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Applications of AI in oil and gas projects towards sustainable development: a systematic literature review

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Abstract

Oil and gas construction projects are critical for meeting global demand for fossil fuels, but they also present unique risks and challenges that require innovative construction approaches. Artificial Intelligence (AI) has emerged as a promising technology for tackling these challenges, and this study examines its applications for sustainable development in the oil and gas industry. Using a systematic literature review (SLR), this research evaluates research trends from 2011 to 2022. It provides a detailed analysis of how AI suits oil and gas construction. A total of 115 research articles were reviewed to identify original contributions, and the findings indicate a positive trend in AI research related to oil and gas construction projects, especially after 2016. The originality of this study lies in its comprehensive analysis of the latest research on AI applications in the oil and gas industry and its contribution to developing recommendations for improving the sustainability of oil and gas projects. This research's originality is in providing insight into the most promising AI applications and methodologies that can help drive sustainable development in the oil and gas industry.

Keywords Artificial intelligence (AI) · Oil and gas projects · Sustainable development · Systematic literature review

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1 Introduction

With the growth of challenges in the oil and gas industry, new technologies are being introduced to maximize performance and help fulfill the increasing demand for oil and gas. Artificial Intelligence (AI) is one of the leading technologies in development. Still, it is being adopted in the oil and gas industry to gain a competitive advantage and reduce the challenges that various oil and gas projects face worldwide (Al Dhaif et al. 2022). The technology has improved the automation in the oil and gas projects, further enhancing reliability and maintaining the incorporation of digital technology in the overall process. The worldwide oil and gas industries generated more than 5 trillion US dollars in 2021 alone, and as the industry grows, it will further contribute to the worldwide economy (Iliinskij et al. 2022).

The sustainability aspect of AI is highly valuable because it is the only way the technology can provide the greatest development for its applications. For example, the oil and gas industry needs high sustainability because of the operations' increasing complexities and market demands, which drive companies to adopt more advanced methodologies than traditional methods (Vaio et al. 2020). AI is expected to improve every aspect of the projects in the oil and gas industry, but its drawbacks cannot be ignored (Pishgar et al. 2021). The rapid development that is going on in AI may likely result in compromising privacy and also reduce the requirements of human resources in the industries of the future. It is critical to the rising development of AI because it will threaten various businesses that depend on human resources and can easily disrupt the economy if it is misused badly. AI must open up new applications that humans never expected before, and the sustainability trends on a global scale are gradually changing. It will have major applications in every industry, including oil and gas. Despite its negative aspects, it is needed in modern industry and construction projects because of the increasing requirements for sustainability (Khalid et al. 2021). Ultimately, AI can be expected to help implement the sustainable development goals in oil and gas projects and make them more tolerable for every stakeholder (Li et al. 2021).

From the start of the twenty-first century, there has been researching on the development of AI and its applications in the industry to create better outcomes for research and practical knowledge. Vast knowledge is available that is relevant to AI and its possible applications that are published in academic journals all over the world. It is because AI has created positive prospects for improving construction engineering productivity and making everything more efficient, which is always the goal of every business and individual human being (Rahman et al. 2021). Furthermore, the technical improvements and possible applications have resulted in increasing the research trends, which results in producing important academic information. In the construction industry overall, the incorporation of AI is greatly investigated. But its availability and relativity to the oil and gas industry are low as compared to other segments of the global industry (Qing 2021).

The lack of a Systematic Literature Review (SLR) makes it completely difficult to know the practical applications of AI in the oil and gas projects that lead them towards sustainable development. Therefore, the objectives of the study are:

- From 2011 to 2022 (September), what is the annual publication trend of AI in oil and gas projects toward sustainable development?
- What are the leading journal contributions in the direction of adopting AI in oil and gas projects toward sustainable development?

- What is the geospatial distribution of research trends in developed and developing countries regarding AI applications in oil and gas projects toward sustainable development?
- What are the oil and gas projects' activities, their features and sustainable assessment towards development?
- What future recommendations can be drawn from this study regarding applications of AI in the oil and gas industry toward sustainable development?

To fulfil the research gap, the SLR was employed as the research methodology to answer each question so that the study could provide positive implications from both a theoretical and practical perspective. It is expected that the answers to these questions will help the oil and gas industry projects become more efficient and provide academy knowledge that will be comprehensive enough to further research.

2 Theoretical background

The oil and gas business is the only one that has benefited from the growing use of artificial intelligence (AI). AI is the attempt to create computer systems capable of doing activities ordinarily requiring human intellect. AI has many potential benefits in the oil and gas business, from exploration and drilling to production and distribution. Due to low oil prices, greater competition, and the need to adopt sustainable practices, the use of AI in oil and gas projects has become more significant in recent years. We mean by "sustainable development" in the oil and gas sector is adopting policies and procedures that allow the industry to satisfy its present energy demands while protecting the environment for future generations. AI may aid sustainable growth in the sector by enhancing efficiency, cutting waste, and bolstering worker protection. AI can improve drilling efficiency, reduce waste, and provide more precise estimates of environmental implications (Vaio et al. 2020).

Additionally, according to recent estimates, it is found that the global oil and gas industries contribute around 3% of the world's GDP, and in the next ten years, it is expected that it will increase to more than 5% (Leal Filho et al. 2022). It is because of the developments that are going on in the oil and gas industry that support millions of jobs along with improving the availability of energy, based on which the global industry is running. The United States is a major contributor to the development of the oil and gas industry, and it is the reason that public and private sector organizations started to invest in increasing the use of the latest technology so that they could easily increase production and further do the projects efficiently (Kumar and Barua 2022). For example, the United States has passed regulations to implement AI for the extraction of oil and gas, and it is still under development because of the limitations of current technologies adopted in the industry. In 2021, the United States government invested around 52.9 billion US dollars in incorporating AI in different industrial segments, while the UK government contributed 4.6 billion US dollars. China is also leading the global industry, and it invested 17.2 billion US dollars in developing AI technology to the greatest level and increasing its applications in oil and gas projects (Kim et al. 2022). Developed economies need to invest in such technology because it is the only way the industry can progress while remaining in the highly competitive market, which is greatly improved by globalization. The minimization of cost is also one of the key factors behind implementing AI technology related to construction projects happening in the oil and gas industry. From a historical perspective, the incorporation of technology

has resulted in reducing the prices of projects, and the same effect can be expected from the oil and gas projects because AI is also helping the companies to drive their cost of operations down so that they can sell their projects competitively in the market (Jiao et al. 2019).

Depicting human functionality is always a major objective of developers who are working on AI. When intelligence integration is made with the machine, it is always expected to perform gradually better with each learning process (Olukoga and Feng 2021). It is because AI is entirely based on simulating human functions as much as possible while following hardware technology's current availability and limitations. Significant improvement has been happening in AI, and that is increasing the communication as well as cognitive thinking abilities of the AI (Vaio et al. 2020; Sinha et al. 2020). It is acceptable that AI will pass the human intelligence limits at some point in the future, and that will be the point where machine intelligence will be more profound than human intelligence. Depending on the requirements, the machines can be programmed to perform any specific function concerning their environment (Desai et al. 2021). It is the basic level of AI, known as narrow artificial intelligence, and it is further expanded by integrating human intelligence, commonly known as general artificial intelligence. The mimicking of human intelligence is computers' main priority when operating in AI, and it is a reason that they provide an effective ability to improve sustainability in the applications without any human intervention (Vaio et al. 2020; Kushzhanov and Mahammadli 2019). The highest level of AI perceived incorporates the intelligence that must surpass the human brain limits. Still, it is practically beyond the rich while using the existing methods of development of AI and technologies (Wang et al. 2021).

AI, sustainable development, and the oil and gas business may all benefit from the "circular economy" paradigm. The circular economy is a way of doing business that places a premium on recycling and reusing materials. Waste and pollution are avoided through design, resources are conserved, and ecosystems are revitalized. Many avenues exist for implementing the circular economy in the oil and gas sector. One strategy is working to lessen the damage done by the extraction and production of oil and gas, in accordance with M. Ávila-Gutiérrez et al. (Ávila-Gutiérrez et al. 2019). Optimizing drilling operations, decreasing energy usage, and enhancing waste management are all ways in which AI might help accomplish this goal. To further implement the circular economy idea in the oil and gas business, artificial intelligence may be used to facilitate the creation of renewable energy options. The sector may lessen its negative effects on the environment and cut down on its reliance on fossil fuels by investing in renewable energy sources like solar and wind power (Ávila-Gutiérrez et al. 2019). The circular economy theoretical framework relies heavily on sustainable development. The oil and gas business may maximize its positive effects on society and the environment while limiting its negative ones if it puts social, environmental, and economic sustainability first. Improved decision-making, risk identification, and stakeholder communication and cooperation are all ways in which AI may contribute to sustainable development. Integrating AI, sustainable development, and the oil and gas sector is theoretically supported by the circular economy framework. Using this theoretical framework, this study is framed.

Some reviews relevant to the applications of AI in the oil and gas segment have been published, but these do not focus on improving the solutions to the challenges that current oil and gas projects face. The traditional approaches mostly utilized in oil and gas construction projects do not significantly improve productivity (Vaio et al. 2020). The academic demand for research is also increasing, along with increasing requirements for literature focusing on AI. Most of the literature further emphasizes the importance of AI in oil and

gas projects due to the complete lack of comprehensive studies that could help the human resources relevant to the oil and gas industry projects adopt this technology. There is also a need for more information on AI techniques and realistic approaches that could be used to improve outcomes in the oil and gas industry.

3 Research methodology

The methodology of this paper is based on conducting the SLR to achieve the objectives as presented in the introduction. The reliability of SLR is high compared to normal literature review because it involves evaluation in successive five stages, which focus on all the inclusion factors needed to select the research papers and then review them (Weißer et al. 2020). The first step is the selection of objectives. Afterwards, it moves towards the selection of appropriate databases of research articles. Credible research databases were selected for this study to increase the reliability of analysis and further improve accuracy in identifying the keywords (Artificial Intelligence (AI); Oil and Gas Projects; Sustainable Development; Systematic Literature Review). The compatible research papers, according to the inclusion factors of the study and also concerning keyboards, are included for SLR. The last step involves the extraction of data so that it can be analysed (Vaio et al. 2023). As the research focuses on identifying the influence of AI on oil and gas construction projects, it is the significant objective based on which the SLR was started. It further involved the variety of features associated with AI and the oil and gas construction field (Temitope Yekeen et al. 2020). For the database selected by the authors of this study, it was decided to choose Scopus, Google Scholar, and ScienceDirect. There is a selection of these databases because of their credibility in research and the way they can provide valuable data for open-access research papers.

Scopus, Google Scholar, and ScienceDirect were picked because of their high standards and reputations as credible sources of information for scholarly research (Vaio et al. 2023). Scopus is an excellent resource for finding relevant articles in the domains of AI and oil and gas projects since it indexes research material from a wide range of scientific, technological, medical, and social science disciplines (Salazar-Reyna et al. 2022). Google Scholar is a free, publicly available search engine that catalogues journal articles, books, theses, and conference proceedings from a wide variety of academic fields and publishers (Snyder 2019). The purpose of this search database is to facilitate a comprehensive search across a variety of resources, including those maintained by universities, libraries, professional organizations, and other online publications (Wohlin and Runeson 2021). Certain keywords and phrases relevant to AI in oil and gas projects were used to narrow the search to just English language papers for this investigation. As a result, the search criteria were not focused on particular journals or areas of study, but rather on the papers' suitability for achieving the study's aims (Turnbull et al. 2021). To guarantee that the search is relevant to the most recent advancements in the area, publications published between 2010 and 2021 were the only ones considered for inclusion in this research. The selection of this decade is further supported by the fast development and evolution of AI technology and their applications. The databases included in this analysis were selected for their credibility and data quality (Polater 2020; Hizam-Hanafiah et al. 2020). Scopus, Google Scholar, and Science-Direct were used to find a variety of articles on the topic of artificial intelligence (AI) in oil and gas projects. No restrictions were placed on the search parameters with respect to the of the disciplines of study in which they were published (Paul et al. 2021). Given the

explosive growth of AI technology and their applications over the last decade, the study's time frame was chosen to include the most recent trends and breakthroughs in the area (Ahmed et al. 2021).

VOSviewer was selected for this investigation for a number of reasons. To begin with, it is a trusted method of bibliometric analysis that can identify the most important publications, authors, and search terms for the study of AI's potential uses in the oil and gas projects. Two, it doesn't need a PhD in bibliometrics to utilize, thus even novice researchers may benefit from it. Finally, it allows researchers to personalize their studies to their own study questions and data by providing a wide variety of choices for constructing maps and visualizations.

The keywords used to search the research articles from the selected databases were: Artificial Intelligence, Oil and Gas Construction, Neural Networks, Machine Learning, Sustainable Development, Sustainability, Offshore Oil and Gas Projects, and Onshore Oil and Gas Projects. Combined keywords and the overall articles were evaluated from the databases. The selection process consisted of eradicating any article that was unrelated to the engineering field, almost exclusively to the construction of oil and gas projects. Further, other areas, such as agriculture and medicine, are also found in the articles, and those were also excluded. The screening process began, with only papers published afterwards being considered. The abstract and title of the screen papers were reviewed from the perspective of their implications according to research objectives. A further screening process was completed to obtain only 115 research articles that fully complied with the requirements of the study. The data extraction process was started based on selected papers, and each piece was reviewed fully to obtain insights according to the research objectives. The methodology provided significant leverage in conducting the SLR only on the research articles relevant to the research topic. The SLR did not only focus on some of the research papers but critically analysed the arguments provided by the existing researchers. The expected outcomes were achieved according to the behaviour of existing research in conjunction with advancements in AI and the field of oil and gas construction projects. The detailed methodology flowchart is shown in Fig. 1.

4 Results

In the following section, the publication trend on an annual day is presented that corresponds with AI in oil and gas construction projects. The annual publication can be presented from the perspective of sustainable development and also the way research is continuing on AI and the oil and gas construction sector. The study objectives: it is important to investigate the publication trends along with the behaviour of research in existing literature, which have provided significant growth in adoption of AI in sustainable development of oil and gas projects. The section presents the overall results obtained from the detailed analysis of research papers as selected through the SLR methodology.

4.1 Annual publication trend

The overall publications selected for the study after 2010 and till August 2022 are listed below. The reason for choosing research papers after 2010 is that the significant level of AI development started in this era. The maximum number of publications was observed in 2020 and 2021. Before that, the existing literature was considerably less, as the number
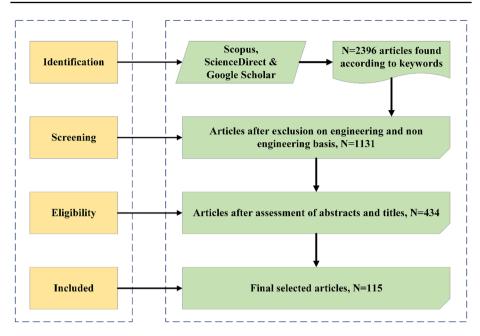
Fig. 1 Research flowchart

of publications decreased when the analysis was conducted in 2011. It is because there is continuous growth in AI research all over the world, and the same behaviour is observed in the scenario of applications of AI in oil and gas construction projects (Choi et al. 2021). The number of publications every year is increasing, which is positive from the perspective of applications of AI and also means that the technology is already at practical levels in the construction of oil and gas projects. The challenges are also increasing over time in oil and gas construction projects, where the adoption of new technology is becoming more evident (Manzoor et al. 2021). Therefore, the research is also supporting the practical scenarios with theoretical evidence. Furthermore, from a historical perspective, it is evident that the AI contribution was not significant before 2010 in oil and gas projects because most of the processes were done traditionally, and the construction sector overall had not adopted even the basic principles of AI, as evident from Fig. 2. The availability of relevant technologies and the increasing computational power of computers have maximised AI development and produced effective outcomes for the overall construction of oil and gas projects.
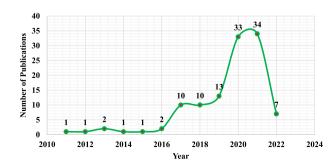
Fig. 2 Annual publication trend of AI in oil and gas project sustainable development

Positive prospects can therefore be established from the annual publication trends, which further strengthens the need for no research in this field to maximise the performance of oil and gas construction projects.

4.2 Contribution of leading journals

Because most research papers are published in the society of petroleum engineers' Journal, the contribution of journals to the sustainable development of AI in all gas construction projects is significant and diverse. The other journals have few papers because there are still substantial advancements in AI, and not every general involves publications as shown in Table 1. Most journals are starting to publish articles on the social media development of AI and oil and gas projects because only single documents exist in such journals.

The behaviour observed from the analysis of the contribution of journals towards AI and system development is completely appropriate because AI is still developing, and there are no sustainable aspects available in the research community which could increase the adoption of AI topics (Ahmed et al. 2021; de Gaudencio et al. 2021). It is also observed that most of the generals in its papers are published more than 2 years after 2016. Most research articles published in 2020 and 2022 have only single evidence in any journal, which fully justifies the scenario under which the research is being conducted and the practical development going on in oil and gas construction projects. Positive expectations exist because future research will expand, and more opportunities will exist for researchers to continue their work on evaluating AI-related development of oil and gas projects.

4.3 Geospatial distribution involving developed and developing countries

In the United States and the United Kingdom, there is significant research in the field of AI, and that is because of the development scale of countries from the perspective of adopting new technologies. It can be considered that the United States is leading the developments

Table 1 Contribution of journals towards AI and sustainable development

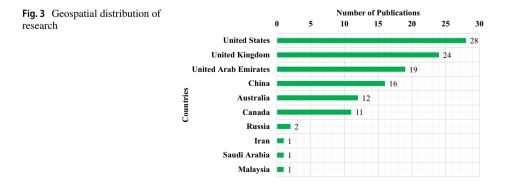| Research articles	Number of articles	Percentage (%)
Journal of Petroleum Technology,	8	6.96
Journal of Petroleum Science and Engineering,	5	4.35
Automation in Construction,	3	2.61
Journal of Energy Resources Technology, Transactions of the ASME,	3	2.61
Arabian Journal for Science and Engineering,	2	1.74
Environment, Development and Sustainability,	2	1.74
Georesursy,	2	1.74
IEEE Access,	2	1.74
Neftyanoe Khozyaystvo—Oil Industry,	2	1.74
Proceedings—SPE Annual Technical Conference and Exhibition,	2	1.74
SPE/IADC Drilling Conference, Proceedings,	2	1.74
Sustainability (Switzerland),	2	1.74
Others	80	69.57

in AI technology, which is further proven from the analysis of research trends, as shown in Fig. 3. The behaviour is completely acceptable because of the United States' significant contribution to petroleum infrastructure development over the last few decades. The country's research is constantly developing new methods of improving the sustainability of oil and gas projects. Similarly, in the case of the UAE, considerable research is being conducted, verified from the perspective of the expansion of new oil fields and establishing offshore and onshore oil structures, which are helping the country grow its economy.

China is also not far behind in AI development and its implementation in oil and gas projects (Stefanakis 2020). Similarly, there is motivation in Australia and Canada to improve the sustainability of oil and gas projects so that they can become more reliable and provide an uninterrupted flow of fuel to meet rising demand. Research evidence from Russia is considerably less, which means there is no significant contribution, and similar is the case with Iran, Saudi Arabia, and Malaysia. However, it is observed that the countries with fewer publications are now developing their interest in the field of AI compared to the developed countries like the United States and the United Kingdom, which have been working on AI for more than two decades now (Som 2021). It can be established from the behaviour of the number of publications and their association with the countries that the development rate in the government influences the research on AI. In contrast, developing countries have started to work on AI and its association with oil and gas projects.

4.4 AI based interventions for oil and gas projects

All the papers involved in SLR were analyzed for the co-occurrence of keywords involved in the abstract title involved in each research article. The links between AI and the associated interventions introduced in the chapter can only be evaluated by visualizing information like a network map.

It is the reason that the VOS Viewer was used to construct the map of links between AI and the most common interventions introduced by it in all selected papers for SLR. From Fig. 4, the association of AI was significant with machine learning, drilling parameters, neural network modeling, neural networks, predictive maintenance, deep learning, drilling and completion, logging interpretation, big data, digital technologies, upstream, and digital transformation. The figure specifically shows the scale of AI-based interventions implemented in oil and gas projects. From the visualization, the prospects related to increased accuracy of SLR can be established because AI applications have significantly increased, resulting in considerably better results for firms
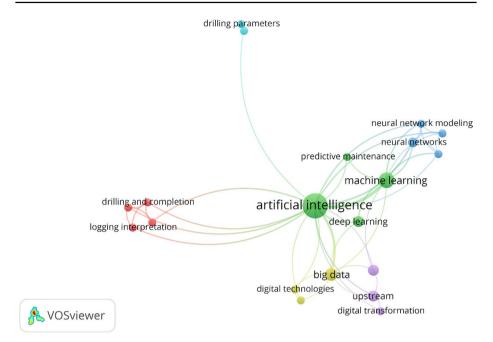
Fig. 3 Geospatial distribution of research

Fig. 4 Visualization of AI and its applications in existing research

operating in high-risk environments. The literature published already shows significant adoption of AI in oil and gas projects, which is positive for the growth of project efficiency.

5 Research article citation trend

Research in oil and gas construction is increasing, evident from the variety of practical-level interventions introduced yearly. From a theoretical perspective, the credibility and importance of any research article are high when more future researchers cite it in their work. As a part of SLR, the detailed evaluation of selected papers was carried out from the perspective of the number of times researchers cited articles in their work. Furthermore, the country-wise distribution was created based on the relativity of research articles to specific countries.

Ten countries were included, and research articles from 2011 to 2022 were analysed and presented in Fig. 5. Countries like the USA, UK, Canada, and UAE have the highest number of articles in the selected tenure. The number of researchers citing the articles is also high compared to other countries. However, it was found that the research work is continuously increasing as the number of publications in each country increases. With a positive research trend, more citations for research articles in the creation of new researchers, and more research efficiency for the developed nations, it can be said that theoretical work in AI is increasing.
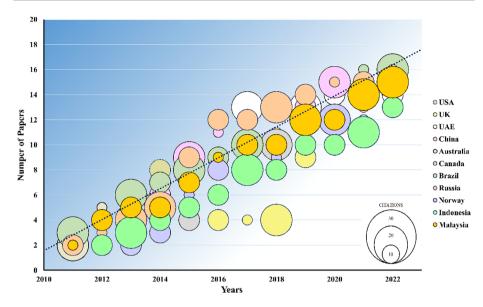
Fig. 5 Country wise research article and their citations trend

5.1 Oil and gas projects towards sustainability

The complex nature of oil and gas construction projects makes them very difficult to compete with the desired sustainability. Therefore, every process implemented in the construction of oil and gas projects must correspond with maximum sustainability to help the relevant stakeholders benefit after completing the tasks (Dmitrievsky et al. 2021a). The high-risk environment creates a negative impact on the construction of oil and gas projects and further has a critical association with economic and environmental concerns. Most of the time, when these projects are initiated under the control of large construction companies, it is entirely possible that the projects may go through substantial delays, eventually disturbing sustainability (Al Dhaif et al. 2022). The societal impact can also not be ignored because it is one of the prominent elements of sustainability where construction projects are initiated. In the last few years, significant development work has been going on to improve the project life cycle in the oil and gas construction sector because it is the only way by which the cost of construction can be reduced, and its maintenance can be made more affordable for the operators (Dmitrievsky et al. 2021b). Every activity undertaken in an oil and gas construction project directly affects the product life cycle and eventually decreases sustainability when not properly monitored (Bag et al. 2021). The direction of each oil and gas project towards sustainability is very difficult to set with traditional means. Still, in every construction phase, it is becoming an important narrative to adopt methods that are far from conventional approaches. Any oil and gas project goes through three major project life cycle phases: construction, operation, and deconstruction (Choubey and Karmakar 2021; Pishgar et al. 2021). The following sections include the critical analysis of oil and gas projects towards sustainability in each of these phases.

5.1.1 Construction phase

Before any construction process is started, it is always important to develop the necessary plans and resource scheduling as it could easily help the construction workers to have better productivity. In the Oil and Gas sector, there is always a lack of documented strategies, which results in a loss of efficiency from a sustainability standpoint when any oil and gas project is in the construction phase (Capello 2020). It is because in project management practises, well-documented strategies are always required because they promise effective cost and time reduction while also focusing on improving resource scheduling. Various new techniques are introduced in the product management practices, and the necessary designs are completed before the construction work is started (Elijah et al. 2021). Still, ultimately, the effectiveness of all of these efforts depends on the major strategy and tools adopted by the project management workforce. Decreasing waste is an important objective of sustainability in the construction phase because when waste is released into the environment in oil and gas projects, it has drastic consequences for the overall ecosystem (Shen et al. 2021; Ruiz-Serna et al. 2019). They are initiated onshore and offshore because of the nature of oil and gas construction projects (Agwu et al. 2018).

Depending on the complexity of overall projects, adopting a well-defined organisational strategy is highly important because, without it, the operational activities in the construction work cannot be completed with maximum sustainability (Li et al. 2021; Syed et al. 2022). It is revealed from the existing research that constant improvements are being made in terms of the reduction of construction waste and also promoting the implementation of better environmental controls that bring every construction project in the oil and gas sector significant steps closer to sustainability (Olukoga and Feng 2021). The practical experience evident from the existing research is passed, which promises further incorporation of all the innovative strategies that help the oil and gas construction projects improve their relativity with sustainability. However, eliminating construction waste and dealing with issues such as resource scheduling and the cost of oil gas projects can be solved when product management departs from traditional approaches (Kaiser 2017).

Because of the various studies carried out under project management during the oil and gas construction phase, these have direct applications from a practical standpoint over each activity in the construction work. Another important aspect revealed by the existing literature is flexibility, which promotes adaptability to the various situations in which construction projects can be initiated and how these projects can bring oil and gas construction work closer to full sustainability (Vaangal 2021). From the future perspective, recent developments in the oil and gas construction phase may bring more reliability in improving environmental compliance and also increase the economic impact. Any strategy that results from the consequence of significant research will always promote the construction phase efficiency in the future. It will also help reduce construction accidents that are not significantly devastating for the workers in construction.

5.1.2 Operation phase

When the construction of oil and gas projects is completed, it is always important for them to start the operations for which they were constructed. The severity and complexity of the overall process involved in the operational phase remain the same as it was in construction. Still, the risks are new from the sustainability perspective, and it needs more robust

strategies (Khan et al. 2020; Mahmoud et al. 2019). The safety factor is highly important because, as the existing research has shown, many safety-related accidents occur on the sites where the oil and gas rigs are operational (Kuang et al. 2021). The risk factors depend entirely on operational process efficiency because, ultimately, there is always a need for an effective working method to bring sustainability to a higher level while increasing product life cycle efficiency (Mehta et al. 2021; Ibrahim et al. 2022). The day-to-day operations in the operational phase of an oil and gas project have the major objective of producing more oil and gas so that the clients can be satisfied. Any active oil and gas project will always be highly efficient when creating more oil and gas (Kuang et al. 2021).

This further complicates the overall operational process because, most of the time, there are certain difficulties through which it is very difficult for the product management workforce to navigate while dealing with the traditional approaches of hazard control and operational process management (Castro Pena et al. 2021). There are always chances of failed operations in oil and gas construction projects when they are going through the active phase because, ultimately, they are dealing with the forces of nature to extract fossil fuels. Several improvements in the theoretical evidence have been made over the last decade. It is because of the increased production of oil and gas worldwide (Salem et al. 2022; Khamis et al. 2020). The modern operational management methods can be entirely related to total quality management or specifically associated with customised operations where the strategies can be significantly diverse from the theoretical research (Ibrahim and Elkatatny 2022).

In the operational phase of the oil and gas projects, the most critical aspect is experienced because it helps in lining the resources appropriately and further streamlining the process, which does not harm every stakeholder (Oort et al. 2021). Significant emphasis is made from the operational perspective in research that it is relevant to safety and, ultimately, without protection, there is no sustainability. Most of the extends happen during the project's active phase because certain challenges in the product life cycle cannot be implemented until the management structure is completely changed. It is because the working efficiency of overall operations systems depends on internal and external factors that always bring the risk of uncertainty to the highest level (Kalinin et al. 2021). The operating method has direct implications for sustainability, which also points out the effective use of relevant new technology to help bring sustainability to the highest level, ultimately improving the operation management of oil and gas projects.

5.1.3 Deconstruction phase

The decommissioning of oil and gas projects starts after their life cycle is completed because, at the end of their operational requirements, it is entirely important to recycle the materials. It is because the construction of oil and gas projects is completed using metals as structural raw materials, which can be easily according to requirements (Feder 2021). Because of the billions of dollars invested in oil and gas projects, recycling them has a direct relationship with ability because it will ultimately improve the environmental benefit and bring this type of product life cycle to be maintained appropriately (Tra et al. 2019; Elkatatny and Mahmoud 2018). The techniques are entirely different in the deconstruction process, in which heavy equipment is always utilised, and specially designed equipment can also be used because the materials resulting after the demolition work is completed will be used to construct the oil and gas projects again (Ghorbani and Behzadan 2021).

The restricted work environment is always maintained when the development is going on in the construction of oil and gas projects. Still, after their services are completed, the process is further complicated because it requires highly skilled workers (Elwan et al. 2021). One of the most effective approaches evident from the literature and practical evidence is using a top-down approach, as it could help the construction workers to demolish the oil and gas rigs promptly (Islamov et al. 2021). It would not be wrong to associate the demolition work of oil and gas wells with the new project management process, which needs specially designed resource management and equipment. However, using any method of demolition will directly impact the environment because, in the end, there is no way to reduce the environmental impact when the exploration of any structure is high (Ahmed et al. 2021). But there has indeed been considerable development over the last few years, which has resulted in the introduction of other methods that make the demolition work easier (Ashraf et al. 2020; Bagheri et al. 2021). For example, after the structural demolition work is completed, it is always the major objective of the product life cycle to shut down the wells that are providing oil and gas. Accidents are common because inappropriate principles are easily adopted when the complex scheduling process is maintained due to limited demolition resources available (Di et al. 2021). However, the accepted reality from the existing research is that the demolition methods need significant improvements to become more relevant with the technology that can bring sustainability to the construction of oil and gas projects. There are implications from the current research need for improvement in the method adopted for planning the demolition work in oil and gas projects (Oort et al. 2021). Mobility is one of the chief factors in demolition work because it can make the resource scheduling process more efficient and reduce time, which is one of the critical factors in any construction project (Table 2).

5.2 Features of oil and gas projects towards sustainability

Because of the complexities involved in oil and gas construction projects, they are significantly different from the perspective of their features and their association with sustainability. The nature of interconnectivity is important to consider here because it connects the other elements of the project towards the goals of sustainability (Rahmanifard and Plaksina. 2019). Similarly, the functionality of oil and gas projects also has value from the perspective of giving an efficient performance. Unpredictability also exists in oil and gas projects, making them highly vulnerable to various risk factors. Similarly, individuality can also be a major feature of oil and gas projects as they always contain certain operations that are not happening in other construction projects.

5.2.1 Interconnectivity

In the oil and gas construction sector, it is very common to have a high level of interconnectivity because the project planners integrate various elements of the construction projects to improve efficiency. It is not suitable for construction projects in the oil and gas sector to have any specific decision associated with any single work package because, alternately, that decision will affect all the other work packages because of interconnectivity (Chernikov et al. 2020). The problems of human resources are also very important because most of the time, when the resource scheduling is being performed, effective engagement of the employees is needed to improve the project efficiency and also make the projects provide benefits to all stakeholders. From a resource management standpoint, effective

Table 2 Sustainable contributions of AI in oil and gas construction phases

Sr.#	AI Interventions	Construction	Operation	Deconstruction	References
1	AI based Predictive Modelling for Construction Safety	√√		√	Koroteev and Tekic (2021)
2	AI for Energy Savings in Construction	√		√	Bello et al. (2015); Baskaran et al. (2019)
3	Machine Learning for Increasing Production of Oil and Gas		√		Chin and Ji (2018)
4	Neural Networks and Construction Risk Identification	√		√	Capello (2020)
5	AI based Project Scheduling and Monitoring	√		√	Sinha et al. (2020); Feder (2020)
6	AI Integrated with Drones for Monitoring	√	√	√	Dmitrievsky et al. (2020); Elyan et al. (2020)
7	Sensory Data Evaluation with AI in Oil Refinery Operations		√	√	Yin et al. (2020); Cherepovitsyn et al. (2020)
8	Performance Monitoring in Oil and Gas Projects with Neural Networks	√	√	√	Ilinova and Chanysheva (2020); Wamba-Taguimdje et al. (2020)
9	Project Resource Management with AI	√	√	√	Bello et al. (2015); Braswell (2013)
10	Process Automation on Oil Rig with AI		√		Rassenfoss (2020); Wang et al. (2020)
11	Maintenance Scheduling and Monitoring with Machine Learning		√		Weatherl (2020); Mao et al. (2020)
12	Deep Learning in Construction	√	√	√	Jeffery and Creegan (2020); Wilson (2020)
13	Machine Learning and AI for Sustainable Production of Oil	√	√	√	Capello (2020); Braswell (2013)
14	Sustainability Evaluation with AI	√	√	√	Temitope Yekeen et al. (2020; Stefanakis (2020)
15	AI Surveillance for Safety Control	√		√	Gooneratne et al. (2020)
16	AI Wearable Tech for Risk Monitoring and Safety Control	√	√	√	Vaio et al. (2020)
17	AI based Autonomous Equipment for Oil Refineries		√	√	Hassan (2020); Baker et al. (2020)
18	Cloud VR/AR for Construction	√		√	de Gaudencio et al. (2021)
19	AI based Twin Modelling	√	√	√	Kushzhanov and Mahammadii (2019); Baskaran et al. (2019)
20	Life Cycle Analysis with AI	√	√	√	Braswell (2013)

planning consumes most human resources' time and energy, resulting in lower employee productivity (Desai et al. 2021). For human resources alone, it is not sustainable to use traditional approaches while also concentrating on the interconnectivity factor. Management and effective resource scheduling take a significant amount of time, which naturally shifts the focus of construction projects to new technologies (Tiencheu et al. 2021; Ferreira et al. 2019). It is because there is always a substantial need for automation in the construction industry, as it diverts the time and attention of human resources to the most critical activities that need to be completed on time (Hassan et al. 2019). Routine management work is entirely handled by the modern systems in which any level of AI is implemented.

Current construction projects in the oil and gas sector require continuous preparation of reports and also analysis of the huge data sets that include qualitative and quantitative information. It is beyond the human resources' certain capabilities that they could deal with the common challenges based on which they can effectively decide the future of any activity in the construction project (Barbosa et al. 2019). With this technology, AI has provided a high level of automation, enabling all the management work to be appropriately automated. It is also possible with this technology to improve the data analysis process (Jiao et al. 2019). The challenges that arise in the oil and gas construction projects from the perspective of interactivity are handled by AI, and it saves a lot of consumption of resources, which is directly proportional to the cost of the oil and gas projects. From the future perspective, it is expected that AI will significantly handle the interconnectivity changes. This will bring the construction of oil and gas projects towards sustainability.

5.2.2 Functionality

In most oil and gas construction projects, there is a significant difference between the scope developed at the initial stages of the project compared to the scope on which the project is completed. It is because the oil and gas construction sector projects are always going through significant revisions and improvements, which create functionality challenges (Schia et al. 2019). In improving budget efficiency and maintaining human resource productivity, it is always important to have better environmental system ability as it also corresponds with maximizing the functionality of oil and gas construction projects (Maity 2019; Sami and Ibrahim 2021). Modern oil and gas construction projects require a dynamic management mode to accommodate design changes or improvements. It makes the workload increase in the construction of oil and gas projects (Vaio et al. 2023; Choi et al. 2021). In normal ways, the human source cannot maintain the required productivity while also changing the project according to revised requirements (Sousa et al. Nov. 2018). When resource consumption increases due to insufficient technological implementation or utilization of modern management methods in oil and gas projects, an innovative solution is required to improve the situation (Kirschbaum et al. 2020; Emmanuel Onyeka Ezim 2022). Significant research is being conducted in AI to develop hardware and software that could support oil and gas projects in difficult times from a functionality standpoint, as well as improve the productivity of human resources so that their skills can be used more effectively (Hasheminasab et al. 2018). It is believed that there is a significant relationship between the AI-equipped solutions for the construction industry and the functionality of every phase of the construction project in the oil and gas industry. This relationship for the project promotes effective decision-making and inclusion of knowledge, which is significant in increasing sustainability. Minimizing energy in any activity in the oil and gas construction project can easily increase the project's certainty, automatically improving its

sustainability (Evangelinos et al. 2018). Further neutralization of AI-enhanced products offers more efficient ways of dealing with functionality problems and automating the different tasks that could help complete the project within the required time. Improvements in functionality positively impact construction projects, providing a competitive advantage and cost savings.

5.2.3 Unpredictability

Various risk factors exist in oil and gas construction projects, and more than 60% of these risk factors are relevant to the safety of the workers, whether they are working offshore or onshore sites. Such projects have a high level of unpredictability, which cannot be managed using traditional risk management approaches such as simple quantitative risk assessment (Poh et al. 2018). The unpredictability increases when oil and gas projects' construction sites are highly vulnerable to natural disasters or systematic failures. Before the construction work starts on these sides, it is always one of the important activities in oil and gas projects to create extensive visibility analysis and develop an effective methodology for improving every aspect of the construction project without using efficiency in time and cost (Negash et al. 2018). Because uncertainties always lead to failure and safety management issues in oil and gas projects, it is always recommended to rely on forecasting approaches and minimise tension with the help of technology.

The factor of stakeholder satisfaction with every activity of oil and gas projects also matters because when a high level of uncertainty exists in matters, it ultimately disturbs the productivity of construction workers (Negash et al. 2018). Comparatively, in the offshore working sites, the unpredictability further increases because of the harsh working environment, which creates significant changes in the original project schedule. Nothing can be said to be final in such construction projects because uncertainty is always present. From the information technology perspective, it is evident that reliance on big data and analysing the information throughout the construction of oil and gas projects with the help of AI can improve efficiency while also minimising routine challenges (Loeken et al. 2018). Therefore, when the uncertainties are recognised earlier, it helps to utilise the workforce's attention and energy for the most critical tasks and doesn't waste time managing the risks. However, it is also true that most of the risk factors are completely unpredictable, meaning that there must always be some space in the project's original schedule so that any possible shortfalls can be accommodated. However, unpredictability will always remain significant in affecting the sustainability of these projects and bringing the oil and gas construction projects towards failure.

5.2.4 Individuality

Every construction project in the oil and gas industry is different from each other. The differences contribute to increasing the individuality in construction projects in which certain approaches are not applicable even if they were successful in the past. When this happens, it automatically increases the challenges for project management, and it becomes practically difficult to control the sustainability of the construction project, which requires individual treatment differently. This always results in the preparation of custom hardware and software tools so the project can be completed successfully. Over the last few years, there has been an improvement in standardising a variety of methods that can be implemented in most of the oil and gas industry construction projects to minimise individuality. But results

are not satisfactory because the essence not only depends on the specifications of the project but also relates to the differences in the human resources (Chin and Ji 2018). When the highly diverse environment contributes to increasing originality, there is always the need for a robust management strategy to help the project management navigate individual challenges (Olukoga and Feng 2021).

The characteristics of every group of human resources working on oil and gas construction projects are different, and their experience and communication skills contribute to increasing the chances of success. The influence on sustainability is at a greater level because individuality is almost impossible to eradicate from the construction sector. A common example of a difference in the quality of work can be considered when two different contractors are working on the same project. The variety of services that contribute to increasing the chances of success and maintaining a better project management policy depends on considering the factor of individuality when planning (Ramos and Akanji 2017). But there are always certain limitations within which the traditional methods of management of projects can work, and they never contribute fully to mitigating the problem of individuality. The AI systems are known to be significant because they help to handle the individuality aspect of oil and gas construction projects and also help human resources to focus their attention on critical activities. Certain abilities of human resources efficiently contribute to minimising the risk of potentially jeopardising the projects (Yazan et al. 2017; Li and Jiang 2017). AI systems are continuously revolutionising the overall construction landscape in the Oil and Gas sector, which has become an important narrative for improving the characteristics and abilities of human resources.

5.3 AI and sustainable assessment

AI is going through a significant evolution process because of the increase in its popularity and applications in every field of life. Consistent development is going on in the sector of AI because no technology is emerging, and AI is considered the future of humanity and the supporter of the 4th industrial revolution. The use of large amounts of data is one of the key benefits associated with AI because the technology's aggressiveness increases when it relies on large data sets obtained from multiple data sources (Rui et al. 2017; Zuofa and Ocheing 2017). It is perceived by the latest research that AI will surpass human intelligence at some point in the future because of its capability to make decisions more accurately. The norm of integration of humans and machines is one of the significant reasons behind adopting effective ways of developing AI technology and providing sustainable growth to all the applications that are very important in engineering. The consistent feedback system associated with AI improves it over time, ensuring its capabilities to build cognitive computation and provide a more realistic level of judgment (Ahmed et al. 2021; Ahmed et al. 2021). From this standpoint, AI has no specific customisation limit because all developments are always relevant to supporting humanity in developing new technology and increasing sustainable development.

Many technologies are waiting to be born just because AI is still going through the evolution process. But the application of technology is significantly increasing. It will also maintain the environmental sustainability that corresponds with the consumer interest and relates to the practical benefit of society (Chan 2011; Chanmeka et al. 2012). From any sustainability perspective, it is always believed that the benefits must be associated with the economy, culture, and environment. Because of this, AI has been able to satisfy all the elements of sustainability because it has appropriate decision-making power, which will

further improve. Engaging consumers across social boundaries is also a significant benefit that creates leverage for businesses, whether they are operating in the construction industry or not. The civil engineering and adoption of AI have continuously increased because the use of big data is constantly growing (Jiao et al. 2019; Kalinin et al. 2021). Most of the project managers and other parties to the contracts always decide to adopt the most effective techniques that can save time and identify the possible risks more efficiently than humans. Fortunately, AI has all the necessary components that ensure the smooth operations of civil engineering and supports effective resource management, which is one of the greater elements in the overall construction industry (Salazar-Reyna et al. 2022; Jeffery and Creegan. 2020). The prospects for improving construction sustainability are very high because AI will produce more effective results as it improves daily. The value of AI corresponding to oil and gas construction projects is discussed here.

5.3.1 Value of AI towards oil and gas projects

In any decade, the human population has been significantly dependent on the use of fossil fuels, and it can be considered as one of the greater factors in which industrial development has started. The increasing demand for oil and gas products worldwide has significantly increased construction projects onshore and offshore. With the growth in the technology used to extract, refine, and transport oil and gas products, it is evident that the use of big data and machine learning is continuously increasing in the oil and gas industry (Chanmeka et al. 2012). Regardless of the development stage of AI, it is significantly used in oil and gas construction projects because it is directly linked to improving the competitive advantage of organisations working on construction projects and trying to make their projects more efficient without any safety risk. AI is an important part of oil and gas perception products because it helps project managers in several ways, such as managing resources and making decisions (Chan 2011; Chanmeka et al. 2012). This helps them improve the efficiency of their projects without sacrificing anything.

The ability of the AI to understand certain approaches from the connections between the data points makes it significantly useful in completing construction projects with effective identification of safety risk factors. Because traditional approaches to risk management do not work in oil and gas construction projects, there is always a high risk of safety, which is one of the major reasons for using AI in such complex construction projects (Choi et al. 2021). Further, human interactions always have chances of errors due to the capabilities of traditional approaches over time, and they cannot work best in a critical environment where an increase in sustainability is required. However, AI has shown significant improvements in increasing performance and improving organisational intentions so that they can correspond with the entire infrastructure and also help the project manager with a more effective problem-solving approach to deal with project-related problems. From the start of the oil and gas construction projects to their finish, AI has applications in every stage, which can be considered one of the significant factors or technologies that can produce sustainable results (Ahmed et al. 2021). The recent COVID-19 pandemic in 2020 has negatively impacted the overall oil and gas construction industry because it needs the adoption of technology to its greatest level in which AI is fully integrated along with reduced human interaction so that errors can be reduced. It is safe to say that oil and gas consultation projects have passed the point where they can no longer rely on traditional methods that require human interaction. Instead, they must now rely as much as possible on automatic processes to get the most out of them.

5.3.2 Value of AI towards sustainability

AI is considered a human-friendly and also environmentally friendly technology which is commonly adopted in the field of civil engineering as it has shown a significant positive impact on the overall industry of construction (Al Dhaif et al. 2022; Ibrahim and Elkatatny 2022). The world is now moving towards a direction where the concept of energy saving is currently appreciated. Also, relying on the traditional approaches, which are time-consuming and don't provide an average to the construction projects in increasing the competitive advantage, is no longer useful. From an economic standpoint in construction projects, the AI office's dependability in budgeting and material estimation is remarkable (Gooneratne et al. 2020). The accuracy with which AI completes the financial analysis of any construction project cannot be achieved through human interaction because of the high risk of calculation errors.

Further, the decision-making approach humans always take in the economic prospectus of construction projects may not always lead the projects towards success. However, the probability of success with utilising the existing level of AI increases above 80%. It is not normal for construction projects involving human interaction to have this success rate. Yet, the future of AI will offer more economic sustainability.

Because of the current inflation going on in the worldwide market and the way construction material supply chains are disrupted, it is evident that the world has to now rely on increasing the utilisation of AI because it offers significant capabilities in increasing the performance of the projects and also making sure that automation is implemented in every aspect of the construction projects happening in the oil and gas industry (Baskaran et al. 2019). From the environmental perspective, it is one of the greater benefits of using AI that it offers a friendly environment to the workers and also integrates the different elements of the construction products to devise a strategy in which the waste is reduced along with safety risk factors that promote environmental degradation. The oil and gas industry is filled with many disasters that have negatively impacted the environment every time they occur (Gupta and Shah 2022).

To improve ecological sustainability, AI is one of the effective tools that does not create strategies with a high risk of degradation of the environment because it promotes effective automation processes along with advanced supply chain management that ultimately enables environmental efficiency (Evangelinos et al. 2018). From the social perspective, it is a reality that AI has utilised the available data to revolutionise the construction of oil and gas projects in such a way that they are now more associated with societal benefits. It is because society is the major stakeholder in complex construction projects when they are happening in highly critical environments, and construction workers are also involved. Because of this, AI has a very high value for the economy, the environment, and society as a whole, and this value will continue to rise as AI gets better and gives us more ways to use it.

6 Discussion of results

Table 3 shows the various contributions that AI has made to improve the performance and management of oil and gas construction projects. The summarized view is presented in the context of various AI-based interventions that specifically relate to safety management,

Table 3 Summary of findings of AI in oil and gas projects

Sr. no.	Applications of AI	Safety management of oil and gas projects	Resource management of oil and gas projects	Sustainable management of oil and gas projects	Risk management of oil and gas projects
1	AI based Scheduling of Projects			✓	
2	Monitoring of Oil and Gas field with AI			✓	
3	Safety Analysis of Projects with AI Modelling	✓			
4	AI based Resource Management		✓		
5	Financial Analysis and AI			✓	
6	Scenario Analysis for Oil and Gas Project Feasibility			✓	
7	AI Risk Mitigation Models for Drilling and Oil Extraction			✓	✓
8	Neural Networks in Cost Management			✓	
9	Oil and Gas Properties Analysis with AI			✓	
10	Forecasting of Oil and Gas Project Efficiency with AI			✓	
11	Machine Learning for Risk Mitigation				✓
12	AI Modelling for Downstream Oil and Gas Projects			✓	
13	AI and Quantitative Risk Analysis in Oil Rig Construction				✓
14	Artificial Neural Networks in Oil and Gas Operations			✓	
15	Service Life Improvements with AI based Data Modelling			✓	
16	Logistics Management in Oil and Gas Projects in AI		✓		
17	Operational Risk Assessment with AI and Deep Neural Networks				✓
18	AI based Decision Support Systems for Oil and Gas Projects			✓	
19	AI based Supply Chain Management in Oil and Gas Projects		✓		
20	AI for Identifying and Predicting Safety Complications in Oil and Gas Construction	✓			

resource management, sustainable management, and the management of oil and gas construction projects. These are the important elements in the oil and gas construction projects in the context of research and practical work being done to improve the applications of AI. However, it is proven that the advancements based on AI have created an impressive impact in revolutionizing oil and gas construction projects and making them more sustainable. The interventions observed in the existing literature and their importance in practical improvements to oil and gas construction projects are presented. These have a highly effective output in making oil and gas construction projects economically, socially, and environmentally sustainable.

Integrating AI, sustainable development, and the oil and gas sector is made possible by the circular economy framework. The sector as a whole can help the transition to a low-carbon economy by embracing circular economy ideas like recycling and reusing materials. From this, a new theoretical framework tailored to AI's role in environmentally responsible oil and gas projects might be conceived. With AI, oil and gas projects may run more efficiently, cutting down on wasted resources like energy. The usage of water in hydraulic fracturing may be minimized as much as possible with the use of AI technology. Risks to oil and gas operations may be better identified and mitigated with the use of AI. Artificial intelligence may aid in risk assessment by evaluating data on environmental conditions and possible risks to pinpoint hotspots and provide early warnings before accidents occur. Artificial intelligence can aid in the growth of renewable energy sources like solar and wind. The oil and gas business may minimize its reliance on fossil fuels and its environmental effect by investing in renewable energy sources. The use of artificial intelligence to aid in making environmentally responsible choices in the oil and gas sector is becoming more feasible. AI may aid stakeholders in making sustainable choices by assessing data on social, environmental, and economic implications. This new theoretical framework would place an emphasis on AI's ability to foster long-term growth in the oil and gas sector. The industry can lessen its negative effects on the environment, boost its operational efficacy, and aid in the shift to a low-carbon economy if it adopts AI technology and circular economy concepts.

The conceptual framework is developed based on the reviewed literature, which separates the contribution of AI and its relativity to the advancements in oil and gas construction projects. The formulation of the conceptual framework is also integrated with the variety of activities that AI has improved over the past decade and resulted in identifying the most important needs of oil and gas construction projects that will be important to consider in the future. The different components of oil and gas construction projects from the perspective of their sustainability are safety, resource management, sustainable management, and risk management as shown in Fig. 6. These are also identified as future needs, incorporated into the conceptual framework and the foundation of AI-based techniques that are important for oil and gas projects. The different solutions that have resulted specifically for the projects are based on improvements by AI in decision support systems, computational analysis, neural networks, Big Data analytics, machine learning and construction using robots. All these specific developments are important in making advancements in oil and gas projects because they relate to the principles of core safety management, where AI has resulted in implementing safety management modelling, which reduces error and improves the predictability of safety risk factors. The machine learning data further enhances the safety management aspect of oil and gas projects by providing AI with the necessary data and valuable support.

Similarly, resource management is improved by AI by promoting interventions such as logistics management and supply chain management. In the context of sustainable
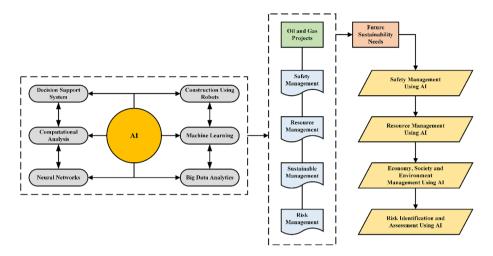
Fig. 6 Theoretical framework

management, AI has made the most significant contribution because it has also improved the scheduling of projects and their monitoring with effective data acquisition. Similarly, AI's financial and scenario analysis aspects have also resulted in the increased use of AI-based tools such as neural networks for cost management and learning about the different specifications of oil and gas projects. The forecasting systems have also improved significantly with applications on the downstream side, where the service life is highly important for oil and gas projects. From the risk management perspective, the mitigation models are improved by AI and applications of neural networks in the post-management principles. This ultimately enhances the quantitative risk analysis and maintains effective operational risk assessment. Therefore, the future directions are summarised in the theoretical framework in the context of all the different components of oil and gas projects where AI has the most critical applications. Furthermore, the theoretical framework justifies improving future studies where the research must be conducted to improve safety, resource management, risk analysis, and sustainability with the help of advanced AI. Through detailed analysis by SLR, the theoretical framework provides the most important path for future researchers to improve the oil and gas projects and summarise the publication and journal contribution trends.

7 Conclusions and limitations

Conclusively, from SLR, it is identified that the pattern of publications has significantly improved after 2018 because of increasing challenges in oil and gas projects and advancements in AI. The contribution of developed countries towards expanding the research on AI specifications in the field of oil and gas projects is high compared to those with less development in oil and gas projects. That is also justified because developed countries need significant interventions based on new technology to improve their oil and gas sector project efficiency. SLR has contributed to creating a practical understanding of oil and gas projects from theoretical and practical perspectives, as well as presenting the importance of AI in improving construction work in those projects. The second contribution is

to critically discuss the impact of AI on the sustainable development of oil and gas projects while also highlighting the most effective benefits of AI. The third contribution is a well-defined theoretical framework, which is useful for future researchers to improve their research outcomes and make oil and gas projects more sustainable. Overall, the research has contributed to setting up the theoretical framework based on summarised existing literature on AI and its association with the sustainable development of oil and gas projects. It is highly useful for accelerating the learning process and improving the applications of the latest AI-based technologies, which are supposed to create tremendous improvements in oil and gas projects. Technological advances are directly related to increasing project productivity, as evidenced by the results of SLR. The recommendations presented based on the theoretical framework in this research are highly useful in guiding and addressing the possible challenges in future research. From the standpoint of the research gap, the study contributes by providing future researchers with the necessary theoretical knowledge for implementing a robust methodology to improve artificial intelligence technology for the sustainable development of oil and gas projects. From the limitations perspective, it is evident that the databases utilized for the research review have a limited number of papers compared to the overall research in AI and oil and gas projects. From the future perspective, a combination of different databases will be required to improve the quantitative and qualitative understanding of the implications of AI for sustainable development. The study is also relevant to the journal articles, while it does not completely reflect the overall literature that involves research on AI and oil and gas projects. These limitations are regarded as excellent opportunities for future researchers where they can focus their work on improving the research results and making oil and gas projects more sustainable.

Declarations

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