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Research Article

Exploring the Triple Bottom Line: A Systematic Review OF Sustainable Development in the Epc Oil and Gas Industry

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ABSTRACT

In the oil and gas industry's EPC sector, the Triple Bottom Line (TBL) was created as an extensive framework for the assessment of sustainable development. The application or impact associated with the TBL approach, which emphasizes the balance between the financial, environmental, and social factors that are associated with the management of initiatives and activities, are the focus of this systematic review. The study examines the integration of TBL concepts by EPC businesses with in the energy industry in order that promote long-term viability, reduce environmental footprints, and support community welfare while maintaining profitability. Through an extensive literature analysis, the research identifies best practices, challenges, and strategic measures adopted by EPC firms to align with global sustainability standards and regulatory requirements. Key findings underscore the importance of increased stakeholder engagement, better resource management, and innovative technology in driving long-term project outcomes. The review also emphasizes the significance of performance metrics and reporting mechanisms to ensure transparency and accountability in TBL implementation. The study concludes that while the adoption of TBL practices has shown promising results, significant gaps remain in harmonizing sustainability efforts across different operational phases of EPC projects. Recommendations for future research include developing standardized sustainability frameworks and expanding empirical studies to assess long-term impacts. It will be useful for government officials, business executives, and researchers those want to promote accountability processes in the energy sector.

Keywords: TBL (TBL), Sustainable Development, EPC Oil and gas industry, Environmental Management

I. INTRODUCTION

The concept of sustainable development is currently receiving substantial attention in the fields of EPC, especially in the context of triple oil and gas industry initiatives (Kabirifar & Mojtahedi, 2019). In response to the contemporary global ecological, social, and financial difficulties, it is imperative that industries implement more comprehensive strategies to assess and attain sustainability objectives (Huddar, 2022). The TBL system, that underscores the equilibrium in environmental, social, and socioeconomic dimensions, has become an indispensable instrument for the evaluation and promotion of sustainable development in a variety of sectors (Abulibdeh et al., 2024). This systematic review explores the application and implications of the TBL framework within the EPC oil and gas industry, emphasizing sustainable growth possibilities, difficulties, and best practices (Nithya Saiprasad, 2019). Throughout history, the energy sector has been under scrutiny for its environmental effects, which include pollution, ecosystem disruption and resource depletion, as well as Greenhouse gas emissions. However, the sector also a critical role in the economic development and global energy security of resource-rich regions. Balancing these complex demands requires a structured approach to sustainability, where the TBL framework provides a valuable lens for evaluation (Ajiake, Matthew Aiyemere, 2015). The TBL assists organizations in achieving a more comprehensive and accountable strategy to project completion and long-term prosperity by combining economic viability, social responsibility, and environmental care (Ghufran et al., 2021).

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In the oil and gas industry, EPC initiatives are distinguished by intricate, large-scale operations that involve significant supplier and stakeholder connections. Sustainable development in this context extends beyond environmental management to include workforce welfare, community engagement, and ethical governance practices (Alhammadi, 2021). The TBL framework encourages companies to consider how their projects impact local communities, employee well-being, and long-term economic stability alongside traditional profit-driven metrics (Alexandru Birsan, 2024). This comprehensive perspective is essential for the promotion of a sustainable future, the prevention of hazards, and the guarantee of compliance with international regulations and standards. Applying the TBL framework for the EPC energy business is fraught with numerous obstacles, despite the potential advantages (Okuguni, 2024). These include the need for standardized metrics, industry-specific benchmarks, and effective data collection mechanisms (Chen et al., 2019). Moreover, the sector faces inherent tensions between profitability and sustainability, often requiring trade-offs and strategic decision-making. The concept in sustainable development is attracting substantial attention to the Triple energy sector, particularly in the fields of Engineering, Purchasing, or Construction (Imran Khan et al., 2024).

This methodical research aims to provide a comprehensive examination of the implantation of the TBL structure in the engineering field, The study will identify significant patterns, success factors, and gaps in the existing corpus of material by reviewing current works, examples, and empirical research. The findings are designed to assist sector managers, policymakers, and researchers by delivering insights to support sustainable growth and encourage responsible business practices within one of the world's major industries. (Adindu Donatus Ogbu et al., 2023).

1.1 TBL (TBL) Framework

In 1994, John Elkington proposed the TBL framework, an integrated approach to measuring business performance that spans beyond its financial measurements (Gimenez et al., 2012). There are three fundamental pillars that are emphasized: People (social sustainable), Planet (environmental sustainable), and Profit (economic sustainable). Organizations are urged to analyze their effect on the basis of social and ecological investments, in along with profits, following this pattern (Eyo Victor Mfon, 2021).

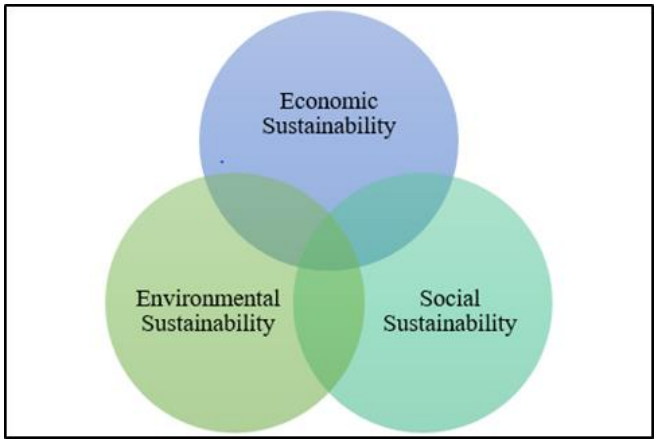

Figure 1: Pillars of TBL (Alexander S. Gillis, 2024)

In the EPC oil and gas business, the TBL technique has attracted substantial attention due to increased concerns about the environment and social duty (K. M et al., 2018). The industry, known for its capital-intensive projects and extensive resource usage, has started to embrace TBL principles to ensure a more balanced approach to development (Onifade et al., 2024). People-focused initiatives include maintaining fair labor practices, enhancing employee well-being, and effectively connecting in local communities. In order to protect ecological systems, Planet emphasizes a decrease of emissions of carbon, pollution, and the adoption of environmentally beneficial technologies (Sala, 2020). The responsibility of sustainability over time and value production for all stakeholders balances with the necessity of profit for company growth (Fauzi et al., 2010).

Adopting the TBL framework enables EPC companies to address sustainability challenges effectively (Venkata Nagarjun Devarapalli, 2024). It allows them to reduce their carbon footprint, promote ethical labor standards, and

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ensure financial stability while meeting stakeholder expectations. By incorporating the TBL principles, organizations can strengthen their business reputation, comply with growing global legislation, while contributing to sustainable development objectives (SDGs) (Mendes et al., 2023). The TBL approach ultimately promotes a more reasonable and sustainable oil and gas industry , thereby ensuring long-term success and protecting the planet and its inhabitants (Timmermans, 2016).

1.2 Sustainable Development in the EPC Oil and gas industry

EPC's energy or gas sector is committed to promoting sustainable growth, a strategy that aims to maintain equilibrium between economic growth and environmental protection (Al-Hajji & Khan, 2016), preservation environmental sustainability and societal stability. The industry's ecological legacy is to be reduced while ensuring the continued supply of energy and economic benefits, which are characterized by resource-intensive operations and complex infrastructure projects. Consequently, a dedication to sustainable practices is necessary (Heim et al., 2023). Introducing green energy systems and sustainable technologies that mitigate greenhouse gas emissions is the primary factor that drives effectiveness for the EPC oil and gas industry (Muhammad Adib Afham & Razali, 2024). With the goal to decrease their effect on the environment, organizations are progressively investing in sustainable construction materials, carbon dioxide capture and storage technology, and energy-efficient equipment. Improved resource efficiency, like optimizing energy and water usage during project periods, is also essential for sustainable development initiatives (Capobianco et al., 2022). Introducing renewable energy systems or sustainable technologies that mitigate greenhouse gas emissions is the primary factor driving efficiency on the EPC oil and gas sector (Takeshi Fukatsu, 2020). Businesses are progressively investing in energy-efficient equipment, sustainable construction materials, or carbon dioxide capture or storage technology to reduce their environmental impact (Lindstrom & Middlecamp, 2016).

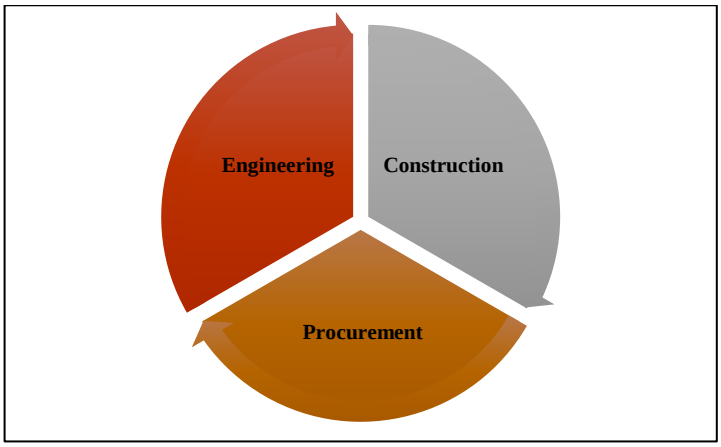

Figure 2: Engineering Procurement Construction (EPC) (Geoffrey Berck, 2021)

Social sustainability is equally important, focusing on stakeholder engagement and community involvement. Oil and gas projects often impact local populations through land displacement and labor issues (Bogumil Terminski, 2011). To address these challenges, companies must engage with local communities, provide fair compensation, create job opportunities, and ensure safe working conditions. Respecting labor rights and promoting workforce diversity are integral to fostering positive community relations and achieving long-term sustainability (Hubbard, 2009). In spite of the Capital-Intensive Nature of EPC construction and the regulatory complexities that present significant challenges, the industry has a plethora of opportunities to lead in sustainable development (Pavan Kumar Akella, 2012). By incorporating innovative strategies, similar to the integration of green energy and principles of the circular economy, companies can retain profitability and improve their environmental sustainability (Ahmed et al., 2024). In the end, a resolute dedication to environmentally friendly growth not only enhances the reputation of the company and the trust of stakeholders, but also benefits to the achievement of global sustainability objectives (Emma Wilson, 2011).

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Table 1: Challenges and Opportunities in Sustainable Development for the EPC Oil and gas industry

Challenges	Opportunities
Sustainable methods and technologies necessitate substantial capital investments.	Innovational technologies, including renewable energy and carbon collection, are successfully implemented.
Regulatory complexities and varying compliance standards across regions.	Implementation of circular economy practices to reduce waste and resource use.
Limited availability of skilled labor for sustainable project execution.	Enhanced corporate reputation and stakeholder trust through sustainability efforts.
Resistance to change due to traditional industry practices.	Energy efficiency and reduction of waste result in long-term cost savings.
Environmental risks such as oil spills and emissions during project phases.	Development of eco-friendly infrastructure and materials to reduce impact.
Social challenges like displacement and labor rights violations.	Community engagement and workforce diversity to foster positive relations.

This table emphasizes the primary obstacles encountered by the EPC energy sector in implementing sustainable practices, as well as the opportunities that result from proactive sustainability initiatives.

II. REVIEW OF LITRATURE

Sustainable methods have to be adopted by the EPC sector of the oil and gas industry to guarantee long-term viability and reduce environmental impact. It is imperative to incorporate social factors in order to drive equitable and sustainable growth across the industry, economic, and environmental variables via the TBL structure. CSR has a critical component of the sustainability strategies of multinational energy companies (Adib Uz Zaman, 2021). Companies vary significantly in their commitment to sustainability, with some investing a larger portion of their net profits into environmental and social initiatives compared to others. This variation in investment reflects the differing levels of commitment to sustainable practices within the industry. Supply chain management is another key area in ensuring sustainability within EPC projects (Huang & Li, 2024). The efficiency of procurement processes is vital in large-scale projects, with digital platforms playing an increasingly significant role in enhancing transparency and minimizing operational risks companies can reduce their environmental impact by incorporating sustainable into the procurement process, in addition to enhancing operational efficiency throughout the supply chain. At the oil and gas industry, management of the environment is an essential element of sustainability. Effective management of environmental remediation costs has been found to correlate positively with the financial resilience of companies (Huang & Li, 2024). Investing in environmental initiatives not only helps improve ecological performance but also boosts financial outcomes, demonstrating that integrating environmental factors into decision-making processes can drive both ecological and financial success.

Green accounting practices, which incorporate environmental factors into financial reporting, have shown to positively impact financial performance (Etim, 2024).. Companies that adopt green accounting can manage resources more effectively, enhancing sustainability while simultaneously improving financial results. The oil and gas industry's capacity to reconcile sustainable practices at financial health is added to by this. The achievement of EPC projects is also significantly influenced by cultural factors, including the administration, planning, communication, people resources, or goal introductions aspects of culture (Ban & Hadikusumo, 2017). Understanding and effectively managing cultural dynamics in international projects are essential for overcoming obstacles and guaranteeing the success of projects, particularly in intricate EPC environments. In order to advance sustainable growth within the energy industry, reporting on sustainability is a critical practice. A multitude of organizations comply with standardized reporting frameworks, including the Global Reporting Initiative's Sector Standards, which provide guidance on meeting specific sustainability benchmarks (Etim, 2024). However, there is a concern that these frameworks might limit progress if companies focus solely on meeting the minimum standards. Continuous

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improvement in sustainability efforts, alongside the development of more comprehensive key performance indicators (KPIs), is required to surpass the fundamental reporting obligations and make additional strides in sustainability. In conclusion, the oil and gas industry faces both significant challenges and opportunities in its journey toward sustainable development. Key strategies such as CSR, supply chain management, environmental cost management, and cultural awareness are all essential for achieving sustainability goals. The use of standardized reporting frameworks, along with the adoption of green accounting, can further contribute to improving performance and fostering ecological stewardship. By integrating these approaches, the industry can continue to enhance its sustainability and meet both environmental and financial objectives, ensuring long-term success.

Table 2: Summary of Research Contributions on the TBL and Sustainable Development in the EPC Oil and gas industry

Authors and Years	Paper Type	Methodology	Findings	Conclusion
(Hafez et al., 2023)	Systematic Review	Review of 134 papers from reliable databases using systematic inclusion/exclusion criteria.	Identified taxonomy, challenges, motivations, and pathways for energy-efficient sustainable buildings.	Energy efficiency is critical for carbon mitigation and sustainability in the building sector.
(Salah et al., 2022)	Systematic Review	Analysis of renewable energy scenarios, challenges, and recommendations for Egypt based on existing studies.	Renewable energy can address Egypt's rising energy demand and environmental issues.	Policies and innovation are vital to achieving sustainable energy goals by 2035.
(Alhaddi, 2015)	Literature Review	Analyzed the research on the incorporation of social, environmental and economic variables into sustainable models.	An extensive framework that evaluates sustainability's economic, environmental, or social components is the TBL.	Consistent terminology is essential for advancing sustainability discussions and applications.
(Huang & Li, 2024)	Bibliometric Review	Bibliometric analysis of supply chain integration strategies in EPC projects.	Highlighted challenges in procurement and integration in international EPC projects.	Flexible tools are needed for effective supply chain management in EPC projects.
(Goh et al., 2020)	Systematic Review	Review of 86 journal papers on TBL (TBL) in sustainable construction.	Integration of TBL in construction faces challenges but offers significant potential for improving sustainability practices.	A framework for integrating TBL is essential for advancing sustainable construction practices.
(Bishoge et al., 2019)	Literature Review	Systematic review of studies from 2010-2018 using a seven-step model.	Community participation remains inadequate in natural gas projects; transparency and local engagement are key issues.	Greater transparency and community engagement are essential for sustainable development in natural gas sectors.

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(Kwarto et al., 2021)	Systematic Literature Review	Critical discourse analysis of the sustainability reporting violations of the Indonesian oil and gas industry.	Many sustainability reports omit negative impacts and non-compliance; CSR practices often diverge from actual community benefits.	Greater transparency and adherence to GRI standards are essential for improving sustainability practices.
(Huang & Li, 2024)	Bibliometric Review	Analyzed research trends in EPC supply chain management using bibliometric methods.	Procurement and supply chain integration are underexplored areas in EPC project management.	Flexible SCM tools are necessary for optimizing international EPC projects.
(Otsubo & Chapman, 2023)	Systematic Literature Review	Reviewed green strategies and vendor selection frameworks for decarburization.	Emphasized deficiencies in the oil and gases sector's green management of supply chains metrics.	Focus on integrating green strategies into vendor selection can enhance decarburization efforts.
(Loviscek, 2021)	Systematic Review	Reviewed 1998-2019 literature on TBL's application in sustainability management.	TBL remains credible but often misused by prioritizing financial over environmental and social dimensions.	Holistic TBL frameworks can enhance sustainable operations management.

Table 3: Summary of Sustainability and Performance in the Oil & Gas Sector

Author(s)	Methodology	Findings	Conclusion
(Hermundsdottir et al., 2024)	Qualitative analysis of Norwegian oil firms transitioning to renewables	Dynamic capabilities such as proactive behavior and collaboration drive green innovation and market entry.	Emphasizes the need for strategic flexibility and dynamic capabilities for successful sustainability transitions.
(Korolo, 2024)	Quantitative study using Return on Assets (ROA) as a metric	Prevention costs reduce financial performance, while detection costs have a positive impact on ROA.	Companies should focus on effective environmental cost management to improve both ecological and financial resilience.
(Mohammad Ahsan ul Amin, 2023)	Case study on BAPEX procurement practices	Bureaucratic complexities and financial constraints hinder sustainable procurement practices.	Calls for systemic government support and reduced procedural barriers for effective sustainability implementation.
(Hannan et al., 2018)	Case study with Operational Excellence Model (OEM) framework	Energy efficiency programs integrated into OEM frameworks can reduce emissions but face challenges with organizational commitment.	Structured energy efficiency strategies need stronger organizational backing for long-term success.

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(Correia, 2019)	Systematic literature review on TBL implementation	TBL often focuses more on financial and environmental aspects while neglecting social components.	Calls for a holistic sustainability model incorporating all three TBL dimensions equally.
(Anser et al., 2020)	Quantitative time-series analysis (1975-2018) using ARCH modeling	Higher energy demand and oil rents increase CO_2 and GHG emissions, supporting the pollution haven hypothesis.	Recommends policy adjustments under Saudi Vision 2030 to reduce emissions while balancing economic growth.
(Alvi, 2022)	Qualitative case study using GRI-based reporting analysis	GRI standards promote transparency but create a ceiling effect, limiting voluntary sustainability improvements.	Calls for an expansion of GRI standards to encourage broader sustainability practices beyond minimal compliance.
(Ankit Duttagupta, 2021)	Comparative case study on CSR strategies in oil firms	BP's CSR spending is significantly lower than Shell and Total S.A., reflecting gaps in sustainability commitments.	Suggests increasing BP's CSR investments to balance economic, social, and environmental impact.
(Etim, 2024)	Desktop review of empirical studies from 2013-2022	Green accounting positively correlates with financial performance due to improved efficiency and waste reduction.	Recommends wider adoption of green accounting practices for financial and environmental sustainability.

2.1 Research Gap

A substantial quantity of study was carried out by the energy sector on sustainable development; however, there are still numerous critical gaps. Many studies concentrate on the economic and environmental aspects during the TBL framework, which results in a significant gap in the concentration on the social dimension (Tseng et al., 2020). The lack of representation of social sustainability underscores the necessity of more comprehensive models in which oil and gas industry incorporate the economic, environmental, and social aspects of sustainability into their strategies (Okeke, 2021). There is a need for more actionable strategies to embed sustainability in procurement and supply chain management. Additionally, limited research explores the influence of cultural factors on sustainability practices in EPC projects, particularly in diverse geographical and organizational contexts (Rudolf & Spinler, 2018). Furthermore, while financial performance linked to sustainability efforts such as green accounting and CSR investments has been explored, the long-term economic impacts of these practices are not well-understood (Ekwueme et al., 2013). The role of dynamic capabilities in driving sustainability transitions, particularly in renewables, also remains under examined. Lastly, although sustainability reporting frameworks like GRI are widely used, their limitations in fostering deeper sustainability practices suggest the need for more flexible and inclusive reporting systems (Jamali, 2006). These gaps indicate a need for more integrated research in the Engineering, Purchasing, and Construction Oil and gas industry.

III. METHODOLOGY

This thorough literature review was carried out in accordance with the following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, which ensures transparency, scientific rigor, and replicability in structured reviews. The PRISMA framework was selected for its standardized method to locating, selecting, and assessing academic works, ensuring a thorough review of sustainable development processes in the Engineering, Procurement and Construction Oil and Gas Industry under the context of the TBL framework.

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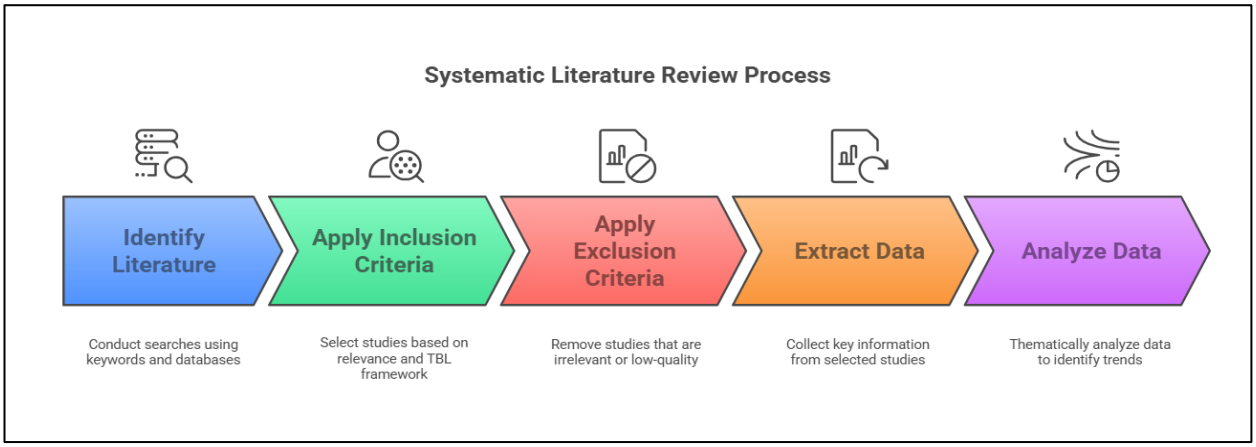

Figure 3: Systematic Literature Review Process

3.1 Search Strategy

A systematic search strategy was implemented to identify pertinent studies that assessed sustainable development in the Engineering, Procurement, and Construction (EPC) Oil and gas industry, with an emphasis on the TBL dimensions of economic, environmental, and social sustainability. The following academic databases were searched: Scopus, Web of Science, IEEE Xplore, Science Direct, and ProQuest Dissertations & Theses. Keywords and Boolean operators were utilized to maximize the identification of relevant literature, with terms such as "TBL," "Sustainable Development," "EPC Industry," "Oil and Gas Sustainability," "Economic Sustainability," "Environmental Sustainability," and "Social Impact." The search was limited to peer-reviewed journal articles, conference papers and dissertations published between 2005 and 2024 to ensure coverage of contemporary practices and developments. After the initial identification of 120 articles, duplicate studies were removed, and the remaining articles were screened for relevance based on the pre-defined eligibility criteria.

3.2 Inclusion and Exclusion Criteria

In order to ensure which the systematic review was conducted satisfactorily, the criteria for both inclusion and exclusion were meticulously developed included only high-quality and pertinent studies, thereby providing valuable insights into sustainable development in the Engineering, Procurement, and Construction (EPC) Oil and gas industry. The inclusion criteria were focused on ensuring the studies addressed core aspects of sustainability within the EPC sector. Specifically, studies had to explicitly focus on sustainable development practices in the Engineering, Procurement, and Construction Oil and gas industry and incorporate the TBL (TBL) framework. Economic, environmental, and social sustainability are the four primary sustainability dimensions that the TBL framework emphasizes, all of which were significant for inclusion.

Furthermore, studies were required to present empirical data or case studies, as these provide practical evidence of sustainability efforts in the EPC industry. In order to guarantee that the research was current and pertinent, only research papers released in 2015 and 2024 was incorporated. In contrast, exclusion criteria were implemented to eliminate studies that were either irrelevant or of inferior quality. These included works that did not directly address the EPC Oil and gas industry, lacked the TBL framework, or were non-empirical, such as opinion pieces and theoretical reviews. Additionally, studies without adequate data or case studies on sustainable practices were excluded to ensure the relevance and quality of the selected research.

3.3 Data Extraction and Analysis

Data extraction involved systematically reviewing the selected studies using a standardized extraction form to maintain consistency and ensure comprehensive coverage of essential study components. Key information was collected, including the study's objectives, which helped define the research scope and focus. The TBL dimensions (economic, environmental, and social) addressed in each study were noted to ensure alignment with the review's core framework. Sustainability practices examined in the studies, such as energy efficiency, waste management, and

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stakeholder engagement, were recorded. Data sources and methodologies, including qualitative, quantitative, or mixed methods, were also extracted to evaluate the rigor of each study. Lastly, key findings and implications related to the effectiveness of sustainability practices in the Engineering, Procurement, and Construction (EPC) sector were summarized. After extraction, the data were analyzed thematically to identify trends, challenges, and opportunities for sustainable development in the EPC Oil and gas industry, leading to actionable insights for future research and industry practices.

Figure 4 provides a visual representation of the systematic review process used in this study, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) model. This flow diagram outlines the various stages involved in selecting studies for the review. At first, 150 records were discovered through exhaustive database searches, which were subsequently complemented by another 20 records obtained through alternative sources. After eliminating duplicates, 170 records were available for further screening. During the screening phase, each record was carefully assessed, resulting in the exclusion of 90 studies due to irrelevance or failure to meet other specific criteria. In the eligibility phase, 60 full-text articles were reviewed for their alignment with the research focus and data completeness. Of these, 15 studies have been eliminated due to incomplete data or noncompliance with the research's scope. Ultimately, 41 studies satisfied the selection criteria and were incorporated into the systematic review, which served as the foundation for the literature review for the study. The objective of this diagram is to elucidate the sequential process that is implemented to guarantee the accuracy, importance, and precision of the research papers chosen for the review, thereby enhancing the robustness and integrity of the results.

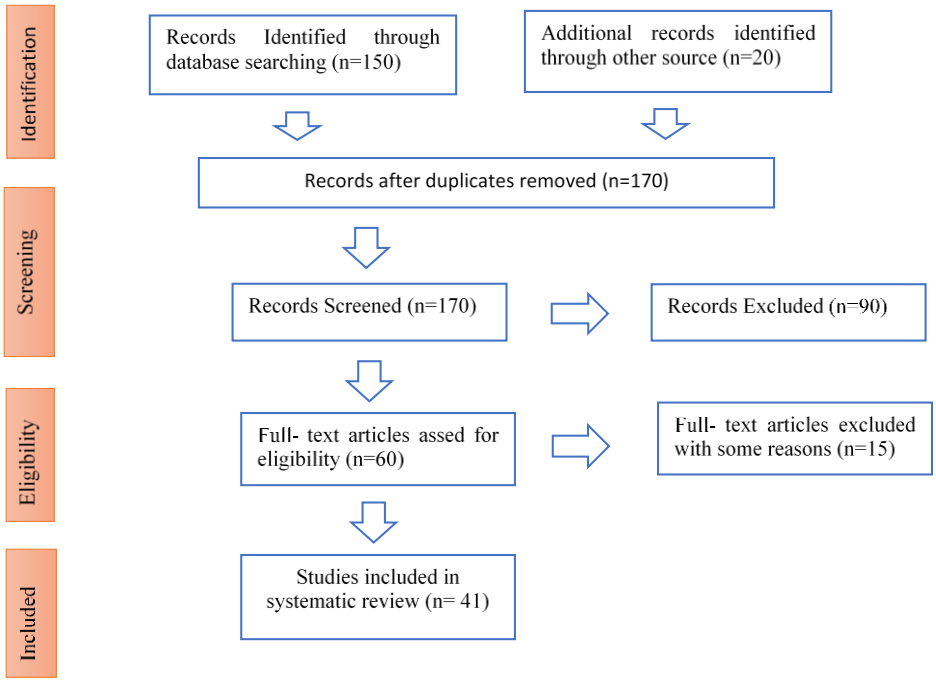

Figure 4: Flow diagram of the study selection process (PRISMA Model).

Figure 5 illustrating the number of reviewed papers published each year from 2015 to 2024. This chart highlights the variability in research activity within the specified time period. The data reveals fluctuations, with 2017 marking a low point of just one paper reviewed, and 2024 showing a peak with seven papers reviewed. The chart also indicates moderate increases in research activity in certain years, such as 2019 and 2022, where five and six papers were reviewed, respectively. This trend suggests that while interest in the topic fluctuated, it steadily increased over time. The peak observed in 2024 points to a rising focus on the subject area, indicating growing scholarly interest and possibly reflecting the increasing relevance of sustainable development in the EPC Oil and gas industry. The purpose of this figure is to visually track the progression of research activity, offering insight into the trends and shifts in the research focus over the past decade.

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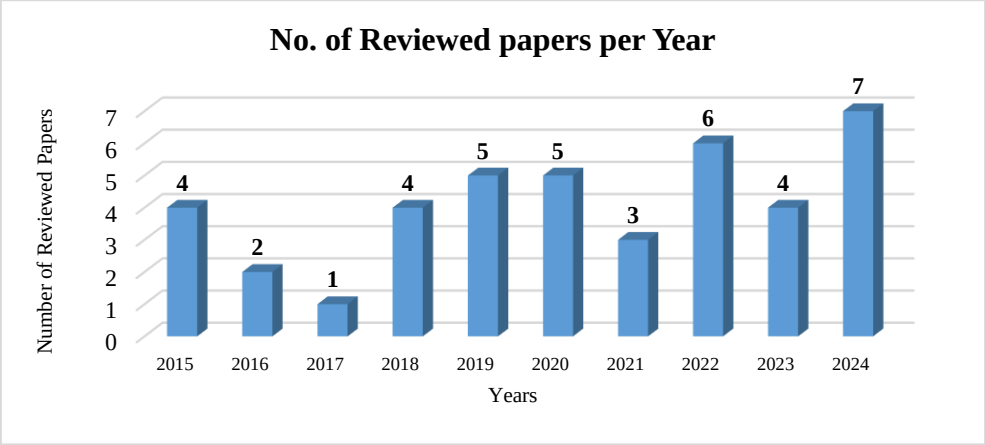

Figure 5: Diagram of reviewed papers.

IV. RESULTS AND DISCUSSION

The outcomes of the study are discussed and evaluated in this section, with a particular emphasis on the effect of the authors' contributions (Lu et al., 2019). The discussion includes the distribution of research across various fields and countries, highlighting patterns in publication volume, citations, and collaborative networks to understand their scholarly influence and global reach (Jacob & Meek, 2013).

4.1 Authors characteristics

Table 4: Authors' Contribution and Influence

Sr. No.	Authors	Publications	Citations	Citations Mean
1	Iztok Podbregar	208	32	0.15
2	Polona Šprajc	176	25	0.14
3	Olja Arsenijević	102	17	0.17
4	Dragan Trivan	100	17	0.17
5	Yvonne Ziegler	98	17	0.17
6	Damjan Maletič	69	7	0.1
7	Mirjana T Radovanović	64	6	0.09
8	Miha Marič	15	3	0.2
9	Marcus Josephus Schultz	12	7	0.58
10	Alenka Baggia	11	1	0.09
11	Mojca Bernik	9	0	
12	Xenia Anastassiou-Hadjicharalambous	9	2	0.22
13	Joseph A Camilleri	9	0	
14	Nicole Petra Juffermans	9	2	0.22
15	Ludhmila Abrahão Hajjar	8	10	1.25

Table 4 provides insights into the contributions and influence of various authors based on their publication count, total citations, and mean citation rate (Milne & Gray, 2013). Iztok Podbregar leads with 208 publications, but his mean citation rate is only 0.15, suggesting extensive contributions but limited individual influence. Similarly, Polona Šprajc (176 publications) and Olja Arsenijević (102 publications) have modest citation averages (0.14 and 0.17), indicating that their work, though active, is not highly cited. In contrast, Marcus Josephus Schultz and Miha Marič stand out with higher citation means of 0.58 and 0.20, respectively, suggesting that although their publication counts are lower, their work has more significant impact. Authors like Ludhmila Abrahão Hajjar and Mojca Bernik show either low citation counts or no citations, implying their contributions are niche or not widely recognized. Authors such as Xenia Anastassiou-Hadjicharalambous and Nicole Petra Juffermans have higher citation means (0.22),

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indicating more influence compared to their publication numbers. Overall, the table highlights a mix of prolific researchers with modest influence and those with fewer but more impactful contributions.

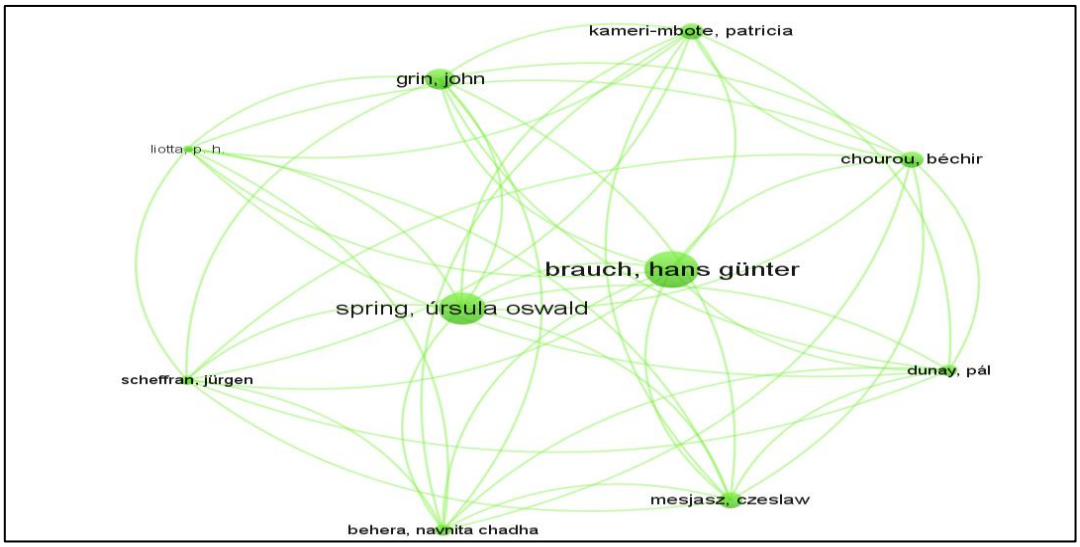

Figure 6: Collaborative Network of Authors

Figure 6 highlights the relationships and contributions of the collaboration network of authors in the study field. Hans Günter Brauch is identified as a central figure, linked to prominent scholars like Ursula Spring, John Grin, and Jürgen Scheffran, indicating substantial collaboration. The size of the nodes reflects each author's centrality, with Brauch's node being the largest. Authors such as Patricia Kameri-Mbote, Béchir Chourou, and Pál Dunay are part of this network, though with more peripheral connections. The connecting lines represent co-authorship, with thicker lines indicating stronger collaborations, showing the network's role in sharing and developing knowledge.

Table 5: Author Contributions by Country Based on Documents, Citations, and Link Strength

Sr. No.	Country	Documents	Citations	Total Link Strength
1	United Kingdom	113	3607	53
2	United States	74	8088	52
3	Italy	44	388	30
4	Germany	52	3204	22
5	Australia	21	3744	20
6	France	26	144	20
7	China	30	4166	17
8	Greece	25	45	16
9	India	23	396	4
10	Japan	30	26	14
11	Brazil	29	31	13
12	Canada	33	319	13
13	Turkey	22	40	13
14	Norway	5	104	12

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15	Spain	29	29	12

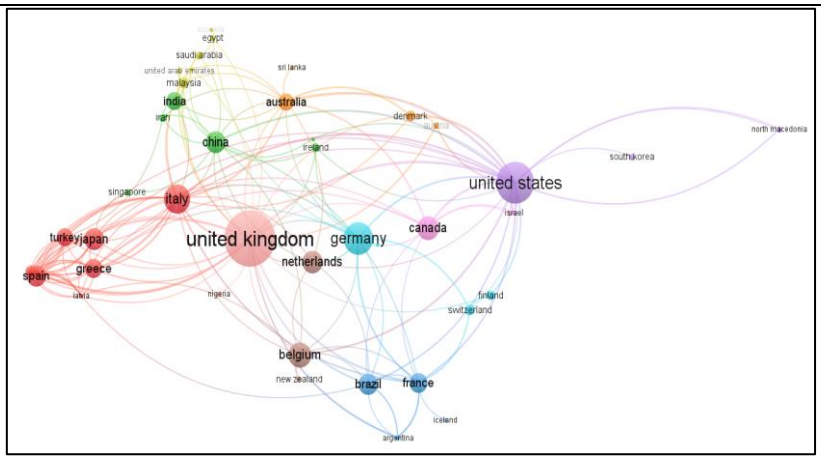

Figure 7: Global Distribution of Research Contributions

The number in documents released, the total link strength, and the number of citations received are the primary focus of Table 5 or figure 7, which provide a summary of author outputs by country. The United Kingdom leads with 113 documents, 3,607 citations, and the highest link strength of 53, indicating significant scholarly output and strong collaborative ties. The United States follows with 74 documents, 8,088 citations, and a link strength of 52, showcasing its substantial influence in the field. Italy ranks third with 44 documents, 388 citations, and a total link strength of 30, suggesting moderate productivity and collaboration. Other countries like Germany, Australia, and China show notable contributions, though with lower link strength compared to the top two. India has fewer documents (23), citations (396), and minimal link strength (4), indicating relatively limited engagement in the field compared to other nations. The table highlights global variations in research output and collaborative impact.

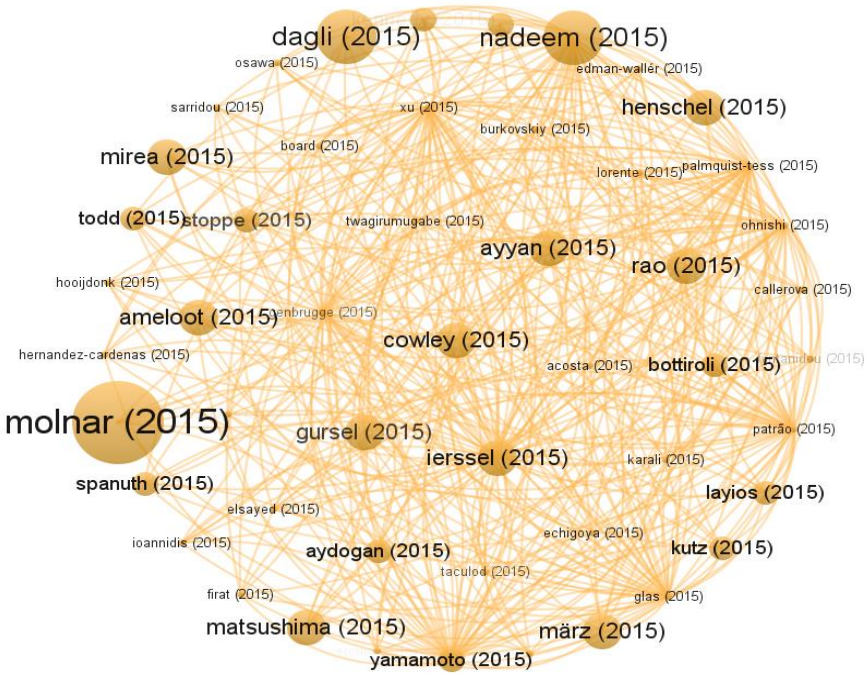

Figure 8: Author Collaboration Network

Figure 8 depicts the collaboration network of authors who contributed to research in 2015. The nodes represent individual authors, with the size of each node corresponding to the level of their collaboration within the network. The large nodes, such as Molnar (2015), Nadeem (2015), and Dagli (2015), indicate that these authors were central

figures in the research community of 2015, with significant collaboration with other scholars. The connecting lines between the nodes represent co-authorships, and the density of connections suggests high collaboration. The overall structure shows a tightly knit research community where many authors were engaged in joint efforts. The density of the network highlights the importance of collective research in advancing knowledge, with several authors, such as Rao (2015) and Henschel (2015), having numerous collaborations within the year. This network underscores the collaborative nature of academic research and the interconnectivity of scholars.

4.2 Publication characteristics

Table 6: Field-wise Distribution of Research Contributions and Citations

Sr. No.	Fields of Research	Publications	Citations	Citations Mean
1	Information and Computing Sciences	911	6974	7.66
2	Commerce, Management, Tourism and Services	808	5355	6.63
3	Biomedical and Clinical Sciences	788	3839	4.87
4	Strategy, Management and Organisational Behaviour	562	3756	6.68
5	Engineering	498	11087	22.26
6	Health Sciences	424	1099	2.59
7	Human Society	397	5118	12.89
8	Philosophy and Religious Studies	290	890	3.07
9	Economics	265	732	2.76
10	Information Systems	253	2144	8.47
11	Built Environment and Design	239	3457	14.46
12	Law and Legal Studies	229	2129	9.3

Table 6 shows the distribution of research contributions and citations across different fields of study, providing insights into productivity and scholarly impact. With a citation mean of 7.66 and the highest number of articles (911), the Information Technology and Computing Sciences area is the most prolific, suggesting an elevated level of research activity while somewhat prominent academic recognition. The Engineering field stands out with the highest citations (11,087) and the highest citation mean (22.26), reflecting its significant influence within academic and industrial communities. Fields such as Human Society (12.89 mean citations) and Strategy, Management, and Organisational Behaviour (6.68 mean citations) also show notable scholarly impact. Health Sciences, with 424 publications and a citation mean of 2.59, reflects fewer citations despite a substantial number of publications. Economics and Philosophy and Religious Studies exhibit lower citation averages, suggesting relatively less citation attention despite ongoing research efforts. Overall, this table underscores the varying levels of impact and productivity across different research disciplines.

V. CONCLUSION

This systematic review highlights the critical role of the TBL framework in promoting sustainable development within the Engineering, Procurement, and Construction Oil and gas industry. The integration of economic, social and environmental variables is crucial for the future viability of initiatives within the sector, as per the results of numerous studies. While numerous authors have contributed to understanding the significance of energy efficiency, corporate social responsibility, and renewable energy, challenges remain in fully integrating these dimensions into industry practices. The reviewed studies reveal a mix of promising approaches and existing barriers, particularly in supply chain management, procurement strategies, and community engagement, which require further attention for more effective sustainability outcomes. The central role of energy efficiency, CSR, and the need for clear and consistent terminology in sustainability reporting has been highlighted as a key area for improvement. Additionally, while some authors suggest frameworks for integrating TBL principles, there is still a gap in developing tools that effectively address the unique challenges of the EPC sector, such as procurement efficiency and stakeholder involvement.

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Future Scope:

Future research in the Engineering, Procurement, and Construction Oil and gas industry should focus on advancing sustainable practices and enhancing the integration of the TBL framework. Key areas for future exploration include:

1. **Refining and Operationalizing the TBL Framework:** Developing more effective methods to implement and measure the integration of economic, environmental, and social factors within EPC projects.
2. **Procurement and Supply Chain Management:** Creating flexible tools and strategies to enhance the sustainability of procurement and supply chain management within the industry.
3. **Overcoming Barriers to Community Participation:** Addressing challenges related to community engagement, transparency, and local involvement to improve social sustainability in projects.
4. **Exploring Emerging Technologies:** Investigating the role of digital platforms and emerging technologies for enhancing supply chain transparency and sustainability efforts.
5. **Examining CSR Practices:** Continued research into the alignment of CSR practices with environmental and social improvements, and how these can foster long-term sustainability in the sector.
6. **Developing Sustainable Performance Metrics:** Creating performance metrics that better evaluate the full impact of EPC projects across all three TBL dimensions (economic, environmental, and social).

By focusing on these areas, future research can drive innovation, improve sustainability, and address the challenges faced by the EPC Oil and gas industry.

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