33%	11%	39%
5	**CATEGORY**	**PRACTITIONERS ONLY**	**ACADEMICS ONLY**	**BOTH**	
	NUMBER	7	5	6	
	PERCENTAGE	39%	28%	28%	

3.4 SAMPLING DESIGN/SAMPLING SIZE

A sample enables the estimation of the population parameters and the items so selected constitute what is technically called a sample (Kothari, 2004); their selection process or technique is called sample design. The type of understanding sought by qualitative researchers demands great flexibility in the data analysis process, as it does in the design and data collection phase. Qualitative research methods are not "routinized," meaning there are many different ways to think about qualitative research and the creative approaches that can be used (Kothari, 2004).

Purposive sampling strategy was used for the study using semi-structured interviews to source for expert opinions about such relationship among the elements of sustainability strategies. This is because only professionals that are at least moderately familiar with the concept of sustainability in project management are chosen for the study. This is the general rule as applied by similar studies within the context of sustainability and project management. Those respondents unfamiliar with sustainability concepts in project management were not considered for the interview.

3.5 PROCEDURE FOR DATA COLLECTION

It is presumed that interviews will be the most suitable data collection method for the study because it will provide an in-depth understanding or view with regards to the subject matter of the study. Therefore, primary data source was used for the study. The primary sources of data refer to as first-hand information obtained by the researchers through one-on-one interviews, the distribution of questionnaires and physical observation. The literature was collected from the most accurate sources of information.

Here, 18 semi-structured interviews with construction professionals and industry academics in the Nigerian construction industry were undertaken to source expert opinions about such relationships among the elements of sustainability strategies as they have a knowledge of the concepts of

sustainability in project management. Participants were asked about the contextual relationships (pairwise) between two strategies, and asked whether a chosen strategy influences or is influenced by the implantation the other strategy. Also, if the chosen strategies influence the implementation of each other or if they are totally unrelated. Twenty-eight (28) contextual relationships were obtained from each respondent and were carefully collated and recorded by the researcher. The interview also allows probing, thereby enabling a richer and extensive information to be collected from the interviewees. Questions relating to the general information about the participants; demographic profiles were also enquired.

3.5 DATA ANALYSIS

This includes the process by which the collected data was analysed for the purpose of modelling the inter-relationships among the sustainability strategies. Interpretive structural modeling (ISM) methodology was used as the analytical tool to analyse and order the expert opinions hierarchically and logically. Interpretive structural modeling (ISM) was used because it is a well-established methodology for identifying relationships among specific items, which define a problem or an issue (Jharkharia and Shankar, 2005). For any complex problem under consideration, a number of factors may be related to an issue or problem. However, the direct and indirect relationships between the factors describe the situation far more accurately than the individual factor taken into isolation. Therefore, ISM develops insights into collective understandings of these relationships (Warfield, 1975). The ISM is **interpretive** as based on group's judgment and decision whether and how the system's elements are linked. It is **structural** as constructed on the relationship's foundation and final structure is exploited from complex set of system's variables. It is also a **modeling** as the final relationship is illustrated in a directed graphical model (Warfield, 1975).

The flow diagram to developing the ISM model for the elements of sustainability strategies towards sustainable management of construction projects is shown in figure 2.

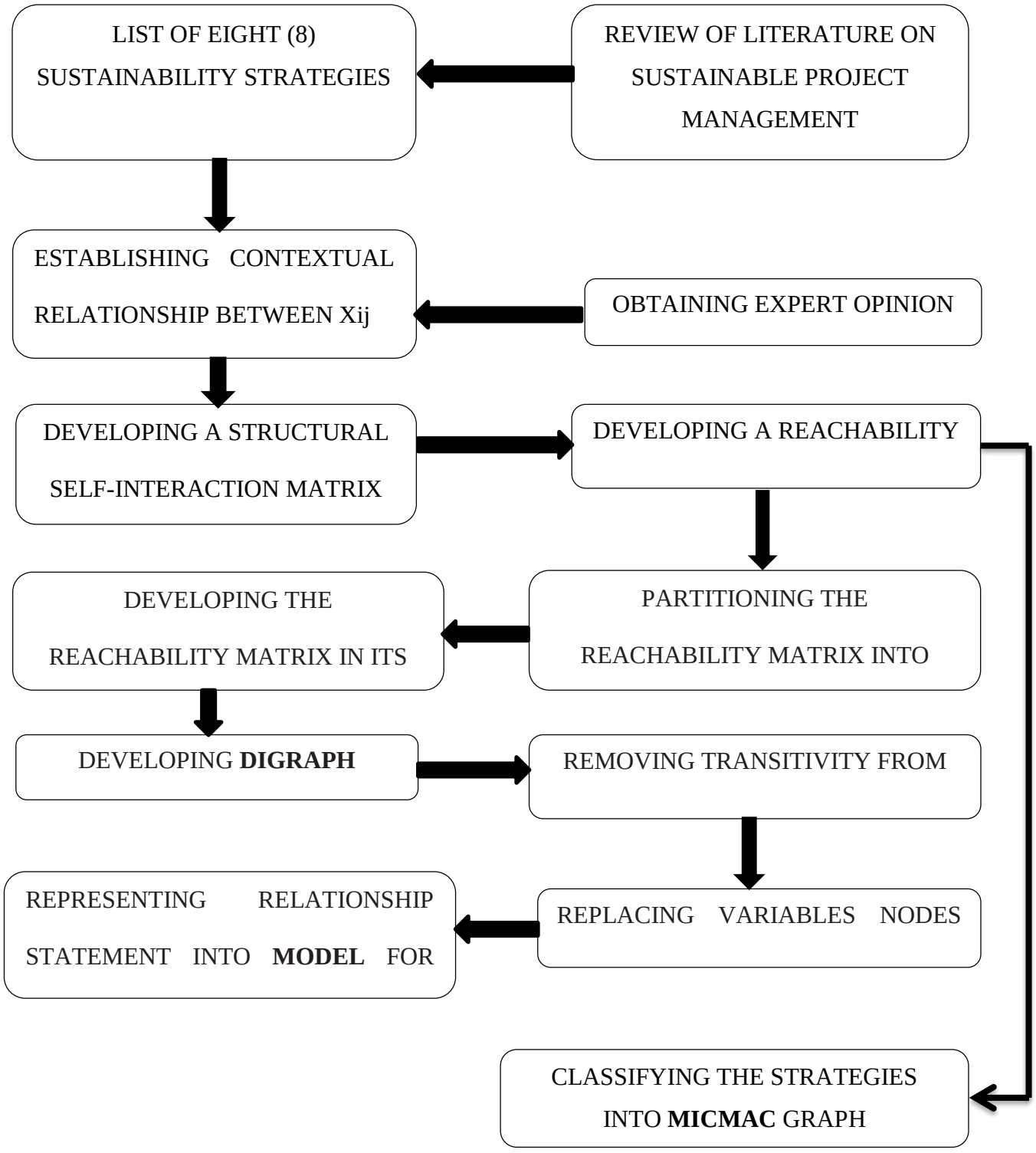


Figure 2: Flow diagram for preparing ISM model (Rajesh, Nikhil and Vivek, 2013).

CHAPTER FOUR

4.0 DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

This chapter gives the presentation of the data gathered through the use of semi-structured interview to source for expert's opinion about the inter-dependencies of the eight identified sustainability strategies. It explains the analysis of the data and interpretation of the results obtained from the analysis. A total of 29 industry practitioners and academics were invited that are well familiar with the concept of sustainability. However, only 18 (62 percent) of them were interested and thus participated in the interview exercise. 5 (17 percent) of them were uninterested in the survey, while the remaining 4 (14 percent) declined to participate in the survey. The data was analysed with the aid of interpretive structural modeling technique.

4.2 DATA PRESENTATION AND ANALYSIS

4.2.1 Discipline

It can be seen from table 3.1 that 9 (50%) of the interviewees or participants are quantity surveyors, followed by Architects having 4 (22%), then followed by builders 3 (17%) and finally engineers were the least of the total targeted population having only 2 (11%).

4.2.2 Level of Educational qualification

Table 3.1 shows that 4 (22%) of the participants are BSc holders and are the least of the total population, whereas 5 (33%) of them are MSc degree holders. Majority of the total population comprise of professionals with doctorate degree 9 (50%), all of which are industry academics and

are well familiar with the concept of sustainability in project management. This gives more reliability to the data collected as half of the participants are highly qualified.

4.2.3 Level of Professional qualification

From table 3.1, it can be seen that majority of the participants 8 (44%) are ranked as members in their respective professional regulatory bodies, followed by interviewees ranked as probation, having 5 (28%), then those that are highly ranked within their professional regulatory bodies as fellows, having 4 (22%). There is only one interviewee who is uninterested in obtaining a membership certificate within his professional regulatory body.

4.2.4 Average years of experience

Table 3.1 shows that the majority of the participants (7 of them, 39%) have an average experience of more than 20 years in their respective, careers ranked as fellows, with some of them even having experience of over 30 years. This reaffirms the fact that the study focused on getting experts opinions on such relationship amongst the strategies from industry academics and practitioners that are well familiar with both concept of sustainability in the field of project management. The next category comprises of those participants with average years of working experience in their respective discipline of 6-10 years (6 of them, 33%), followed by those with 0-5 years (3 of them, 33%), and they are ranked as probation members. The least of them are those with an average of 16-20 years (2 of them, 11%).

4.2.5 Category of professionalism

Lastly, table3.1 also shows that majority of the participants (7 of them, 39%) are focused only on practicing their professions while 5 (28%) of them are focused only on the academic line of practice. However, some of the participants 6 (33%) are both focused on the practical and academic

aspect of their professional discipline and are said to be the ones that are well conversant with the concept of sustainability in project management practice.

4.3 THE ISM METHODOLOGY FOR SUSTAINABILITY STRATEGIES

The data collected from the participants are analysed through the following steps of the ISM methodology

4.3.1 The structural self-interaction matrix (SSIM)

After identifying the eight strategies, semi-structured interviews with experts were conducted to ascertain experts' opinions about the interrelationships between these strategies. A total of 18 interviews were conducted with industry practitioners and academics and were asked questions about the relationship between each two strategies (pairwise relationship). Due to the complexity and non-binding nature of the interviews, the collected answers were interpreted to find the contextual relationships among the eight strategies and orderly inputted the results into the Structural Self-Interaction Matrix (SSIM) shown in table 4.1.

For the purpose of developing the SSIM, the following four symbols are used to show the direction of relationship between elements (i and j) of the sustainability strategies:

V – Element j will be achieved by element i; also referred to as forward relationship

A – Element i will be achieved by element j; also referred to as reverse relationship

X – Element i and j will help to achieve each other; also referred to as dual relationship

O – Both elements i and j are unrelated. also referred to as critical relationship

Table 4.1: Structural self-interaction matrix

s/n	**ELEMENTS OF SUSTAINABILITY STRATEGIES**	**STR 1**	**STR 2**	**STR 3**	**STR 4**	**STR 5**	**STR 6**	**STR 7**	**STR 8**
1	Setting strategic and tactical sustainability goals	—	V	V	A	X	V	V	A
2	Emphasizing sustainability in project design	A	—	V	A	V	V	V	A
3	Developing sustainable supplier practices	A	A	—	A	X	V	O	A
4	Setting sustainability policies by the government	V	V	V	—	V	V	V	V
5	Influencing sustainability of project practices by the government	X	A	X	A	—	V	V	A
6	Inclusion of sustainability-promoting actors in project organisation	A	A	A	A	A	—	V	A
7	Developing sustainability competencies and skills	A	A	O	A	A	A	—	A
8	Sustainability emphasis in project port-folio management	V	V	V	A	V	V	V	—

From table 4.1, it can be seen that strategy 1 has influence in achieving all the other strategies with the exception of strategy 4 and 8 as they both help in achieving strategy 1 itself. This strategy is the key to aligning project and overall strategies (Aarseth et al., 2016). It means Focusing explicitly on sustainability issues when developing project strategies, paying special attention to instances where sustainability issues align with other concerns.

For the second strategy at the second row, it can be seen that most of the participants agree that strategy 2 influences only four strategies with the exception of strategy 4 and 8 also. This shows that strategy 2 is influenced only by strategy 1, 4 and 8, as it can only be implemented when these strategies are fully implemented. It can be characterized as a strategic choice to actively focus on sustainability during the development of the project design (Abidin and Pasquire, 2007), through value management and life cycle management.

For the third strategy, which is focused on sustainable supplier practices, it can be seen that it is one of the less influential strategies amongst the other strategies as it only influences one strategy and has no relation with one of the strategies. Aarseth et al. (2016) it normally falls to the project owner to develop guidelines required for this strategy and other necessary support.

At the fourth row, which is concerned with setting sustainability policies by the government, participants established that strategy 4 is the bedrock of all the other strategies as no other strategy can be achieved successfully without prior to its implementation. It is the only strategy that influences every other element. Block and Paredis (2013) argued the need for “entrepreneurial political leadership” in developing an agenda for sustainable urban transformations. Governors/mayors in cities must act entrepreneurially to drive sustainable urban development and the important role of “entrepreneurial political leadership” in various forms to ensure that sustainability implementation in managing projects is a success.

At the fifth row, influencing sustainability practices, and is about incorporating sustainability in projects through different types of technical solutions, systems and standardized practices that are promoted by the host at the industry level. It can be seen that this strategy and two other strategies both help in influencing each other, while influencing two other strategies. Also it can be noted that, this strategy is influenced by both strategy 4 and 8, as well as strategy 2 as it is a strategic level strategy. This strategy is influenced by half of the strategies and also has influence on the other half. Examples of such practices are specified waste management systems, required environmental management systems and different design tools that in themselves support sustainability (Bossink, 2002).

At the sixth row, the strategy is about inclusion of sustainability promoting actors, Particularly the engagement of local stakeholders, such as authorities, local public and NGOs in the planning, development and execution of projects and project-related decision-making has been brought up as a relevant factor in promoting sustainability (Ross et al., 2010; Yunus and Yang, 2014). It can be seen that this strategy depends on the implementation of all the other strategies before it can be implemented. Hence, it only influences the achievement of a single strategy.

At the seventh row, the strategy is concerned with expanding competencies and skill sets of project managers, local public, other team members etc. it is the only strategy that is influenced by all the other strategy and has no relation with one of the strategies. This strategy strongly relies on the implementation of other strategies, making it the most dependent strategy.

Lastly, the eighth strategy, which entails applying criteria that emphasize sustainability effects when considering which projects to approve for implementation. This strategy is influenced by one strategy only, while influencing the achievement of all the other strategies. This shows that it is the second most influential strategy influencing others in the system of the strategies.

4.3.2 The initial reachability matrix

The SSIM has been converted into a binary matrix, called the Initial reachability matrix by substituting V, A, X and O by 1 and 0 as per the case. The substitution of 1's and 0's are done as shown below:

- If the (i, j) entry in the SSIM is V, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry becomes 0.
- If the (i, j) entry in the SSIM is A, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry becomes 1.
- If the (i, j) entry in the SSIM is X, the (i, j) entry in the reachability matrix becomes 1 and the (j, i) entry also becomes 1.
- If the (i, j) entry in the SSIM is O, the (i, j) entry in the reachability matrix becomes 0 and the (j, i) entry also becomes 0.

Table 4.2: The Initial reachability matrix

s/n	ELEMENTS OF SUSTAINABILITY STRATEGIES	STR 1	STR 2	STR 3	STR 4	STR 5	STR 6	STR 7	STR 8
1	Setting strategic and tactical sustainability goals	1	1	1	0	1	1	1	0
2	Emphasizing sustainability in project design	0	1	1	0	1	1	1	0
3	Developing sustainable supplier practices	0	0	1	0	1	1	0	0
4	Setting sustainability policies by the government	1	1	1	1	1	1	1	1
5	influencing sustainability of project practices by the government	1	0	1	0	1	1	1	0
6	Inclusion of sustainability-promoting actors in project organisation	0	0	0	0	0	1	1	0
7	Developing sustainability competencies and skills	0	0	0	0	0	0	1	0
8	Sustainability emphasis in project port-folio management	1	1	1	0	1	1	1	1

4.3.3 The final reachability matrix

For the final reachability matrix [aij] 8×8 we calculate the driving power and dependence for each of the sustainability strategies from the initial reachability matrix as shown in Table 4.2, For a particular strategy, the driving power is the total number of strategies (including itself) which it may help achieve. The dependence is the total number of strategies (including itself) which may help achieving it.

Table 4.3: Final reachability matrix

s/n	**ELEMENTS OF SUSTAINABILITY STRATEGIES**	**STR 1**	**STR 2**	**STR 3**	**STR 4**	**STR 5**	**STR 6**	**STR 7**	**STR 8**	**DRIVING POWER**
1	Setting strategic and tactical goals	1	1	1	0	1	1	1	0	**6**
2	sustainability in project design	0	1	1	0	1	1	1	0	**5**
3	sustainable supplier practices	0	0	1	0	1	1	0	0	**3**
4	Setting sustainability policies	1	1	1	1	1	1	1	1	**8**
5	sustainability of project practices	1	0	1	0	1	1	1	0	**5**
6	sustainability-promoting actors in project organisation	0	0	0	0	0	1	1	0	**2**
7	sustainability competencies and skills	0	0	0	0	0	0	1	0	**1**
8	project port-folio management	1	1	1	0	1	1	1	1	**7**
	DEPENDENCE	**4**	**4**	**6**	**1**	**6**	**7**	**7**	**2**	

4.3.4 Level identification/partitions

After the final reachability matrix, level partition takes place. For this reachability and antecedent set for each element is obtained, shown in table 4.4. The **reachability se**t consists of the element itself and the other elements which it may help achieve, whereas the **antecedent set** consists of the element itself and the other elements which may help in achieving it. After that, the **intersection set** is obtained for all elements. The element, for which the reachability set is same as the intersection set, comes at the top of the ISM hierarchy. It implies that this top-level element will not lead to achieve any other element. Once the top-level element is found, it is separated out from the other elements. Then, the same method is used to determine next level strategy. The process is repeated till the level of each strategy is determined. The levels are used to construct the ISM model for sustainable management of construction projects.

Table 4.4: Results of level partitions

ITERATION	SUSTAINABLE STRATEGIES	REACHABILITY SET	ANTACEDENT SET	INTERSECTION SET	LEVEL
5th	STR 1	1,2,3,5,6,7	1,4,8	1	V
5th	STR 2	2,3,5,6,7	1,2,4,8	2	V
3rd	STR 3	3,5,6	1,2,3,4,7,8	3,5	III
7th	STR 4	1,2,3,4,5,6,7,8	4	4	VII
4th	STR 5	1,3,5,6,7	2,4,5,8	3,5	IV
2nd	STR 6	6,7	1,2,3,4,5,6,8	6	II
1st	STR 7	7	1,2,3,4,5,6,7,8	7	I
6th	STR 8	1,2,3,5,6,7,8	4,8	8	VI

For the subsequent partitions or levels identification, we remove the top level strategy i.e. strategy 7 which has the same variables in its reachability set and intersection set to get the next (second) iteration. Also, by removing the top level strategy of the second iteration i.e. strategy 6 which has the same variables in its reachability set and intersection set, the next (third) iteration is further identified. The process is repeated until the last level i.e. strategy 4 is finally identified. At the fifth iteration (appendix 2.0), it can be seen that both strategy 1,2 and 8 are having the same elements in both reachability set and intersection set. One would argue that all of the three strategies should be placed at the same level (fifth level) of the final diagraph. This cannot stand, as strategy 8 is having a higher driving power of 7 compared to an average of 6 between strategy 1 and 2. Also because strategy 1 and 2 are higher dependency powers of 4 compared to a weaker dependency power of 2 by strategy 8. As such, strategy 8 cannot be placed at the same level as strategy 1 and 2.

4.3.5 The conical matrix

The Conical Matrix is the step just before building the digraph. It is developed by clubbing together the strategies in the same level, across rows and columns of the final reachability matrix.

Table 4.5: The conical matrix

Rank	**SUSTAINABILITY STRATEGIES**	**STR 7**	**STR 6**	**STR 3**	**STR 5**	**STR 2**	**STR 1**	**STR 8**	**STR 4**	**DRIVING POWER**
7	sustainability competencies and skills	1	0	0	0	0	0	0	0	**1**
6	promoting actors in project organization	1	1	0	0	0	0	0	0	**2**
3	sustainable supplier practices	0	1	1	1	0	0	0	0	**3**
5	sustainability of project practices	1	1	1	1	0	1	0	0	**5**
2	sustainability in project design	1	1	1	1	1	0	0	0	**5**
1	Setting strategic and tactical goals	1	1	1	1	1	1	0	0	**6**
8	project port-folio management	1	1	1	1	1	1	1	0	**7**
4	Setting policies by the government	1	1	1	1	1	1	1	1	**8**
	DEPENDENCE	**7**	**7**	**6**	**6**	**4**	**4**	**2**	**1**	

4.3.5 Developing the diagraph

The preliminary diagraph developed from the conical form of the reachability matrix, including transitive links is obtained. It is generated by nodes and lines of edges. Now a final diagraph is developed by removing the transitive links to represent the chain of influence of these strategies considering the relationships in the Reachability matrix. Strategy 3 and 5 are incorporating

transitivity and also strategy 1 and 2. This means there is an indirect relationship between (3 and 5) and (1 and 2). The diagraph is used to represent the elements and their inter-dependencies in terms of nodes and edges. In this development, the top level factor is positioned at the top of the diagraph and the second level factor is positioned at the second position and so on, until the bottom level factor is placed at the lowest position in the diagraph.

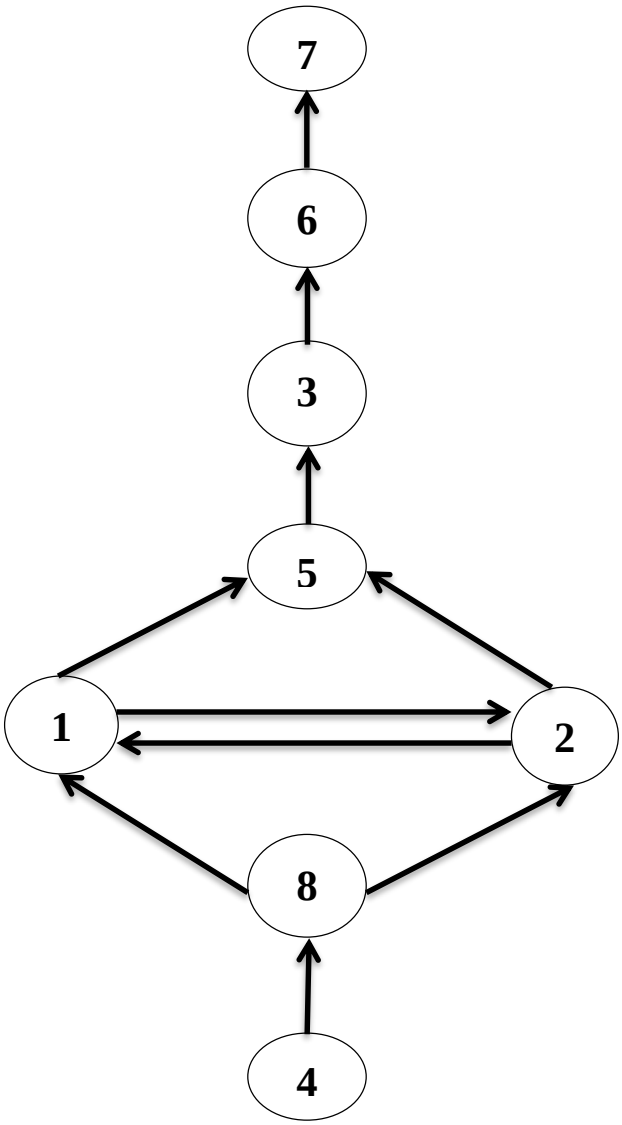


Figure 3: The final Digraph showing the levels of the elements of the strategies.

4.3.7 The ISM based model

Then finally the ISM is developed from the resultant digraph by replacing sustainability strategies nodes with statements (Figure 4). The ISM framework is reviewed to check the conceptual inconsistency and incorporating the necessary modifications.

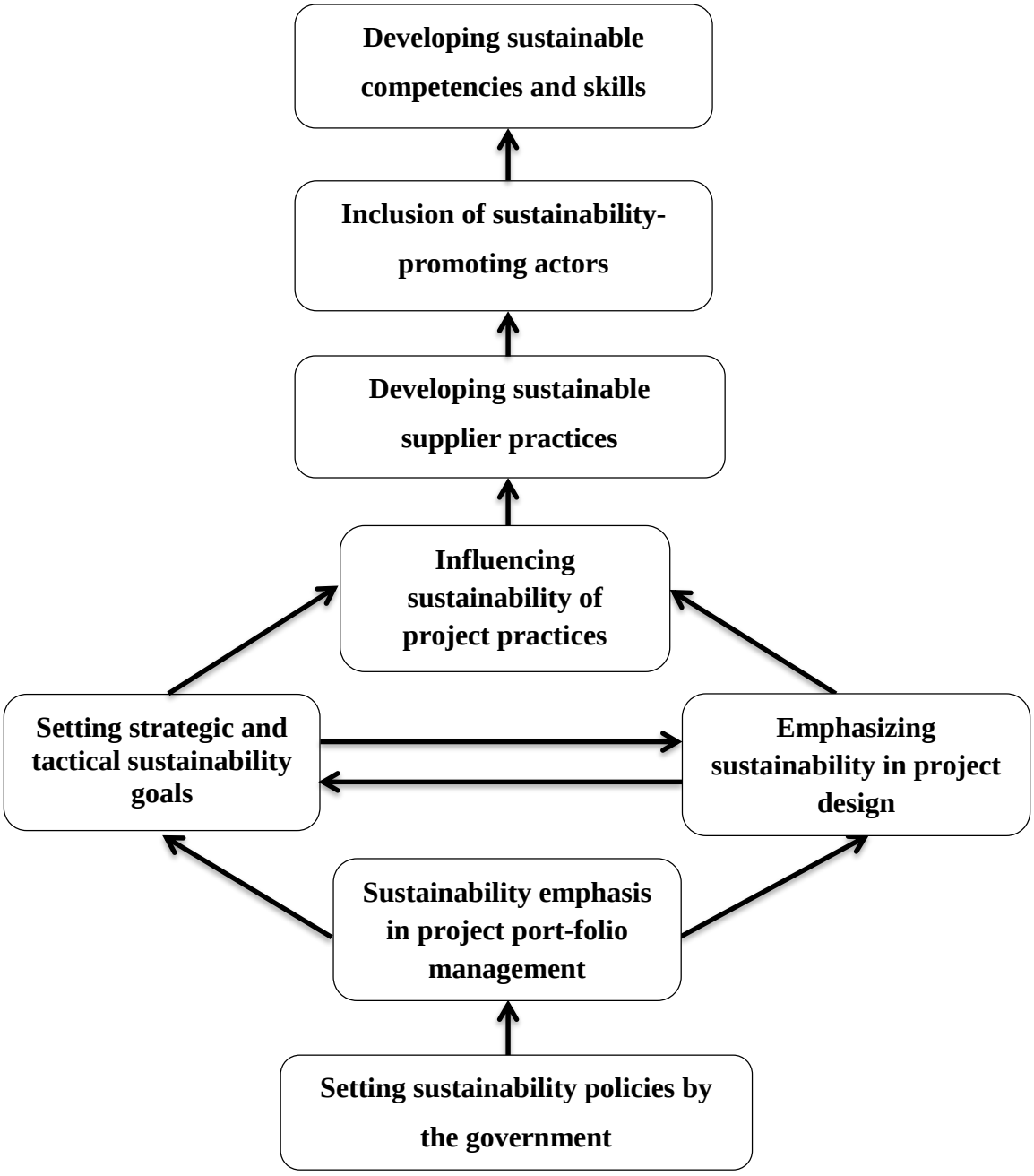


Figure 4: The Interpretive structural model showing levels of sustainability strategies.

The strategy “developing sustainability competencies and skills” through formal training of project manager and key project team members, governmental/regulatory actors as well as the general public on sustainability, lies at the top of the hierarchy as it cannot help in achieving any other strategy. At the second level lies the ”inclusion of sustainability promoting actors” particularly the engagement of local stakeholders, such as authorities, local public and NGOs in the planning, development and execution of projects. This strategy helps achieve the top level strategy above its level with the help of third and fourth level strategies. These two strategies are concerned with developing and influencing sustainability practices such as e.g. use of ecological materials and prefabrication, construction tools, and waste management systems by the project owner and support by the government respectively.

In order to develop and influence those sustainability practices, the fifth level strategies which lie at the strategic project level such as ”setting strategic and tactical sustainability project goals” and ”emphasizing sustainability in project design” must be implemented simultaneously. This signifies that these two project level strategies help each other to achieve the top strategies concerned with sustainability practices above them in the ISM hierarchy.

The pressure to ensure and implement sustainability should come from the governments in many countries at large, through the establishment of laws, regulations, norms, guidelines. This strategy sits at the bottom of the hierarchy as it is the most influential and vital strategy which must be in place to ensure the implementation of other strategies. This strategy can be smoothly achieved when either the public or private client organisations lay strong sustainability emphasis on project port-folio management when deciding which project to fund and approve for implementation. This organisational level strategy influenced only by the bottom strategy, influences the implementation of both strategic and operational project level strategies above it.

4.3.8 The MICMAC analysis

Cross-Impact Matrix Multiplication Applied to the Classification analysis is abbreviated as MICMAC analysis. The purpose of MICMAC analysis is to analyse the drive power and dependence power of the elements of sustainability strategies. MICMAC principle is based on multiplication properties of matrices. It is done to identify the key factors that drive the system in various categories. Based on their drive power and dependence power, they have been classified into four categories i.e. autonomous factors, linkage, dependent and independent factors. On the x-axis we have dependency and on the y-axis we have driving power (Sharma, Gupta and Sushil, 1995). In general, a strategy with a higher dependence power indicates that several other strategies should be implemented before this strategy can be implemented. A strategy with a higher driving power means that it should be implemented prior to the implementation of other strategies.

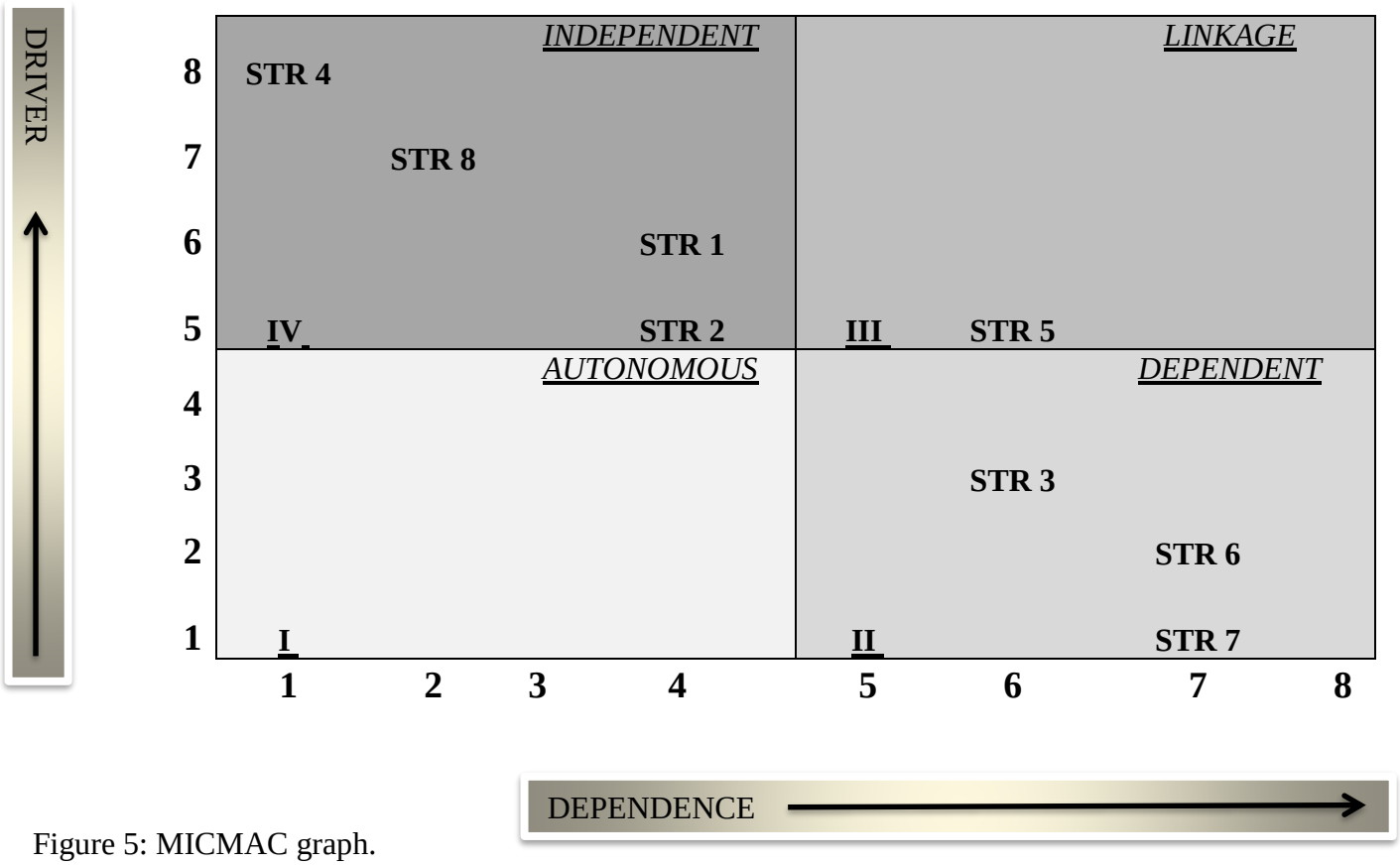


Figure 5: MICMAC graph.

- **QUADRANT I**

This quadrant also known as autonomous quadrant contains variables with lower or weak dependency (0 to 4) and driving powers (0 to 4). It can be seen that none of the strategies are found in this quadrant, signifying that all of the strategies are significant in achieving sustainability practices and practitioners have to give attention to all of the identified strategies.

- **QUADRANT II**

This quadrant contains strategies with weak driving powers (0 to 4) and strong dependency (5 to 8). Three strategies occupy this quadrant, namely, strategy 3, 6 and 7. These mean that developing sustainable supplier practices (3, 6), inclusion of sustainability promoting actors (2, 7), and developing sustainability competencies and skills (1, 7) are highly dependent on the implementation of other strategies prior to their implementation. They are also known as dependent strategies.

- **QUADRANT III**

This quadrant contains strategies with strong dependency (5 to 8) and strong driving power (5 to 8). Strategy 5, which is 'influencing sustainability of project practices by the government (5, 6)', is the only variable in this quadrant. This strategy is unstable in the fact that any action on this factor will have an effect on others and also a feedback effect on themselves. It is also known as linkage strategy.

- **QUADRANT IV**

This quadrant contains strategies with strong driving powers (5 to 8) and weak dependency (0 to 4). There are four strategies in this quadrant; strategy 4, 8, 1 and 2. It can be seen that strategy 4, 'setting sustainability policies by the government (8, 1)' is the most influential strategy amongst all the other strategies as it is the starting point of all the other strategies and also helps in achieving

all the remaining strategies. ‘Sustainability emphasis in project port-folio management’ is the second most influential strategy (7, 2) and is only influenced by strategy 4. ‘Setting strategic and tactical sustainability goal’ (6, 4) and ‘emphasizing sustainability in project design’ (5, 4) are the other strategies that other strategies precede their implementation. Strategies in the fourth quadrant are also referred to as independent strategies.

A factor with a very strong drive power, called the ‘**key factor**’ or ‘**high priority strategy’** falls into the category of independent or linkage factors.

The objective behind this classification is to analyse the driver power and dependency of these strategies (Jharkharia and Shankar, 2005). In general, a strategy with higher driver power means that it should be implemented prior to the implementation of other strategies with weak driver powers.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 SUMMARY OF FINDINGS

This summarizes the analysis of the result presented in chapter four and draws major findings from them.

1. The study was able to assess the inter-relationships amongst the elements of the sustainability strategies using the SSIM in table 4.1 and it was revealed that “developing sustainable supplier competences and skills” is totally unrelated with “supporting sustainable supplier practices”. This was found to be the only unrelated correlation.
2. The SSIM was converted into the reachability matrices to determine the driving powers and dependences for each of the elements of the sustainability strategies, and used as a basis for constructing the ISM model.
3. The ISM based model comprises of seven levels of the elements of sustainability strategies, developed orderly and hierarchically. It shows that ‘Setting sustainability policies by the government’ is at the bottom of the structure, influencing the implementation of other strategies and flows to the top of the model to the inclusion of other actors and finally to developing their sustainability competencies and skills, which lies at the first level.
4. “Setting sustainability policies by the government” was found to be the key factor or high priority element, influencing the implementation of every other element of sustainability strategies.
5. “sustainability competences and skills” was found to be the element with the highest dependency power. It relies on the implementation of all the other elements prior to its implementation as it influences none of the elements of the sustainability strategies.

6. The strategies were classified into three clusters or quadrants using the MICMAC analysis into three clusters depending on their driver and dependency powers. The objective behind this classification is to analyse the driver power and dependency of these elements of strategies.
    a. Independent elements;
        i. Setting sustainability policies by the government
        ii. Project portfolio management
        iii. Setting strategic and tactical sustainability goal
        iv. Including sustainability in project design
    b. Linkage elements
        i. Sustainability of project practices
    c. Dependent elements
        i. Sustainable supplier practices
        ii. Sustainability promoting actors
        iii. Sustainability competences and skills
7. None of the elements of the strategies fall under the autonomous quadrant which has low driving power and low dependence powers. This signifies that all the eight elements of the sustainability strategies are significant in achieving sustainability goals.

5.2 CONCLUSION

Sustainability practices within the context of project management still remain in its infancy. However recent studies are currently trying to integrate both concepts and growing trend is picking up momentum.

With the aid of ISM approach, the study established that there is an existing inter-relationships amongst the elements of the strategies, which resulted in the development of an ISM-based framework to analyze the interactions among various elements of sustainability strategies into 7 different levels. The ISM based model developed describes the elements of the sustainability strategies far more accurately than the individual elements taken into isolation. Therefore, ISM based model develops insights into collective understandings of the relationships these elements.

Also, the study shows that the eight elements of the sustainability strategies were classified into 4 independent elements, 3 dependent elements and a linkage element using the MICMAC analysis. All of the elements are significant in achieving sustainability goals as none of the elements fall into the autonomous quadrant.

Finally, the study also revealed that “setting sustainability policies by the government“ is the most influential and key strategy along with sustainability emphasis in project port-folio management. These strategies have strong driving power and weaker dependencies and thereby occupying the independent cluster of the MICMAC analysis. Therefore, these strategies must be implemented prior to the implementation of other strategies as they have higher driving powers.

On the other hand, the study also revealed that “inclusion of sustainability promoting actors and developing their competencies” are highly dependent on the implementation of other elements, as they both have a very strong dependency powers and low driving powers. This implies that their implementation is highly dependent on other elements of the sustainability strategies.

5.3 RECOMMENDATIONS

1. It is recommended that practitioners supported by project owners, should focus on strategies in quadrants IV, having stronger driver powers and weak dependencies and later focus on strategies in quadrant II, with higher dependencies as the project proceeds.
2. The government should ensure that its sustainability policies are well developed and strictly adhered to, towards achieving sustainability at the operational levels of projects.
3. Achieving sustainable practices will always be a challenge. As such, all project stakeholders from the government agencies down to operational workers involved in a project, should actively be involved translating sustainability objectives into concrete practical actions, using the holistic model to facilitate decision making.

5.4 RECOMMENDATION FOR FURTHER STUDIES

1. Because the ISM model is not statistically validated, further studies should aim at validating the results of this study with use of a linear equation modeling such as structural equation modeling (SEM) technique.
2. Other techniques can be used to establish the interrelationships amongst these strategies such as AHP, which produce different result due to differences in the approaches used.
3. Further studies should aim to investigate, for each of the triple bottom line practices of sustainability (social, economic and environmental), which of those strategies is more significant or effective in achieving each of the TBL practices. By so doing, practitioners would have prior knowledge of the effectiveness of each strategy on each of those TBL perspectives of sustainability before implementing a particular practice.

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APPENDIX

1.0 RESEARCH INTERVIEW GUIDE

This document is an interview guide aimed at **‘’Modelling the inter-relationships amongst the elements of sustainability strategies for sustainable management of construction projects’’** it is drafted for the purpose gathering relevant data on the concept of sustainability in project management. The main content of the interview guide is concerned with sustainability strategies adopted by the project organisation, host organisation and mutual strategies toward ensuring and achieving sustainable project practices. These strategies comprise concrete activities and practices through which sustainability challenges are managed in projects.

The guide consists of two sections; the first section is concerned with the interviewee’s information and the second section consists of a table listing all the strategies and along with their brief descriptions.

1.1 RESPONDENT’S DEMOGRAPHIC INFORMATION

1. Level of educational qualification attained.

First Degree[ ] Master Degree[ ] Doctorate Degree[ ]

2. Discipline?

Architect[ ] Builder[ ] Engineer[ ] Quantity Surveyor[ ]

3. Level of professional qualification attained.

Probation[ ] Member[ ] Fellow[ ] others, ----------

4. Average years of experience of respondent.

0 – 5 years[ ] 6 – 10 years[ ] 11 – 15 years[ ] 16 – 20 years[ ] Over 20 years[ ]

5. Category of professionalism

Practitioner only[ ] Academician only[ ] Both[ ]

1.2 RESPONDENT'S GUIDE

The table below contains a list of eight identified strategies from the literature and their brief descriptions. You are required to study these strategies and establish the relationship between one strategy in relation to another strategy i.e. whether a chosen strategy influences the other strategy, or influenced by it, both influence each other and also if they are both unrelated. Repeat the iterations until all the other correlations are established.

s/n	SUSTAINABILITY STRATEGIES	DESCRIPTION
STR 1	**Setting strategic and tactical sustainability goals.**	Focusing explicitly on sustainability issues when developing project strategies, paying special attention to instances where sustainability issues align with other concerns are keys to this strategy.
STR 2	**Emphasizing sustainability in project design.**	A strategic choice to actively focus on sustainability during the development of the project design through Value management and life cycle management in projects' design phase.
STR 3	**Developing sustainable supplier practices.**	Supporting suppliers in implementing sustainable practices such as e.g. use of ecological materials and prefabrication developed by the project owner.
STR 4	**Setting sustainability policies by the government**	This strategy focuses on the establishment of laws, regulations, norms and guidelines that promote sustainability of the projects in the host country.
STR 5	**influencing sustainability of project practices by the government**	That is supporting the incorporation of sustainability into project practices and technical systems through, e.g., construction tools, prefabrication and waste management systems.
STR 6	**Inclusion of sustainability-promoting actors in project organization**	Particularly the engagement of local stakeholders, such as authorities, local public and NGOs in the planning, development and execution of projects.
STR 7	**Developing sustainability competencies and skills**	through formal training of project manager and key project team members, governmental/ regulatory actors as well as the general public on sustainability.
STR 8	**Sustainability emphasis in project port-folio management**	This relies on emphasizing sustainability criteria amongst other criteria. Also entails applying criteria that emphasize sustainability issues when deciding which projects to fund and approve for implementation by the government.

1.3 INTERVIEWER'S SECTION

Contextual relationship = leads to what to enter into the white cells;

Enter **V** when a row strategy on the influences the strategy on column.

Enter **A** when a column strategy influences the row strategy.

Enter **X** when the row and column strategies influence each other.

Enter **O** when there is no relation between the row and the column strategies.

s/n	SUSTAINABILITY STRATEGIES	STR 1	STR 2	STR 3	STR 4	STR 5	STR 6	STR 7	STR 8
1	Setting strategic and tactical sustainability goals.								
2	Emphasizing sustainability in project design.								
3	Developing sustainable supplier practices.								
4	Setting sustainability policies by the government.								
5	Influencing sustainability of project practices by the government.								
6	Inclusion of sustainability-promoting actors in project organisation.								
7	Developing sustainability competencies and skills.								
8	Sustainability emphasis in project port-folio management.								

2.0 LEVEL PARTITION (SECOND ITERATION)

ITERATION	SUSTAINABLE STRATEGIES	REACHABILITY SET	ANTACEDENT SET	INTERSECTION SET	LEVEL
5th	STR 1	1,2,3,5,6	1,4,8	1	V
5th	STR 2	2,3,5,6	1,2,4,8	2	V
3rd	STR 3	3,5,6	1,2,3,4,7,8	3,5	III
7th	STR 4	1,2,3,4,5,6,8	4	4	VII
4th	STR 5	1,3,5,6	2,4,5,8	3,5	IV
2nd	STR 6	6	1,2,3,4,5,6,8	6	II
6th	STR 8	1,2,3,5,6,7,8	4,8	8	VI

3.0 LEVEL PARTITION (THIRD ITERATION)

ITERATION	SUSTAINABLE STRATEGIES	REACHABILITY SET	ANTACEDENT SET	INTERSECTION SET	LEVEL
5th	STR 1	1,2,3,5	1,4,8	1	V
5th	STR 2	1,2,3,5	1,2,4,8	2	V
3rd	STR 3	3,5	1,2,3,4,8	3,5	III
7th	STR 4	1,2,3,4,5,8	4	4	VII
4th	STR 5	1,3,5	2,4,5,8	3,5	IV
6th	STR 8	1,2,3,5,8	4,8	8	VI

4.0 LEVEL PARTITION (FOURTH ITERATION)

ITERATION	SUSTAINABLE STRATEGIES	REACHABILITY SET	ANTACEDENT SET	INTERSECTION SET	LEVEL
5th	STR 1	1,2,5	1,4,8	1,2	V
5th	STR 2	1,2,5	1,2,4,8	1,2	V
7th	STR 4	1,2,4,5,8	4	4,1,2	VII
4th	STR 5	1,2,5	2,4,5,8	1,2,5	IV
6th	STR 8	1,2,5,8	4,8	1,2,8	VI

5.0 LEVEL PARTITION (FIFTH ITERATION)

ITERATION	SUSTAINABLE STRATEGIES	REACHABILITY SET	ANTACEDENT SET	INTERSECTION SET	LEVEL
5th	STR 1	1,2	1,4,8	1,2	V
5th	STR 2	1,2	1,2,4,8	1,2	V
7th	STR 4	1,2,4,8	4	1,24	VII
6th	STR 8	1,2,8	4,8	1,2,8	VI

6.0 LEVEL PARTITION (SIXTH ITERATION)

ITERATION	SUSTAINABLE STRATEGIES	REACHABILITY SET	ANTACEDENT SET	INTERSECTION SET	LEVEL
7th	STR 4	4,8	4	4	VII
6th	STR 8	8	4,8	8	VI

7.0 LEVEL PARTITION (SEVENTH ITERATION)

ITERATION	SUSTAINABLE STRATEGIES	REACHABILITY SET	ANTACEDENT SET	INTERSECTION SET	LEVEL
7th	STR 4	4	4	4	VII