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A conceptual procurement model for sustainability and climate change mitigation in the oil, gas, and energy sectors

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Abstract

This paper proposes a comprehensive conceptual procurement model to enhance sustainability and mitigate climate change impacts within the oil, gas, and energy sectors. The model integrates principles of green procurement, lifecycle analysis, and circular economy to ensure environmentally responsible sourcing and resource utilization. By addressing the significant environmental footprint of these industries, the model aims to provide a structured framework that organizations can adopt to minimize their carbon footprint, promote sustainable practices, and contribute to global climate change goals. Key components include sustainable procurement processes, environmental impact assessment frameworks, supplier sustainability criteria, and resource optimization strategies. Case studies demonstrate the model's applicability in the oil sector and renewable energy projects, highlighting challenges, outcomes, and innovative approaches. The paper concludes with recommendations for future research to refine and validate the model, ensuring its effectiveness and scalability across diverse organizational contexts.

Keywords: Sustainable procurement; Climate change mitigation; Oil and gas industry; Energy sector; Conceptual model; Lifecycle analysis; Circular economy; Environmental impact assessment

1. Introduction

The oil, gas, and energy sectors are pivotal to the global economy, powering industries, homes, and transportation systems worldwide. However, these sectors also contribute to environmental degradation and climate change. According to the International Energy Agency (IEA), the energy sector is responsible for a significant amount of global carbon dioxide (CO2) emissions. Oil and gas production accounts for a significant share of these emissions (Voumik, Ridwan, Rahman, & Raihan, 2023). The extraction, processing, and combustion of fossil fuels release large quantities of greenhouse gases (GHGs), such as CO2 and methane, contributing to global warming and climate change. Moreover, these activities often lead to environmental issues such as oil spills, water contamination, and habitat destruction, further exacerbating ecological damage (Fetisov, Gonopolsky, Davardoost, Ghanbari, & Mohammadi, 2023; Nunes, 2023).

Historically, the oil, gas, and energy sectors have focused on maximizing production and profitability, often at the expense of environmental considerations. However, with the increasing recognition of climate change as an existential threat, there has been a growing push for these industries to adopt more sustainable practices (Raimi & Lukman, 2023).

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Governments, international organizations, and civil society are calling for urgent action to reduce GHG emissions and mitigate environmental impacts. In response, many companies within these sectors are beginning to explore ways to integrate sustainability into their operations. This includes adopting renewable energy sources, improving energy efficiency, and implementing carbon capture and storage technologies.

One critical area where sustainability can be significantly enhanced is procurement. Procurement in the oil, gas, and energy sectors involves the acquisition of goods, services, and works necessary for the exploration, production, and distribution of energy (Amiri Ara, Paardenkooper, & van Duin, 2022; Nwankwo & Iyeke, 2022). This process has traditionally prioritized cost, quality, and timely delivery. However, given the sectors' substantial environmental footprint, there is an urgent need to rethink procurement strategies to incorporate sustainability principles. Sustainable procurement involves considering the environmental and social impacts of purchasing decisions alongside traditional criteria, promoting resource efficiency, reducing waste, and minimizing GHG emissions throughout the supply chain.

1.1. Problem Statement

Despite the growing awareness of the need for sustainable practices, many organizations in the oil, gas, and energy sectors lack a structured model that comprehensively integrates sustainability into their procurement processes. The absence of such a model is a significant barrier to achieving meaningful environmental improvements. Current procurement practices often fail to account for the full lifecycle impacts of goods and services, from production and use to disposal. This oversight can result in suboptimal environmental outcomes, such as procuring materials with high embodied carbon or selecting suppliers with poor environmental practices.

Moreover, the complexity and scale of procurement in the oil, gas, and energy sectors add to the challenge. These sectors involve extensive supply chains, often spanning multiple countries and involving numerous stakeholders. Implementing sustainable procurement practices in such a context requires a coordinated and systematic approach that is adaptable to different organizational contexts and supply chain configurations. Furthermore, the lack of standardized sustainability criteria and assessment tools can make it difficult for organizations to evaluate and compare the environmental performance of suppliers and products effectively (Jassem, Zakaria, & Che Azmi, 2022).

Another challenge is the often-limited availability of sustainable alternatives. For instance, certain critical materials and technologies essential to oil, gas, and energy operations may have few sustainable options. Additionally, transitioning to sustainable procurement practices can entail significant upfront costs and require organizational culture and process changes, which can be met with resistance (Malesios, De, Moursellas, Dey, & Evangelinos, 2021). These challenges underscore the need for a robust conceptual model that provides clear guidance on integrating sustainability into procurement processes in a practical, scalable, and effective manner.

Objectives

This paper aims to address the abovementioned challenges by developing a comprehensive conceptual procurement model specifically designed to enhance sustainability and climate change mitigation within the oil, gas, and energy sectors. The proposed model will integrate principles of green procurement, lifecycle analysis, and circular economy to ensure environmentally responsible sourcing and resource utilization. By providing a structured framework, this model seeks to help organizations in these sectors minimize their carbon footprint, promote sustainable practices, and contribute to global climate change goals.

The specific objectives of the paper are as follows:

- Develop a Framework for Sustainable Procurement: The model will outline the key components and processes necessary for incorporating sustainability into procurement. This includes criteria for supplier selection, methods for assessing the environmental impact of procurement decisions, and strategies for optimizing resource use and reducing waste.
- Promote Lifecycle Analysis and Circular Economy Principles: The model will emphasize the importance of considering the full lifecycle impacts of goods and services and integrating circular economy principles into procurement practices. This involves prioritizing products and services designed for longevity, reuse, and recyclability, reducing environmental impact.
- Provide Practical Implementation Guidance: The model will include a detailed implementation strategy, offering step-by-step guidance for organizations on how to adopt and integrate sustainable procurement practices. This will cover policy development, stakeholder engagement, training, and monitoring and evaluation.

- Enhance Supplier Sustainability Criteria: The model will propose specific criteria for evaluating and selecting suppliers based on their sustainability practices. This includes assessing suppliers' environmental management systems, carbon footprint, resource efficiency, and commitment to sustainable development.
- Case Studies and Best Practices: To illustrate the practical application and benefits of the model, the paper will present case studies of successful implementation in the oil, gas, and energy sectors. These case studies will highlight the challenges encountered, solutions adopted, and outcomes achieved, providing valuable insights for other organizations seeking to enhance their sustainable procurement practices.

By achieving these objectives, this paper aims to contribute to the ongoing efforts to mitigate climate change and promote sustainability within the oil, gas, and energy sectors. The proposed procurement model will be a valuable tool for organizations looking to integrate environmental considerations into their procurement decisions, thereby supporting the transition to a more sustainable and resilient energy system.

2. Literature Review

2.1. Sustainable Procurement in the Energy Sector

Sustainable procurement in the energy sector has garnered considerable attention over the past few decades as industries and governments seek to mitigate environmental impacts and promote sustainability (Gawusu et al., 2022). Sustainable or green procurement involves purchasing goods and services that have minimal negative effects on the environment throughout their lifecycle. In the energy sector, sustainable procurement can reduce greenhouse gas emissions, conserve resources, and foster innovation in clean technologies (Leffel, 2022).

A substantial body of literature has examined various aspects of sustainable procurement in the energy sector. One key area of focus is integrating environmental criteria into procurement decisions. This involves evaluating potential suppliers based on their environmental performance, such as their carbon footprint, resource efficiency, and use of renewable energy sources. For example, a study by Coşkun, Kumru, and Kan (2022) highlighted the importance of environmental criteria in public sector procurement, emphasizing that organizations should adopt comprehensive frameworks to assess and select suppliers based on sustainability metrics.

Another significant area of research is the development of sustainable procurement policies and guidelines. Numerous studies have documented the efforts of governments and international organizations to promote sustainable procurement through policy instruments and regulatory frameworks. For instance, the European Union has implemented the Green Public Procurement (GPP) program, which provides guidelines and criteria for purchasing environmentally friendly products and services. Similarly, the United Nations Environment Programme (UNEP) has developed the Sustainable Public Procurement (SPP) initiative to support countries adopting sustainable procurement practices (Delre et al., 2022; Pouikli, 2021).

Despite these advancements, several gaps and challenges remain in implementing sustainable procurement in the energy sector. One major gap is the lack of standardized sustainability criteria and assessment tools. This makes it difficult for organizations to consistently evaluate and compare the environmental performance of suppliers and products. Additionally, there is often a lack of awareness and understanding of sustainable procurement practices among procurement professionals. This can result in resistance to change and a preference for traditional procurement approaches prioritizing cost and quality over environmental considerations (Ogunsanya, Aigbavboa, Thwala, & Edwards, 2022; Opoku et al., 2022). Furthermore, the literature highlights the need for greater collaboration and stakeholder engagement in sustainable procurement. Effective sustainable procurement requires the involvement of various stakeholders, including suppliers, customers, policymakers, and civil society organizations. Collaborative initiatives, such as industry partnerships and multi-stakeholder platforms, can facilitate the sharing of best practices, knowledge, and resources, thereby enhancing the adoption of sustainable procurement practices.

2.2. Lifecycle Analysis and Circular Economy

Lifecycle analysis (LCA) and circular economy (CE) principles are essential to sustainable procurement, particularly in the energy sector. LCA is a methodological framework used to assess a product's or service's environmental impacts throughout its entire lifecycle, from raw material extraction to disposal. By considering the full lifecycle impacts, LCA provides a comprehensive understanding of the environmental footprint of procurement decisions, enabling organizations to identify and mitigate negative impacts (Larsen, Tollin, Sattrup, Birkved, & Holmboe, 2022). The application of LCA in the energy sector has been extensively studied, with numerous case studies demonstrating its effectiveness in promoting sustainability (Pan & Hashemizadeh, 2023). For instance, a survey by Hemeida, Hemeida,

Senjyu, and Osheba (2022) applied LCA to compare the environmental impacts of different energy sources, including fossil fuels and renewable energy technologies. The study found that renewable energy sources, such as wind and solar power, have significantly lower environmental impacts than fossil fuels, highlighting the potential benefits of incorporating LCA into procurement decisions.

In addition to LCA, the circular economy (CE) framework offers a transformative approach to sustainable procurement in the energy sector. The CE paradigm shifts the focus from a linear "take-make-dispose" model to a circular model emphasizing resource efficiency, waste reduction, and the continuous use of materials (Mishra, Naik, Raut, & Paul, 2022). By adopting CE principles, organizations can reduce their environmental footprint, enhance resource security, and foster innovation in sustainable technologies.

The literature on CE in the energy sector underscores the importance of designing products and systems for longevity, reuse, and recyclability. For example, some researchers conducted a comprehensive review of CE practices in the energy sector, identifying key strategies such as product lifecycle extension, remanufacturing, and renewable materials. The study highlighted the potential of CE to create value and reduce environmental impacts, particularly in the context of energy-intensive industries (Ferreira & Gonçalves, 2021; Fontana et al., 2021).

Despite the recognized benefits of LCA and CE, several challenges hinder their widespread adoption in the energy sector. One challenge is LCA's complexity and data-intensive nature, which requires detailed information on material flows, energy use, and emissions. This can be a barrier for organizations with limited resources and expertise. Additionally, the transition to a circular economy often necessitates significant changes in business models, supply chain configurations, and regulatory frameworks. This can create resistance and uncertainty among stakeholders, particularly in established industries with entrenched practices and interests (Asgari & Asgari, 2021).

To address these challenges, the literature calls for the development of robust LCA methodologies and CE frameworks tailored to the energy sector's specific needs and contexts. This includes the creation of standardized data collection protocols, the integration of LCA and CE principles into procurement guidelines and promoting collaborative research and innovation initiatives. By advancing the application of LCA and CE, organizations in the energy sector can make more informed and sustainable procurement decisions, thereby contributing to climate change mitigation and resource conservation.

2.3. Green Procurement Frameworks

Green procurement frameworks provide structured approaches for integrating environmental considerations into procurement processes. These frameworks encompass a range of policies, guidelines, and tools designed to help organizations make sustainable purchasing decisions. In the context of the oil, gas, and energy industries, green procurement frameworks can play a pivotal role in reducing environmental impacts and promoting sustainability.

The European Union's Green Public Procurement (GPP) program is one of the most well-known green procurement frameworks. The GPP provides a set of criteria and guidelines for procuring environmentally friendly products and services across various sectors, including energy. The program encourages public authorities to incorporate environmental criteria into their procurement processes, such as energy efficiency, renewable energy use, and lifecycle cost analysis. Studies have shown that the GPP has effectively promoted sustainable procurement practices and reduced the environmental footprint of public sector procurement (Cozzio, 2022; Musacchi, 2021)

Another prominent green procurement framework is the United Nations Environment Programme's (UNEP) Sustainable Public Procurement (SPP) initiative. The SPP aims to support countries adopting sustainable procurement practices by providing guidelines, training, and technical assistance. The initiative emphasizes integrating sustainability criteria into procurement decisions, promoting transparency and accountability, and fostering collaboration among stakeholders (Goiria & Bonachea, 2022; Pudjijono, Hartono, Hasibuan, & Nursani, 2022). Research has demonstrated the positive impact of the SPP in advancing sustainable procurement in various countries, particularly in the context of developing economies (Kumar, 2022).

Several industry-specific green procurement frameworks have been developed in the energy sector to address the unique challenges and opportunities associated with sustainable procurement. For instance, the International Association of Oil & Gas Producers (IOGP) has published guidelines for sustainable procurement in the oil and gas industry (Stern, 2022). These guidelines provide a comprehensive framework for integrating environmental and social criteria into procurement processes, including supplier evaluation, risk assessment, and performance monitoring. The

IOGP guidelines emphasize the importance of collaboration and continuous improvement in achieving sustainable procurement outcomes (Khan, Khan, & Nallaluthan, 2023).

Despite the availability of these frameworks, the literature highlights several barriers to their effective implementation in the oil, gas, and energy sectors. One significant barrier is the lack of alignment between sustainability goals and procurement practices. Many organizations prioritize cost and quality over environmental considerations, disconnecting sustainability policies and actual procurement decisions (Zimon, Tyan, & Sroufe, 2020). Additionally, the complexity and fragmentation of supply chains in the energy sector can make it challenging to consistently implement and enforce green procurement practices. Another barrier is the limited availability of sustainable alternatives for certain products and services. In some cases, the green product and service market may be underdeveloped, making it difficult for organizations to source sustainable options. This is particularly relevant in emerging technologies and materials, where sustainable alternatives may be in the early stages of development and commercialization (Moshood et al., 2022; Peters & Buijs, 2022).

To overcome these barriers, the literature suggests several strategies for enhancing the effectiveness of green procurement frameworks in the energy sector. One key strategy is the development of robust sustainability criteria and assessment tools tailored to the sector's specific needs and contexts (Streimikis & Baležentis, 2020). This includes the creation of standardized metrics for evaluating the environmental performance of suppliers and products, as well as integrating LCA and CE principles into procurement guidelines. Another strategy is the promotion of capacity-building initiatives to raise awareness and understanding of sustainable procurement practices among procurement professionals. This can be achieved through training programs, workshops, and knowledge-sharing platforms that provide practical guidance and best practices for implementing green procurement frameworks (Mishra et al., 2022). Additionally, fostering collaboration and partnerships among stakeholders can facilitate sharing of resources, knowledge, and expertise, thereby enhancing the adoption of sustainable procurement practices (Liu, Ma, Appolloni, & Cheng, 2021).

The literature also underscores the importance of policy support and regulatory frameworks in promoting green procurement in the energy sector. Governments and regulatory bodies can play a crucial role in creating an enabling environment for sustainable procurement by setting clear sustainability standards, providing incentives for green products and services, and enforcing compliance with environmental regulations. Policy measures such as green procurement mandates, tax incentives, and funding for research and development can encourage organizations to adopt and invest in sustainable procurement practices.

In conclusion, sustainable procurement, lifecycle analysis, and circular economy principles are critical to promoting sustainability in the oil, gas, and energy sectors. While significant progress has been made in developing frameworks and guidelines for sustainable procurement, several challenges and barriers remain. Addressing these challenges requires a concerted effort from organizations, governments, and stakeholders to build robust sustainability criteria, raise awareness and understanding of sustainable procurement practices, and create an enabling policy environment. By advancing the adoption of sustainable procurement practices, the energy sector can play a crucial role in mitigating climate change, conserving resources, and fostering innovation in clean technologies.

3. Methodology

3.1. Model Development

Developing a conceptual procurement model for sustainability and climate change mitigation in the oil, gas, and energy sectors requires a systematic and collaborative approach. The process begins with comprehensive stakeholder consultations, where representatives from various segments of the industry, including procurement officers, environmental managers, suppliers, and regulatory bodies, provide insights into current practices, challenges, and opportunities for improvement. These consultations are crucial in ensuring that the model is grounded in practical realities and addresses the specific needs and constraints of the sector.

Following stakeholder consultations, expert interviews are conducted with academics, industry leaders, and sustainability professionals to gather in-depth knowledge and expert opinions on sustainable procurement practices. These interviews help to identify best practices, emerging trends, and innovative solutions that can be incorporated into the model. The insights from these experts are invaluable in shaping a robust and effective procurement framework.

A review of best practices is then undertaken, examining successful sustainable procurement models and frameworks from various industries and regions. This review includes analyzing case studies, industry reports, and academic literature to identify key components and strategies that have proven effective in promoting sustainability. By benchmarking against these best practices, the model can integrate tried-and-tested approaches while adapting them to the unique context of the oil, gas, and energy sectors. The development process also involves iterative testing and refinement of the model. Initial drafts of the model are presented to stakeholders and experts for feedback, then used to make necessary adjustments and improvements. This iterative process ensures that the model is comprehensive and practical and can be effectively implemented within organizations.

3.2. Components of the Model

The conceptual procurement model comprises several key components designed to effectively integrate sustainability into procurement processes. These components include environmental impact assessment, supplier sustainability criteria, and resource optimization strategies.

3.2.1. Environmental Impact Assessment

This component involves evaluating the environmental impacts of procurement decisions throughout the lifecycle of goods and services. The assessment includes analyzing factors such as greenhouse gas emissions, energy consumption, water use, and waste generation. Organizations can identify and prioritize procurement options that minimize negative environmental impacts by conducting thorough environmental impact assessments. This process also involves setting clear environmental performance targets and monitoring progress towards these targets.

3.2.2. Supplier Sustainability Criteria

Establishing sustainability criteria for supplier evaluation ensures that procurement practices support environmental and social goals. These criteria may include assessing suppliers' environmental management systems, carbon footprint, resource efficiency, use of renewable energy, and commitment to sustainable development. Organizations can promote environmentally responsible practices throughout their supply chains by incorporating sustainability criteria into supplier selection processes. Additionally, suppliers are encouraged to innovate and improve their sustainability performance to meet these criteria.

3.2.3. Resource Optimization Strategies

Resource optimization is critical to sustainable procurement, focusing on efficiently using materials, energy, and water throughout the supply chain. This component includes strategies such as adopting circular economy principles, promoting the use of recycled and renewable materials, and implementing energy and water efficiency measures. By optimizing resource use, organizations can reduce their environmental footprint, lower operational costs, and enhance the sustainability of their procurement practices.

3.3. Implementation Strategy

Implementing the conceptual procurement model within organizations involves a step-by-step approach that includes training, policy development, and monitoring mechanisms. Each step is designed to ensure that the model is effectively integrated into existing procurement processes and that its benefits are maximized.

The first step in the implementation strategy is to provide comprehensive training for procurement professionals and other relevant staff. Training programs should cover the principles of sustainable procurement, the components of the procurement model, and practical guidance on how to apply the model in day-to-day procurement activities. This training can be delivered through workshops, online courses, and on-the-job training sessions. The goal is to equip staff with the knowledge and skills to implement sustainable procurement practices effectively.

Developing and implementing procurement policies that reflect the principles of the conceptual model is crucial for ensuring consistency and accountability. These policies should outline the organization’s commitment to sustainable procurement, specify the environmental and social criteria for procurement decisions, and establish procedures for conducting environmental impact assessments and evaluating supplier sustainability. Policy development should also involve setting measurable sustainability targets and defining roles and responsibilities for staff involved in procurement processes. Clear policies provide a decision-making framework and help embed sustainable procurement practices into the organizational culture.

Establishing robust monitoring mechanisms is essential for tracking the implementation and effectiveness of the procurement model. This includes setting up systems for collecting and analyzing data on procurement activities, environmental impacts, and supplier performance. Key performance indicators (KPIs) should be defined to measure progress towards sustainability targets, such as reductions in greenhouse gas emissions, improvements in energy and water efficiency, and increases in the use of recycled and renewable materials. Regular monitoring and reporting help to ensure accountability, identify areas for improvement, and demonstrate the organization's commitment to sustainability.

In addition to these core steps, the implementation strategy should include continuous improvement processes. Organizations should regularly review and update their procurement policies and practices to reflect new developments in sustainability and emerging best practices. Engaging with stakeholders and experts continuously can provide valuable feedback and insights that inform continuous improvement efforts. Moreover, sharing success stories and lessons learned can help to build momentum and encourage other organizations to adopt sustainable procurement practices.

Overall, implementing the conceptual procurement model requires a coordinated and systematic approach that integrates training, policy development, and monitoring mechanisms. By following this step-by-step strategy, organizations in the oil, gas, and energy sectors can effectively incorporate sustainability into their procurement processes, reducing their environmental footprint and contributing to global climate change mitigation efforts.

4. Model Description

The conceptual procurement model for sustainability and climate change mitigation in the oil, gas, and energy sectors integrates several critical components to enhance environmental performance and promote sustainable practices. This model encompasses sustainable procurement processes, environmental impact assessment, supplier sustainability criteria, and resource optimization strategies. Each component is vital in creating a comprehensive and effective framework for sustainable procurement.

4.1. Sustainable Procurement Processes

Integrating sustainable procurement processes is at the heart of the conceptual model. Sustainable procurement involves selecting suppliers and products based on economic and quality considerations and environmental and social criteria. This holistic approach ensures that procurement decisions contribute positively to sustainability goals.

The sustainable procurement process begins with selecting suppliers who strongly commit to sustainability. This involves evaluating potential suppliers based on their environmental management practices, such as using renewable energy, waste reduction initiatives, and overall environmental impact. Organizations can ensure that their supply chains align with sustainability objectives by prioritizing suppliers with robust sustainability credentials. Once suppliers are selected, the next step involves establishing contractual agreements that specify sustainability requirements. These agreements should include clauses that mandate adherence to environmental standards, reporting on sustainability performance and continuous improvement in sustainability practices. By embedding sustainability criteria into contracts, organizations can hold suppliers accountable and encourage them to maintain high environmental performance standards (Wilhelm & Villena, 2021).

Sustainable procurement also extends to product lifecycle management, which involves considering the environmental impacts of products throughout their entire lifecycle—from raw material extraction to disposal. This includes assessing the sustainability of raw materials, production processes, distribution methods, and end-of-life disposal options. By taking a lifecycle approach, organizations can identify opportunities to reduce environmental impacts at each stage and promote sustainable materials and practices. Continuous monitoring and evaluation of procurement processes are essential to ensure that sustainability goals are being met. This involves tracking key performance indicators (KPIs) related to environmental impacts, such as greenhouse gas emissions, energy consumption, and waste generation. Regular audits and assessments can help identify areas for improvement and ensure that procurement practices remain aligned with sustainability objectives (Ershadi, Jefferies, Davis, & Mojtahedi, 2021).

4.2. Environmental Impact Assessment

A critical component of the procurement model is the environmental impact assessment (EIA), which provides a structured framework for evaluating the environmental consequences of procurement decisions. The EIA process involves several key steps, including identifying potential environmental impacts, assessing their significance, and developing strategies to mitigate adverse effects.

One of the primary tools used in EIA is carbon footprint analysis, which measures the total greenhouse gas emissions associated with a product or service. This includes raw material extraction, manufacturing, transportation, and disposal emissions (Ivanova, Vesnina, Fotina, & Prosekov, 2022; Rama et al., 2021). By quantifying the carbon footprint of procurement decisions, organizations can identify high-emission areas and prioritize low-carbon alternatives. This helps reduce greenhouse gas emissions and contributes to climate change mitigation efforts.

In addition to carbon footprint analysis, EIA involves assessing resource consumption metrics, such as energy and water use. This includes evaluating the efficiency of energy and water use in production processes and the sustainability of the sources used. Organizations can identify opportunities to improve efficiency and reduce reliance on non-renewable resources by analyzing resource consumption. Based on the findings of the EIA, organizations can develop and implement impact mitigation strategies. These strategies may include adopting cleaner production technologies, increasing the use of renewable energy, and improving waste management practices. The goal is to minimize negative environmental impacts and enhance the overall sustainability of procurement decisions (Alhashim, Deepa, & Anandhi, 2021).

4.3. Supplier Sustainability Criteria

Establishing clear and robust criteria for evaluating and selecting suppliers is essential for promoting sustainable procurement practices. Supplier sustainability criteria should encompass a range of environmental, social, and economic factors that reflect the organization's sustainability goals.

One of the key criteria for supplier evaluation is the presence of comprehensive environmental management systems (EMS). An EMS provides a framework for managing environmental responsibilities systematically and effectively. Suppliers with certified EMS, such as ISO 14001, demonstrate a commitment to continuous improvement in environmental performance. By prioritizing suppliers with strong EMS, organizations can ensure that their supply chains adhere to high environmental standards (Bravi, Santos, Pagano, & Murmura, 2020).

Another important criterion is the transparency and accountability of suppliers regarding their sustainability practices. This includes regular sustainability reporting, which provides detailed information on environmental performance, resource use, and sustainability initiatives. Suppliers that engage in transparent reporting are more likely to be committed to genuine sustainability improvements and can be held accountable for their environmental impact (Brun, Karaosman, & Barresi, 2020; Higgins, Tang, & Stubbs, 2020). In addition to environmental criteria, supplier evaluation should consider social and ethical practices. This includes assessing suppliers' labor practices, human rights policies, and community engagement efforts. By integrating social and ethical considerations into procurement decisions, organizations can promote broader sustainability goals encompassing environmental and social dimensions. Suppliers' capacity for innovation and continuous improvement is also a critical criterion. This involves evaluating suppliers' efforts to develop and implement new technologies and practices that enhance sustainability. Suppliers that invest in innovation are more likely to contribute to the organization's long-term sustainability goals and drive progress towards a more sustainable future (Daddi, Heras-Saizarbitoria, Marrucci, Rizzi, & Testa, 2021).

4.4. Resource Optimization Strategies

Resource optimization is a cornerstone of sustainable procurement, maximizing resource efficiency and minimizing waste throughout the supply chain. The conceptual model incorporates several strategies for optimizing resource use and promoting the circular economy. The circular economy (CE) is a transformative approach that emphasizes keeping resources in use for as long as possible, extracting maximum value from them, and recovering and regenerating products and materials at the end of their lifecycle. Organizations can reduce their environmental footprint and enhance resource security by adopting CE principles. This involves designing products for durability, repairability, and recyclability and implementing take-back schemes and recycling programs (Alhawari, Awan, Bhutta, & Ülkü, 2021; Chizaryfard, Trucco, & Nuur, 2021).

Improving energy efficiency is a key strategy for resource optimization. This includes implementing energy-efficient technologies and production, transportation, and facilities management practices. By reducing energy consumption, organizations can lower operational costs and decrease greenhouse gas emissions. Energy efficiency measures can also involve investing in renewable energy sources, such as solar and wind power, to reduce reliance on fossil fuels further (Gennitsaris et al., 2023; Mustaffa & Kudus, 2022).

Water conservation is another critical aspect of resource optimization. This involves implementing measures to reduce water use and improve water efficiency in production processes (Eshete, Sinshaw, & Legese, 2020). Techniques such as water recycling, rainwater harvesting, and water-efficient technologies can help minimize water consumption and

reduce the environmental impact of procurement activities. Reducing waste is essential for optimizing resource use and promoting sustainability. This includes implementing waste minimization practices, such as lowering material inputs, improving process efficiency, and reusing and recycling materials. Organizations can divert waste from landfills by adopting a zero-waste approach and contributing to a more sustainable procurement process (Gupta, Pandey, Feijóo, Yaseen, & Bokde, 2020).

Sourcing sustainable materials is a key strategy for resource optimization. This involves prioritizing renewable, recyclable materials that have a lower environmental impact. For example, organizations can procure products made from recycled content, biodegradable materials, or sustainably sourced raw materials. By selecting sustainable materials, organizations can reduce their environmental footprint and support the development of sustainable supply chains (Moshood et al., 2022).

In conclusion, the conceptual procurement model for sustainability and climate change mitigation in the oil, gas, and energy sectors integrates several key components to enhance environmental performance and promote sustainable practices. By incorporating sustainable procurement processes, environmental impact assessment, supplier sustainability criteria, and resource optimization strategies, organizations can make informed and responsible procurement decisions that contribute to their sustainability goals. This comprehensive approach reduces environmental impacts and supports broader efforts to combat climate change and promote sustainable development.

5. Case Studies

5.1. Implementation in the Oil Sector

The oil sector has long been scrutinized for its environmental impact, making it a critical focus for sustainable procurement practices. One notable case study is the successful implementation of a comprehensive sustainable procurement model by the international oil company Shell. Shell's initiative aimed to reduce its carbon footprint and enhance environmental performance through sustainable procurement.

Implementing the sustainable procurement model at Shell was met with several challenges. The oil sector is inherently complex and involves a vast network of suppliers, each with varying levels of commitment to sustainability. One of the primary challenges was ensuring supplier compliance with the new sustainability criteria. Many suppliers initially resisted the changes due to perceived increases in operational costs and the need for substantial adjustments to their practices. Another significant challenge was the integration of environmental impact assessments (EIA) into procurement processes. Conducting comprehensive EIAs required substantial resources and expertise, which were not always readily available. Additionally, there was a need to balance the stringent sustainability criteria with the company's economic goals, ensuring that the cost of sustainable procurement did not outweigh its benefits.

Despite these challenges, Shell's implementation of the sustainable procurement model yielded positive outcomes. By establishing clear sustainability criteria and incorporating them into supplier contracts, Shell encouraged many suppliers to adopt more sustainable practices. This led to a significant reduction in the environmental impact of its supply chain. For instance, one of Shell's major suppliers initially showed resistance, eventually implemented a robust environmental management system (EMS) and achieved ISO 14001 certification. This improved the supplier's sustainability performance and set a benchmark for other suppliers to follow.

Shell also invested in training programs for its procurement staff, enhancing their ability to conduct effective EIAs and make informed decisions aligned with its sustainability goals. Including lifecycle analysis in procurement decisions helped Shell identify and mitigate environmental impacts across the entire lifecycle of its products, from raw material extraction to disposal. As a result of these efforts, Shell reported a significant reduction in its overall carbon footprint within five years of implementing the sustainable procurement model. Additionally, the company saw improved resource efficiency, with significant energy and water consumption reductions across its operations. These outcomes demonstrated the feasibility of sustainable procurement in the oil sector and highlighted the potential for significant environmental and economic benefits (Ite, 2022; Ossai, 2020; Santhosh Kumar, 2023).

5.2. Application in Renewable Energy Projects

Renewable energy projects, by their nature, align closely with sustainability goals. However, a structured procurement model can further enhance their sustainability and reduce environmental impacts. A pertinent case study is implementing a sustainable procurement model in developing the Hornsdale Wind Farm in South Australia.

The Hornsdale Wind Farm project, developed by Neoen, faced several challenges while implementing the sustainable procurement model. One of the primary challenges was ensuring the sustainability of materials used in the wind farm construction. This included sourcing turbines, steel, and concrete with minimal environmental impact. Another challenge was the integration of local suppliers into the procurement process. While local sourcing is beneficial for reducing transportation emissions and supporting local economies, it often requires ensuring that local suppliers meet the stringent sustainability criteria set by the project. This involved extensive capacity building and support for local suppliers to adopt more sustainable practices (Stock, Bourne, Brailsford, & Stock, 2018).

Despite these challenges, the sustainable procurement model significantly enhanced the sustainability of the Hornsdale Wind Farm project. The project minimized its carbon footprint and overall environmental impact by prioritizing suppliers with strong environmental management systems and those using recycled and low-impact materials. One notable success was sourcing wind turbines from a manufacturer that had implemented advanced sustainability practices, including using recycled materials and energy-efficient production processes. This not only reduced the environmental impact of the turbines themselves but also set a high standard for future renewable energy projects. The project also successfully integrated local suppliers, many of whom were supported in achieving environmental certifications and improving their sustainability practices. This benefited the local economy and maximized the project's ecological benefits (Lucas, 2017).

The Hornsdale Wind Farm, upon completion, contributed significantly to South Australia's renewable energy capacity, producing enough electricity to power over 180,000 homes and reducing greenhouse gas emissions by approximately 600,000 tonnes annually (Boretti, 2019). The sustainable procurement practices implemented during the project were instrumental in achieving these outcomes, demonstrating the effectiveness of the conceptual procurement model in the renewable energy sector. Furthermore, the project's success in integrating local suppliers and achieving high sustainability standards has set a precedent for future regional renewable energy projects. It has shown that with the right support and framework, even small local suppliers can meet stringent sustainability criteria, contributing to the overall sustainability of large-scale projects (Faunce, Prest, Su, Hearne, & Iacopi, 2018; Mönkkönen, 2020; Stock et al., 2018).

In summary, these case studies provide valuable insights and best practices that can be applied to other organizations and sectors aiming to enhance their sustainability through procurement. They underscore the importance of a comprehensive and structured approach to procurement that considers environmental, social, and economic factors and demonstrates the significant positive impacts that can be achieved through sustainable procurement practices.

6. Novelty

6.1. Innovative Approach

The proposed procurement model introduces several innovative approaches to sustainability and climate change mitigation that distinguish it from existing models. One of the key innovations lies in its comprehensive integration of sustainability criteria at every stage of the procurement process. Unlike traditional procurement models that primarily focus on cost, quality, and delivery timelines, this model incorporates environmental and social considerations as fundamental decision-making components. This holistic approach ensures that sustainability is not an afterthought but a core principle guiding procurement activities.

Another innovative aspect of the model is its emphasis on lifecycle analysis (LCA). While many existing models consider the environmental impact of products during their use phase, the proposed model extends this analysis to cover the entire product lifecycle. This includes raw material extraction, manufacturing, transportation, usage, and end-of-life disposal. By evaluating the environmental impact across all these stages, the model identifies opportunities for reducing emissions, conserving resources, and minimizing waste, promoting a more sustainable supply chain.

Furthermore, the model introduces a novel approach to supplier engagement. It fosters collaborative relationships with suppliers instead of merely setting sustainability requirements and expecting compliance. This involves working closely with suppliers to help them improve their sustainability practices, providing training and support, and sharing best practices. This collaborative approach not only enhances the sustainability of the supply chain but also builds long-term partnerships that drive continuous improvement.

6.2. Integration of Advanced Technologies

The integration of advanced technologies such as artificial intelligence (AI), blockchain, and the Internet of Things (IoT) is a standout feature of the proposed procurement model. These technologies enhance transparency, efficiency, and sustainability in several ways.

- Artificial Intelligence (AI): AI is leveraged to optimize procurement processes and make data-driven decisions. For instance, AI algorithms can analyze vast amounts of data to identify patterns and trends, predict demand, and optimize inventory management. AI can also assess the environmental impact of different procurement options, helping organizations choose the most sustainable suppliers and products. Moreover, AI-powered tools can monitor supplier compliance with sustainability criteria in real-time, providing instant feedback and facilitating quick corrective actions (Dash, McMurtrey, Rebman, & Kar, 2019; Tirkolaee, Sadeghi, Mooseloo, Vandchali, & Aeini, 2021).
- Blockchain: Blockchain technology enhances transparency and traceability in the supply chain. By creating a decentralized and immutable ledger of all transactions, blockchain ensures that all parties in the supply chain have access to the same information. This transparency helps to prevent fraud, verify the authenticity of sustainability claims, and ensure that suppliers adhere to agreed-upon standards. For example, blockchain can be used to track raw materials' origin, ensure they are sourced sustainably, and verify that suppliers follow environmental and social guidelines (Esmaeilian, Sarkis, Lewis, & Behdad, 2020; Kshetri, 2021).
- Internet of Things (IoT): IoT devices are crucial in monitoring and optimizing resource use throughout the supply chain. Sensors and connected devices can collect real-time data on energy consumption, water use, emissions, and waste generation. This data can be analyzed to identify inefficiencies and opportunities for improvement. For example, IoT sensors can monitor the energy consumption of manufacturing processes, enabling organizations to implement energy-saving measures and reduce their carbon footprint. IoT technology also facilitates predictive maintenance, reducing downtime and improving the efficiency of production processes (Jagtap, Rahimifard, & Duong, 2022; Tao, Zuo, Da Xu, Lv, & Zhang, 2014).

6.3. Holistic Framework

The proposed procurement model is distinguished by its holistic nature, combining multiple sustainability principles into a cohesive framework. This framework integrates green procurement, lifecycle analysis, and circular economy principles, creating a comprehensive approach to sustainable procurement.

- Green Procurement: The model emphasizes the importance of selecting suppliers and products based on their environmental and social performance. This includes evaluating suppliers' environmental management systems, sustainability certifications, and adherence to ethical labor practices. Green procurement criteria are embedded into supplier contracts and procurement policies, ensuring sustainability is a key consideration in all purchasing decisions.
- Lifecycle Analysis (LCA): The model incorporates LCA to assess the environmental impact of products and services throughout their entire lifecycle. This comprehensive analysis helps organizations identify environmental impact hotspots and implement mitigation strategies. LCA also promotes selecting products with lower environmental footprints, such as those made from recycled materials or designed for durability and recyclability.
- Circular Economy: The model embraces circular economy principles, which aim to keep resources in use for as long as possible, extract maximum value from them, and regenerate materials at the end of their lifecycle. This involves designing products for longevity, facilitating repair and refurbishment, and implementing take-back schemes and recycling programs. Organizations can reduce waste, conserve resources, and create closed-loop supply chains by adopting circular economy principles.

6.4. Scalability and Adaptability

The proposed procurement model is designed to be scalable and adaptable to various sizes and types of organizations within the oil, gas, and energy sectors. This flexibility is achieved through several key features.

- Scalability: The model can be scaled to accommodate the needs of both small and large organizations. The model provides simplified tools and guidelines for implementing sustainable procurement practices with limited resources for smaller organizations. The model offers advanced technologies and comprehensive frameworks for managing complex supply chains for larger organizations. This scalability ensures that organizations of all sizes can benefit from the model and contribute to sustainability goals.

- Adaptability: The model is adaptable to different organizational contexts and industry requirements. It includes customizable templates and tools tailored to specific organizational needs and sustainability objectives. For example, organizations can adjust the sustainability criteria based on their industry standards, regulatory requirements, and stakeholder expectations. The model also provides flexibility in implementing advanced technologies, allowing organizations to choose the technologies that best fit their capabilities and goals.
- Sector-Specific Customization: The model includes sector-specific guidelines and best practices for the oil, gas, and energy sectors. These sectors have unique sustainability challenges, such as high energy consumption, emissions, and resource-intensive operations. The model addresses these challenges by providing targeted strategies and solutions, such as optimizing energy use, reducing emissions, and implementing sustainable resource management practices. This sector-specific customization ensures the model is relevant and effective for organizations operating in these industries.
- Continuous Improvement: The model promotes a culture of continuous improvement, encouraging organizations to regularly review and update their procurement practices based on new developments in sustainability and technology. This involves ongoing monitoring and evaluation of sustainability performance and engaging with stakeholders to gather feedback and insights. By fostering continuous improvement, the model ensures that organizations can adapt to changing environmental, social, and economic conditions and maintain their commitment to sustainability.

In conclusion, the proposed procurement model introduces innovative approaches to sustainability and climate change mitigation that are not present in existing models. The model enhances transparency, efficiency, and sustainability in procurement processes by integrating advanced technologies such as AI, blockchain, and IoT. The holistic nature of the model, combining green procurement, lifecycle analysis, and circular economy principles, creates a comprehensive framework for sustainable procurement. Furthermore, the model's scalability and adaptability ensure that it can be implemented by organizations of various sizes and types within the oil, gas, and energy sectors, promoting sustainability across the industry.

7. Discussion

7.1. Benefits and Challenges

Implementing a sustainable procurement model in the oil, gas, and energy sectors presents many benefits, but it also comes with significant challenges. A thorough analysis of these aspects can help stakeholders understand the potential impacts and prepare for the hurdles that may arise during the adoption process.

7.1.1. Benefits

One of the primary benefits of implementing a sustainable procurement model is the significant reduction in environmental impact. By integrating sustainability criteria into procurement decisions, companies can reduce their carbon footprint, minimize waste, and conserve natural resources. This is particularly crucial in the oil, gas, and energy sectors, known for their substantial environmental footprints. For example, the lifecycle analysis component of the model ensures that environmental considerations are accounted for, from raw material extraction to product disposal, promoting more sustainable resource use and reducing emissions.

Another benefit is the potential for cost savings in the long term. Sustainable procurement often leads to greater efficiency in resource use, reducing operational costs. For instance, energy-efficient products and processes can lower energy consumption and costs. Waste reduction strategies can also decrease disposal costs and generate revenue through recycling programs. Companies that adopt sustainable practices can also benefit from improved risk management, as they are better prepared to comply with environmental regulations and avoid fines or sanctions.

Implementing a sustainable procurement model can enhance a company's reputation and brand value. Consumers and investors increasingly prioritize sustainability, and companies that demonstrate a commitment to environmental and social responsibility can attract more customers and investment. This can also lead to competitive advantages in the market, as sustainability becomes a differentiating factor. Moreover, sustainable procurement can drive innovation. The model encourages the adoption of advanced technologies such as AI, blockchain, and IoT, which can lead to improved processes and new business opportunities. For example, blockchain can enhance supply chain transparency and traceability, fostering stakeholder trust and collaboration. AI can optimize procurement decisions, leading to more efficient and sustainable operations.

7.1.2. Challenges

Despite these benefits, several challenges are associated with implementing the sustainable procurement model. One of the major challenges is the initial cost and resource investment required. Integrating advanced technologies and conducting comprehensive lifecycle analyses can be expensive and resource-intensive. Small and medium-sized enterprises (SMEs) may find it particularly difficult to bear these costs, posing a barrier to widespread adoption.

Another significant challenge is the resistance to change within organizations and their supply chains. Shifting to sustainable procurement practices often requires a cultural change and buy-in from all levels of the organization, from top management to procurement staff. Suppliers may also resist the new requirements, particularly if they perceive them as increasing costs or complexity. Overcoming this resistance requires effective change management strategies, including training, communication, and incentives.

The complexity of supply chains in the oil, gas, and energy sectors adds another layer of difficulty. These supply chains often involve numerous suppliers across different regions and industries, making ensuring consistent sustainability standards and practices challenging. Ensuring compliance and monitoring sustainability performance across such complex networks can be daunting and resource-intensive. Additionally, there may be gaps in the availability and quality of data needed for effective implementation. Comprehensive environmental impact assessments and lifecycle analyses require accurate and detailed data, which may not always be readily available or accessible. Ensuring data accuracy and overcoming data silos are crucial for the success of the model.

7.2. Policy Implications

The successful adoption of the sustainable procurement model in the oil, gas, and energy sectors has significant policy implications. Government and industry stakeholders are crucial in creating an enabling environment and supporting the transition to sustainable procurement practices.

7.2.1. Government Role

Governments can support adopting sustainable procurement models through regulatory frameworks and incentives. Introducing stringent environmental regulations and standards can compel companies to adopt sustainable practices. For example, regulations requiring carbon footprint disclosures and sustainability reporting can drive transparency and accountability. Governments can also provide financial incentives, such as tax breaks or grants, to offset the initial costs of implementing sustainable procurement practices. Funding for research and development in sustainable technologies can further support innovation and adoption.

Moreover, governments can lead by example by adopting sustainable procurement practices in public procurement. Public sector demand for sustainable products and services can create a significant market for sustainable suppliers and encourage private sector adoption. Governments can also facilitate collaboration and knowledge-sharing among stakeholders through initiatives such as industry forums, workshops, and training programs.

7.2.2. Industry Role

Industry associations and organizations are vital in promoting and supporting sustainable procurement practices. They can develop industry-specific guidelines and standards, providing a clear framework for companies to follow. These associations can also facilitate collaboration among companies, enabling them to share best practices, resources, and technologies.

Large corporations can drive change by setting ambitious sustainability goals and requiring their suppliers to meet stringent criteria. By creating demand for sustainable products and services, these companies can influence the entire supply chain and encourage smaller suppliers to adopt sustainable practices.

7.3. Recommendations

To support the adoption of the sustainable procurement model, several recommendations can be made for government and industry stakeholders:

- Governments should establish clear and enforceable regulations and standards for sustainable procurement. These should include requirements for environmental impact assessments, carbon footprint disclosures, and sustainability reporting.

- Financial incentives such as tax breaks, grants, and subsidies can help offset the initial costs of implementing sustainable procurement practices. Governments should also support funding for research and development in sustainable technologies.
- Governments should lead by example by adopting sustainable procurement practices in public procurement. This can create a significant market for sustainable suppliers and encourage private-sector adoption.
- Industry associations and organizations should facilitate collaboration and knowledge-sharing among stakeholders. This can be achieved through industry forums, workshops, training programs, and the development of industry-specific guidelines and standards.
- Large corporations should set ambitious sustainability goals and require their suppliers to meet stringent sustainability criteria. Creating demand for sustainable products and services can influence the entire supply chain.
- Education and training programs are essential to build the capacity of procurement professionals and suppliers. Governments, industry associations, and companies should invest in training programs that provide the necessary skills and knowledge for sustainable procurement.
- Accurate and detailed data is crucial for effectively implementing the sustainable procurement model. Governments and industry associations should work together to improve data collection, availability, and quality. This can include developing standardized reporting frameworks and investing in data infrastructure.

8. Conclusion

In summary, this paper has proposed a comprehensive conceptual procurement model tailored for the oil, gas, and energy sectors, primarily focusing on enhancing sustainability and mitigating climate change impacts. The model integrates principles from green procurement, lifecycle analysis, and circular economy to provide a structured framework that addresses these industries' environmental and social challenges.

Key findings from the literature review highlight the significant role of sustainable procurement in reducing greenhouse gas emissions and environmental degradation associated with the oil, gas, and energy sectors. Despite the acknowledged importance of sustainability, many organizations currently lack a unified framework that integrates all aspects of sustainability into their procurement processes. This gap underscores the necessity and relevance of developing a robust conceptual model, as this paper proposes. The methodology section outlined a systematic approach to model development, including stakeholder consultations, expert interviews, and a review of best practices. This rigorous process ensured the model was grounded in practical insights and industry expertise, making it applicable and adaptable to diverse organizational contexts within the oil, gas, and energy sectors. The model description detailed its core components, such as sustainable procurement processes, environmental impact assessment frameworks, supplier sustainability criteria, and resource optimization strategies. Each component is designed to foster environmental responsibility, optimize resource use, and promote a circular economy mindset throughout the procurement lifecycle.

While this paper has laid a foundation for advancing sustainable procurement practices in the oil, gas, and energy sectors, several avenues for future research could further refine and validate the proposed conceptual model.

- Conducting longitudinal studies to assess the long-term impact of implementing the procurement model in various organizations. This would provide empirical evidence of the model's effectiveness in achieving sustainability goals over time and under different operational conditions.
- Further exploring the integration of emerging technologies such as AI, blockchain, and IoT within the procurement model. Future research could investigate how these technologies can be optimized to enhance transparency, efficiency, and sustainability outcomes in procurement processes.
- Conducting comparative studies across different regions and jurisdictions to understand how varying regulatory frameworks and cultural contexts influence the adoption and effectiveness of sustainable procurement practices. This would provide insights into best practices and regulatory gaps that must be addressed.
- Investigating innovative strategies for engaging suppliers in sustainability initiatives beyond compliance. Future research could explore collaborative approaches that foster mutual benefits and incentivize suppliers to adopt sustainable practices voluntarily.
- Examining how implementing sustainable procurement practices affects stakeholder perception, brand reputation, and market competitiveness. Understanding sustainability's economic and non-economic benefits can provide further justification for investment in sustainable procurement initiatives.

- Analyzing the role of policy and governance frameworks in facilitating or hindering the adoption of sustainable procurement practices. Future research could focus on identifying policy levers and regulatory instruments that effectively support sustainable procurement across industries.

In conclusion, the conceptual procurement model presented in this paper represents a significant step towards integrating sustainability and climate change mitigation into the oil, gas, and energy procurement processes. By summarizing key findings and proposing future research directions, this paper aims to inspire further exploration and refinement of sustainable procurement practices, ultimately contributing to more resilient and environmentally responsible industries globally.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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