Article

Not peer-reviewed version

A literature review of Environmental, Social and Governance (ESG) indicators in the Construction Industry

Isaac Akomea-Frimpong *, Collins Eli Agar, Abdul-Razak Alidu, Maame Yaa Ohenewaa-Ayisi, Benjamin Baah, Samuel Oduro, Michael Owoahene Acheampong, Elvis Adjei Konadu, Emmanuel Maalu, Dramani Arimiyaw, Roksana Jahan Tumpa, Renata Mwinome Kuutiero, Amir Ghanbaripour, Caleb Boadi

Posted Date: 2 August 2024

doi: 10.20944/preprints202408.0203.v1

Keywords: Climate change; Construction industry; ESG; Sustainability; Literature review; social diversity

Article

A Literature Review of Environmental, Social and Governance (ESG) Indicators in the Construction Industry

Isaac Akomea-Frimpong [1,*], Collins Eli Agar [2], Abdul-Razak Alidu [2], Maame Yaa Ohenewaa-Ayisi [2], Benjamin Baah [2], Samuel Oduro [2], Michael Owoahene Acheampong [2], Elvis Adjei Konadu [2], Maalu Emmanuel [2], Dramani Arimiyaw [3], Roksana Jahan Tumpa [4], Renata Mwinome Kuutiero [5], Amir Naser Ghanbaripour [6] and Caleb Boadi [1]

[1] Western Sydney University, Sydney, Australia
[2] Department of Construction Technology and Management, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
[3] Department of Building and Real Estate, Hong Kong Polytechnic University, Kumasi, Hong Kong
[4] School of Engineering and Technology, Central Queensland University, Sydney, Australia
[5] Department of Timber Structures and Building Construction, Technical University of Munich, Munich, Germany
[6] Faculty of Society and Design, Bond University, Gold Coast, Australia
* Correspondence: 90943718@westernsydney.edu.au

Abstract: Matters relating to preservation of environmental resources and climate change, social inclusion and diversity, and open and sound governance have rapidly gained global attention. However, little is known about the construction industry in meeting the environmental, social and governance (ESG) criteria towards sustainable development. In this study, the purpose is to identify the key ESG indicators for construction development. A systematic literature review was undertaken using data from Scopus, PubMed, Google Scholar, JSTOR, ProQuest, and Web of Science. The results show some of the key ESG indicators as climate resilience and green construction activities (at the project level), and active stakeholder engagement and effective project governance (at the firm level) and meeting environmental and social regulation requirements (industry/national level). The limitation of the article is in the sample size of twenty-six journal articles with future expectation of increment as ESG gain more acceptance in the construction industry. This study will be significant for the design of practice framework and policies on ESG in the construction industry. Comprehensively, this study presents relevant ESG indicators for construction management and presents essential information for future research.

Keywords: climate change; construction industry; esg; sustainability; literature review; social diversity

1. Introduction

As stakeholders continue to place a greater focus on environmental protection, social inclusion, as well as open and accountable ESG disclosures have reached a crescendo within the 21st century together with traditional financial disclosures. The construction sector, like any other sector like manufacturing, fashion, retail, and mining is significantly affected by ESG disclosures in a variety of ways. Darnall, *et al.* [1] and Akomea-Frimpong, *et al.* [2] mentioned that the built environment emits 30% or more of carbon emissions, and larger than 40% of energy consumption together with 32% of the world's natural resources. These evidences show that the construction industry should be involved in sustainability drive to minimise these challenges in the release of emissions, energy usage and the plundering of natural resources by meeting the ESG targets [3,4]. The goal of ESG in the construction sector is to improve the standards of environmental consciousness and promote more

 doi:10.20944/preprints202408.0203.v1

eco-friendly project design and operations [5]. The construction sector is also expected to reduce the amount of waste it produces, maximize recycling, and reuse efforts, and incorporate circular economy principles into its design decisions [6]. Furthermore, construction firms may utilize ESG reports to identify areas of poor implementation of inclusion and diversity policies. Increasingly, there is a policy shift towards a mixture of environmental and social responsibility strategies in the construction sector [7]. According to Heal [8] and [9], by showing commitment to environmental sustainability and social responsibility, construction companies may enhance their reputation among stakeholders. Moreover, the preference among stakeholders to companies with positive ESG policies is high. Thus, firms in the construction sector that prioritise ESG issues are likely to have extended sustainable effects [10]. These firms may attract investors that value ESG elements and develop a reputation for ethical business operations by sharing information about their ESG initiatives. Finally, ESG reporting is increasingly becoming a regulatory requirement in some jurisdictions (countries) [11]. Therefore, contractors may avoid legal fines and reputational damage by complying with these regulations. In the attempt to harvest the above-mentioned benefits from ESG practices and reporting, construction firms may be confronted with unclear ESG criteria (indicators) [12,13]. Without criteria to measure the implementation of ESG in the construction sector, some firms may attempt to present misleading and substandard ESG reports to stakeholders. Some firms may manipulate annual disclosures on ESG to paint a picture of embracing sustainable practices against the backdrop of self-engineered and questionable benchmarks [14]. Therefore, this article aims at identifying the key ESG indicators in the construction industry from existing literature.

The arguments for this paper are as follows. First, the current literature on ESG is skewed to manufacturing, retail, banking and other sectors with very few studies on the construction research field [15]. These industries operate differently from the construction sector. Construction projects go through a lifecycle embracing different stages and stakeholders with diverse and complex interests [16]. There is a dearth of scholarly works on ESG application to resolve these complexities in informing the measurement of ESG in construction activities. Second, practical indicators on ESG towards construction development remains not clearly defined and in some countries and industries not existent on construction sector [17,18]. With the world inching towards more sustainable zero-carbon emission and inclusive construction policies, it is evident the construction industry needs to adapt to changing social, economic, environmental and governance progress [19,20]. The rest of the sections of the study is the following: an overview of the methodology followed by outcomes of the analysis of the data including discussions of the results. Finally, the conclusions, implications, and limitations.

2. Methodology

Literature on ESG in the construction industry were retrieved and analysed following the systematic literature review approach (SLR) [21]. The steps outlined in the SLR include:

2.1. Search Strategy

The first stage involves identifying relevant literature in various bibliographic databases. A systematic search and retrieval of relevant documents were conducted in Scopus, ProQuest, Web of Science, Google Scholar, and PubMed. These databases are prominent depositories for indexing a large number of studies in [22]. The keywords utilised in the search include: “Environmental, social and governance” OR “ESG” OR “ESG disclosures” OR “ESG reporting” OR “ESG report*” OR “ESG disclos*”, AND “construct* industry” OR “building sector” OR “construction sector” OR “Built* Environment”. This search resulted in 531, 426, 5433, 3257 and 132 documents in PubMed, Scopus, ScienceDirect, Web of Science, ProQuest, EBSCOhost, and Google Scholar respectively. Supplementarily, the searches in the databases were supported by checking the citations and reference lists of articles to retrieve additional documents inclusive of grey literature (theses and reports). At this stage, a total of 178 studies were found increasing the number of studies to 9977.

 doi:10.20944/preprints202408.0203.v1

2.2. Eligibility Criteria

The eligibility criteria set for the analysis of the studies identified through Step 2.1 include the following inclusion and exclusion criteria:

i. Document type: Include peer-reviewed journal articles. Articles published in journals go through rigorous peer-reviewed processes against other documents such as conference papers, reports and books which were excluded [23,24].
ii. Language: Include studies published in English and exclude articles written in languages other than English [25].
iii. Full-text accessibility: Include documents available and downloadable in full-text, exclude not-found and not downloadable articles [26].
iv. Focus: Include articles with coverage of ESG in the construction industry especially ESG indicators [27].

2.3. Selection of Relevant Documents

A total number of 9799 documents were found in Scopus, other documents from Web of Science, EBSCOhost, Google Scholar, ProQuest, and PubMed as explained in Stage 2.1. Additional results of 178 documents from citation (or reference) search and grey literature were added to the 9799 documents. A total of 9977 documents were imported into Endnote to remove duplicates among databases. At this stage, 1572 documents were removed due to duplication. The paper titles and the summary of the abstracts of the remaining 4871 underwent screening. The eligibility criteria set in Section 3.2 was applied to screen the titles and abstracts by all the authors. A total of 4724 documents were removed after this process. Further, the remaining 147 articles were fully read in view of the eligibility criteria. In the end, 26 articles with 121 articles removed because they failed to meet the eligibility criteria.

2.4. Data Extraction and Analysis

Extraction of the relevant data from the selected 26 documents to address the research objective was performed by all the authors. Preferably, Microsoft Excel sheet was utilised to record the data extraction. Data extracted by an author was checked and rechecked by all the other authors. Data extracted includes bibliometric information about the 26 articles including author(s), document type, publishing entity and year, country of origin, the aims/objective/focus of the studies, and research design. In addition, texts and statements on ESG indicators were extracted and recorded in Microsoft Excel after repetitive reading and comparing all the articles. The identified texts, words, phrases and statements were thoroughly analysed and grouped into themes based on similar patterns and purposes [28]. The authors conferred and cross-checked the themes on the ESG indicators. The mean scores of the key groups of the ESG indicators in Table 3 were calculated using the number of articles from which the indicators were identified divided by the total indicators within the four latent variables [29]. The purpose of the calculation is to rank the order of importance of the latent variables (principal ESG indicator groups). The formula for the mean score is:

$$\sum\left(\frac{RA_i}{N}\right) = MS$$

where MS is mean sore, RA_i is the relevant study from which the indicators are identified and N is all the observed variables in a latent variable.

3. Findings and Discussions

3.1. Description of Selected Studies

As demonstrated in Figure 1, Figure 2 and Figure 3, the studies included in this analysis were made up of peer-reviewed journal articles (26 articles). The peer-reviewed journal articles are scholarly works assessed by scholars in the same field of construction management and published by academic journals such as "Sustainability, Journal of Cleaner Production and Journal of

 doi:10.20944/preprints202408.0203.v1

Management in Engineering" [30]. With the exception of Mukhlisin, *et al.* [31] and Siew, *et al.* [32], all the studies were published after 2015 which is after the implementation of the UNSDGs which promote environmental, social and governance practices [33]. Studies were conducted in highly developed countries including Australia, Canada, United Kingdom, Finland, Japan, United States, Russia, and Spain. China and India are exceptions, developing nations that recorded eight studies. In these developing countries, there is an increasing interest in ESG-related issues to preserve the environment, minimise climate change risks, and support projects towards attaining the net-zero emission targets [34]. While most of the studies covered general construction projects together with specific focus on buildings and infrastructure projects such as sports complex and entertainment centres.

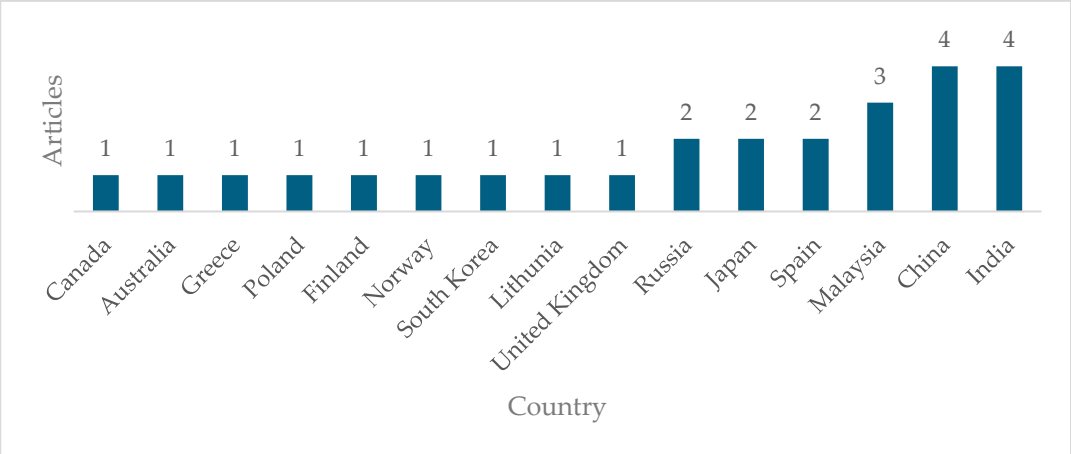

Figure 1. Geographical location of the studies.

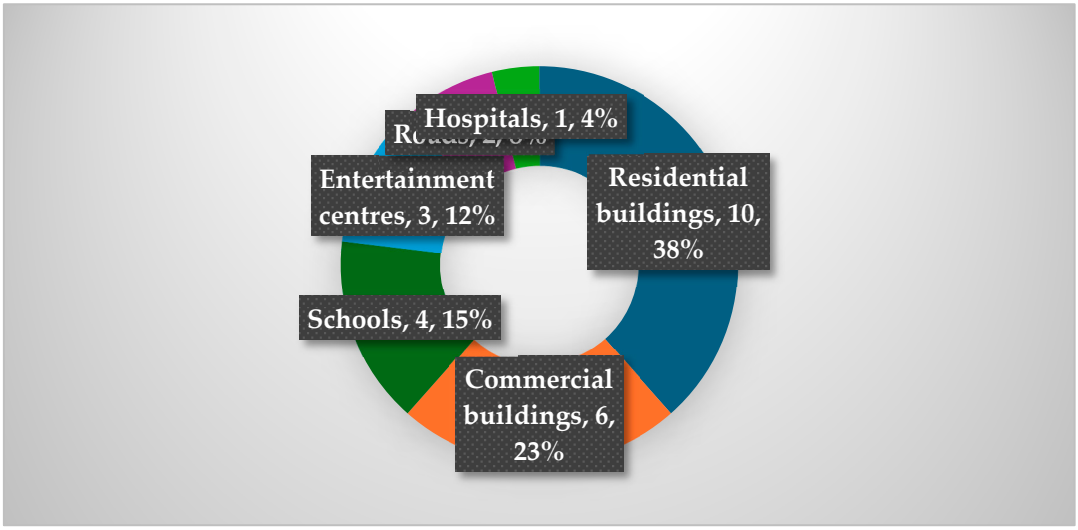

Figure 2. Different projects identified in the papers.

 doi:10.20944/preprints202408.0203.v1

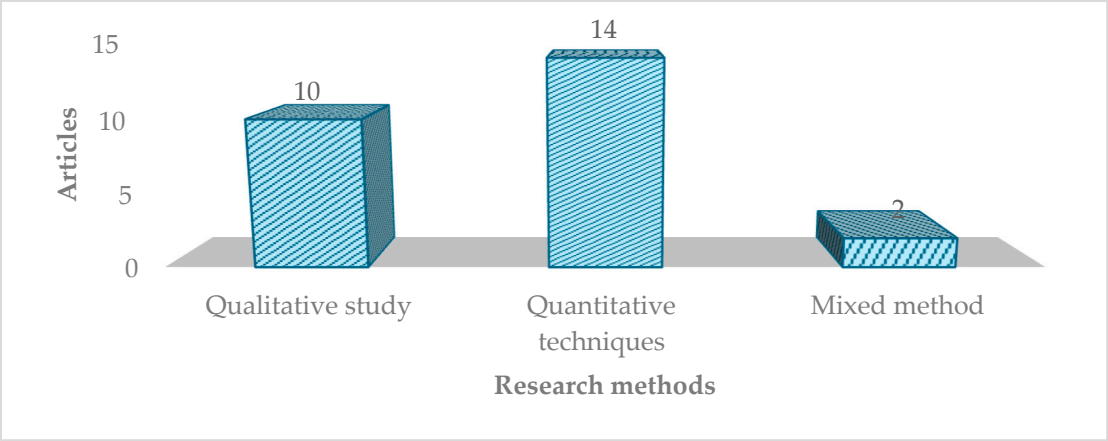

Figure 3. Methods of research used in the articles.

3.2. ESG Indicators in Construction Industry

In Table 1, a total of 96 indicators of ESG on performance in the construction industry are presented. These ESG indicators are relevant benchmarks in assessing responsible and sustainable practices [1,35]. ESG indicators seen in Table 2 go beyond traditional financial metrics to provide a more complete understanding of the construction industry's environmental, social, and governance policies and practices [36]. The prominent ESG indicators in Table 2 include the attainment of low or zero carbon emission from construction activities. This indicator measures the level of greenhouse gases emitted by a construction project, aiding in the assessment of project's environmental impact and efforts to mitigate climate change [37]. This indicator encourages project managers to incorporate eco-friendly and sustainable project measures and smart technologies for net-zero carbon emission targets [38,39]. Employee wellbeing and turnover rate is another term for the rate at which construction workers and construction professionals are treated as well as leaving a construction firm over a given period. This ESG indicator presents the critical results of a firm's ability to attract and retain talent. A high employee turnover rate may indicate problems with employee satisfaction, work culture, or management practices, which can have long-term consequences for the company's success and sustainability. Another important indicator is community engagement, which measures a company's level of involvement and impact in the communities in which it operates [18]. It assesses a construction firm's efforts to foster positive relationships within communities where projects are constructed and operated in the built environment. This indicator takes philanthropic activities, employee volunteerism, and community investments into account [40]. To provide a summary of the rest of the ESG performance indicators in Table 2, the explanations are in three forms of ESG: environmental dimension, social inclusion, accountability and transparency in governance. The environmental dimension evaluates the construction industry's environmental impact [15].

Table 1. ESG indicators for the construction industry.

S/N	ESG indicator	Explanation	Source (refer to Table 1)
ESG1	Climate resilient	Ability of projects to cope with changing weather conditions	1, 2, 8, 10, 3, 14, 26
ESG2	Ecological adaptation score	High survival of organisms in an area where a project is built	1, 9, 20, 22
ESG3	Efficient project resource management	Maximum and efficient usage of project resources which includes the protection of the environment	4, 8, 7, 9, 19, 11, 18, 21
ESG4	Affordability and Security measure	Affordable houses for low-income earners	3, 16, 1, 23

 doi:10.20944/preprints202408.0203.v1

ESG5	Resident Voice	Concerns of residents and communities are incorporated in ESG framework	11, 22, 1, 24
ESG6	Resident Support	Initiatives from builders are supported by the residents and the community.	7, 25, 9, 21
ESG7	Collaborative placemaking	More emphasis on the needs of the people who will use the building space	6, 9, 13, 21, 26
ESG8	Effective corporate systems and controls on governance	The overall structure and approach to governance on ESG implementation	1, 6, 7, 4, 21, 13, 14, 23
ESG9	Reliable supply chain of construction materials	The housing provider procures responsibly, considering supplier diversity and screening and sustainable procurement practices	21, 8, 4, 11, 25
ESG10	Environment Management Systems	The practices and established systems to mitigate the environment impact of projects	3, 9, 20, 19, 10
ESG11	Stakeholder Engagement/ Collaboration	Getting stakeholders to be part of ESG conversation and implementation	3, 14, 15, 11, 7, 4
ESG12	Diversity and inclusion	An open and inclusive work culture	3, 5, 13, 9
ESG13	Green biodiversity	This involves developing natural land by restricting some operations to protect plant and animal life	2, 7, 10, 9, 15, 17
ESG14	Lowest waste and Pollution	Few records of wastes and hazardous air pollution	5, 3, 4, 1, 9, 5, 15, 16, 12, 17, 19, 20
ESG15	Charity and Community Engagement/ Volunteering and Probono Work	This could be in a form of donations and support to various charitable and education-related organisations on a pro-bono basis.	5, 7, 12, 9
ESG16	Additional Employment/ Local jobs creation	Providing job opportunities for locals where projects are developed	9, 10, 2, 1, 14, 19
ESG17	Enhancement of professional social and skill development	Continuous training and development of project team members on ESG	2, 14, 25, 15, 22
ESG18	Positive health status of project teams	Active consideration of the health and wellbeing of project staff including managers and construction workers	2, 6, 1, 5, 7, 8, 4, 3, 10, 9, 10, 22
ESG19	Minimum carbon emissions	This involves reducing the overall carbon footprint of projects	2, 5, 8, 7, 1, 19, 24
ESG20	Robust policies and guidance documentation	These documents govern business activities	2, 3, 1, 15
ESG21	Energy consumption/saving rate	Total amount of energy needed for a given process measured in MWh	9, 11, 12, 7, 3, 17, 19, 20, 6, 5, 12
ESG22	Least greenhouse gas effects	Minimum of carbon emissions into the environment	2, 7, 13, 14, 17, 18, 19, 9, 20, 5, 12, 16

 doi:10.20944/preprints202408.0203.v1

ESG23	Compliance with environmental regulations and standards	The extent to which the environmental regulations and standards are adhered to by firms	9, 7, 9, 21, 25
ESG24	Voluntary environmental practices beyond compliance	Projects should have environment impact levels below the standard limits	10, 8, 11, 19, 21
ESG25	Level of environmental awareness training and programs	Construction workers and connected stakeholders are trained and influenced by sustainable environmental practices	9, 12, 13, 6, 7, 23
ESG26	Environmental information disclosure score	The level at which environmental information of a project is disclosed against the ESG global standards considered relevant in the industry	10, 7, 3, 20, 25
ESG27	High return on investment	High ratio between the net income of projects and investments	14, 10, 8, 21, 26
ESG28	Current assets to liabilities score	Dividing total present assets by recent liabilities incurred	16, 8, 14, 20, 21
ESG29	Summary of the stakes in the firms	Percentage of ownership of the firm's green assets	7, 9, 16, 25
ESG30	Total assets of the firm	Gross assets of a firm inclusive of environmental and social capital	13, 14, 20, 15, 10
ESG31	Longevity of firm existence	The length of firm inception to present	7, 14, 15, 21
ESG32	Cost-benefit analysis score	A score to assess the economic viability of methodologies used in projects	11, 7, 20, 17, 18, 19, 23, 25
ESG33	Firm procurement decisions	The choices made by firms when procuring services affect the environment	11, 13, 6, 24
ESG34	Anti-discrimination and equal opportunity	Avoiding the distinction between employees to disadvantage some and advantage others	17, 18, 6, 21
ESG35	Gender balance	Percentage of full-time employment, contractor and consultant positions held by women	19, 20, 6, 3, 25
ESG36	Risk and credit rating score	The potential risks associated with a project and the possible benefits of a project	8, 4, 7, 8, 1, 13, 3, 20
ESG37	Level of employee engagement	The degree to which employees identify with the goals and values of the organization	7, 5, 10, 23
ESG38	Extent of community investment	The measure of how much is invested into communities enduring the impacts of activities from firms	5, 7, 10, 26, 19
ESG39	Board independence	Availability of independent directors to avoid being unduly influenced by a vested interest	14, 5, 3, 1, 20
ESG40	Executive compensation	Commendable cash and non-financial benefits to top leaders who are committed to implementation of ESG in project management	5, 9, 13, 5, 1, 17

 doi:10.20944/preprints202408.0203.v1

ESG41	Ethics and compliance training	Training to educate employees about the rules, regulations, and new policies they should adhere to	5, 7, 8, 3, 18, 10, 22, 25
ESG42	Count of data privacy and security breaches	Measure of the rate at which unauthorized parties gain access to sensitive data of a firm	12, 5, 9, 20
ESG43	Supplier audits	Availability of deliberate plans and controls on purchasing and supply risks	8, 14, 15, 5, 21
ESG44	Sustainable growth rate	The measure of maximum rate of growth that a company can sustain without additional debt	6, 11, 4, 14, 26
ESG45	Environmental efficiency	Reducing environmental destruction as much as possible while providing the expected deliverables	14, 17, 20, 10, 14
ESG46	Recycled greenhouse gas	This involves capturing more greenhouse gases than releasing	7, 9, 15, 2, 21
ESG47	Level of drainage contamination	How projects lead to the contamination drainage systems in the communities	1, 6, 15, 26
ESG48	Application of circular economy scores	Circular Economy Score considers several parameters for each of the 5 pillars, and the outcome is a value between 0 and 100	4, 11, 15, 25
ESG49	Extent of accountability	The level at which responsibility is accepted for honest and ethical conduct towards others by the firm	2, 7, 15, 1, 20
ESG50	Lifecycle rating of projects	Rating the projects across the various stages of the project lifecycle phases	16, 9, 15, 21
ESG51	Green development	Incorporation of green construction practices into project development.	16, 17, 18, 19, 22
ESG52	Labour productivity	The total volume of output per unit labour of a firm	4, 6, 16, 2
ESG53	Process improvement	Regular upward improvement in processes towards the achievement ESG goals	1, 5, 7, 16
ESG54	Achievable project goals	These are stipulated project goals which are specific and achievable	5, 16, 7, 2
ESG55	Use of renewable energies	The use of renewable energies in place of fossil fuels during and after project delivery	7, 19, 17, 11
ESG56	Promotion of basic human rights	Enforcing and ensuring fundamental rights of employees and stakeholders	9, 16, 7, 6, 3, 5
ESG57	Food security	The measure of the ability of Individuals to access nutritious and sufficient food	4, 10, 17, 22
ESG58	Eradication of modern slavery	Avoiding the exploitation of employees and individuals in the community for commercial gains of the project	12, 19, 7
ESG59	Sustainable infrastructure	Undertaking projects which considers the social, economic, and environmental implications	2, 7, 15, 20
ESG60	LEED-certified projects	Green construction activities on projects happen within the requirements of LEED framework.	2, 16, 7, 9
ESG61	Disaster recovery and response	The rate at which a firm recovers from a disaster or manages a disaster for minimum negative impacts	1, 5, 7, 25

 doi:10.20944/preprints202408.0203.v1

ESG62	Smart engineering and technology solutions	A method, processes, and IT tools to design and develop innovative infrastructure	4, 6, 8, 18, 7
ESG63	Employee attraction and retention	Finding the right kind of people that fit into your company ethos while creating structure, processes, and procedures that keep your employees engaged and working for your firm	2, 8, 18, 23, 26
ESG64	Presence of ESG Oversight	Regulatory compliance; formal ESG oversight structures; reporting and transparency	1, 6, 9, 15, 8, 11
ESG65	Minimum records of greenwashing (behaviour)	Greenwashing is the overstatement of the environmental and social credentials of an organisation or product	2, 4, 6, 1, 16
ESG66	Innovation	This could be in a form of embracing new technologies in the industry	5, 7, 4, 10, 19
ESG67	Balance ecosystem	Provision of projects that support a natural habitat which is sustainable and where there is interdependency	17, 8, 5, 11
ESG68	Preserve cultural heritage	Keeping the artifacts and traditions of a community intact while projects are developed	18, 3, 6, 2
ESG69	Economic prosperity	The measure of the economic growth, economic security, and economic competitiveness of a firm	2, 7, 8, 22, 25
ESG70	Enough economic capital	Ensuring that the amount of capital that needed to survive any risks that the firm takes is adequate	1, 14, 7, 8
ESG71	Gender pays ratio	Median male salary to median female salary	2, 5, 6, 23, 24
ESG72	Temporary worker rate	Percentage of full-time positions held by part-time/contract/temporary workers.	15, 6, 23, 25
ESG73	Non-discrimination records	This ensures that no one is denied their rights because of certain factors like race and gender	1, 3, 13, 22
ESG74	Incentivized pay to construction workers	Additional compensation awarded to construction workers for results they achieved	1, 5, 3, 17, 24
ESG75	Fair labour practices	Practices that guarantee the equitable and unbiased protection of both employers and employees	2, 4, 7, 3, 21
ESG76	Supplier code of conduct	Eco-friendly supply chain channels together with respectful and fair workplace for employees.	3, 8, 13, 3
ESG77	Robust internal systems against corruption	There are explicit codes of ethics and governance structures against corruption of all forms	3, 7, 10, 12
ESG78	Regular sustainability reports	Regular reporting on the environmental, social, and economic risks and opportunities of a firm	3, 7, 9, 11, 19, 17, 18, 26
ESG79	External stakeholder assurance	Ensure the interests of different stakeholders are satisfied	21, 4, 15, 3, 16

 doi:10.20944/preprints202408.0203.v1

ESG80	Effective management and supervision	Measure of the output of employees based on direction, guidance, and control of the working force by management	2, 10, 11, 4, 13
ESG81	Requirements on ESG are clearly transparent	Open disclosure of ESG requirements for construction firms to follow	3, 7, 4, 3, 23
ESG82	Overall firm performance	The total performance of a firm inters of profits, growth, customer satisfaction and sustainability	2, 8, 13, 18
ESG83	User satisfaction ratings	This measures a customer's satisfaction with an organization	1, 4, 6, 18, 24
ESG84	Increased quality of life	The level of satisfaction of employees across all aspects of their lives and well-being	18, 19, 4, 9, 1
ESG85	Acceptable level of heat and the cooling of indoors of the projects	The acceptable level of heating and the cooling of the building for minimum environmental impacts	20, 6, 8, 7
ESG86	Reduction of economic and social disparities between regions	Reducing the unequal distribution of income and opportunity between different groups in society	12, 19, 2, 5, 20
ESG87	Decreasing rate of poverty	Reducing the ratio of the number of people in each community whose income falls below the poverty line	1, 4, 8, 19, 1, 25
ESG88	Social inclusion and cohesion	A measure of how all groups have a sense of belonging, participation, inclusion, recognition, and legitimacy.	2, 3, 19, 2, 8, 24
ESG89	Sustainable property investment	Investing in projects which are sustainable and environmentally friendly both during construction and in use	1, 6, 17, 19, 24
ESG90	Regulation and compliance requirements	A construction firm adheres to council regulations and local practices	2, 9, 15, 10, 25
ESG91	Rate of client cancellations and delays	The rate at which projects are delayed by firms and the potential of project cancellation by clients	1, 3, 10, 7, 15
ESG92	Technological readiness	The proclivity of employees to embrace and use new technologies for sustainable projects	2, 9, 12, 18, 23
ESG93	Social innovativeness	Design and implementation of modern solutions to enhance the wellbeing and welfare of communities	18, 19, 2, 23
ESG94	Green carbon-neutral badge	Application of environmentally conscious technologies and software platforms to monitor ESG performance and LEED compliance in projects.	12, 14, 1, 14
ESG95	Fair and equitable compensation to workers.	Employees are remunerated fairly.	1, 5, 7, 2, 8
ESG96	Government involvement and advocacy	litigation, lobbying, and public education on ESG by government	3, 1, 21, 3

 doi:10.20944/preprints202408.0203.v1

Table 2. Classification of the ESG indicators at different levels of analysis.

Principal variable	S/N	Specific variable	Level of analysis		
			Project level	Firm level	Meso-macro level
Environmental indicators	**ESGE**				
	ESG1	Climate resilient	X		
	ESG2	Ecological adaptation score	X		
	ESG9	Reliable supply chain of construction materials	X		
	ESG10	Environment Management Systems	X	X	
	ESG13	Green biodiversity	X		
	ESG14	Lowest waste and Pollution	X		
	ESG19	Minimum carbon emissions	X		
	ESG21	Energy consumption/saving rate	X		
	ESG22	Least greenhouse gas effects	X		
	ESG23	Compliance with environmental regulations and standards	X	X	
	ESG24	Voluntary environmental practices beyond compliance	X	X	
	ESG25	Level of environmental awareness training and programs		X	
	ESG26	Environmental information disclosure score		X	
	ESG43	Supplier audits	X		
	ESG44	Sustainable growth rate	X	X	
	ESG45	Environmental efficiency	X	X	
	ESG46	Recycled greenhouse gas	X		
	ESG47	Level of drainage contamination	X		
	ESG51	Green development	X	X	
	ESG55	Use of renewable energies	X		
	ESG57	Food security		X	
	ESG60	LEED-certified projects	X		
	ESG61	Disaster recovery and response	X	X	
	ESG62	Smart engineering and technology solutions	X	X	
	ESG67	Balance ecosystem	X	X	
	ESG76	Supplier code of conduct	X		
	ESG85	Acceptable level of heating and the cooling of the building	X		
	ESG94	Green carbon-neutral badge	X		
Economic indicators	**ESGEc**				
	ESG27	High return on investment	X	X	
	ESG28	Current assets to liabilities score	X		
	ESG29	Summary of the stakes in the firms		X	
	ESG30	Total assets of the firm		X	
	ESG31	Longevity of firm existence		X	
	ESG32	Cost-benefit analysis score	X	X	
	ESG52	Labour productivity	X	X	
	ESG69	Economic prosperity			X
	ESG70	Enough economic capital	X	X	
	ESG74	Incentivized pay to construction workers	X		

 doi:10.20944/preprints202408.0203.v1

	ESG86	Reduction of economic and social disparities between regions			X
	ESG87	Decreasing rate of poverty			X
	ESG89	Sustainable property investment		X	
	ESG95	Fair and equitable compensation to workers	X		
Governance indicators	**ESGG**				
	ESG3	Efficient project resource management	X		
	ESG8	Effective corporate systems and controls on governance		X	
	ESG20	Robust policies and guidance documentation	X	X	
	ESG33	Firm procurement decisions		X	
	ESG36	Risk and credit rating score		X	X
	ESG39	Board independence		X	
	ESG40	Executive compensation		X	
	ESG41	Ethics and compliance training	X	X	
	ESG42	Count of data privacy and security breaches	X	X	
	ESG48	Application of circular economy scores	X		
	ESG49	Extent of accountability		X	
	ESG50	Lifecycle rating of projects	X		
	ESG53	Process improvement	X	X	
	ESG54	Achievable project goals	X		
	ESG64	Presence of ESG oversight	X	X	
	ESG65	Minimum records of greenwashing (behaviour)		X	
	ESG66	Innovation	X	X	
	ESG77	Robust internal systems against corruption		X	
	ESG78	Regular sustainability reports	X	X	
	ESG80	Effective management and supervision		X	
	ESG81	Requirements on ESG are clearly transparent	X	X	
	ESG82	Overall firm performance		X	
	ESG90	Regulation and compliance requirements	X	X	X
	ESG92	Technological readiness	X	X	
	ESG96	Government involvement and advocacy			X
Social indicators	**ESGS**				
	ESG4	Affordability and Security measure		X	
	ESG5	Resident Voice			X
	ESG6	Resident Support			X
	ESG7	Collaborative placemaking		X	X
	ESG11	Stakeholder Engagement/ Collaboration		X	X
	ESG12	Diversity and inclusion	X	X	
	ESG15	Charity and Community Engagement/ Volunteering and Probono Work		X	X
	ESG16	Additional Employment/ Local jobs creation			X
	ESG17	Enhancement of professional social and skill development		X	X
	ESG18	Positive health status of project teams		X	
	ESG34	Anti-discrimination and equal opportunity		X	
	ESG35	Gender balance		X	
	ESG37	Level of employee engagement	X	X	
	ESG38	Extent of community investment		X	X
	ESG56	Promotion of basic human rights		X	X

 doi:10.20944/preprints202408.0203.v1

ESG58	Eradication of modern slavery			X
ESG59	Sustainable infrastructure		X	X
ESG63	Employee attraction and retention	X	X	
ESG68	Preserve cultural heritage		X	X
ESG71	Gender pays ratio		X	
ESG72	Temporary worker rate	X	X	
ESG73	Non-discrimination records		X	
ESG75	Fair labour practices		X	X
ESG79	External stakeholder assurance			X
ESG83	User satisfaction ratings			X
ESG84	Increased quality of life			X
ESG88	Social inclusion and cohesion			X
ESG91	Rate of client cancellations and delays			X
ESG93	Social innovativeness		X	X

In addition, construction firms are assessed based on their environmental initiatives, such as the implementation of environmentally-friendly energies, net-zero greenhouse gas emissions, and sustainable supply chains [41]. Climate change policy, water management, pollution prevention, biodiversity impacts, and green building practices are some examples from Table 1.

The Social dimension of ESG indicators examine the construction industry's social impact, including its interactions with employees, users of construction projects, communities, and other stakeholders [42]. The performance indicators in Table 2 that depict the social dimensions of ESG include the treatment of construction workers, the construction firm's dedication to employee well-being, diversity and inclusion policies and practices, labour standards, high score of user satisfaction, community engagement, and philanthropic activities [43]. The Governance indicators assess the project management practices and structures within the construction industry. It entails evaluating a firm's leadership, project steering committees and board structures, executive compensation, transparency in decision-making processes, and adherence to ethical and legal requirements [44]. Internal systems, leadership ethics, transparency, executive compensation, board diversity, corruption policies, and shareholder rights are all evaluation criteria of ESG in the built environment. To support the various findings, several studies within and outside the construction industry have confirmed the importance of ESG framed within the performance indicators of construction firms, and an instance is the field of socially responsible investment (SRI) [45]. ESG-induced performance indicators were used as a proxy for sustainability performance in the SRI market [6]. By reporting these ESG indicators, the authors mentioned that it caused an increment in the share value of the companies, and it enhanced the priorities of societal progression, good governance, and preservation of the environment. In the built environment, Musarat, Alaloul, Irfan, Sreenivasan and Rabbani [37], posited that improved ESG performance benchmarks is seen in the climate resilience and low risks of investments. In addition, Kim and Lee [46], argued for the importance of benchmarks and ratings on ESG for the construction firms can learn from to develop project related ESG performance indicators. Using multiple firms from different industries, Hayashi, Hiyama and Kubo [16], established that companies should develop and implement risk-inspired ESG scores to assess the financial investments in construction projects. Further, it was explained in the articles that the implementation of ESG guiding framework relates and involves stakeholders in performance management. However, during times of crisis, such as the coronavirus crisis, the application, and effects ESG practices vary depending on the project and organisational policies and practices. Deamer, *et al.* [47] found that the coronavirus pandemic impacted the finances of firms negatively but firms with enhanced ESG practices had better performance outcomes.

The use of ESG indicators is growing in popularity in all industries inclusive of the construction industry. Well-established and holistic ESG performance indicators are helpful in assisting organisations to identify areas for improvement, manage risks, and improve corporate reputation and long-term value [35]. ESG indictors also provide useful information for financiers to make

 doi:10.20944/preprints202408.0203.v1

informed decisions and allocate capital to green construction projects with the focus on sustainable development [48]. However, there are some drawbacks to using ESG indicators. Studies have pointed lack of transparency and convergence to these metrics as different organisations and projects demand different ESG indicators. Different rating agencies also assess ESG performance using different methods and criteria, resulting in a lack of agreement on definition and measurement [4]. Because of these disparities, different opinions and ratings abound on the best ESG performance benchmarks for projects [18]. Furthermore, concerns have been raised on the ethical dimensions ESG indicators and inadequate integration of all the UN SDGs. ESG rating agencies pick and choose biased standards to measure sustainable practices of construction firms [45,49]. Such ratings are heavily influenced by the project managers. Critics of ESG indicators and its disclosures especially the extreme right-wing politicians in the United States, for instance, see ESG incorporation into public projects as a waste of money and "woke" capitalism. [50] Supported by corporate allies and fossil fuel lobbyists, these right-wing politicians have initiated bills and reviewed project contracts to avoid the disclosure of ESG indicators in public projects.

 doi:10.20944/preprints202408.0203.v1

3.3. Conceptualising the Review Findings

In Table 2 and Figure 4, the ESG indicators from Table 1 have been classified using the three baselines of sustainability (social, economic and environmental) together with a fourth pillar of "governance" in the reference to existing literature [51]. Bose [4] argued that ESG establishes the financial, social and ecological balance in the construction projects. Moreover, ESG is also an avenue for stakeholders to realise the social responsibility and contribution of construction firms to societies [52]. Stakeholders in the construction sector pursue long-term investment and social capital development through ESG with strong support from environmental protection and governance policies. ESG is also a prime indicator of sustainability for construction stakeholder's investment and ensures the promotion of net-zero principles [53].

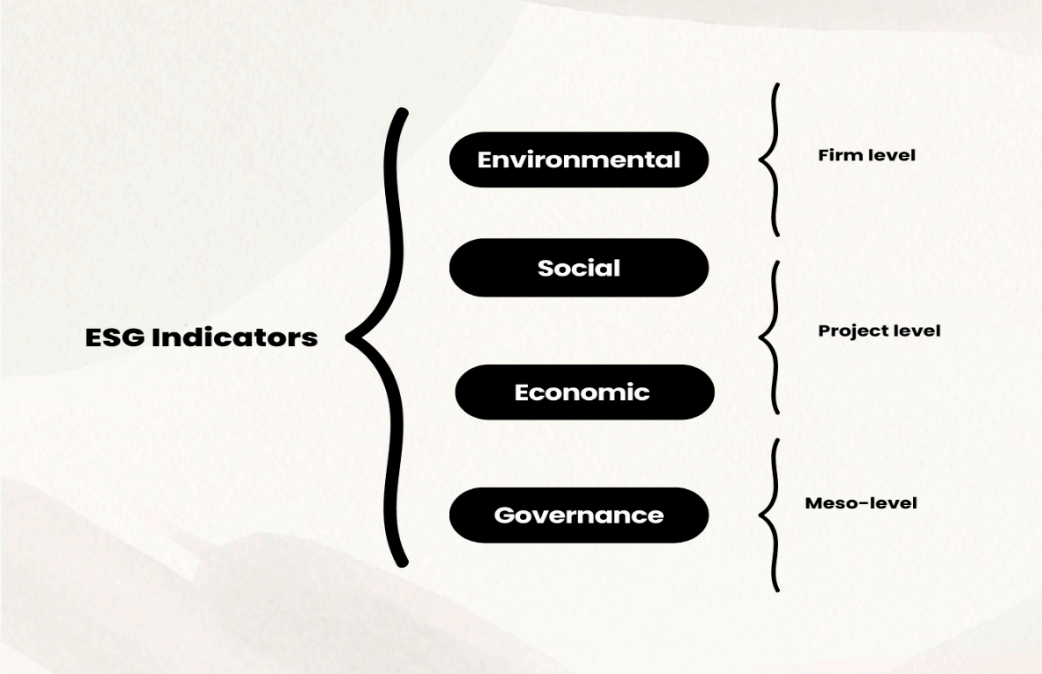

Figure 4. Principal ESG indicators.

Similarly, continual disclosure of ESG indicators and practices serves as an image enhancing strategy to attract responsible investors, and manage long-term sustainability into construction development [17]. Further, the importance of the four basic pillars of ESG are investment analysis and decision-making strategies in the construction industry were ranked in the order of importance in Table 3 putting on the environment indicators (1st), social progress (2nd), and governance (3rd) and economic prosperity (4th).

Environmental Indicators

In the wake of the explosion of the ESG concept in construction industry discussions, ESG disclosures/reporting is a frequently used to acknowledge the project and firm performance reports beyond the conventional financial statements [20]. Environmental reporting involves construction corporations revealing the impacts of their activities on safeguarding the environment, climate and biodiversity [1]. ESG reporting comprises a comprehensive publication of the firm's ESG actions, including the initiatives and elements of ESG performance outside the influence of management [45]. Erkens, Paugam and Stolowy [7] recounted that typically, environmental disclosure of construction firms is voluntary, and the process is not well-defined and standardised for all firms. Environmental reports advocates and increases the availability of ESG data to researchers and practitioners, and encourages construction firms to adjust their actions and conducts to minimise carbon emissions [18]. These requirements maybe project specific or requirements from the industry and currently the

 doi:10.20944/preprints202408.0203.v1

European Union. Bose [4] claims that, external stakeholders such as the European Union and environmental pressures groups are increasingly demanding the disclosure of non-financial environmental information beyond what is typically accessible in financial statements on construction activities. ESG reporting is viewed as a prerequisite for environmental responsibility wooing investment funding for sustainable construction activities.

Social Indicators

Brogi, Lagasio and Porretta [18] and Chen, Wang, He and Zhang [40] claimed the relevance of social ESG indicators and the possibility of substituting the bluewashing of these key metrics of progress from contractors. These behaviours of construction firms are demonstrated in the misleading information on transitioning to inclusive construction project practices. According to Lokuwaduge and De Silva [54], these deceptive practices in disclosing social sustainability practices in construction projects are common in attracting the support of traditional authorities and the public at large to execute projects. EY [55] reported that contractors within the construction sector overstate a project's inclusion strategies with false and creative financial reporting methodologies to present diversity, equity and inclusion (DEI) metrics. The report continued that construction firms sometimes publish vague or unverifiable social claims on projects with the aim of attracting financial investments and court public support. Heal [8] also stated that construction firms are prone to using irrelevant corporate social responsibility claims to distract the public from significant and harmful environmental impacts of projects. A critical institutional account of decoupling these false claims, according to Erkens, Paugam and Stolowy [7], is to develop a well-planned and coordinated organisational strategies to promote the transition of sustainable, inclusive and green project practices. Construction firms and project management professionals should be trained to meeting stakeholder expectations on zero-carbon emissions without really altering project practices. The construction industry is heavily reliant on fossil fuel products such as coal and petroleum to support projects that have adverse impacts on the environment and future generations [56]. Project managers and project steering committees should support realistic and justifiable projects without having enough and sustainable finance to support green project development.

Governance Indicators

The rising concerns on undefined disclosing indicators of governance malpractices of firms highlight the diversion from sustainable reporting standards increase the risks of information asymmetry [57,58]. Stakeholders are misled to believe that every activity and transaction has been reported but in reality things have been hidden to the detriment of the well-being of the stakeholders concerning adhering to project and firm level regulations. Hadro, *et al.* [59] mentioned that poor governance systems on construction transactions are subtle authorisation of fraud and misleading reporting from the top management of construction firms. Galvin [60] and Eisenkopf, Juranek and Walz [35] revealed the commitments from the management emphasise on the genuineness of firms efforts to improve the state of the organisational and project structures for sustainable construction development. To continue to ensure continuous improvement in the governance framework, regulations and government support should be available to fine dishonest disclosures of organisations and measures to fight climate change [44,61].

Economic Indicators (4th Rank)

Construction firms should be the source of economic prosperity as projects built by this industry form the foundation of societal development [62,63].So, construction firms should present the contribution the industry has made towards the economic development of societies in their reportage [44,62]. Construction companies should desist from exclusively presenting only positive news and omit negative news related to their economic activities that are detrimental to the society. Corporate deceptions and manipulations in the process of financial reporting their environmental activities be checked with the established indicators [54]. Contractors should be wary of legitimising unethical

 doi:10.20944/preprints202408.0203.v1

behaviours on presentation of fraudulent financial reports to enhance their image and annual performance [40]. Investors into projects should be equipped with ESG ratings to woo public praise and private investments [46,62].

Table 3. Computation and ranking of the principal ESG indicators.

	Environmental indicators	Economic indicators	Governance indicators	Social indicators
	4	3	1	2
	2	2	2	4
	5	3	3	3
	2	1	3	2
	1	2	2	1
	3	3	5	1
	1	2	2	4
	4	2	2	3
	3	2	3	3
	1	1	2	4
	2	2	3	3
	2	1	1	1
	1	1	4	4
	5	1	3	1
	6		2	4
	5		3	1
	3		2	3
	2		2	3
	3		1	5
	1		3	4
	4		2	2
	3		4	2
	3		3	3
	2		3	1
	3		3	3
	3			2
	1			3
	4			2
				3
Sum	79	26	64	77
Mean score	2.82	1.86	2.56	2.66
Ranking	1st	4th	3rd	2nd

5. Implications of the Study

The findings of this research are relevant for the promotion of awareness and integration of ESG indicators in sustainable practices in the construction industry. These indicators will be relevant in

 doi:10.20944/preprints202408.0203.v1

ESG reporting on construction activities to investors, clients, and the public [64]. With comprehensive ESG disclosure indicators, construction professionals can confidentially regularly disclose information about their environmental and social performance against measured metrics. This will help improve the image of the construction firms and the performance of projects. Construction companies may develop risk mitigation strategies that consider ESG factors, ultimately reducing project-related risks [54]. This study will again draw the attention of the contractor to the ethical cost they will incur for their improper actions. This will make the private contractor realize the importance of ethical responsibilities in construction. Financial investors in the construction of projects will be drawn to consider social, ethical, ecological, governance and sustainable priorities in their investment decisions [13]. The integration of social and economic blind supervision will effectively curb contractor fraudulent environmental behaviour [37]. However, at present, the studies on ESG have focused largely on firm specific variables with limited focus on specific projects at the project level, extremely little is known about ESG practices comparative to firm-level measures on social, governance and environmental responsibilities. Therefore, it is essential to expand ESG models and practices on project specific indicators [44]. Projects such as sanitation, water, airports and ports and education have not received ESG-related practice models. Hence this study calls for the consideration of distinct ESG-inspired project management practices that ensures disparities between regions and project sizes.

From the results of this study, it is expected that advanced research may be considered to develop a framework for ESG reporting and disclosure [60,65]. This will ease the exercise of the firms in disclosing information regarding their environmental, social, and economic performance, to determine which firm is doing well as far as ESG is concerned and which components of the construction firms needs to be improved to meet the ESG standards. Also, the study is expected to influence the following issues relating to ESG that have received fewer investigations, and development of practice models from construction researchers. Future studies can focus on these, to include: deciphering how ESG connects with the construction industry; managing ESG risks; ESG-inspired supply chain and procurement; measuring, monitoring, and reporting ESG performance [45]. Additional topics for study include the rating, tracking, and planning of ESG indicators, use and misuse of ESG disclosures; firm culture, diversity, inclusion, and leadership changes; GHG emissions and social equity dimensions for the construction industry [10]. Moreover, the list of further research areas can embrace leadership and managerial aspects of implementing ESG; smart technologies on blockchain, digitization, and artificial intelligence for ESG implementation; insurance costs and impacts on small to medium-sized construction companies.

The outcomes of this study promote the inclusion of societal changes and social fabric within construction organisations and communities in which projects are constructed. As the world gravitates towards diversity and inclusive policies, project practices and performance evaluation will be shaped by ESG indicators [18,38]. Diversity and social inclusion policies in the construction industry will ensure everyone including communities and cultures is respected and integrated into the project management. Emphasis on reduction of wage losses, unemployment, improved education and better health and safety care are implemented within the construction sector. Greenwashing stands against societal ethics and regulations, and it is crucial that construction firms develop frameworks to address these ethical problems. The study has provided checklists for contractors to be aware and implement measures to mitigate them.

6. Conclusions

This study identified the major ESG indicators within the construction sector. The findings from this study based on past literature highlights the various ESG indicators in construction projects that aim at reaching sustainability targets in the construction industry. The results were classified into project, firm and industry (and/or national) indicators of ESG. Key indicators on ESG at these levels include lowest pollution and waste and green biodiversity (project level), present of ESG oversight and inclusive policies at the firm level, and robust regulations on climate change and government support at the industry and national levels. With respect to the four classified ESG pillars, the

 doi:10.20944/preprints202408.0203.v1

dominant indicators include climate resilient and green project practices (environmental indicators), high return investment and maximum current asset ratio (economic indicators), community involvement and stakeholder support (social indicators), and effective project governance and equitable labour laws (governance indicators). As explained in Section 4, these findings have significant implications for the policies, practice, society, the environment, and future studies. However, this study has inherent limitations. The main limitations of this study are the lack of application of these identified ESG indicators to practical project, firm and industry cases in construction project management. Theoretically, inadequate journal articles exist on the ESG indicators in the construction industry, and this is evident in the 26 articles used for this study. It is suggested that more studies should be conducted to deepen the theoretical underpinning of the concepts of ESG in the construction industry together with validation of empirical real-life project and firm data.

Appendix: Retrieved articles for the analysis

Article (Authors, Year)
1. Li, *et al.* [66]
2. Mukhlisin, Ibrahim, Jaafar and Razali [31]
3. Li, *et al.* [67]
4. Baabou, Bjørn and Bulle [6]
5. Wang, Zeng, Xia, Wu and Xia [36]
6. Siew, Balatbat and Carmichael [32]
7. Chastas, Theodosiou, Kontoleon and Bikas [39]
8. Barykin, Strimovskaya, Sergeev, Borisoglebskaya, Dedyukhina, Srklyarov, Sklyarova and Saychenko [49]
9. Hayashi, Hiyama and Kubo [16]
10. Chen, Wang, He and Zhang [40]
11. Musarat, Alaloul, Irfan, Sreenivasan and Rabbani [37]
12. Lin and Zhang [68]
13. Hadro, Fijałkowska, Daszyńska-Żygadło, Zumente and Mjakuškina [59]
14. Siew [11]
15. Aksenova, Kiviniemi, Kocaturk and Lejeune [5]
16. De Castro, Pacheco and González [64]
17. Norang, Støre-Valen, Kvale and Temeljotov-Salaj [9]
18. Park, Kim, Lee, Kim and Kong [10]
19. Apanaviciene, Daugeliene, Baltramonaitis and Maliene [38]
20. Kempeneer, Peeters and Compernolle [13]
21. Adewumi, *et al.* [69]
22. Balon, *et al.* [70]
23. Srivastava, *et al.* [71]
24. Zhang, *et al.* [72]
25. Singh and Kumar [73]
26. Halder and Batra [74]

Author Contributions: Conceptualization of the paper, literature review, methodology, data collection, cleaning and analysis, writing all done by all the authors: supervision and review of article Isaac Akomea-Frimpong. All authors have consented to the article by reading and agreeing to the manuscript.

Funding: This research has no funding support.

Data Availability Statement: Data for this article will be available upon request from the corresponding author.

Acknowledgments: Thank you for all comments from anonymous reviewers and editors in making this article rich.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Darnall, N.; Ji, H.; Iwata, K.; Arimura, T.H. Do ESG reporting guidelines and verifications enhance firms' information disclosure? *Corporate Social Responsibility and Environmental Management* **2022**, *29*, 1214-1230.
2. Akomea-Frimpong, I.; Agyekum, A.K.; Amoakwa, A.B.; Babon-Ayeng, P.; Pariafsai, F. Toward the attainment of climate-smart PPP infrastructure projects: a critical review and recommendations. *Environment, Development and Sustainability* **2023**, doi:10.1007/s10668-023-03464-x.
3. Chastas, P.; Theodosiou, T.; Kontoleon, K.J.; Bikas, D. The Effect of Embodied Impact on the Cost-Optimal Levels of Nearly Zero Energy Buildings: A Case Study of a Residential Building in Thessaloniki, Greece. *Energies* **2017**, *10*, doi:https://doi.org/10.3390/en10060740.
4. Bose, S. Evolution of ESG reporting frameworks. *Values at Work: Sustainable Investing and ESG Reporting* **2020**, 13-33.
5. Aksenova, G.; Kiviniemi, A.; Kocaturk, T.; Lejeune, A. From Finnish AEC knowledge ecosystem to business ecosystem: lessons learned from the national deployment of BIM. *Construction management and economics* **2019**, *37*, 317-335.
6. Baabou, W.; Bjørn, A.; Bulle, C. Absolute Environmental Sustainability of Materials Dissipation: Application for Construction Sector. *Resources* **2022**, *11*, 76.
7. Erkens, M.; Paugam, L.; Stolowy, H. Non-financial information: State of the art and research perspectives based on a bibliometric study. *Comptabilité-Contrôle-Audit* **2015**, *21*, 15-92.
8. Heal, M. Sustainability in Construction Practices as Emphasis on Environmental Investing in ESG Model Grows. 2022.
9. Norang, H.; Støre-Valen, M.; Kvale, N.; Temeljotov-Salaj, A. Norwegian stakeholder's attitudes towards EU taxonomy. *Facilities* **2023**, *41*, 407-433, doi:10.1108/F-03-2022-0051.
10. Park, E.; Kim, Y.; Lee, A.; Kim, J.; Kong, H. Study on the Global Sustainability of the Korean Construction Industry Based on the GRI Standards. *International Journal of Environmental Research and Public Health* **2023**, *20*, doi:10.3390/ijerph20054231.
11. Siew, R.Y.J. Critical evaluation of environmental, social and governance disclosures of Malaysian property and construction companies. *Construction Economics and Building* **2017**, *17*, 81-91, doi:10.5130/AJCEB.v17i2.5328.
12. Yu, E.P.-y.; Van Luu, B.; Chen, C.H. Greenwashing in environmental, social and governance disclosures. *Research in International Business and Finance* **2020**, *52*, 101192.
13. Kempeneer, S.; Peeters, M.; Compernolle, T. Bringing the user Back in the building: an analysis of ESG in real estate and a behavioral framework to guide future research. *Sustainability* **2021**, *13*, 3239.
14. Zhao, E.; May, E.; Walker, P.D.; Surawski, N.C. Emissions life cycle assessment of charging infrastructures for electric buses. *Sustain. Energy Technol. Assess.* **2021**, *48*, 14, doi:10.1016/j.seta.2021.101605.
15. Ebolor, A.; Agarwal, N.; Brem, A. Sustainable development in the construction industry: The role of frugal innovation. *Journal of Cleaner Production* **2022**, *380*, doi:10.1016/j.jclepro.2022.134922.
16. Hayashi, T.; Hiyama, K.; Kubo, R. CASBEE-Wellness Office: An objective measure of the building potential for a healthily built environment. *Japan Architectural Review* **2021**, *4*, 233-240.
17. Chen, G.; Wei, B.; Dai, L. Can ESG-responsible investing attract sovereign wealth funds' investments? Evidence from Chinese listed firms. *Frontiers in Environmental Science* **2022**, *10*, 935466.
18. Brogi, M.; Lagasio, V.; Porretta, P. Be good to be wise: Environmental, Social, and Governance awareness as a potential credit risk mitigation factor. *Journal of International Financial Management & Accounting* **2022**, *33*, 522-547.
19. Clementino, E.; Perkins, R. How do companies respond to environmental, social and governance (ESG) ratings? Evidence from Italy. *Journal of Business Ethics* **2021**, *171*, 379-397.
20. Buniamin, S.; Nik Ahmad, N.N. An integrative perspective of environmental, social and governance (ESG) reporting: A conceptual paper. **2015**.
21. Page, M.J.; McKenzie, J.E.; Bossuyt, P.M.; Boutron, I.; Hoffmann, T.C.; Mulrow, C.D.; Shamseer, L.; Tetzlaff, J.M.; Akl, E.A.; Brennan, S.E. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *International Journal of Surgery* **2021**, *88*, 105906.

22. Kukah, A.S.; Akomea-Frimpong, I.; Jin, X.; Osei-Kyei, R. Emotional intelligence (EI) research in the construction industry: a review and future directions. *Engineering, Construction and Architectural Management* **2021**, *ahead-of-print*.
23. Jandrić, P. A peer-reviewed scholarly article. *Postdigital Science and Education* **2021**, *3*, 36-47.
24. Mahood, Q.; Van Eerd, D.; Irvin, E. Searching for grey literature for systematic reviews: challenges and benefits. *Research synthesis methods* **2014**, *5*, 221-234.
25. Brenya, R.; Akomea-Frimpong, I.; Ofosu, D.; Adeabah, D. Barriers to sustainable agribusiness: a systematic review and conceptual framework. *Journal of Agribusiness in Developing and Emerging Economies* **2022**.
26. Panic, N.; Leoncini, E.; De Belvis, G.; Ricciardi, W.; Boccia, S. Evaluation of the endorsement of the preferred reporting items for systematic reviews and meta-analysis (PRISMA) statement on the quality of published systematic review and meta-analyses. *PloS one* **2013**, *8*, e83138.
27. Kukah, A.S.; Akomea-Frimpong, I.; Jin, X.; Osei-Kyei, R. Emotional intelligence (EI) research in the construction industry: a review and future directions. *Engineering, Construction and Architectural Management* **2022**, *29*, 4267-4286.
28. Kennedy, R.A.; McKenzie, G.; Holmes, C.; Shields, N. Social support initiatives that facilitate exercise participation in community gyms for people with disability: a scoping review. *International Journal of Environmental Research and Public Health* **2022**, *20*, 699.
29. Chan, A.P.; Nwaogu, J.M.; Naslund, J.A. Mental ill-health risk factors in the construction industry: systematic review. *Journal of construction engineering and management* **2020**, *146*, 04020004, doi:https://ascelibrary.org/doi/full/10.1061/(ASCE)CO.1943-7862.0001771.
30. Björk, B.-C.; Solomon, D. The publishing delay in scholarly peer-reviewed journals. *Journal of informetrics* **2013**, *7*, 914-923.
31. Mukhlisin, M.; Ibrahim, A.; Jaafar, O.; Razali, S.F.M. Electrochemical assessment of water quality as an effect of construction. *Int.J.Electrochem.Sci.* **2012**, *7*, 5467-5483.
32. Siew, R.Y.; Balatbat, M.C.; Carmichael, D.G. The relationship between sustainability practices and financial performance of construction companies. *Smart Sustain. Built Environ.* **2013**, *2*, 6-27.
33. Akomea-Frimpong, I.; Jin, X.; Osei-Kyei, R.; Kukah, A.S. Public–private partnerships for sustainable infrastructure development in Ghana: a systematic review and recommendations. *Smart Sustain. Built Environ.* **2023**, *12*, 237-257.
34. CHIA. *An ESG Reporting Standard for Australian Community Housing*; Community Housing Industry Association: 2023.
35. Eisenkopf, J.; Juranek, S.; Walz, U. Responsible Investment and Stock Market Shocks: Short-Term Insurance without Persistence. *British Journal of Management* **2023**, *34*, 1420-1439.
36. Wang, G.; Zeng, S.; Xia, B.; Wu, G.; Xia, D. Influence of financial conditions on the environmental information disclosure of construction firms. *Journal of Management in Engineering* **2022**, *38*, 04021078.
37. Musarat, M.A.; Alaloul, W.S.; Irfan, M.; Sreenivasan, P.; Rabbani, M.B.A. Health and safety improvement through Industrial Revolution 4.0: Malaysian construction industry case. *Sustainability* **2022**, *15*, 201.
38. Apanaviciene, R.; Daugeliene, A.; Baltramonaitis, T.; Maliene, V. Sustainability Aspects of Real Estate Development: Lithuanian Case Study of Sports and Entertainment Arenas. *Sustainability* **2015**, *7*, 6497-6522, doi:https://doi.org/10.3390/su7066497.
39. Chastas, P.; Theodosiou, T.; Kontoleon, K.J.; Bikas, D. The effect of embodied impact on the cost-optimal levels of nearly zero energy buildings: A case study of a residential building in Thessaloniki, Greece. *Energies* **2017**, *10*, 740.
40. Chen, Y.; Wang, G.; He, Y.; Zhang, H. Greenwashing behaviors in construction projects: there is an elephant in the room! *Environmental Science and Pollution Research* **2022**, *29*, 64597-64621.
41. Emmitt, S.; Ruikar, K. *Collaborative design management*; Routledge: 2013.
42. Huang, R.; Huang, Y. Does internal control contribute to a firm's green information disclosure? Evidence from China. *Sustainability* **2020**, *12*, 3197.
43. Paganin, G. Sustainable finance and the construction industry: New paradigms for design development. *Techne* **2021**, *22*, 79-85, doi:10.36253/techne-10600.
44. He, Q.; Wang, Z.; Wang, G.; Zuo, J.; Wu, G.; Liu, B. To be green or not to be: How environmental regulations shape contractor greenwashing behaviors in construction projects. *Sustainable Cities and Society* **2020**, *63*, 102462.
45. Friedman, H.L.; Heinle, M.S.; Luneva, I.M. A theoretical framework for ESG reporting to investors. *Available at SSRN 3932689* **2021**.
46. Kim, J.; Lee, Y. Association between Earnings Announcement Behaviors and ESG Performances. *Sustainability* **2023**, *15*, 7733.
47. Deamer, L.; Lee, J.; Mulheron, M.; De Waele, J. Building sustainability impacts from the bottom up: Identifying sustainability impacts throughout a geotechnical company. *Sustainability (Switzerland)* **2021**, *13*, doi:10.3390/su132111981.

 doi:10.20944/preprints202408.0203.v1

48. Cao, Y.; Xu, C.; Kamaruzzaman, S.N.; Aziz, N.M. A systematic review of green building development in China: Advantages, challenges and future directions. *Sustainability* **2022**, *14*, 12293.
49. Barykin, S.E.; Strimovskaya, A.V.; Sergeev, S.M.; Borisoglebskaya, L.N.; Dedyukhina, N.; Srklyarov, I.; Sklyarova, J.; Saychenko, L. Smart City Logistics on the Basis of Digital Tools for ESG Goals Achievement. *Sustainability* **2023**, *15*, 5507, doi:https://doi.org/10.3390/su15065507.
50. Gillan, S.L.; Koch, A.; Starks, L.T. Firms and social responsibility: A review of ESG and CSR research in corporate finance. *Journal of Corporate Finance* **2021**, *66*, 101889.
51. Yue, X.; Han, Y.; Teresiene, D.; Merkyte, J.; Liu, W. Sustainable funds' performance evaluation. Sustainability, 12 (19), 8034. **2020**.
52. Giamporcaro, S.; Gond, J.-P.; O'Sullivan, N. Orchestrating governmental corporate social responsibility interventions through financial markets: The case of French socially responsible investment. *Business Ethics Quarterly* **2020**, *30*, 288-334.
53. Brice, J.; Cusworth, G.; Lorimer, J.; Garnett, T. Immaterial animals and financialized forests: Asset manager capitalism, ESG integration and the politics of livestock. *Environment and Planning A: Economy and Space* **2022**, *54*, 1551-1568.
54. Lokuwaduge, C.S.; De Silva, K.M. ESG risk disclosure and the risk of green washing. *Australasian Accounting, Business and Finance Journal* **2022**, *16*, 146-159.
55. EY. *The current state of ESG reporting in the engineering and construction industry*; 2021.
56. Gałecka-Drozda, A.; Wilkaniec, A.; Szczepańska, M.; Świerk, D. Potential nature-based solutions and greenwashing to generate green spaces: Developers' claims versus reality in new housing offers. *Urban Forestry & Urban Greening* **2021**, *65*, 127345.
57. Akerlof, G.A. The market for "lemons": Quality uncertainty and the market mechanism. In *Uncertainty in economics*; Elsevier: 1978; pp. 235-251.
58. Zhang, K.; Pan, Z.; Janardhanan, M.; Patel, I. Relationship analysis between greenwashing and environmental performance. *Environment, Development and Sustainability* **2023**, *25*, 7927-7957.
59. Hadro, D.; Fijałkowska, J.; Daszyńska-Żygadło, K.; Zumente, I.; Mjakuškina, S. What do stakeholders in the construction industry look for in non-financial disclosure and what do they get? *Meditari Accountancy Research* **2022**, *30*, 762-785.
60. Galvin, P. Building Blocks of the Future Our Story: How My Company Developed Modular Construction with Recycled Shipping Containers is Advancing Solutions to the Affordable Housing Crisis and Environmental Sustainability. *Real Estate Issues* **2020**, *44*, 1-8.
61. Siano, A.; Vollero, A.; Conte, F.; Amabile, S. "More than words": Expanding the taxonomy of greenwashing after the Volkswagen scandal. *Journal of Business Research* **2017**, *71*, 27-37.
62. Lyon, T.P.; Maxwell, J.W. Greenwash: Corporate environmental disclosure under threat of audit. *Journal of economics & management strategy* **2011**, *20*, 3-41.
63. Marquis, C.; Toffel, M.W.; Zhou, Y. Scrutiny, norms, and selective disclosure: A global study of greenwashing. *Organization Science* **2016**, *27*, 483-504.
64. De Castro, A.V.; Pacheco, G.R.; González, F.J.N. Holistic approach to the sustainable commercial property business: analysis of the main existing sustainability certifications. *International Journal of Strategic Property Management* **2020**, *24*, 251-268.
65. Willan, C.; Janda, K.B.; Kenington, D. Seeking the Pressure Points: Catalysing Low Carbon Changes from the Middle-Out in Offices and Schools. *Energies* **2021**, *14*, 8087, doi:https://doi.org/10.3390/en14238087.
66. Li, R.Y.M.; Li, B.; Zhu, X.; Zhao, J.; Pu, R.; Song, L. Modularity clustering of economic development and ESG attributes in prefabricated building research. *Frontiers in Environmental Science* **2022**, *10*, 977887.
67. Li, X.; Huang, Y.; Li, X.; Liu, X.; Li, J.; He, J.; Dai, J. How does the Belt and Road policy affect the level of green development? A quasi-natural experimental study considering the CO2 emission intensity of construction enterprises. *Humanities & Social Sciences Communications* **2022**, *9*, doi:https://doi.org/10.1057/s41599-022-01292-4.
68. Lin, Y.-H.; Zhang, H. Impact of contractual governance and guanxi on contractors' environmental behaviors: The mediating role of trust. *Journal of Cleaner Production* **2023**, *382*, 135277.
69. Adewumi, A.S.; Opoku, A.; Dangana, Z. Sustainability assessment frameworks for delivering Environmental, Social, and Governance (ESG) targets: A case of Building Research Establishment Environmental Assessment Method (BREEAM) UK New Construction. *Corporate Social Responsibility and Environmental Management* **2024**.
70. Balon, V.; Bagul, A.; Kumar, R. Green construction supply chain barriers assessment: Evidence from Indian construction industry. *Global Business Review* **2024**, 09721509241231107.
71. Srivastava, S.; Iyer-Raniga, U.; Misra, S. Integrated approach for sustainability assessment and reporting for civil infrastructures projects: Delivering the UN SDGs. *Journal of Cleaner Production* **2024**, *459*, 142400.
72. Zhang, F.; Liu, B.; An, G. Do Government Subsidies Induce Green Transition of Construction Industry? Evidence from Listed Firms in China. *Buildings* **2024**, *14*, 1261.

 doi:10.20944/preprints202408.0203.v1

73. Singh, A.K.; Kumar, V.P. Establishing the relationship between the strategic factors influencing blockchain technology deployment for achieving SDG and ESG objectives during infrastructure development: an ISM-MICMAC approach. *Smart Sustain. Built Environ.* **2024**, *13*, 711-736.
74. Halder, A.; Batra, S. Navigating the Ethical Discourse in Construction: A State-of-the-Art Review of Relevant Literature. *Journal of Construction Engineering and Management* **2024**, *150*, 03124001.