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A study on the importance of sustainable environmental management strategies for oil and gas construction projects: a systematic review

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Abstract

From the Arctic to the desert, the tropical rainforest to the temperate woodland, and even the mangroves and offshore areas, the oil and gas industry truly spans the globe. The main objective of the study is to examine the importance of sustainable environmental management strategies for oil and gas construction projects. The study also focuses on waste management in industrial construction and the contributions of industrial ecology. In addition, the study also examines risk assessment in oil and gas construction projects by considering DEMATEL-ANP. In conclusion, the study focuses on the importance of environmental management in the corporate governance of oil and gas producers.

Keywords

Sustainable development, hydrocarbon resources, oil and gas projects, environmental criteria, economic criteria, social criteria.

Introduction

The oil and gas industry is global, with operations taking place in every nation on every continent (excluding Antarctica) and in every conceivable habitat (from the Arctic to the desert, the tropical rainforest to the temperate forests, the mangroves to the offshore). The world will continue to put a premium on oil and gas reserves for the foreseeable future. Primary energy consumption was close to 8000 million metric tons of oil equivalents in 1994, with oil and gas accounting for 63%, coal for 27%, nuclear for 7%, and hydro for 3%. The aim is to meet the world's energy demands in a manner that is in line with current best practices and does little damage to the environment. The process of extracting oil and gas from the earth has sometimes caused environmental damage in the past. Air and water pollution, oil spills, contamined land, accidents, and fires have all been reported at various times and places. The social repercussions of operations, especially in marginalized communities, have garnered more attention from academics in recent years. The oil and gas industry has been actively implementing measures to protect the environment for some time. While great progress has been made, professionals in the field concur that much more study and advancement are possible. The Earth Summit, also known as the United Nations Conference on Environment and Development (UNCED), took place in Rio de Janeiro, Brazil, in June 1992. With the help of Agenda 21, environmental challenges that had previously been dealt with in isolation were placed into a global framework at the United Nations Conference on Environment and Development (UNCED), and the conference's findings were easily translated into national action plans. Also included are the often-overlooked facets of social change and the influence on cultural values that accompany development projects, especially those located near traditionally marginalized populations (Shooshtarian, 2022). The overall effect of Agenda 21 on national policy has been substantial, with numerous groups shifting their structures and plans of action to conform with international bodies. One of Agenda 21's most striking features is the prominence it gives to individual performers and their respective parts. The importance of business is highlighted, as is the need for collaboration between businesses and governments. There seems to have been some success with these suggestions. The oil and gas industry's E&P (Exploration and Production) Forum (now known as the IOGP – International Association of Oil & Gas Producers) and International Petroleum Industry Environmental Conservation Association (IPIECA), along with other leading business organizations, have launched a variety of environmental projects, usually in conjunction with government agencies on a national or worldwide scale (Hatema, 2022).

Objectives of the study

The main objective of the study is to examine the importance of sustainable environmental management strategies for oil and gas construction projects. The study also focuses on:

- to examine waste management in industrial construction in relation to the contributions from industrial ecology;
- to analyze risk assessment in oil and gas construction projects by considering DEMATEL-ANP;
- to bring focus to the importance of environmental management in the corporate governance of oil and gas producers.

Literature Review

Waste management in industrial construction relating to the contributions from industrial ecology

According to Freitas (2017), due to its role in transforming raw materials into the built infrastructure essential to socioeconomic growth, the construction industry is deeply embedded in almost every other sector of the economy. Despite its importance to civilization, the construction industry has been shown to have negative effects on the environment. The growing creation of and possible negative impacts on the environment from construction waste are only two examples of why this is a pressing problem. The building and demolition sector is responsible for 35% of all global solid waste, making it the biggest waste source in certain nations. Even though most construction waste is inert, the lack of management plans that focus on reusing, recycling, and other ways to recover it reduces the amount of space in landfills and uses up natural resources.

Lèbre (2015) analyzed that, in response to the pressing issue of construction waste, several nations have enacted stringent environmental legislation, including landfill tonnage limits, recycling targets, disposal fees, and financial incentives for effective waste management throughout construction projects. To cope with the numerous types of trash created and to ensure legal compliance, contractors must actively engage in waste avoidance, reduction, recycling, and management during execution of construction projects. According to researchers, waste management in construction activities should begin with the design and procurement stages and continue through the technologies and strategies implemented onsite. Designers of a project would do well to think about ways to cut down on waste creation, such as by using practical design schemes, making use of secondary materials, standardizing building supplies, coordinating dimensions, and employing cutting-edge building techniques. Saavedra (2018) stated that, for their part, onsite management approaches that stick to design documentation, limit the quantity and scope of design modifications, and more accurately estimate materials needed at each construction stage have all been highlighted as having the substantial potential to decrease waste creation. The location of construction debris may also be affected by how it is handled onsite. Practices like waste segregation and optimizing onsite material reuse, for example, can reduce the need for landfill disposal of construction debris and the number of materials used on a job site. Waste management plans are acknowledged for their relevance to good waste management in oil and gas projects, but their extensive distribution is one of the least common practices in construction. In addition, the literature emphasizes the need for proper oversight of waste management operations and cooperation between the various stakeholders. Hond (2000) noted that many researchers have studied how to effectively handle construction debris, but the field of Industrial Ecology

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(IE) has not yet been given its due. Industrial ecology has emerged as a potential strategy for reforming the industrial system using a toolkit of ecological principles, methods, and perspectives. Industrial ecology concepts and practices have spread throughout the world in recent decades, from the first self-organized symbiotic symbiosis in Kalundbourg to planned initiatives driven by China's National Policy for Eco-Industrial Parks (EIP) and even further in the form of Japan's Eco-town program. The potential contributions of industrial ecology ideas and models to material loop closure in the context of the circular economy prompted a reevaluation of their use. In recent years, the concept of a "Circular Economy" has emerged as a framework with the stated goal of maximizing resource productivity through the widespread use of closed-loop manufacturing practices. Beasley (2000) stated that the objectives of the circular economy can only be realized by using methods and practices from a wide range of academic disciplines. When it comes to reintegrating trash and by-products into the economy, industrial ecology is crucial to the adoption of cross-company techniques. In the literature, there are examples of how industrial ecology has been used in the real world in many different fields and settings. Arbolino (2018) analyzed that home building and commercial, government, and institutional building are the two main subsets of the construction business. The construction of industrial facilities, including power plants, factories, refineries, and mines, includes the planning, execution, and upkeep of all mechanical and structural parts. It is a highly specific, narrow subset of construction industry. According to Kering (2016), the technical and managerial complexity of a typical industrial construction project is amplified by its high cost, the number of involved trades and disciplines, and the interconnectedness and tight coupling of its engineering and construction activities. Due to the co-location of contractors, subcontractors, and other stakeholders on the same project site, it has been hypothesized that industrial ecology location-based strategies might be used to reduce environmental burdens in wide range of industrial construction projects. The literature on industrial ecology highlights waste management synergies afforded by proximity as potential that, if properly investigated, may provide substantial advantages. Pauliuk (2022) pointed out that industrial symbiosis and eco-industrial parks are examples of inter-firm initiatives that rely on the synergistic potential afforded by close physical contact (Eco-Industrial Park). The academic community agrees that industrial symbiosis is a process that connects flows among industrial players using the trading of by-products, the pooling of resources, and the provision of services in tandem. As a result, Eco-Industrial Park has become a standard by which other business communities might aspire to achieve their goals of environmental improvement, financial success, and social well-being through the sharing of resources such as materials, energy, and knowledge. Sharing of infrastructure and utilities, shared services, and trash exchange are all integral parts of an eco-industrial park from a technical or operational standpoint, and they all help to maximize productivity while minimizing waste. since much prior research on industrial ecology theory and practice has concentrated on manufacturing hubs, industrial ecology hasn't yet been thought of as a way to deal with environmental and resource problems on construction sites, where many firms related to the construction industry are located together.

Risk assessment in oil and gas construction projects by considering DEMATEL-ANP

According to Zhu (2022), rising energy consumption necessitates a global investment of $38 trillion in energy projects by 2035. One of the most important considerations in talks on sustainable development is energy. Extensive investment, a large number of investors, complicated technology, and the one-of-a-kind character of Open Geospatial Consortium projects all contribute to significant risk. Economic, political, social, and technological hazards may coexist with environmental and calamity hazards, among others. Recognizing energy-related risk is not only necessary for the construction business but also for the upstream and downstream segments of the oil and gas industry. Sustainable oil and gas supply chains and processing rely heavily on construction projects. Because of this, developing-world governments are under intense scrutiny to guarantee projects will be completed on schedule with minimal disruptions and flaws. Saving money and being more competitive in the energy market are both benefits of risk management. Nasri (2022) analyzed that to assist businesses planning or involved in Open Geospatial Consortium projects in developing strategies to guarantee sustainable energy supply chains, it is important to identify and analyze the primary risks encountered by such projects. As a result, Open Geospatial Consortium organizations may

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benefit from careful planning, the efficient execution of risk management, and the adoption of suitable solutions to remove, transfer, or control the relevant risks if they identify, emphasize, and analyze these aspects.
Rostamzadeh (2022) stated that when considering the nature, process, activities, technical complexity, organization, and environment of the construction industry, it is easy to see why this sector has earned such a reputation for being fraught with danger. ISO 31000 defines risk as an impact of uncertainty on goals, whereas the Cambridge Dictionary defines a "risk factor" as a fact or event that raises the probability of the risk occurring. An increasing number of stakeholders, a lengthy project duration, and contact with a response from both an external and internal environment all contribute to this risk. Interactions between a wide range of parties, including designers, owners, suppliers, contractors, and subcontractors, also contribute to a significant number of underlying dangers. According to Kamranfar (2022), there are a variety of systematic and formal approaches to finding, analyzing, categorizing, reacting to, and managing risks throughout a project's life cycle, which may be found in the body of knowledge known as project risk management. It is a dynamic process that aims to maximize the degree to which risks are eliminated, controlled, and mitigated by decreasing the likelihood of undesirable outcomes while increasing the likelihood of desirable ones. At least one project goal, such as budget, schedule, quality, safety, might be affected positively or negatively by the presence of risk. Risk is an inevitable part of every oil and gas project, although it may be reduced, shifted, transferred, accepted, or disregarded. Lin (2022) pointed out that all project hazards cannot be eliminated. Therefore, initiatives that successfully identify risks early on and analyze and manage them tend to have a higher chance of success. Cost overruns, poor performance, and delays in an soiland gas project are the result of insufficient focus and risk assessment. Unlike many other fields, oil and gas projects are not very good at studying and assessing potential risks. When it comes to pricing energy regulations, Open Geospatial Consortium projects must use some kind of risk management system to prevent setbacks like cost overruns and schedule slips. Because of the impact on construction decision-making, the most significant group hazards and associated risk variables must be identified. Therefore, it is important to identify the primary group risks and unknown elements, categorize them, evaluate them, and keep an eye on them as the project progresses to maximize the likelihood of success and lower potential risk. Shahabi (2022) says that MCDM (Multi-Criteria Decision-Making) methods like TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), AHP (Analytic Hierarchy Process), ANP (Analytic Network Process), and DEA (Data Envelopment Analysis) have been used in recent research to look at the risks of construction projects. Both the upstream and downstream sectors of the oil and gas industry have incorporated MCDM into their operations. These methods become invaluable when working with difficult issues like those involving intricate systems, unknown variables, and little data. According to Li (2022), so far, Open Geospatial Consortium project risk assessments have not accounted for the interplay between elements in the best-fit models. Several fields of study have adopted the DEMATEL-ANP method, which combines the methods of the Decision-Making Trial and Evaluation Laboratory (DEMATEL) and Analytic Network Processes (ANP) to remedy this deficiency. DEMATEL's ability to depict the complicated interrelationships across criteria is why experts say it is the finest risk reduction method when used in tandem with ANP. To determine the appropriate weights for each risk factor, ANP considers the interdependencies and feedback between them. So, DEMATEL-ANP is a powerful tool that helps managers choose the best way to deal with risks in general.

Risk Management

Guo (2022) analyzed that, given the far-reaching implications that risk may have on metrics like quality, productivity, performance, and the bottom line, risk management is a crucial component of the decision-making process. Due to their fluid and complicated nature, construction projects are especially vulnerable to risk and uncertainty. Risks threaten the success of a project and neglecting them has been demonstrated to cause schedule and budget overruns in construction projects. Predicting the occurrence of events that have a negative influence on the project goal and outlining necessary procedures to mitigate the impact of these occurrences is the essence of risk management, which is an integral aspect of project management.
Li (2022) stated that even though risk management has been the subject of several studies, the common consensus among them is to "manage" risks to "maximize" possibilities. People might think of risk management as a policy, which is a strategy or concept

for making choices to achieve the desired outcome. Kemp (2010) stated that the ISO 31000:2009 standard suggests implementing a set of policies, practices, and procedures for managing risk across the board. To make an educated choice on how to deal with potential dangers, it is common practice to use a technique known as "risk management." In the construction industry, risk management is a useful strategy that may aid in the detection and mitigation of potential threats throughout the project's lifespan. Tsai (2022) analyzed that risk management is essential for successful projects, and the whole approach is used in many aspects of construction projects to guarantee the quality of the result. Successful projects have been shown to place a premium on risk management. Thus, risk management has been regarded as crucial for construction projects to boost performance and guarantee the attainment of project goals. According to Kenzong (2022), for risk management to be effective, a comprehensive evaluation of the many processes involved is required. Many researchers in the aforementioned area have proposed different risk management strategies. A full risk management plan will include steps to recognize and classify threats, evaluate those threats, and react accordingly. According to Ghaffar, the 2020 PMI simplified the complex process of risk management into six simple steps: A risk management plan consists of six steps: (1) risk management planning, (2) risk identification, (3) qualitative risk analysis, (4) quantitative risk analysis, (5) risk response planning, and (6) risk monitoring and control. But the author simplified the procedure into six basic steps: key issues that could become problems are identified; creative analysis is generated; new methods, which are similar to developing a policy instrument, such as coordination and consultancy, are presented; decisions are made; operations are carried out; and the policy's efficacy is evaluated. He (2022) pointed out that the term "risk management" refers to a set of procedures that aims to lessen the negative effects of potential negative outcomes by identifying, evaluating, and ranking risks in terms of managerial resources, and then keeping tabs on and controlling those risks in an organized and cost-effective manner. Furthermore, a good risk management method necessitates the involvement of a project manager in several jobs and responsibilities, such as encouraging confidence to achieve project goals, giving a series of favorable alternative actions, expanding the probability of success, minimizing undesirable occurrences and uncertainties, enhancing real estimates, and decreasing rework by raising team understanding of risk.

The importance of environmental management in the corporate governance of oil and gas producers

According to García-Sánchez, in 2022, exploration and production will make up the "upstream" portion of the oil and gas business, while refining, processing, distribution, and marketing will make up the "downstream" portion. Companies in the industry may be either fully integrated (having interests in both the upstream and downstream segments) or they may specialize in one segment, such as exploration and production (often abbreviated as "E&P" or "upstream") or refining and marketing (often abbreviated as “R&M“ or “downstream") only. Companies with a worldwide presence are frequently referred to as "multinationals," whereas those with a more regional focus are often called "independents." Many oil and gas companies get their names from the countries that own them because the governments of those countries have put their oil and gas interests in national companies. Ikuru (2022) stated that service and contractor firms are vital to the upstream sector since they offer a wide variety of essential technical services, from geophysical surveys and drilling and cementing to food and hotel services in support of operations. Handfield (2015) examined that, consequently, contractors are becoming more and more a part of their oil company customers' organizational structures and cultural ethos as a result of the mutually beneficial interaction between the two groups. In 1912, geologists were engaged in the discovery of the Cushing Field in Oklahoma, USA, marking the beginning of the modern scientific search for oil. While the basic steps have not changed, engineering and technological advancements have made significant gains in efficiency and safety.

Exploration surveying

Agarwal (2022) stated that desk investigations using geological maps are the initial step in the hunt for hydrocarbon-bearing rock formations. This helps pinpoint large sedimentary basins. After that, you may utilize an airplane's camera to look for interesting terrain features, including faults or anthills. Field geological evaluations are followed by magnetic, gravimetric, or seismic surveys to get more specific data. Measurements of minor changes in the gravitational field at the surface of the earth are used in the gravimetric method, whereas fluctuations in the

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strength of the magnetic field are used in the magnetic method. Aircraft and survey ships are used to take measurements on land and at sea, respectively.
Purwanti (2022) examined how the seismic method locates subterranean or underwater geological features by analyzing how sound waves are reflected by different types of rock. The acoustic energy is blasted into the earth in a concentrated burst, where it propagates as a wave. At the points where the strata dip or rise, energy is either absorbed by the deeper layers or reflected on the surface. At this point, it is detected by an array of sensitive receivers, such as geophones or seismometers on land or hydrophones under the ocean's surface. Cherepovitsyn (2020) explained that the electrical impulses are amplified, filtered, digitally recorded, and then evaluated after being sent via specific links to a transportable laboratory. Environmental concerns have shifted the industry away from dynamite and toward lower-energy methods like land-based vibroseis (consisting of a generator that hydraulically sends vibrations into the soil) and the air cannon (releasing compressed air). The shot-hole (dynamite) approach is preferred over vibroseis in places where preserving plant cover is crucial.

Exploration drilling

According to Dhoraisingam (2022), once a potentially fruitful geological structure has been located, exploratory boreholes are the sole means to verify the existence of hydrocarbons as well as the thickness and internal pressure of a reservoir. Driller jargon for wells dug in search of hydrocarbons is "exploration" or "wildcat." The peculiarities of the subterranean geological formations determine the optimal placement for a drill site. Generally speaking, it is feasible to strike a compromise between environmental protection rules, logistical requirements, and the necessity for efficient drilling. According to Mak (2020), a pad is built at the location of land-based operations to house drilling machinery and associated facilities. Between 4,000 and 15,000 square meters of land are needed for a single exploratory well pad. Pads are built in many ways depending on factors including climate, soil, and topography. Several different types of mobile offshore drilling units (MODUs) are available for use while conducting operations at sea. The kind of MODU used is determined by factors such as water depth, seabed conditions, and weather. Jackups, semi-submersibles, and drill ships are some of the most popular types of mobile rigs utilized offshore, while barges may be employed in shallow, sheltered seas.
Knizhnikov (2022) analyzed that it is common practice for land-based drilling rigs and their ancillary tools to be disassembled into modules for portability. Drilling rigs can be shipped via land, air, or sea depending on factors like module size, weight, and location. On location, workers assemble both the rig and a self-contained base camp. Common parts of drilling rigs include the derrick, mud pumps, generators, cementing gear, and storage tanks for both fuel and water. The support camp has everything it needs to run itself, including living quarters for the staff, a dining hall, a communications hub, a place to maintain and store vehicles, a helipad for use at outlying locations, a supply of fuel, and a place to dispose of garbage. A modest space (about 1000 square meters) upwind from the drilling rig is ideal for the camp's placement.
Qian (2022) stated that when drilling begins, mud or other drilling fluid is pumped down the drill pipe and back up to the surface machinery in a continuous cycle. It is used to regulate hydrostatic pressure below the earth, cool the bit, and remove the waste rock. Blowout preventers, which are a set of steel rams activated hydraulically and designed to shut swiftly around the drill string or casing, considerably limit the chance of an uncontrolled flow from the reservoir to the surface. The steel casing is lowered into the finished borehole segments and cemented in place. The borehole's integrity is preserved, and subsurface formations are protected by the casing, which also serves as a structural support system.
According to NWOKIKE (2022), typically, drilling activities occur continuously. Borehole drilling may take anything from a few weeks to a few months, depending on the geological conditions and the depth of the hydrocarbon-bearing deposit. When a hydrocarbon deposit is located, preliminary good tests are run to measure flow rates and formation pressure; these tests might take up to a month. Oil, gas, and formation water might be produced during these tests, all of which must be disposed of safely. The rig is typically disassembled and relocated to a new location once drilling and preliminary tests have been completed. Exploratory drilling can be used to find commercial amounts of hydrocarbons. Once this is done, a wellhead valve assembly can be put in place.

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If the well does not have enough hydrocarbon to be used for business, the site will be shut down and made stable before being put back to its original state or a different one that was agreed upon. Cement plugs are used to seal open rock formations and prevent wellbore fluids from migrating upward. A cement plug seals up the wellhead and top joint of the casings, which have been cut into the earth.

Findings and discussion

The oil and gas industry is really global, with operations taking place in every nation on every continent (excluding Antarctica) and in every viable habitat (from the Arctic to the desert, the tropical rainforest to the temperate forests, the mangroves to the offshore). The world will continue to put a premium on oil and gas reserves for the foreseeable future. Primary energy consumption was close to 8000 million metric tons of oil equivalents in 1994, with oil and gas accounting for 63%, coal for 27%, nuclear for 7%, and hydro for 3% (Hatema, 2022). The aim is to meet the world's energy demands in a manner that is in line with current best practices and does little damage to the environment.

The process of removing oil and gas from the earth has sometimes caused environmental damage in the past. Air and water pollution, oil spills, contamined land, accidents, and fires have all been reported at various times and places. The social repercussions of operations, especially in marginalized communities, have garnered more attention from academics in recent years. The oil and gas industry has been actively implementing measures to protect the environment for some time. While significant progress has been made, experts in the field agree that much more research and advancement are possible. The Earth Summit, also known as the United Nations Conference on Environment and Development (UNCED), took place in Rio de Janeiro, Brazil, in June 1992.

Conclusions

While focusing on waste management in industrial construction and the contributions from industrial ecology, it was concluded that the construction industry permeates almost every other part of the economy due to the function it plays in transforming raw resources into the physical infrastructure necessary for social and economic development. Although the construction industry is crucial to human progress, it has been linked to harmful consequences for the ecosystem. Reasons for the urgency of this issue include the rising generation of construction waste and the potentially detrimental effects of this trash on the environment. The construction and demolition industry generates 35% of all solid trash worldwide, making it the largest contributor in certain countries. Despite construction waste being mostly inert, it contributes to a lack of landfill space and a drain on natural resources due to a lack of recovery-focused waste management solutions.

Several countries have established strict environmental regulations, such as landfill tonnage limitations, recycling objectives, disposal fees, and financial incentives for proper waste management during execution of projects, in response to the urgent problem of construction waste. Contractors need to actively participate in waste avoidance, waste reduction, recycling, and waste management throughout construction projects to deal with the many forms of rubbish generated and to maintain legal compliance. Researchers have shown that to effectively manage waste while carrying out the projects, waste prevention measures need to be included in the planning and procurement phases as well as the technologies and methods used at construction sites. Using secondary materials, standardizing building supplies, coordinating proportions, and using innovative construction procedures are all good approaches for designers to reduce the amount of trash produced by a project.

While examining risk assessment in oil and gas construction projects by considering DEMATEL-ANP, it was found that as energy needs continue to rise, the world will need to spend $38 trillion on energy projects by 2035. The topic of energy is essential to discussions on long-term sustainability. Open Geospatial Consortium initiatives carry a high degree of danger due to their uniqueness, high cost, and the quantity and diversity of their investors and sponsors. Environmental and catastrophic risks may occur with economic, political, social, and technological risks, among others. All parts of the oil and gas industry, from exploration to refining, must be aware of energy-related risks, not only the construction sector. Construction projects are crucial to the maintenance of oil and gas supply lines and processing facilities. Consequently, governments in developing countries are under a lot of pressure to ensure that their projects will be carried out on time and without any problems. The advantages of risk management include cost savings and enhanced competitiveness in the energy market.

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According to Nasri's analysis (2022), identifying and analyzing the key risks experienced by such projects is essential for assisting firms considering or engaged in Open Geospatial Consortium projects in implementing strategies to ensure sustainable energy supply chains. Therefore, if Open Geospatial Consortium firms identify, stress, and evaluate these factors, they may profit from careful planning, the efficient execution of risk management, and the adoption of viable solutions to eliminate, transfer, or control the relevant risks.

It is simple to understand why the construction business has a reputation for being so risky when one considers its nature, processes, activities, technical complexity, organization, and surroundings. The Cambridge Dictionary defines a "risk factor" as a fact or occurrence that enhances the possibility of the risk happening, whereas ISO 31000 defines "risk" as the effect of uncertainty on objectives. This risk rises with the number of people involved in the project, the time it takes to complete it, and each time it interacts with the environment, both inside and out. A great deal of the underlying risk is the result of interactions among several stakeholders, such as the designers, owners, suppliers, contractors, and subcontractors. Project risk management is the collection of practices and procedures for identifying, assessing, and responding to potential threats to the success of a project at any stage in its life cycle. Risk management is an ongoing activity with the ultimate goal of minimizing the possibility of negative consequences while maximizing the possibility of positive ones. The existence of risk may have a positive or negative impact on at least one project objective, such as the budget, timeline, quality, safety. Every construction project has some degree of risk, regardless of how much of it is mitigated, transferred, accepted, or overlooked.

To examine the importance of environmental management in the corporate governance of oil and gas producers, it was found that the "upstream" part of the oil and gas industry consists of exploration and production, while the "downstream" part consists of refining, processing, distribution, and marketing. There are two types of companies operating in the oil and gas industry: those that are "fully integrated" (meaning they have stakes in both the upstream and downstream sectors) and those that focus exclusively on either exploration and production (often referred to as "E&P" or "upstream") or refining and marketing (often referred to as “R&M” or "downstream"). Many people use the term "multinationals" to describe companies that operate on a global scale, whereas the term "independents" is more often used to describe companies that operate on a regional scale. Because many governments have vested their oil and gas holdings in national firms, such companies often take their names from the nations that possess them. According to Ikuru (2022), service and contractor companies play an important role in the upstream industry by providing a broad range of technical services, such as geophysical surveys, drilling, cementing, and even catering and lodging in support of operations. As a consequence of this mutually advantageous engagement, contractors are increasingly integrated into the organizational structures and cultural ethos of their oil firm clients. The current scientific quest for oil started in earnest in 1912, when geologists in Oklahoma, USA, discovered the Cushing Field. The fundamentals remain the same, but improvements in engineering and technology have greatly increased efficiency and reduced risk.

Recommendations

It is essential for the oil and gas industry to map the energy flows and emissions across the companies through internal and external performance benchmarking, target setting, and reporting, piloting and deploying new technologies to monitor and reduce emissions through state of the art technologies such as the CCUS (Carbon Capture, Utilisation and Storage), as well as developing new technologies that can help with mitigation.

- Resource use, waste, and greenhouse gas emissions affect the natural environment and biodiversity.The industry needs to focus on the prevention of pollution and environmental degradation, community awareness, engagement, and behavior change.

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