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CONTEMPORARY CHALLENGES OF SUSTAINABILITY AND REGENERATION IN THE CONSTRUCTION INDUSTRY

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Abstract: The building industry contributes significantly to national economic and social growth. Nonetheless, the industry has had a substantial environmental impact. As a result, the building industry has faced a tremendous challenge in ensuring its sustainability. Globally, the construction sector is not extremely productive. This study was important because of its academic and societal impacts. The findings had a discernible impact on the advancement of knowledge in academia and would also contribute to the body of knowledge on using cutting-edge materials in the construction sector. It would be referenced in the academic work of upcoming scholars and researchers In general, empirical evidence revealed that the most significant challenges associated with environmental management were cost increases, a lack of environmental awareness, a lack of environmental education and training, a scarcity of green materials and components, a lack of understanding of environmental legislation, poor communication, and a lack of commitment. The benefits that accrued from the adoption of sustainable construction practices in accordance with the results included compliance with the environmental legislation and regulations, contribution to the environmental protection, and improvement of staff working conditions.

Index Terms – Construction Projects, Environment, Mitigation, Sustainability Challenges

I. INTRODUCTION

The purpose of this literature review is to understand and explain what has been published about the use of cutting-edge construction materials for a greener built environment, as well as the benefits and downsides of implementing novel approaches. With a focus on the construction industry, it considers research and policy documents on the adoption of innovative techniques (De Wit 2016). Three issues have been investigated in the literature: (1) introducing new practices into the construction sector, (2) the economic benefits of using novel materials to create a greener built environment, and (3) the challenges of implementing sustainability in the construction industry (De Wit 2016). This literature study begins by examining the economic benefits of new materials for a greener built environment in order to acquire a broad understanding of the drivers, barriers, and enablers of change (Alves et al. 2018). Sustainability for businesses and nations depends on environmental innovation (Skordoulis et al. 2020). There is mounting proof that sustainable buildings bring financial benefits to building operators, owners, and tenants. Building sustainably means using recyclable

and renewable materials, while also taking into account the environment near the construction site and the amount of energy and resources consumed. Strong stakeholder cooperation is necessary to achieve the goals of sustainable housing, and effective stakeholder management is crucial to the success of complex projects. Major stakeholders need to be fully informed about the process and actively involved in order to achieve sustainable housing. A multitude of stakeholders shared the overarching objective of selecting appropriate sustainable technologies to reduce energy and carbon emissions and develop sustainable retail buildings. Understanding how incentives affect a company's operations, personnel, structural costs, tax liabilities, and financial statements, as well as utilizing new technology and data analytics to uncover the greatest possibilities, can help an organization reduce operating expenses and increase net income (Matheny, 2023). Energy-efficient buildings are more valuable and improved operational efficiency and lower operating expenses (Christensen, Robinson, and Simons 2018). Property managers could promote sustainability agendas by maintaining Eco-certifications, participating in Eco-bench-marking, and managing green leases. Businesses could deliver specialized goods and greater services by learning about customer preferences (Chikwuado 2020). Adopting sustainable practices is not just the right thing to do; it is also a strategic necessity that will benefit all parties involved in the long run. Corporate sustainability has many advantages and can add value in a variety of ways. Regulations and regulatory frameworks must serve the public interest, and regulatory policy seeks to make sure that this is the case. New ideas will be captured if the broadest range of stakeholders is included in the regulatory process (OECD 2010). Informed decisions about what, who, and how to regulate are made easier by an efficient regulatory framework that promotes both economic growth and the rule of law. Effective upper management, according to Duncan, Kingi, and Brunsdon (2018), is a key facilitator of change in the building and construction sector. While avoiding obstacles like dispersed leadership and inconsistent decision-making, group responsibility for change and improvement can offer consistency of vision and desire for change. Understanding the present performance and recognizing your strengths and shortcomings will help to solve sustainability difficulties. To design for a sustainable future, a lot of effort and dedication is needed, and this calls for Self-education (Wamsler 2020). To make sure that sustainability becomes ingrained in the business practices and that input is received from all areas of the organisation, encourage participation from a diverse range of staff members. The use of design thinking by technology corporations to address issues and come up with novel solutions to global problems could be gained from designing for a sustainable future (Frigione & Aguiar 2020). The Environmental, Social, and Governance (ESG) framework, according to Blayse & Manley (2004), is utilized to evaluate how well an organization performs on a range of ethical and sustainable business issues

II. POPULATION AND SAMPLE

Convenience and volunteer sampling are one of those approaches used in this study, and as a result, 118 construction professionals out of a total population of 200 responded to the questionnaire (Ekwuno and Dr. Nel (2022). A probability mechanism is not used in convenience sampling in order to make a selection. This is a simple and inexpensive strategy to use. Applicants are selected for convenience and volunteer sampling based on how easily and frequently they are available. By employing this system, research effort encounters fewer roadblocks. For example, it is simpler to include friends or family in a sample than it is to specifically target strangers (Ekwuno and Dr. Nel 2022). On the other hand, a sample is a subset of responders selected to be typical of the total population. The questionnaire approach was determined to be a fairly appropriate instrument for this study, as the researcher aimed to reach out to a minimum of 200 construction professionals. In actuality, the researcher saved time by using this approach. In order to obtain the necessary number of respondents for this study, the researcher used a straightforward sampling technique known as convenient sampling for the questionnaire distribution. Snowball sampling, which involved sending out emails to stakeholders, was used to get more responses. The questionnaire was distributed by the thesis's researcher using Survey Monkey, hand delivery, and email. This study also considered the margin of error of 5%, confidence level of 95%, and z-score of 1.96 in calculating the sample size. However, the sample size for this investigation was determined using the simplified formula below:

s = 6Pze
s = Sample Size
P = Target population
e = Confidence Interval or Margin of Error or Level of Precision of 5%.
z = z-score in line with the confidence level of 95%

Table 1: Confidence Level and Margin of Error

The Sample size: for ±3%. ±5% ±7% and ±10% Precision Levels
Where the Confidence Level is 95% and e = 0.05, z-score = 1.96

Size of Population	Sample Size(s) for Precision (e) of				
	±3%	±5%	±7%,	±10%	
100 Minimum		**59**			
125		74			
150		89			
175		103			
200		**118**			
225		133			
250		147			
275		162			
300		177			
325		192			
350		206			
375		221			
400		236			
425		250			
450		265			
475		280			
500		294			

Table 2: Confidence Level and Confidence Interval (z)-Values

Confidence level	z-score
70%	1.04
75%	1.15
80%	1.28
85%	1.44
90%	1.65
92%	1.75
95%	1.96
96%	2.05
98%	2.33
99%	2.58

Confidence intervals express how definite or unsure a sampling strategy is, as well as how uncertain a certain statistic is (Ekwuno and Dr. Nel 2022). To put it simply, a confidence interval shows the level of assurance that survey results accurately represent what would be expected if a population-wide survey were feasible. A researcher's level of confidence that a population will choose an answer within a certain range is expressed as a percentage. A 95% confidence level, for instance, indicates that there is 95% confidence that the outcome will fall between x and y. The proportion of time that an estimate between the upper and lower bounds of the confidence interval is predicted to reproduce another way to quantify the confidence level (Ekwuno and Dr. Nel 2022). This is what the alpha value indicates. Confidence levels and confidence intervals are frequently confused by people. The confidence level expresses a value within the range of a confidence interval. The margin of error is utilized to determine this range. The margin of error indicates the extent to which the opinions expressed by the general public will be reflected in the survey results.

III. DATA AND SOURCES OF DATA

In this study, 200 semi-structured questionnaires were distributed to the stakeholders. Out of the 200 distributed questionnaires, 118 responses were obtained. 82 questionnaires were unreturned. The table below shows the information:

Table 3: Target Population and Response Rate

	Target Population	Returned Rate	Unreturned Rate
	200	118	82
Percentage		59%	41%

To assess the reliability of the research instrument, reliability correlation coefficient was used. The degree of association between two variables, factors, or data sets is evaluated in science and finance using correlation coefficients. The degree to which two variables have a linear relationship is statistically measured by the correlation coefficient. The value of **Correlation Coefficient (r)** ranges from -1.0 to 1.0. A correlation of 1.0 indicates that there is a direct relationship or an absolute positive correlation, while a correlation of -1.0 indicates that there is an absolute negative correlation. The correlation estimate is incorrect if the calculated number is greater than 1.0 or less than -1.0. A correlation quantification error is indicated by a calculated numerical range that is greater than 1.0 or less than -1.0. There is no linear relationship between the movements of variables in a correlation of 0.0. A two-variable complete correlation can be represented by either + 1 or -1. The correlation is positive when one variable rises as the other rises, and negative when one falls as the other rises. A correlation of zero '0' indicates total absence. Two hundred questionnaires were prepared and distributed to 200 stakeholders in the construction industry. One hundred and eighteen participants responded. Using this figure, the correlation coefficient, r was calculated. This helped in calculating the Cronbach's Alpha (α). With this, the reliability of the research instrument was determined. Using the number of returned and unreturned questionnaires and the number of questionnaires distributed, the correlation coefficient was calculated using the formula below:

Reliability Correlation coefficient (r) $= 1 - \frac{0.5x}{3s + y} = 0.78$

s signifies sample size (returned questionnaires)
x signifies the target population
y signifies unreturned questionnaires
r signifies reliability correlation coefficient

Table 4: Calculation of Correlation Coefficient (*r*)

Target population (n)	Sample size (No. of Returned questionnaires 0 (x)	No. of unreturned questionnaires (y)	Correlation coefficient (r)
200	118	82	0.78

Looking at the correlation coefficient in table 7, the calculated value of 0.78 fell within the range of 0.7 to 1. This signified strong positive relationship between the two variables as indicated in table 8 below.

Table 5: Coefficient correlation values

Correlation coefficient	Correlation strength	Correlation type
0.7 to 1.0	very strong	positive
0.5 to 0.7	strong	positive
0.3 to 0.5	moderate	positive
0 to 0.3	weak	positive
0	none	zero
0 to -0.3	weak	negative
-0.3 to -0.5	moderate	negative
-0.5 to -0.7	strong	negative
-0.7 to -1.0	very strong	negative

Using the calculated reliability correlation coefficient of 0.78, the Cronbach alpha was calculated to determine the degree of internal consistency of the research instruments, as shown below:

Cronbach's Alpha (α) is calculated using:

$$\alpha = \frac{kr}{(1 + (k-1)\, r}$$

Where;
k = number of returned questionnaires.
r = correlation coefficient

$$\alpha = \frac{118 \times 0.78}{1 + (118-1)0.78} = 0.99$$

From the above calculation, the reliability of the research instrument shows a strong positive relationship between the two variables, this means that the research sample size is sufficient to draw a conclusion on the study. If the Cronbach alpha is less than 0.70, the data collection would continue until sufficient information is gathered.

According to Max Hilsdorf (2020), the degree of internal consistency is determined using the table 7 below**:**

Table 6: Tabulation of Cronbach Alpha

No. of Returned Questionnaire (k)	Reliability Correlation Coefficients (r)	Cronbach's Alpha (α)
118	0.78	0.99

The Cronbach Alpha is 0.99 with reference to table 6 above. From table 7 below, it is evident that the degree of internal consistency of the research instrument is excellent.

Table 7: Degree of internal consistency

Cronbach's Alpha	Degree of internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

Source: Max Hilsdorf (2020)

IV. THEORETICAL FRAMEWORK

According to Smith et al. (1998), sustainable development (SD) is a method of human development in which the use of resources is intended to satisfy human needs while maintaining the sustainability of natural systems and environmental circumstances. The idea of sustainable development (SD) is linked to several aspects of socio-economic development, which tries to ascertain what societies require in order to survive. The Brundtland Commission popularized the term "sustainable development," which refers to the idea that the next generation should have the same level of chances for well-being as the current generation. In other words, sustainable development is defined as "non-decline" in the context of human welfare, which can be measured using human utility, incomes, and consumption levels, depending on the method of analysis (Khataybeha, Subbarinia, and Shurmana 2010). Broadly speaking, socioeconomic development (SD) focuses on attaining and sustaining economic growth in relation to other socioeconomic development elements. It attempts to satisfy the highest standards of human needs and enhance living circumstances while providing the financial means necessary for environmental preservation (Deniyi, Mohamed, & Rasak 2020). The concept of sustainable development is multifaceted and based on many presumptions in various nations. In recent decades, scholars, governments, and organizations (such as the World Bank, International Monetary Fund (IMF), and World Trade Organization (WTO) have defined the sustainable development approach by considering environmental factors and human living standards (David, 1996). The integration of economic, social, and environmental issues in decision-making and policy-making at all levels of development aspects is the fundamental concept of sustainable development, according to Adeniyi, Sarajul , & Kolawole (2020) research. This aids in the comprehension of the many facets of sustainable development, their intricate relationships, and the facilitation of policy choices meant to forward the objectives of sustainable development. Almost all conventional areas of economic and governmental activity, including economic planning, agriculture, engineering, health, energy, water, natural resources, industry, education, and the environment, must be involved in the integration process (Adeniyi, Sarajul , & Kolawole 2020). According to several studies by Larsson, Jansson, & Boholm, (2019), the wealthy profit is from population expansion, while the rest of the population bears the consequences of resource depletion, social stress, environmental degradation, and other issues. According to the World Commission on Environment and Development (2011), the two central ideas of sustainable development are the concept of "needs," specifically the basic needs of the world's poor, which should be prioritized, and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet the needs of the present and the future, Costanza (2003) revealed. Sustainable development goes beyond mere economic expansion; it necessitates a shift in the composition of growth, making it less dependent on materials and energy and more impact-equitable, Heintz & Wamelink (2015) indicate. All nations must implement these adjustments as part of a set of policies meant to preserve the amount of ecological capital on hand, enhance income distribution, and lessen the degree of susceptibility to economic downturns (Heintz & Wamelink 2015). According to David (1996), sustainable development (SD) is about attaining the economic growth required to satisfy human needs, raise living standards, and supply the funds required to enable environmental conservation. The two main goals of sustainable development are to create sustainable human institutions that provide security as well as opportunities for social interaction and spiritual development, and a sustainable economy that fairly meets human needs without depleting natural resources or removing waste beyond the capacity of the environment to renew itself. Developing a common vision of

a sustainable and desirable society is the most crucial task facing humanity today. Among the most crucial concerns is how to contribute to permanent prosperity within the world's biophysical constraints in a way that is just and equal to all of humanity, from the current generation to the generations to come (Herman, 1992; Costanza, 2003). The long-term preservation of the elements and behaviours that improve the environment's quality is known as environmental sustainability. This factor's measurement highlights the general health and viability of living systems in all of their varied and comprehensive characteristics (Costanza, 2003).

V. RESEARCH METHODOLOGY

To address the research issues, this study first gathered secondary data on the following subjects: economic benefits of sustainability, perceptions of stakeholders regarding sustainable construction, the role of stakeholder perspectives, economic incentives to promote sustainable implementation, economic benefits influence on decision-making process, necessity for corporate sustainability, regulatory bodies influence on the economic benefits, social and environmental co-benefits, championing sustainability at work, stakeholders views on sustainability practices, need to be rich to be sustainable, design thinking on sustainable development, stakeholders comparison of sustainability with ESG (environment, social, and governance, and sustainability challenges and their remedial strategies for a sustainable future.

The primary purpose of conducting secondary data in this section was to establish the foundation of the study's literature review. The majority of the secondary data included in this section came from online sources as well as books and peer-reviewed publications. In addition, preliminary secondary data research was carried out in this study to establish a methodology and to furnish details regarding sustainability within a global framework. Furthermore, secondary research aided in the identification, comprehension, and analysis of the sustainability implementation methodologies currently used by the construction sector through the availability of Internet and print material. Currently, the majority of the information used to create methodology literature came from reading peer-reviewed research publications like Saunders, Lewis, and Thornhill (2009) and Collins and Hussey (2009). The primary data sources used to produce the global sustainability analysis were online resources. To respond to the predetermined research questions, this study also used primary data collecting system.

Questionnaires, focus groups, or one-on-one interviewing techniques were selected as the key data collection instruments. During an interview, which was a method of gathering data, the researcher asked respondents open-ended questions, as stated by Nanda (2005). By asking respondents to define the circumstance, the researcher tried to collect the relevant data. There were three main ways to formulate interviews: semi-structured, non-structured, and structured (Thomas, McGee, & Wilson (2010). A list of questions and themes were provided for the semi-structured interviews that would be done for this study. The format of the interviews was one-on-one or focus group. Data from prominent departmental managers, heads, and business owners, as well as industry professionals serving as project managers for the worldwide construction sector, were gathered for the study through interviews and questionnaires. However, it was thought that gathering knowledge from professionals in the field would be extremely beneficial in creating the most effective tactics for sustainable implementation.

This primary data collection method was chosen because, using the same set of questions, a sizable number of people's perceptions could be obtained regarding sustainable practices and strategies used by the construction industry around the world. These strategies were identified through one-on-one interviews with experts and secondary research. The questionnaire, which was semi-structured in nature, consists of questions that defined sample characteristics. In addition, additional inquiries were made to find out how the stakeholders viewed the sustainability section. Stakeholders in the construction industry in South Africa are consulted regarding the effectiveness of sustainable practices. The study used a three-point Likert scale, which goes from disagreement to agreement, to record the range of responses. Scale 1 indicates disagreement, scale 2 is Neutral, and scale 3 is Agreement.

Table 8: 3 Point-Likert scale factors

Scale	Factor
Agreement	3
Neutral	2
Disagreement	1

Source: Matell and Jacoby (1971)

When used in a survey or research setting, the 3-Point Likert Scale is a potent assessment instrument that is used to determine how strongly people feel about things. In a survey, straightforward inquiries that only allow for yes or no responses may be deceptive. And the reason for this is that they don't go into great detail about people's values, aspirations, fears, beliefs, or personalities. For example, political affiliation is not something that can be answered with objectivity when asking yes/no questions. One can have liberal views on education while holding conservative views on religion or abortion rights, for instance. It is advised to measure the degree of agreement or disagreement with multiple questions rather than just one. After that, to obtain a more precise assessment of the beliefs, values, opinions, etc., average or combine the responses. A 3-point Likert scale chart could be useful in this situation. With options ranging from disagree to agree to, the visualisation could give a comprehensive understanding of people's opinions. The 3-point Likert Scale Chart is easy to read and understand.

VI. RESULTS AND DISCUSSION

At the end of the data collection, 118 stakeholders participated in the survey. The responses from the stakeholders tabulated as follows: 50 from the client perspective, 37 from consultant perspective, and 31 from contractor perspective. The results showed that, for most stakeholders such as client, the most important indicator affecting the implementation of sustainability is lack of knowledge and skills (w = 1.0), followed by Higher initial costs of green construction (w = 0.99) and supported by Poverty and Social Disparity (w = 0.98). Demand and the role of clients, on the other hand, is of low importance compared to the other categories (w = 0.80). See Table 9 – 12 below:

Table 9: Ranking stakeholders' responses based on the weighted RII

S/No	Sustainability factor	Client	Consultant	Contractor	Overall		Degree of effect
		RII	RII	RII	Mean RII	Rank	
1	Inadequate training and education	0.97	0.87	0.89	0.91	**5**	**AE**
2	Environmental impact	0.94	0.93	0.89	0.92	**4**	**AE**
3	Unaddressed health and safety issues	0,94	0.81	0.86	0.87	**7**	**AE**
4	Higher initial costs of green construction	0.99	0.96	0.91	0.95	**2**	**AE**
5	Unfamiliarity with green technologies	0.84	0.77	0.91	0.84	**9**	**AE**
6	Inappropriate policies and instruments for steering sustainable development	0.92	0.90	0.97	0.93	**3**	**AE**
7	Lack of awareness	0.86	0.88	0.86	0.86	**8**	**AE**
8	Lack of communication among project team members	0.94	0.81	0.91	0.88	**6**	**AE**
9	Demand and the role of clients	0.80	0.93	0.80	0.84	**9**	**AE**

10	Difficulty in obtaining the required material resources	0.94	0.91	0.88	0.91	**5**	**AE**
11	Lack of sustainable product information	0.97	0.93	0.96	0.95	**2**	**AE**
12	Lack of knowledge and skills	1.0	0.90	0.86	0.92	**4**	**AE**
13	Climate Change and Its Ramifications	0.86	0.59	0.92	0.79	**10**	**AE**
14	Poverty and Social Disparity	0.98	0.98	1.0	0.98	**1**	**AE**

Degree of effect

00.0 ≤ disagree effect (**DE**) ≤ 50.0
50.0 ≤ neutral effect (**NE**) ≤ 60.0
60.0 ≤ agree effect (**AE**) ≤ 100

Table 10: Client Relative Importance Index (RII)

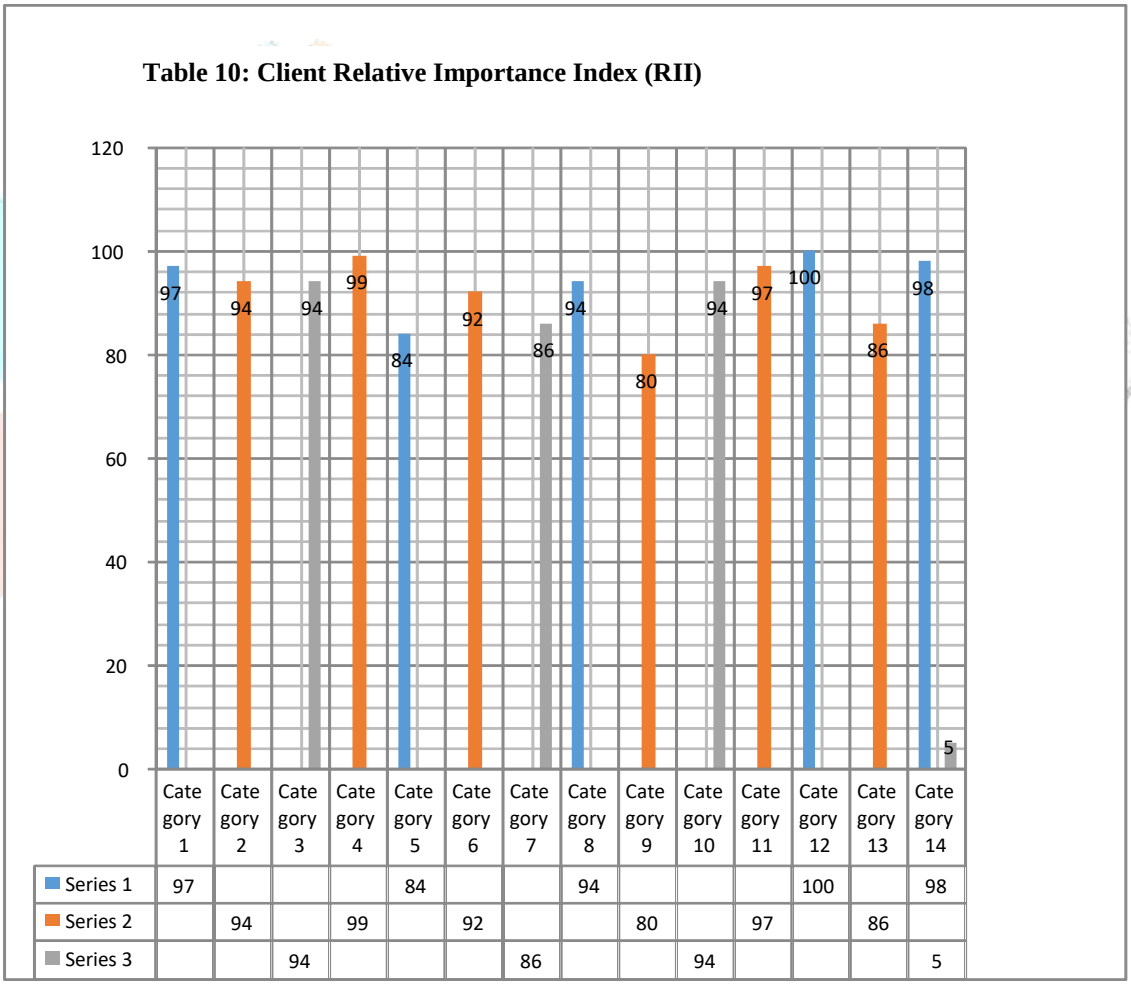


Table 11: Consultant Relative Importance Index (RII)

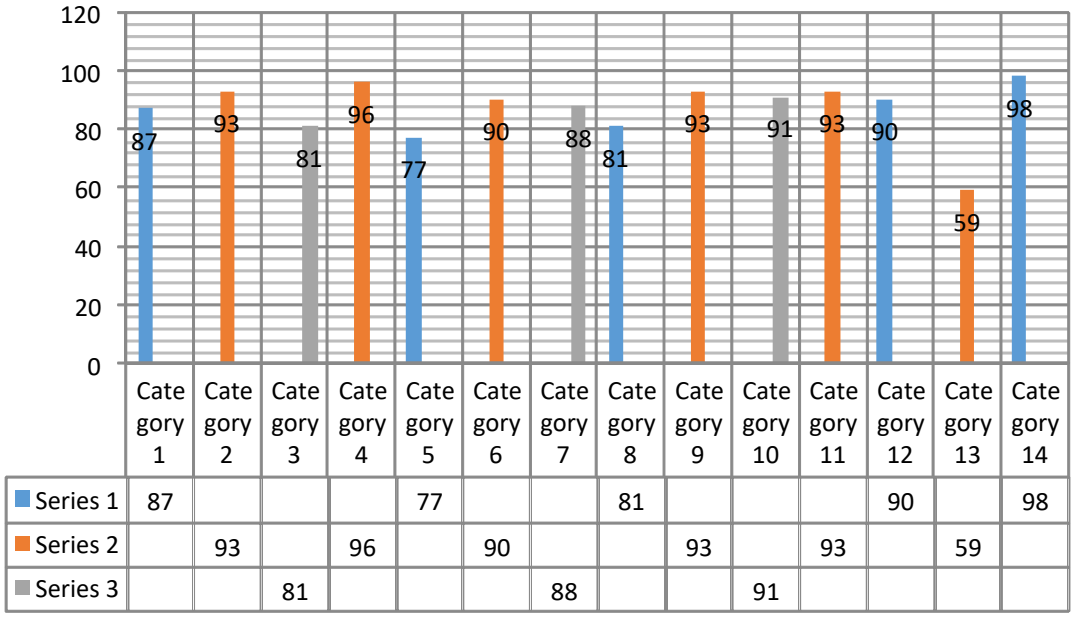
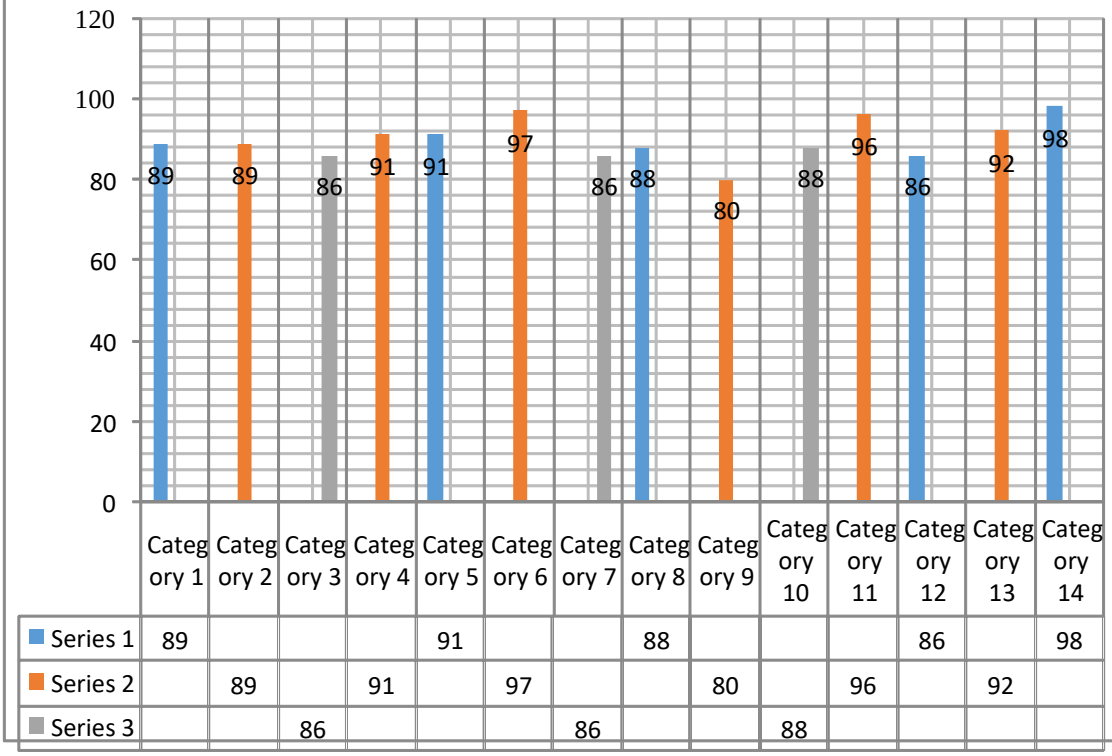


Table 12: Contractor Relative Importance Index (RII)



It is also interesting to note that for all stakeholders from the study, poverty and Social Disparity was placed on a higher value than those other indicators (0.98). The four most important indicators provided by the study are as follows: Higher initial costs of green construction with mean value of w=0.95, Lack of sustainable product information with w=0.95, Inappropriate policies and instruments for steering sustainable development with w=0.93, Environmental impact with w=0.92 and Lack of knowledge and skills with w=0.92. Conversely, the three least important sustainable weighted indicators according to stakeholders are Climate Change and Its Ramifications (0.79) and unfamiliarity with green technologies (0.84) and demand and the role of clients with w=0.84.

Twelve interviewees in all stated that the primary factor influencing the adoption of sustainability initiatives in their companies is the higher upfront expenses of green construction. Recognizing this as a motivator reveals how businesses see sustainable development. Since sustainability requires a balance between social, environmental, and economic factors, it is critical to consider all relevant factors. A structural imbalance resulting from material selections may require additional work and cost, ultimately leading to an unbalanced building consisting of three pillars. When expensive delays arise, implementing a more complex sustainable design triggers more problems than benefits. In the same way, it's critical to ensure that no structural element is overdesigned and that the project is financially feasible. Using sustainable energy sources seems to satisfy competitive advantage standards. In order to create a unique capability, it permits cost reduction in addition to resource efficiency, both of which are elements of sustainable development. An interviewee from the construction industry provided the following quote, which explains the steps done to lower energy consumption. The interviewee outlines a successful strategy for cutting energy use that involves creating natural ventilation systems, which significantly lowers the cost of the ventilation systems that must be installed throughout the structure. This leads to operational effectiveness as well, when an inventive solution to a problem is provided by achieving efficiency in order to obtain a feature needed for a structure at no ongoing expense.

The environmental factor outweighs other sustainability indices, according to an analysis of existing practices in the field of sustainable construction. This means that in every construction industry project, environmental impact should be considered as priority The implementation of sustainable practices in the construction industry is brought to light by this research, and construction businesses are provided with a tool that enables them to view sustainability as a multifaceted issue that is approached equally from all angles. Additionally, this tool can be used for stakeholder management because it makes it possible to incorporate the opinions and viewpoints of different stakeholders, monitor project performance, plan necessary measures to improve performance, and communicate results easily. Construction companies engaged in the design, construction, operation, and/or maintenance stages are the target audience for the suggested assessment tool. It is determined that the sustainable tools could be applied, meaning that the contractor would be involved from the start and would take on the roles of both designer and constructor. Examining the client's viewpoint and his ability to accept the suggested sustainability instrument makes this problem more difficult. Typically, it shows that the stakeholders should compile a list of sustainability criteria using established guidelines and standards. The ultimate goal of attaining sustainable development is undoubtedly shared by all involved parties, but the use of the suggested assessment tool as a client requirement is still debatable because there are no clear assessment criteria and there is a dearth of data available for many sustainability-related aspects. Therefore, more research is required to determine whether using the suggested assessment method from the client's perspective is feasible. Since all types of construction projects can benefit from the indications that made up the final list, the suggested framework's applicability is not limited to any one type of project.

VII. CONCLUSION

This study made an effort to address the main research questions. Industry innovation is necessary for productivity growth. The industry needs to shift in order for innovation to meet demand. Without the transformation that allows for innovative new processes and techniques, the industry faces the risk of missing out on the opportunity to capitalize on this demand. Numerous studies have made clear how much reform is required in the construction sector. These evaluations offer recommendations for modifications to particular areas of practice along the value chain of the industry, with an emphasis on increasing productivity to meet the growing demand for construction. The construction industry should use novel materials to boost efficiency. The increasing and wasteful use of resources has resulted in poverty, pollution, poor health, loss of biodiversity, and climate change. These problems are related to one another and frequently make one another worse. It makes sense that the planet's natural resources are finite because humans have depended on them for millennia to thrive. Scarcity can lead to price hikes, problems, and conflicts. It can also leads to increased efforts to find new resources, often with unexpected or odd results. The scale of the environmental and socioeconomic concerns is enormous. It takes a fundamental shift in mindset to accomplish sustainable growth. This require dematerialization, cradle-to-cradle production techniques, and a move from products to services in addition to just optimizing resource use. Building energy retrofit as a catalyst for sustainability cannot be integrated into socio-technical ideas without an

empirical framework, which prevents the construction sector from creating project value and advancing continuously.

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