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Analytical Study of Trends in Measuring Sustainability Performance and Indexes

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ABSTRACT

Sustainability was a crucial underpinning for addressing and mitigating the impacts of climate change. It was not only considered a moral responsibility but also a key element in building a sustainable future. The measurement of sustainability index and performance played a very important role in various sectors because it provided an objective basis for evaluating the economic, social, and environmental impacts of a company or organization's activities. Various sectors needed to play a key role through the implementation of integrated sustainability activities, including efforts to reduce pollution, utilize resources efficiently, increase engagement with communities as stakeholders, and ensure sustainable economic progress. This study aimed to explore and analyze the trend of measuring sustainability index and performance that were developing from various relevant literature through a systematic literature review. The method used in this study was a systematic literature review by adopting the PRISMA-P stages. The PICOS Framework was used in compiling inclusion and exclusion criteria. The PRISMA-P 2020 protocol was employed in the screening process, and VOSviewer was used in the bibliometric analysis. Based on the analysis, it was concluded that research related to sustainability in the higher education and construction project sectors was important to explore further. The most popular method used was the mixed method, while observation and questionnaires were the most widely used data collection methods.

Keywords: *sustainability, index measurement, performance measurement, systematic literature review.*

Introduction

Climate change has become a major challenge of this century, requiring an integrated global response from various sectors and stakeholders including business, government, and society. In this context, sustainability becomes a critical foundation for addressing and reducing the impacts of climate change. Sustainability is not only a moral responsibility, but also a key element in building a sustainable future. Measuring sustainability indexes and performance becomes an important instrument in understanding the extent to which a system, be it an organization, region, or country, has contributed to efforts to mitigate climate change and adapt to its impacts.

Sustainability index and performance measurement has a very big role in various sectors because it provides an objective basis for evaluating the economic, social and environmental impacts of company or organization activities. In the government sector, measurement of sustainability performance helps identify best practices and ensures that implemented policies and programs provide sustainable added value to society [1]. In the industrial sector, such measurement was a major and important challenge for making sustainable policy and business decisions, thus creating a positive impact on the environment and society [2] In recent years, sustainability has also become a very important study and was widely discussed by researchers [3]. In the context of sustainable supply chains, performance measurement also plays a crucial role in driving technology adoption and managing environmental impacts, supporting the integration of environmentally friendly business practices [4]. Thus, measurement of sustainability index and performance becomes an essential instrument to direct various sectors towards more sustainable practices.

Sustainability was measured using three perspectives called the triple bottom line, namely economic benefits, environmental impact reduction, and social welfare [5]. Therefore, various sectors must play a key role through the implementation of integrated sustainability activities, including efforts to reduce pollution, utilize resources efficiently, increase engagement with communities as stakeholders, and ensure sustainable economic progress. Assessing and evaluating sustainability performance was fundamental to achieving effective sustainable performance management. Accurately tracking economic, environmental, and social outcomes served as an essential step in identifying areas for improvement, pinpointing their origins, and determining the best ways to address them [6].

A critical aspect in measuring sustainability index and performance was the development of sustainability performance indicators. These serve as essential elements for organizations to evaluate their progress towards sustainability goals. The indicators used must be tailored to the specific contexts of different industries and organizational sizes, as evidenced by studies highlighting the challenges faced by small and medium enterprises (SMEs) in adopting effective sustainability [7]. To integrate multiple indicators into a cohesive assessment tool, frameworks and methods were needed. Frameworks and methods serve as important tools in this endeavor, providing a structured approach to assessing sustainability across multiple dimensions, including economic, environmental, and social factors. For example, propose a conceptual framework that combines the three pillars of sustainability (economic, environmental, and social) into a single index, enabling organizations to effectively evaluate their overall sustainability performance [8]. The involvement of various sectors, both private sector, government, and community in sustainability efforts places an important role on the availability of accurate and relevant data. Therefore, this study will also explore the challenges and opportunities in data collection for measuring sustainability indices and performance. How data can be accessed, managed, and analyzed efficiently is a crucial question that needs to be answered to improve the accuracy and precision of measurement results.

In this context, this research aims to explore and analyze the trend of measuring sustainability index and performance that were developing from various relevant literature. Furthermore, various variables and indicators, frameworks and methods as well as the dynamics of data collection for measuring sustainability index and performance that are currently used from various relevant literature will be explore and analyze too. A deep understanding of these methods is expected to help stakeholders in designing and implementing more effective sustainability strategies. Thus, this study answers the following questions:

RQ1: How are the trends in sustainability performance and index measurement?
RQ2: What is the most methodologies used for measuring sustainability indexes and performance?
RQ3: What is the most variables used in measuring sustainability indexes and performance?

Research Methods

This literature review uses the Systematic Literature Review (SLR) method. Focusing on specific research questions allowed the SLR to systematically identify, select, and critically appraise the relevant body of research [9]. In this literature review, a systematic literature review was conducted on Scopus-indexed academic articles published in the period 2019 to 2023. The stages of this literature review adopt the PRISMA-P stages carried out by [10]. Table 1 provided a summary of these stages

Table 1. PRISMA-P Stage

Stage	Name	Description
Stage-1	Identification	Searching and collecting articles with certain keywords and time limits
Stage-2	Selection	Reviewing the relationship between the title of the article obtained and the research subtopic
Stage-3	Validation	Checking the depth of the article content and its relationship to the research discussion subtopics
Stage-4	Synthesis	Integration and analysis of data or findings from validated articles descriptively or quantitatively in the form of meta-analysis

Data was taken from the Scopus database. Scopus is the most popular source of scientific articles among researchers and is considered a comprehensive data source that can guarantee reliability and validity. Data collection was carried out in December 2023 and was limited to the last 5 years from 2019 to 2023 to ensure the freshness of the literature. Literature search was conducted through the

ScienceDirect platform. The articles taken were articles written in English and were research articles, excluding conference papers and book chapters. The search used three combinations of keywords using Boolean operators and phrase search strategy. Keywords and search results are presented in Table 2 below:

Table 2. Keywords combination

No.	Name	ScienceDirect
1	"Sustainability Index" AND Assessments	5
2	"Sustainability Performance" AND Assessments	23
3	("Sustainability Index" OR "Sustainability Performance") AND measurement	5
4	"Sustainability Index" AND Assessments	33

After the articles are collected with the defined keywords, the next step in the data filtering process is carried out by following the PRISMA 2020 Protocol. The use of PRISMA-P 2020 has the potential to provide significant benefits to various stakeholders. Through comprehensive reporting, readers can evaluate the accuracy of the method, so that the findings produced can be relied on [11]. Before carrying out further selection, the Inclusion and Exclusion criteria were first prepared based on the PICOS framework (Population, Intervention, Comparison, Outcomes and Study) as presented in Table 3.

Table 3. PICOS Framework

Criteria	Inclusion	Exclusion
Population	Sustainability	Other
Intervention	Sustainability index measurement	Not mentioned
Comparison	Sustainability performance measurement	Not mentioned
Outcomes	Sustainability index measurement Indicators Sustainability index measurement Method Sustainability index measurement data collection	No primary outcome measured
Study	Publish 2019 to 2023 Peer review journal Written in English	Publish before 2019 Other Not Written in English

Figure 1. PRISMA-P Diagram

The next PRISMA-P process was carried out online through the app.covidence.org platform. This process includes literature filters to the extraction process. After collecting 33 articles from sources

as presented in Table 2, a filtering of duplicate articles was carried out with the result that no duplicate articles were detected. Thus, 33 articles will enter the title and abstract screening stage. This title and abstract screening taken into account the suitability of the title and abstract with the focus of the study. In this screening, 13 articles were not appropriate and had to be removed, leaving 20 articles that were considered to meet the criteria for a full text review. A full text review was carried out by reading the text thoroughly and in depth by paying attention to the inclusion and exclusion criteria that have been previously designed as presented in table 4. The full text review provides 5 articles that must be eliminated for various reasons based on the exclusion criteria as presented in Figure 1. Finally, 15 articles meet the criteria related to measuring the sustainability index and performance. The PRISMA-P process diagram is presented in Figure 1.

Results and Discussion

Data analysis was carried out in the form of bibliometric analysis of 15 final articles using the help of VOSviewer version 1.6.20 software. Bibliometric analysis served as a scientific method employing quantitative techniques to analyze and assess the production of scientific literature within a specific field or topic, aiming to discern trends, patterns, and the impact of scientific publications. To identify relationships between articles through keywords, a Co-Occurrence analysis was conducted [12]. Furthermore, an analysis of the profile and analysis of the indicators used was also carried out with reference to 3 main aspects or indicators of sustainability, such as environment, society and economy. Bibliometric analysis with VOSviewer version 1.6.20 produced three important maps, namely Network Visualization, Overlay Visualization and Density Visualization as shown in figures 2, 3, and 4.

Figure 2 presents a network visualization map and describes the existence of 4 clusters consisting of red cluster, green cluster, blue cluster, and yellow cluster. The red cluster includes studies on sustainability KPI analysis in the higher education sector, the green cluster focuses on studies on sustainability indicators in the construction project sector, the blue cluster focuses on research on the development of sustainability measurement models and the yellow cluster focuses on the sustainability performance measurement framework in companies. In-depth analysis shows that the broad framework was research in the field of sustainability related to sustainability performance measurement and indicators that influence it in various sectors.

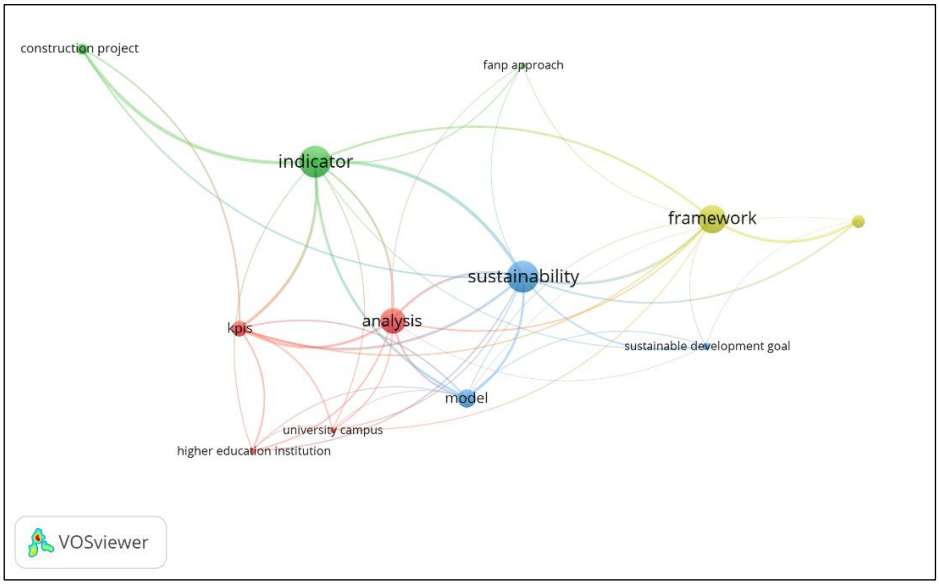

Figure 2. VOSviewer Network Visualization

Figure 3 represents the development of research topic trends based on keywords from 2019 to 2023 based on colors from the lightest to the darkest. The bright yellow color describes that the research topic is the newest. Based on Figure 3, it can be seen that sustainability studies in higher education are the newest topic and need to be explored further in the future. The next topic that is still new and needs to be explored further is sustainability studies in construction projects.

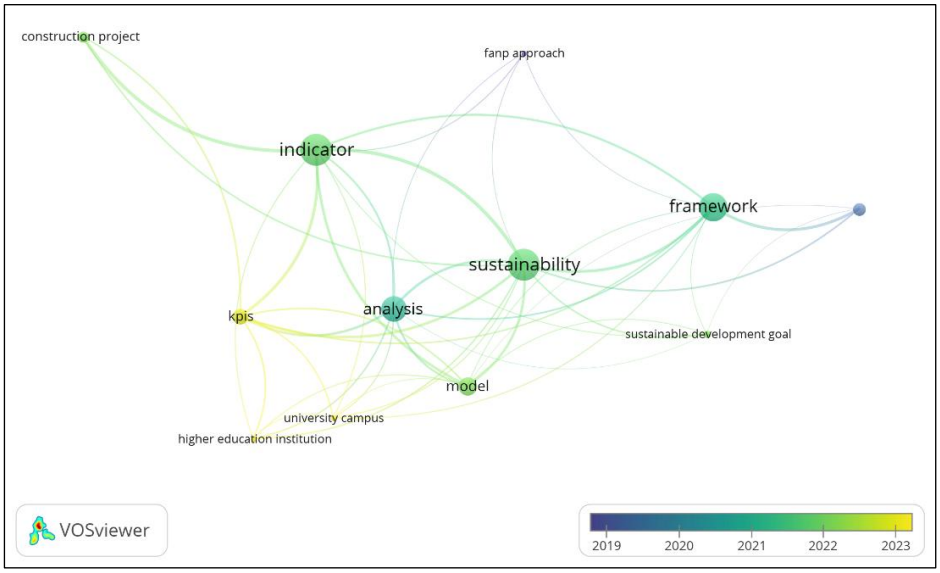

Figure 3. VOSviewer Overlay Visualization

Figure 4 shows the density of research related to the topic. The brighter the color that appears, the more the topic has appeared, and conversely, the darker the color represents that the topic has appeared less. Based on Figure 4, it can be concluded that the topic related to sustainability in higher education and sustainability in construction projects has not been researched enough during the last 5 years and needs to be developed further in the future.

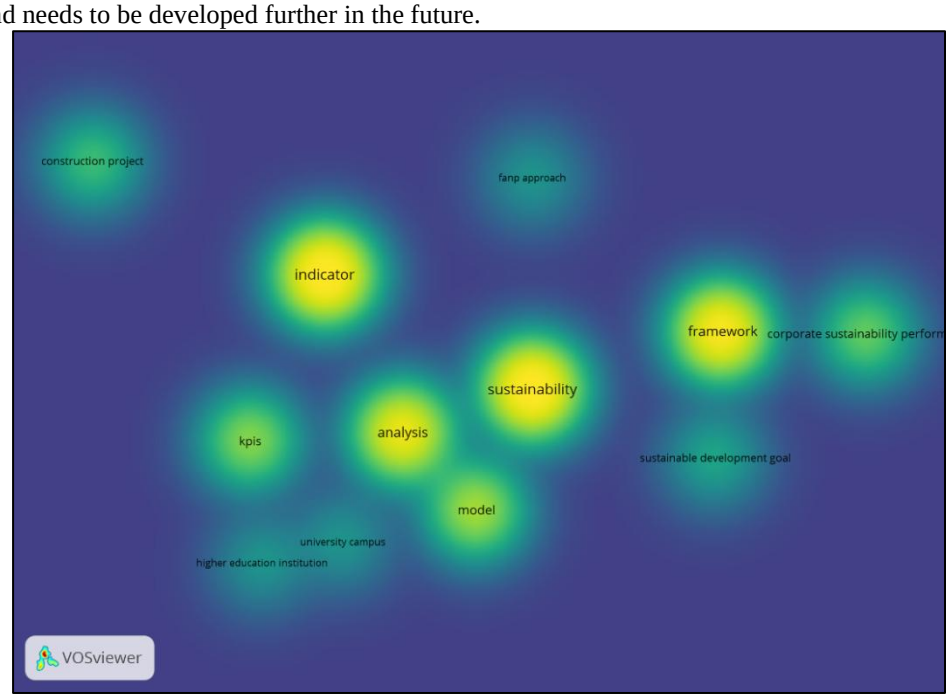

Figure 4. VOSviewer Density Visualization

The trend of research development related to sustainability performance from 2019 to 2023 is presented in Figure 5. In 2019 there were 4 topics, but in 2020 no topics were found that met the requirements. However, in the following year from 2021 to 2023 there was a significant increase. This shows that in the last 3 years the topic has become a concern for researchers. This positive trend is expected to increase further in the future.

Figure 5 also shows that in terms of methodology, mixed methods and quantitative methods are the most widely used and dominant methods in this study. Expert opinion and the Delphi method are the most widely used qualitative methods to identify sustainability indicators. Meanwhile, MCDM, FANP, ANP, AHP, FSE-DEMATEL and Logarithmic Percentage Change-driven Objective Weighting (LOPCOW) are the dominant quantitative methods used to make decisions.

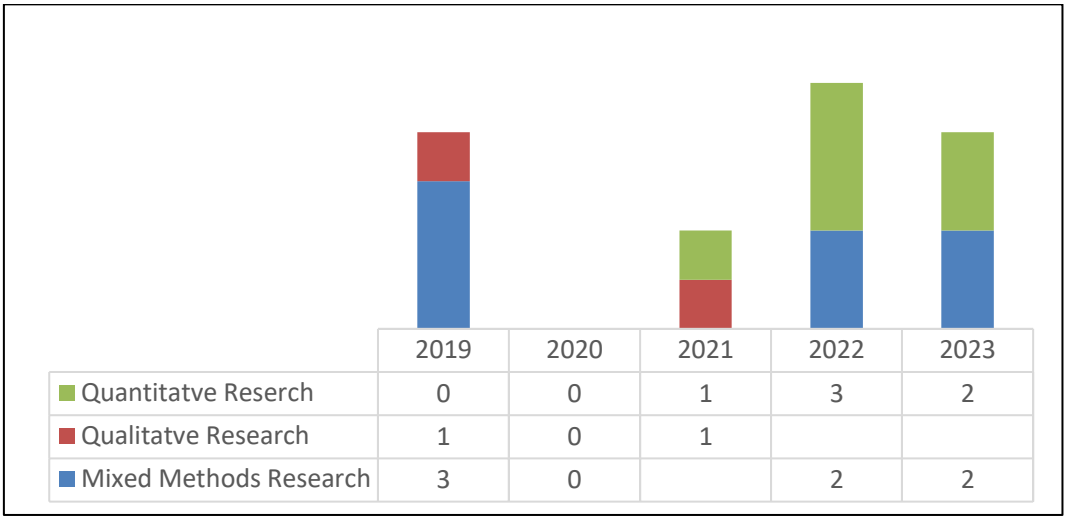

Figure 5. Research trends and methodologies used from 2019-2023

Mapping of indicators used to measure sustainability performance in 15 selected articles against the 3 main pillars of sustainability (environment, society and economy) was presented in Table 4. The data presented in the Table 4 reveals that the majority (60%) of studies conducted between 2019 and 2023 have incorporated the three core pillars of sustainability. However, the remaining 40% of studies fail to fully address all of the essential sustainability criteria. In addition, 3 studies provide additional indicators, namely; [13] added the Healthcare indicator, [14] added consumer perception, operation status, and Impact on power grid indicators, and [15] added an indicator in the form of a combination of society and economy into a socio-economic indicator.

Table 4. Mapping sustainability of indicators

Author, Year	Environment	Society	Economy	Other
Bashir et al., 2023 [16]	☑	☒	☒	☒
Moghayedi & Awuzie, 2023 [17]	☑	☑	☑	☒
Saihi et al., 2023 [18]	☑	☑	☑	☒
Ijadi Maghsoodi et al., 2023 [13]	☑	☑	☑	☑
Zhang et al., 2022 [14]	☑	☒	☑	☑
Shanmugam et al., 2022 [19]	☑	☑	☑	☒
Rajabi et al., 2022 [15]	☑	☒	☒	☑
Ivo de Carvalho et al., 2022 [20]	☑	☑	☑	☒
Ecer & Pamucar, 2022 [21]	☑	☑	☑	☒
Torkayesh et al., 2021 [22]	☒	☑	☒	☒
Ramos et al., 2021 [23]	☑	☑	☑	☒
Raoufi et al., 2019 [24]	☑	☒	☒	☒
Wicher et al., 2019 [6]	☑	☑	☑	☒
Pislaru et al., 2019 [25]	☑	☒	☑	☒
Islam et al., 2019 [5]	☑	☑	☑	☒

Conclusion

In Conclusion, based on the bibliometric analysis, it can be concluded that research related to sustainability in the higher education sector and the construction project sector is still not widely studied in the last 5 years. So that research in this sector is important to be explored further in the future. The most widely used method in sustainability studies in the last 5 years is a mixed method between qualitative and quantitative. The majority (60%) of studies have integrated the three core pillars of sustainability, while the remaining 40% have not fully addressed all essential sustainability criteria.

Based on the results and discussion, Future research direction is to develop a method for measuring sustainability indexes and performance in the higher education sector and the construction project sector by considering the three main pillars of sustainability (environment, society and economy).

In addition, based on a study conducted by [16] which only studied the relationship between indicators in the environmental aspect, a study of the relationship between indicators of the three aspects of sustainability also needs to be studied further.

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