Review of Sustainable Procurement Systems and Applications inVarious Case Studies

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(Received: Nopember 2024, Revised: Februari 2025, Accepied: April 2025)

Abstract—The objective of this research is to explore the determining factors of the sustainable procurement adoption of the public procurement. This strategy could promote facilitate novel knowledge how various elements influence sustainable procurement. This research adopts a systematic literature review strategy to synthesise current bibliographies on sustainable procurement. Findings from synthesis of 33 relevant articles are determinant, role, indicator, conceptual and impact of the sustainable procurement. This research suggests comprising sustainable aspect as a critical element to consider in procurement process beside economic and social aspect. This research contributes to the public procurement literature and the literature on determinants of sustainable procurement.

Keyword: procurement systems, procurement applications, sustainable procurement, systematic literature review.

Intisari—Tujuan dari penelitian ini adalah untuk mengeksplorasi faktor-faktor penentu adopsi pengadaan publik yang berkelanjutan. Strategi ini dapat memfasilitasi pengetahuan baru tentang bagaimana berbagai elemen mempengaruhi pengadaan berkelanjutan. Penelitian ini mengadopsi strategi tinjauan literatur sistematis untuk mensintesis bibliografi terkini mengenai pengadaan berkelanjutan. Temuan dari sintesa 33 artikel terkait adalah determinan, peran, indikator, konseptual dan dampak pengadaan berkelanjutan. Penelitian ini menyarankan untuk memasukkan aspek berkelanjutan sebagai elemen penting untuk dipertimbangkan dalam proses pengadaan selain aspek ekonomi dan sosial. Penelitian ini berkontribusi pada literatur pengadaan publik dan literatur mengenai faktor-faktor penentu pengadaan berkelanjutan.

Kata Kunci: sistem pengadaan, aplikasi pengadaan, pengadaan berkelanjutan, tinjauan literatur sistematis.

I. INTRODUCTION

The concept of sustainability has increasingly become a priority for both public and private sector organizations [1]. Policymakers, with the power to select environmentally friendly products, play a crucial role in promoting sustainable technologies and goods, thus supporting current environmental goals [2], [3]. Public procurement, which constitutes a significant part of GDP, represents about 10% to 15% of the total GDP [4]. By adopting sustainable standards in bids, public procurement can significantly influence the adoption of sustainable technologies and products. Procurement, the process of acquiring products or services through tenders, is critical for public officials [5], [6]. Although many policy documents support, control, and evaluate public procurement, the incorporation of environmental considerations remains voluntary for public officials [7]. Therefore, it is essential to enhance understanding of the factors that influence authorities to adopt sustainable procurement practices [8].

This research investigates the determinants that influence authorities to adopt sustainable procurement practices. The study's main contribution is the development of a model for including sustainable standards in specific procurement bids, which diverges from existing research that often treats individual, company, and political decisions as exogenous factors [4], [9], [10]. These conventional models frequently overlook the sustainable procurement decision-making process and the varying effects of implementing sustainable procurement strategies and incorporating green standards in specific bids. Literature suggests that individual impacts on sustainable procurement practices in public offices are crucial [4], [9]. Public servants' decisions are influenced by organizational characteristics, such as centralization and resources, and political aspects, such as political party directives. The proposed model aims to provide a general framework for future studies on sustainable procurement practices in public organizations, aiding the construction of sustainable procurement adoption practices and organizational scope. Additionally, the scope of organizations is significantly correlated with the tendency to use sustainable procurement practices, as larger organizations may benefit from economies of scale but face challenges in integrating sustainability criteria

P-ISSN 1858-2680
E-ISSN 2723-4673

due to organizational complexities [11], [12]. Sustainable procurement practices are vital for promoting technologies that address environmental considerations, particularly in sectors like transportation, which accounts for about 25% of global greenhouse gas emissions [13]. This study aims to identify and analyze the key determinants that influence the adoption and implementation of sustainable procurement practices in both public and private sectors. By developing a robust classification system for sustainable procurement research, this study facilitating a deeper understanding of the factors driving sustainable procurement and providing a framework for future studies in this field.

II. LITERATURE REVIEW

A. Procurement

Procurement is the process of acquiring supplies, particularly for governments or organizations [14]. It also encompasses a series of structured processes designed to streamline an organization's procurement activities to achieve desired outcomes, save costs, reduce time, and foster mutually beneficial supplier relationships Public procurement closely mirrors private sector procurement, involving the complete process of acquiring goods, services, and hiring civil servants. Patrucco et al. (2017) described public procurement as the acquisition of goods and services by governments and state-owned enterprises (SOEs), highlighting its significant role in the overall demand for goods and services [15]. Thus, procurement can be understood as the process of obtaining goods, services, or works from external sources, applicable to both public and private sectors. Additionally, procurement is a strategic function aimed at acquiring necessary goods or services at the best value to meet the organization's needs.

B. Sustainable Procurement

As environmental issues have gained prominence, the term "sustainable procurement" has become more common in academic literature [9]. Green procurement involves considering environmental aspects in purchasing decisions, such as buying eco-friendly products and services and promoting the production of environmentally friendly products [16]. It represents the initial stage of a sustainable supply chain, focusing on green suppliers and the environmental performance of projects [17]. According to Cheng et al. (2018), green procurement is a crucial part of supply chain management, emphasizing the product life cycle and promoting environmentally friendly practices [17]. It is essential in public sector sustainability initiatives, involving the purchase of eco-friendly products and services by public organizations [18]. Green procurement involves deliberate purchases considering the environmental impact throughout a product's life cycle, aligning with environmental goals and corporate or governmental social responsibility.

There is a growing body of literature on sustainable procurement practices, analyzing their implementation, commitment, and policy effectiveness [9]. Recent studies have used quantitative strategies to assess the environmental and financial impacts of these practices, particularly in the building sector, influenced by private organization mandates [19]. Other research has expanded on sustainable procurement strategies within various goals and overlapping policy strategies, contributing to the understanding of these practices [20]. Understanding the determinants of sustainable procurement adoption can improve environmental outcomes and provide insights into policy challenges. Previous research has highlighted the influence of individual, organizational, and political characteristics on sustainable procurement practices, noting that individual incentives play a significant role in their acceptance in public organizations [4]. Public officials should follow procedures that promote transparency and enhance proposal evaluations [4], [5]. However, budget limitations and cost-effectiveness often take precedence over sustainable criteria, impacting procurement decisions [5], [22].

C. Criteria and Standards for Sustainable Procurement

The European Commission (2023) recommends adopting the "green deal" approach to implement environmentally conscious procurement, suggesting that technical specifications in procurement documents should be based on technical standards with environmental

P-ISSN 1858-2680
E-ISSN 2723-4673

considerations or ecolabel criteria [32]. Ecolabels, which can appear on products, packaging, and in promotional materials, are designed to control negative environmental impacts throughout a product's lifecycle while promoting environmentally friendly products and services. In sustainability-focused projects, fulfilling contract requirements is crucial, particularly when an authority assesses the project's environmental feasibility, requiring compliance with environmental requirements, appropriate materials, and detailed documentation [33].

In Indonesia, the Minister of Environment and Forestry issued Regulation No. 5 of 2019 on Eco-Friendly Labels for Goods and Services Procurement, marking the country's first law governing sustainable public procurement [34]. This regulation covers various products, encouraging the procurement of environmentally friendly goods and services across multiple government sectors [35]. Despite a comprehensive regulatory framework, implementation remains limited, with few sustainable public procurement policies in some provinces [36]. Almost all OECD member countries have developed strategies to support sustainable public procurement. For instance, Canada's policy mandates environmental considerations in procurement decisions and requires monitoring and reporting on green procurement performance [38]. In the United States, the General Services Administration (GSA) consolidates information from federal environmental programs to assist federal agencies in purchasing environmentally friendly products and services, while the Department of Defense (DoD) aims for 100% compliance with mandatory federal affirmative procurement programs [17].

III. METHODOLOGY

The primary purpose of this study is to identify research gaps related to sustainable standards in procurement and their antecedents, focusing on "sustainable procurement practices" and the "public sector." A systematic review, based on PRISMA methods, was employed to understand, assess, and create an overall linked outcome of publications on these themes [39]. This approach involves counting, classifying, and determining the inclusion of relevant publications to ensure a comprehensive literature research background for the study.

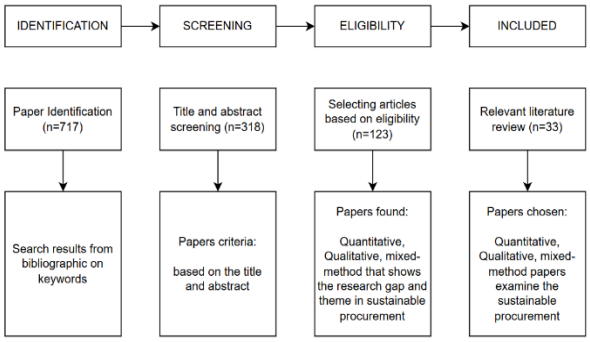

Figure 1. PRISMA Graph

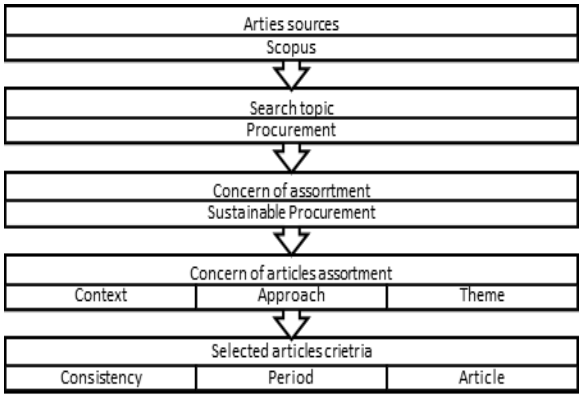

Figure 2. Logical choices direction of analysed documents

This study focused on "sustainable procurement" and its determinants, emphasizing the necessity of analyzing research articles to explore gaps beyond the selected issues. It includes documents related to the application of sustainable procurement in various fields to ensure a robust analysis. Articles were selected from Scopus, a comprehensive database, and were organized to address the research's main topics, such as "advanced and developing nations," consequences, and methodologies used [40]. The analysis involved categorizing each article based on its context, purpose, and conclusions, requiring validation from professionals to ensure accuracy [41], [42]. This method provides a comprehensive examination of sustainable procurement, narrowing the scope to focus on its pressing issues and research gaps. The categorization of articles from diverse publishers and contexts ensures a well-defined research scope and emphasizes the need for a robust article classification system [43].

P-ISSN 1858-2680
E-ISSN 2723-4673

IV. RESULTS

The search results from Scopus Preview identified 33 articles that genuinely discuss sustainable procurement, as shown in Table 1. Some research articles were excluded because the keywords used did not align with the scope or context of the research topic.

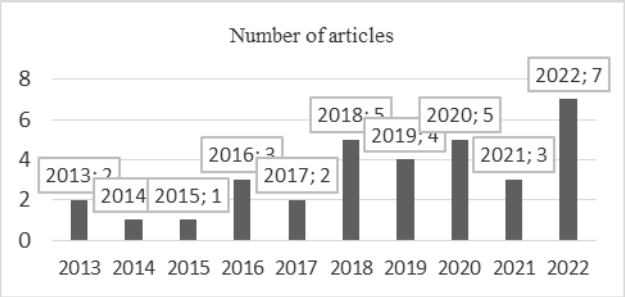

Figure 3. Number of Selected Articles Yearly Based

Based on the yearly selection of articles shown in Figure 2, the research articles relevant to the context of sustainable procurement will be discussed in groups in the results chapter. The selected years primarily include 2018, 2019, 2020, and 2022.

A. Criteria and Standards for Sustainable Procurement

In the classification of research articles, various contexts of sustainable procurement are examined, divided into twelve categories as shown in Table 1. The majority of the articles (40%) discuss procurement in a general context, followed by construction (18%), education (3%), and transportation (3%). This classification also considers the type of products being tendered, such as goods or services, indicating that procurement practices can vary significantly between different contexts like construction, education, and transportation. Notably, discussions on electricity and energy, both renewable and non-renewable, are quite limited despite their critical importance. Additionally, there is a need for more discourse on sustainable procurement related to food and water, as these areas are currently underrepresented in the literature.

Table 1. Articles Classification based on the Context

Context	Amount	Percentage
General	13	40
Construction	6	18
Education	3	9
Transportation	3	9
Cleaning service and equipment	1	3
Clothing	1	3
Electricity	1	3
Energy	1	3
Foods	1	3
Healthcare	1	3
Logistic service	1	3
Water environment treatment	1	3
Total	33	100

Moreover, mostly research article's locations are on the Global context (11%), China (10%), Netherland (10%), Norway (6%), German (6%), Iran (6%), and 51% on the other locations. Table 2 shows that the research of the sustainable procurement has already spread from not only on the Netherland as a West country but also to the other continents, such as China and Singapore, Pakistan, Malaysia and Iran in Asia.

Table 2. Articles based on the location

Locations	Amount	Percentage
Global	4	11
China	3	10
Netherland	3	10
Norway	2	6
German	2	6
Iran	2	6
Sweden	1	3
Australia	1	3
Austria	1	3
Belgium	1	3
Brazil	1	3
Denmark	1	3
EU	1	3
Finland	1	3
Italy	1	3
Latin America	1	3
Malaysia	1	3
Nigeria	1	3
Pakistan	1	3
Singapore	1	3
Spain	1	3
Sweden	1	3
USA	1	3
Total	33	100

B. Classification of the Articles Based on the Research Approach

More than 50% previous research has been conducted with quantitative strategy with 18 articles. While 39% of

P-ISSN 1858-2680
E-ISSN 2723-4673

the articles analysed by qualitative approach (e.g case study, conceptual, and grounded theory). Last, mixed-method research strategy research just used in two articles or about 6% or the total article as shown in Table 3.

Most qualitative research are conducted with case study approach and conceptual articles. Regarding the research approach, the future research will be interesting to validate the concept proposed by previous case study and conceptual articles. The case study articles were conducted mostly in education sector. Besides there are also research of clothing, food and energy. While conceptual research proposes environmental, social and economic [43], [44] and circular economy variable [45] as the determinant variables of sustainable procurement. Only an article was conducted by text analysis, grounded theory and SLR approach per each strategy. Future research would be needed to enrich more on the sustainable procurement topic area with SLR, grounded theory and text analysis strategy.

Table 3. Reviewed Articles

Author	Country	Context	Issue	Determinant	Research Method	Parameter
[48]	Finland	Education	To analyse the functioning of a successful sustainable procurement programme	Organizational: strategic management and top-level commitment	Qualitative-case study	Strategic manage-ment; resources; key personnel
[49]	Norway	Transport-ation	To analyse implementation of sustainable public procurement of freight transportation	Political: political decision and strategies Economic: financial benefits Environmental: pro environmental	Mixed method	Product; cost; vendor capacity; working capital
[44]	German	Cleaning service and equipment	To explore the progress of ecological sustainability procurement implement-ation	Environmental: pro environmental	Qualitative-conceptual	Environ-ment; Cost; Supplier selection
[47]	Norway	Transport-ation	To explore the effect of sustainable public procurement of electric car based on the various stakeholders' perspectives	Individual: senior manager support Organizational: financial benefits Political : political signal Other: infrastructures	Qualitative-grounded theory	Product; cost; vendor capacity; working capital; stakeholders; environ-ment; socio-culture
[50]	China	Construct-ion	To explore the drivers, the challenge and the impact of the adoption of sustainable procurement	Individual: awareness and technical capacity Organizational: economic benefits and competitive pressure Political: regulation and legislation Other: environmental reasons	Quantita-tive survey	Product; cost; vendor capacity; working capital; environ-ment; socio-economy; government
[51]	Nigeria	Construct-ion	To analyse the barriers to implement sustainable procurement	Organizational: economic benefits and competitive pressure, knowledge	Quantita-tive survey	Product; cost; vendor capacity; working capital; regulatory; fiscal incentives
[52]	Pakistan	Education	To analyse the drivers and deterrent of sustainable procurements	Individual: growth mindset Organizational: interdepartmental corporation Political: government regulation	Qualitative-case study	Organiza-tional cooperation; government; environ-ment
[56]	Denmark	Transport-ation	To examine the sustainable procurement drivers in an lengthy multi-tier	Individual: personal value Organizational: top management support Political: government	Quantita-tive survey	Cost; vendor capacity; environ-ment; socio-economy;

P-ISSN 1858-2680
E-ISSN 2723-4673

Author	Country	Context	Issue	Determinant	Research Method	Parameter
			environment	regulation and legislation		government; regulation
[53]	China	Water environ-ment treatment	To know the role of sustainable supplier to the sustainable procurement	Environmental: pro environmental supplier, Capability: suppliers' sustainable financial capabilities, suppliers' sustainable technology capabilities	Quantita-tive survey	Cost; vendor capacity; working capital; suppliers; finance; technology
[57]	Netherland	Clothing	To explore intermedia-tion role on circular economic through sustainable procurement	Consultation activities on procurement	Qualitative-case study	Product; cost; vendor capacity; public demand; government
[58]	EU	Construct-ion	To examine the sustainable procurement indicator and the sustainable criteria in the construction sector	Environmental: pro environmental supplier, minimum energy and material performance, recycled material usage, waste management, minimum pollution Social: safety of workers Economic: management system	Qualitative-conceptual	Product; cost; vendor capacity; environ-ment; regulation; environ-ment; training
[54]	Belgian	General	To analyse the barrier of sustainable public procurement implementa-tion	Environmental: pro environmental Social: social return and local/SME oriented Ethic: ethical trade Circular economy Capability: Innovation capability	Qualitative-text analysis	Product; cost; environment; trends; regional differences
[45]	Iran	Electricity	To examine the sustainable supplier on the sustainable procurement adoption	Environmental: Pro environmental supplier Economic: cost (financial benefit) Social: job creation Circular: eco-friendly and recyclable material	Qualitative-conceptual	Cost; vendor capacity; suppliers; socio-economy; environ-ment
[55]	Global	General	To examine the impact of pressure on the sustainable procurement adoption	Pressure: government's and citizens' pressure	Quantita-tive survey	Product; organizations; citizen attitude; economy
[26]	Global	General	To explore the determinant of sustainable public procurement .	Individual: personal behaviour Organizational: organizational size, top management strategy, and policy Competency: operational tool	Qualitative-SLR	Cost; vendor capacity; organization; economy; manage-ment
[59]	Brazil	Construct-ion	To explore barrier of the sustainable procurement adoption	Individual: employee perception Organizational: long-term planning, sustainable organizational culture, top management support Knowledge and training: knowledge and training of sustainable procurement Political: government regulation	Quantita-tive survey	Product; cost; organization
[60]	Iran	General	To explore the role economic and environment-al variable in sustainable	Economic: cost Environmental: pro environmental supplier	Mixed-method	Cost; vendor capacity; economy; environ-ment

P-ISSN 1858-2680
E-ISSN 2723-4673

Author	Country	Context	Issue	Determinant	Research Method	Parameter
			procurement implementation			
[61]	Netherland	General	To explore the role of ability, motivation and opportunity in sustainable procurement implementation	Individual: commitment Capability: knowledge and skills Organizational: organizational learning capacity	Quantita-tive-survey	Product; vendor capacity; individual
[62]	Global	General	To explore the determinant of sustainable public procurement	Economic: cost Social: employee's safety and health Environmental: efficiency and pollution reduction	Quantita-tive-survey	Product; cost; vendor capacity; supplier; socio-economy; environ-ment
[63]	Singapore	General	To construct a conceptual to implement public procurement environment-ally oriented	Organizational: energy-efficiency strategy Environmental: environmental standards	Quantita-tive survey	Product; vendor capacity; environ-ment; organization
[64]	Latin America	General	To explore the sustainable public procurement	Individual: employee awareness Organisational: top management support and economic benefit, supplier, resources Pressure: pressure	Quantita-tive-survey	Product; cost; organization; economy; environ-ment
[65]	Global	General	To develop sustainable procurement purchases model	Environmental: Suppliers' sustainable criteria	Qualitative-conceptual	Product; vendor capacity; environ-ment; supplier; organization
[66]	Norway	Energy	To explore the effect of formal governance and policy requirement in the sustainable public procurement	Political: formal governance and policy requirement	Qualitative-case study	Product; vendor capacity; regulation; government; environ-ment; supplier; organization
[46]	Iran	Construct-ion	To construct a conceptual to implement public procurement	Economic: cost Social: job creation and worker safety Environmental: efficiency of material, pollution, green technology	Quantita-tive survey	Product; cost; vendor capacity; organization; environ-ment
[20]	Australia	Healthcare	To explore the challenges of implementing sustainable public procurement	Organizational: energy-efficiency strategy Political: government regulation and legislation Environmental issue Public pressure issues	Quantita-tive-survey	Product; cost; vendor capacity; organization; government; NGO
[67]	USA	General	To examine the role of leadership style of top leader to sustainable procurement adoption	Organizational: top leaders' leadership style	Quantita-tive survey	Organiza-tion
[12]	Netherland	General	To explore the role on behaviour toward implementing sustainable procurement	Individual: behaviour to adopt sustainable procurement	Quantita-tive-survey	Product; organization; government
[68]	Spain	Education	To explore the determinants of implementing sustainable public procurement	Organizational: having the Public Procurement Manual and environmental department Social: pro environmental; organise awareness and media campaigns	Qualitative-case study	Product; environ-ment; university; promoters; regulation

P-ISSN 1858-2680
E-ISSN 2723-4673

Author	Country	Context	Issue	Determinant	Research Method	Parameter
[27]	Sweden, Italy, Denmark, Austria	Foods	To explore the determinant of sustainable procurement implementa-tion	Political: government regulation and legislation Environmental issue Social issues	Qualitative-case study	Product; cost; vendor capacity; environ-ment; government; regulation; culture; economy
[69]	Sweden	Construct-ion	To explore the role on dialogue procedure implementing sustainable procurement	Discussion between authority and contractors	Quantita-tive-survey	Product; vendor capacity; environ-ment; organization
[70]	Malaysia	General	To explore the determinant of sustainable procurement	Individual: awareness to adopt sustainable procurement Social: working conditions labour standard, health & safety Environment: pro environmental Politic: political support	Quantita-tive survey	Product; organization; environ-ment
[71]	German	Logistic service	To explore the effect of sustainable procurement aspect on logistic service	Environmental: ecology Social aspect	Quantitative survey	Product; vendor capacity; environment; organization
[72]	China	General	To examine the adoption of sustainable procurement issue	Organizational: economic motives Political: regulations Public pressure issues	Quantitative survey	Product; regulation; stakeholders; organization

C. Classification of the Articles Based on the Process

Sustainable procurement could be analysed based on the determinant, role, indicator, conceptual and impact of the sustainable procurement. The determinants are economic and environmental; ability, motivation and opportunity; formal governance and policy requirement; leadership style of top leader; behaviour; sustainable supplier; pressure, regulations, rewards & incentive gains, and stakeholders exert pressure to motivate adoption of GPP practices, and dialogue procedure. The role of sustainable procurement is legitimising sustainable public procurement development work, constructing sustainable public procurement development work, facilitating expert support and facilitating peer support. The indicators of sustainable procurement are LEED, BREEM, CASBEE and SBTool [45]. The conceptual to implement sustainable procurements are a scenario-based bi-objective two-stage mixed possibilistic-stochastic programming model [46]. The impact of sustainable procurements is on the innovation, environmental, economic, and social impacts [47] as shown in Table 1. This research then proposes environmental elements integrating with economic and social element as criteria of procurement.

V. DISCUSSION

The review of sustainable procurement systems and applications across various case studies provides insights into how different countries and sectors are integrating environmental considerations into their procurement processes. The primary goal of this research is to identify the factors that determine the adoption of sustainable procurement in public procurement, aiming to provide a comprehensive understanding of how various elements influence these practices. The result, as shown in Table 4, showed a comprehensive review of sustainable procurement systems and the applications across multiple case studies globally. The articles explore various determinants influencing sustainable procurement adoption, such as organizational, political, economic, and environmental factors.

Berg et al. (2022) in Finland and Karlsson et al. (2022) in Norway demonstrate the importance of strategic management, political decisions, and environmental strategies in sectors like education and transportation [48], [49]. Similarly, Kozuch et al. (2022) in Germany and Langseth & Moe (2022) in Norway emphasize the role of environmental considerations and stakeholder perspectives in sectors such as cleaning services and

P-ISSN 1858-2680
E-ISSN 2723-4673

electric car procurement [47], [44]. These studies underscore the need for top-level commitment and strategic management to drive successful sustainable procurement programs. In construction, research by Opoku et al. (2022) in China and Oyewobi & Jimoh (2022) in Nigeria highlights the drivers, challenges, and barriers to sustainable procurement adoption, focusing on factors like individual awareness, economic benefits, and regulatory frameworks [50], [51]. Further, studies in various countries such as Pakistan (Shaikh & Channa, 2022), Denmark (Kannan, 2021), and China (Li et al., 2021) examine the influence of interdepartmental cooperation, personal values, and sustainable supplier capabilities in sectors like education, transportation, and water environment treatment [52], [53]. These findings suggest a need for comprehensive approaches that integrate economic, environmental, and social criteria in procurement processes.

Additionally, research by Grandia & Kruyen (2020) in Belgium and Raj et al. (2020) globally emphasize the impact of social, ethical trade, and circular economy aspects on sustainable procurement [54], [55]. Studies by Kannan et al. (2021) in Iran and Sönnichsen & Clement (2020) globally explore the roles of government pressure, organizational size, and top management strategies [26], [45]. The synthesis of these studies indicates that sustainable procurement requires a holistic approach, combining strategic management, regulatory support, and stakeholder engagement to address economic, social, and environmental criteria effectively. This multifaceted approach is crucial for promoting sustainable practices in public procurement and achieving long-term sustainability goals. The result would help authority be objectively on procurement process and decision-making process as those three comprehensive criteria.

VI. CONCLUSION

The review of sustainable procurement systems across various case studies underscores the critical role of sustainable procurement in promoting environmental, economic, and social sustainability globally. Successful implementation hinges on a comprehensive approach integrating strategic management, political commitment, and stakeholder engagement. Key factors influencing adoption include individual awareness, organizational support, regulatory frameworks, and economic incentives. The research spans diverse sectors such as education, transportation, cleaning services, healthcare, and logistics, highlighting the benefits of tailored strategies that consider sector-specific criteria. Prioritizing eco-friendly suppliers, reducing waste, and incorporating life-cycle cost analysis can lead to significant cost savings and enhanced reputations for organizations. Overall, the synthesis of 33 studies emphasizes the need for a holistic approach that balances economic, environmental, and social considerations, aiding public authorities and organizations in making informed, objective decisions and fostering innovation and resilience in procurement processes, thereby supporting global sustainability efforts.

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E-ISSN 2723-4673