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CHALLENGES AND FACTORS INFLUENCING THE IMPLEMENTATION OF GREEN LOGISTICS: A CASE OF SUSTAINABLE SUPPLY CHAIN PRACTICES IN THE OIL AND GAS INDUSTRY, OMAN

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Abstract: *Studies with reference to sustainability in the oil and gas industry, had its inception during the year 1990, ever since, it has got improved in a longitudinal manner. Oil and gas companies, to a greater extent, highlight the term green supply chain management (GSCM), to exhibit their reporting, associated with sustainability related interventions. This article aims to evaluate the challenges and the factors, that influence the implementation of green logistics, as means of sustainable supply chain practices, in the oil and gas industry, Oman. Irrelevant to the nature of oil and gas company, the logistical operations, to a greater extent rely on fossil fuels, as well as non-renewable energy. This to a greater extent, has an impact on environmental sustainability, making it complex for oil and gas companies in Oman, to be able to accomplish balance between protection of environment and efficacy in an economic manner. The conceptual underpinning, behind green logistics is to reduce forms of environmental emissions, through means of deploying sustainable practices. The Oman vision 2040, to a greater extent, has emphasised the oil and gas companies, to shift to renewable and futuristic methodologies and process wherever possible. This adds intensity to the rationale behind the study, of identifying the factors, that influence the adoption of green logistics, across the supply chain operations for oil and gas industry in Oman (Bremner, 2019).*

Keywords: *Oil & Gas Industry, Supply Chain Management, Green Logistics, Environmental Sustainability.*

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Introduction

The role of logistics is inevitable especially in supply chain management interventions. These range from planning storage of data, controlling the activities and most importantly distribution of products to that of consumption stage. The usual approach of logistics interventions, have their focus in procurement, wider distribution, management of inventory, extended maintenance and does not include any forms of marketing interventions or product assessments (Furman, 2019). Green logistics, focuses on manufacturing, distributing, lean packaging, management of products, with abundance of focus in material and waste management. This to a greater extent, indirectly encourages conservation of energy, a transportation, that is driven by fuel efficiency, all these enabling a wider alignment towards environmental and social goals of an organization. The crucial goal of green logistics, is to shed the impact of logistical interventions on the environment, either by reduction of energy usage, or through Waste cutting, enabling a strong brand value, financial credit of cost cutting through optimal utilization of energy resources. Also, green logistics intends to shed the emission in carbon or any other forms, simultaneously promoting use of eco-friendly box package and most importantly transportation systems in the oil and gas (Buchholz, 2020).

Problem Statement:

Hence, logistics needs to be environmentally friendly, especially in the context of oil and gas companies, so it encourages the unique selling proposition of organizations, for sustainable development. It also promotes efficiency, in supply chain through procurement and finalization of eco-friendly materials, suppliers, there by adopting green transportation system for customer delivery. The research on logistics, to a greater extent takes into consideration adoption of green design, procurement of environmentally conscious vendors, deployment of sustainable manufacturing practices, green marketing, reverse logistics and efficient transportation and communication systems (Furman, 2019).

Literature Review:

In evaluating the adoption of green logistics, the report highlights, both external and internal factors, that influences and play an important role. External factors, range from the influence from consumer perspective, suppliers, government and institutional mandates, regulation in international context, intensity of competition, overall brand reputation, social responsibility respectively. When it comes to internal factors, it ranges from the level of environmental awareness within the organization, the overall culture within the firm, technological access and readiness, financial feasibility and support, government policies influencing the operations, overall benefits linked with its implementation and most importantly the intention to implement green logistics (Boykoff, 2019). The study deploys a secondary data assessment through use of valid and reliable source of information in form of previous research works, articles, e zines, thesis, industry reports, there by evaluating the factors that drive the adoption of green logistics in supply chain for oil and gas industry in Oman.

Theoretical Framework:

Factors influencing the adoption of green logistics in supply chain management in oil and gas sector Oman:

The discussions highlight the set of factors and challenges, that influence the implementation of green logistics in the oil and gas sector for Oman.

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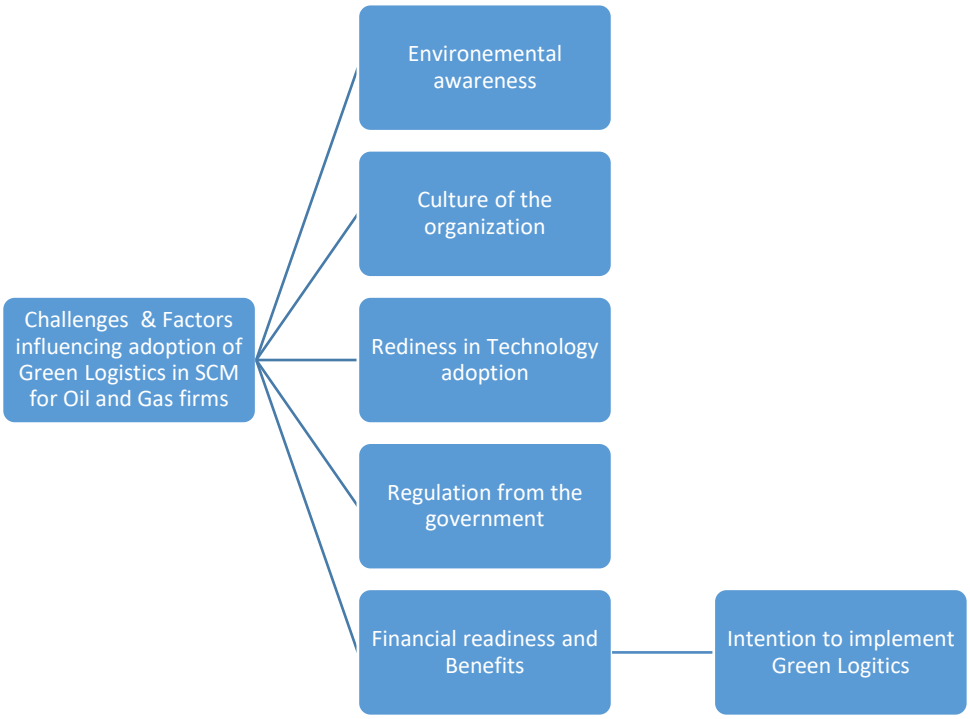

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Environmental Awareness:

Multiple research projects have highlighted the importance of environmental awareness, especially in the context of implementing green logistics interventions. This particular factor, to a greater extent, underlies the level of awareness, amongst each one of the logistics stakeholders, especially with reference to sustainable operations and environmental responsibility (Perotti, 2021). When an organization acts and deploys initiatives, in an eco-friendly manner, it can impact the reputation and at the same time, drive green innovation comprising, inclusion of eco design principles and practices. And because of the customer pressure, arising from the external environment, it enables and drives financial performance (Bonham, 2016). This is where the managers, are expected to empower and offer the associates / subordinates, with higher level of flexibility and decision making. The deployment of green logistics, is not merely driven by mandatory legislative policies, but also through means of critical understanding towards human resource and environment. Studies, being executed in the oil and gas firms, with reference to logistics, highlighted the outcome of implementing green logistics, in areas of companies image. There are appropriate cost benefits in long term basis, promotion of competitiveness, ability to respond to societal needs.

Reflecting on the oil and gas industry in Oman, and its commitment towards environmental awareness, as a driver of green logistics adoption, there are multiple examples. Petroleum development Oman, being the largest oil producer, has incorporated the environmentally sustainable practices, into the operations. The objectives, has been to reduce emission and waste, with the intention of accomplishing net zero carbon emissions by 2050. The company's environmental awareness, variable, very much reflects in reduction of more than 600,000 tonnes of carbon dioxide, that it accomplished through means of enhancing renewable energy, across manufacturing and logistics operations (Bose, 2021).

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Oman LNG has equally focused on deploying appropriate monitoring systems, in the supply chain and logistics operations, that did help to accomplish a 10-percentage reduction in annual emissions in the last 5 years.

All the above highlighted variables and results is an outcome of Oman government's commitment, in enhancing ability of oil and gas companies, to adhere to stringent environmental standards. The Paris agreement, to a greater extent, has enabled and emphasised 50 percentage of oil and gas companies, to shift and deploy green technologies and logistic solution. Hence the environmental awareness, is an outcome of regulatory requirement and realization of long term benefits and sustainable operations, by the players in oil and gas industry (Boykoff, 2019).

There are multiple options, that drives the social supervision, as these range from public reporting and gaining access to opinions, from subject matter experts. This to a greater extent, can impact the effectiveness of policy, laid down by the government and hence there is more responsibility, for the enterprises to make changes to their behaviour. The green logistics policies, to a greater extent will be driven by any forms of public dissatisfaction, that will pressurise, the government to be able to derive them in a stable manner (Khalizani, 2017).

(Abidin, 2022) highlights, multiple factors that represent the environmental awareness, variable, which has a greater driveability in adopting green logistics. The overall knowledge of environmental issues, is a crucial variable for an organization, to be able to understand the necessity of green logistics in supply chain management. These can range from, understanding of challenges by the logistics stakeholders in environment, such as, climate change depletion of natural resources activities causing pollution.

The perception of environmental impact is another important factor, that governs the environmental awareness. This particular aspect, examines the extent to which each one of the shareholders in logistics are able to understand the impact their activities, over the environment (Buchholz, 2020). It also highlights, awareness that these stakeholders hold, on any form of negative consequences, that the logistics operations of the company, will have over the external environment. Additionally, another attribute being, the commitment to environmental sustainability. This particular factor, to a greater extent evaluates how individuals and organizations, have been highly committed to sustainable business practices. It obviously also highlights the extent, to which the top management, is ready to invest in green technologies and is also keen to know the emerging eco-friendly processes and systems, that will also adhere to environmental legal laws while implementation (Burns, 2018).

Environmentally responsible practices, is a crucial factor influencing the adoption of green logistics. These practices range from the reduction of waste, promoting energy efficient practices, deploying standard operating procedures, to drive recycling interventions, and integrating key performance indicators and key performance systems, associated with reduction of carbon footprint efforts. (Butler, 2018) also highlights, the extent to which each of the stakeholders, are engaged in such environmental activities as a part of green supply chain management.

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Factor	Description
The overall knowledge over the issues in environment	The implementation of specific environmental practices, demands the understanding over waste reduction, efficacy in energy, recycling practices and intention to shed carbon footprint.
The perception towards the environment and impact	Customer satisfaction, is a crucial driver that enables company to deploy green logistics interventions. But then, not all the organizations express a genuine commitment towards green logistics adoption.
Commitment associated with sustainable practices	Oman oil marketing company – OOMCO, has extensively focused on reducing the carbon emissions, across transportation and logistics. Fuel efficient vehicles, has been their priority, there by being able to report 15 percentage reduction in fuel consumption. Such quantifiable metrics, did help oil and gas firms to align their vision mission and operations alongside the goals of Oman vision 2040.
Engagement level with the stakeholders	Social supervision, has been influencing the adoption of the green logistics and its implementation. Social supervision comprises, the task of public monitoring especially with reference to any act of negative environmental exhibitions. These can range from inaction of government, or the violation of the green laws by the organizations.
Monitoring as well as deploying appropriate reporting structures and norms	When there are specific performance system and environmental metrics, that is integrated with the existing enterprise resource, of oil and gas companies, there is an increased transparency and scope for deploying environmental practices.

These can range from the partnership that companies have with environmental organizations, and thereby promoting more level of engagement in sustainability programs. This, highlights the fact, monitoring and reporting of environmental performance, is a crucial factor influencing the deployment of green supply chain in oil and gas (Comfort, 2022).

Culture of the Organization Across Oil and Gas sector:

There are multiple studies, that have enlarged the role of organizational culture especially in the deployment of green logistics practices. This can range from understanding the extent to which leaders of the organization are supportive, to be green supply chain interventions. The extent to which associates, are involving in these practices and most importantly the strategic goals of organizations, being able to focus on sustainability. Undeniably, such mission and vision statements, will enhance the attitude and behaviour of each one of the department and employees, in oil and gas companies towards sustainability. The role of green logistics technology, cannot be ruled out, as it is becoming more important to promote commercial sustainability. The extended commitment, from the departmental leaders, will also focus on defining exhibiting training and development programs, with reference to green concept that will shift away the traditional thinking in the oil and gas companies in Oman (Dekhtyar, 2020).

The internal organizational culture in oil and gas sector, the management's commitment to play a significant role in green intervention development, will be crucial. These will eventually depend on the overall competency level of leaders, the knowledge, that is being gained in the

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oil and gas sector, with reference to sustainability practices. Focus in addressing any form of internal resistance to change, when such revolutionary ideas are adopted. (Khalizani, 2017) highlights, the importance of performance measurement, for oil and gas companies, failing which, it is going to be complex to monitor the activity that has been defined earlier. The role of communication cannot be excluded, as it is capable of fine tuning an organizational image alongside reputation (Furman, 2019). The senior management encouragement and their support, will play an eminent role in deploying any form of green logistics practices. (Khalizani, 2017)further highlights the understanding of economic benefits, by oil and gas companies, in order to understand the competitive source of advantage and also complying with legislations. When oil and gas companies, are able to understand the sources of rising transportation cost and there by reducing them as a part of green logistics intervention (Graci, 2018). On the whole, the organizational culture, to greater extent can influence green logistics and its implementation.

Critical understanding of the leadership support, is evaluated on the basis of to what extent they advocate for sustainability and also play a proactive role in allocation of resources. The employee engagement initiatives, in oil and gas companies will indirectly promote their monetary and non-monetary rewards, so that active participation is gained (Bremner, 2019). Collaboration and teamwork will do a greater extent also enable the cross functional teams in oil and gas companies towards the knowledge sharing platform. Critical evaluation of the return on the investment, being gained over the training and development programs, in green supply chain logistics will play a crucial role (Graci, 2018).

(Laguir, 2021)highlights the understanding of organization structure, as means of encouraging creativity and decentralised decision making, towards adopting green supply chain practices. He adds, there is more scope for change management and its adaptation at ease, when there is a decentralised decision making.

Factors in Organizational Culture	Description in the context for Oman's Oil and Gas Industry
Support from the leaders	Exhibits, the extent to which the leaders in the oil and gas companies have been able to offer their support for sustainable logistics. Leaders across petroleum development Oman and Oman oil marketing, to a greater extent encourage energy efficient technologies and also deployment of green initiatives.
Employee and the level of Engagement	The proactive engagement of employees, with reference to green logistics for oil and gas companies in Oman, is of utmost importance. (Shearer, 2019) highlights only 40 percentage of associates, being adequately trained in this regard, which calls for introduction of new interventions and modules.
Sustainable centric practices	Oil and gas companies needs to prioritise sustainability as their primary objective. The increased integration of green logistics, to the strategic goals, will enable them to synchronise with Oman vision 2040.
Level of awareness and internal / external communication	Oman LNG, has regular communication audit internally to engage employees with conversations on green practices. These to a greater extent, has promoted green initiatives and brainstorming sessions amongst the associates.

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Team work as well as collaboration	The degree of collaboration, within the teams, through undergoing stages of Tuckman team development, enables ease of green logistics deployment.
Evaluation of the performance and recognition	Petroleum development Oman, makes use of appropriate performance metrics, related to emissions and energy savings, so that the appropriate managers or rewarded alongside subordinates.
Training and Development	It is very much important to bring in the subject matter experts and also the E learning designers, in order to derive hybrid learning and development modules for the audience in oil and gas sector.
Organizational structure and SOP	The standard operating procedures, should be transparent. The overall organizational structure, has to be decentralised and encourage higher level of autonomy and accountability, to the managers and subordinates.
Change Management	Oil and gas companies, must also take the help of external consultants who have critical understanding, of the change management models such as ADKAR and Lewin's 3 step model of change, to identify change agents and also reduce resistance to change for deploying green logistics.
Stakeholder relationship	Eco friendly suppliers, needs to be equally trained and be a part of the green supply chain deployment in oil and gas sector.

The culture of a particular organizations, will to a greater extent, impact the implementation of green logistics as well as the sustainable practices in the supply chain. Hence the culture within the oil and gas sector, should prioritize more scope for innovation and creative thought process, towards environmental sustainable practices. Leadership plays a pivotal role and this is why petroleum Development Corporation of Oman and Oman oil marketing company, have always invested in leadership style and development programs as a part of green logistics initiative across creative, transactional styles (Agyabeng, 2022). More than 60 percentage of associates in Oman oil and gas industry as per the studies of (Weidinger, 2019) have highlighted the engaging levels of associates, towards sustainable practices. One of the key credit, that drives this particular situation, is the leadership commitment, as petroleum development of Oman have launched a green logistics programmes in 2022, with their intentions being to reduce 15 percentage of the emissions, by shifting to electric vehicles and also optimising the supply chain routes (IBP, 2022).

Majority of the oil and gas companies in Oman, are yet to realise the importance of training and development with green logistics practices (Isaak, 2023). It also indicates a technological gap, so the form either relies on external consultants or internal subject matter expert should derive the learning modules. This can range from also enhancing the employee skill to manage and operate the electric or hybrid vehicles, alongside making use of Internet of Things or sensors, to promote energy efficient tracking systems, for business decision making in oil and gas. Oman LNG have reported 10 percentage increase, in operational efficiency by means of shifting to sustainable fuel as of 2021. But there lies more scope for these companies, to be able to deploy these technology and get inspired from rest of the sectors, other than oil and gas in Oman (IBP, 2022).

The financial considerations is a crucial hurdle that limits the culture of an organization to be able to promote green logistics in oil and gas. There is no denying, the initial cost of shifting to such sustainable logistics, is complex to justify. But going by the statistics of Oman oil

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marketing company, that witnessed at 12 percentage reduction, in logistics cost through sustainable transportation system, is an example of how rest of the players can deploy it. The introduction of the government incentives, in Oman has also promoted subsidies and tax breaks for company that has consistently, invested in sustainable technologies thereby migrating towards giving logistics in the supply chain. This to a greater extent, reduces the financial risk and promotes green logistics in a strategic plan. The company also, was able to reduce the logistics function by 8 percentage and its planning to add another 5 percentage in the next 3 years (Khan, 2019).

Strong collaboration, with each one of the stakeholders of an organization including the suppliers and logistics partners is a crucial reflection of organizational culture. Oman LNG, has been able to partner with logistics providers who have offered low emission transportation systems that enable them to reduce the emissions, by 10 percentage since 2020. The company also has included reward systems, for the department that accomplishes highest level of energy efficiency, as well as waste reduction (Mohammad, 2019).

Readiness in Technology Adoption

The technological readiness of companies, to a greater extent depends on access to infrastructure as well as subject matter expertise. Obviously, the technological factors that influence the adoption of green logistics, in supply chain will depend on the overall complexity as well as the maturity of technological innovation. Issues ranging from compatibility lack of infrastructure development, can't impact the intention of companies to adopt green practices. When it comes to oil and gas innovations, the green material and green energy have played a crucial role in reducing, waste pollution as well as the greenhouse gas emissions. Concepts such as underground logistic system, has gained more momentum this can contribute to reduction of traffic disturbances and formation of congestions. (Ndlovu, 2018) highlights the important issue being, the data management and security for oil and gas companies. There is a strong necessity for investing, in firewall techniques, that can save the logistics and supply chain data to external hackers or phishers.

Technological readiness is a crucial factor to determine to which organizations in the oil and gas sector are can implement the green logistics. It not only focuses on gaining access to the latest emerging technologies, but also to ensure that the appropriate infrastructure subject matter expertise and resources or synchronised (Pandey, 2018). In the case of Oman oil and gas industry multiple players such as petroleum development Oman, Oman oil company, Oman oil refineries and petroleum industries have been leading the way in terms of green logistics in the supply chain. Of course appropriate, level of challenges, is also faced by them in technological integration (Jazairy, 2020).

One of the key attributes has been the infrastructure availability that influences technological readiness, for Oman oil and gas sector. Petroleum development Oman, has invested in infrastructure improvement, that has altogether electrified the logistics fleet. The wider number of electric vehicle charging stations, at key operational sites has helped towards migration of sustainable logistics. But there lies more gap, as alternate fuel stations or more in number than the electric vehicle stations. Companies such as shell Oman, has been working with partnership with the government, to enhance the electric vehicle charging points that can promote sustainable logistics for the entire oil and gas sector (Shearer, 2019). But there is a growing criticism over the fact the electric vehicles, do emit more emissions equally to that of the internal combustion engines, that acts as a challenge for deploying green logistics in the oil and

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gas sector. The technical expertise and human resource management, is too important attributes that drives green logistics technology adoption. The Oman oil and gas company as per the views of (Shearer, 2019) have highlighted only 45 percentage of this staff or having awareness over green logistics and there is a huge gap in technological readiness (Zayani, 2018). By means of collaborating, with subject matter experts companies such as Oman LNG, have been able to implement new training modules, in smart logistics platforms used of Internet of Things and also operate energy efficient vehicles. ORPIC, has equally faced more challenges when it comes to gaining access to compatibility with existing systems. The integration of a new green logistics technology, with the existing framework is a crucial challenge for migration towards green supply chain for Oman oil and gas. However, such interventions, look contribute to considerable amount of reduction in fuel consumption and demonstrate, the long term benefits in investing over green practices.

Allocation of the resources is a challenge for the green logistics industry as a whole as it is widespread across the financial and human resources. Allocation of financial budget by Oman gas company by about 15% to the green technology adoption is a welcome move. But amidst, the overall investment being made by the financial team, there lies more challenge for small and medium sized companies in Oman, to be able to convinced stakeholders in investing more capital for technological upgrades. However the lack of how the government incentives can be capitalised on prevails in place and this calls for creating specialised role similar to the top British petroleum in Oman (Singha, 2020). The oil and gas company, has collaborated with local universities, in order to arrive at programs and internships to the young Omani's with reference to understanding conceptual underpinnings of logistics technologies comprising energy efficient transportation and digital logistics assessment (Weidinger, 2019).

Factors in Technological readiness	**Description**
Access to infrastructure	When it comes to the adoption of enhanced oil recovery systems, Oman has been a front runner in deploying such green practices. Companies, such as petroleum development Oman, have multiplied their infrastructure to support solar powered steam generation for the oil recovery task. About 23 percentage of Oman's, current oil production is governed by the enhanced oil recovery systems. PDO has equally invested more than one billion $, in upliftment of digital infrastructure to optimise the production efficiency (Peng, 2021).
Technical Expertise	International oil companies and their collaboration with Oman oil and gas firms like PDO have enhanced the overall subject matter understanding over digital oilfield technologies and use of cutting IT systems (Shearer, 2019).
Allocation of Resources and Compatibility	PDO was able to allot more than $500 million in spending over renewable energy and carbon acquisition projects. But this also calls for the proactive involvement of human resource manager, in arriving at resource assessment and training need analysis (Graci, 2018).
Management of Data and security	Majority of the companies in oil gas sector, have been focusing on management of the security and the data by making use of ethical hackers and firewall integration systems.

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Scalability and flexibility, cannot be ruled out as companies such as ORPIC, have taken an iterative yet step by step approach for scaling their logistics technologies, to green mode. The firm, initially collected all the data in its existing internal combustion fleet and thereby made use of different conditions, to evaluate the possibility of including hybrid over electric vehicles in the operations. The automated fleet management system, is emerging technology as these to a greater extent enable vehicle transition to hybrid and electric models. Decision making across, the entire oil and gas supply chain, becomes easier for the managers as it offers real time data on fuel efficiency, as well as tracking of emissions without compromising on the mining or delivery times (D'Silva, 2020).

The Regulations from Government:

Multiple studies, to a greater extent have highlighted the role of government regulation especially in driving the green logistics practices in supply chain. There is an important role of the regulatory framework, standards being set on their environmental context, and support of policy and initiatives. The intervention of the government, in this regard over the private sector is higher. But then the government, has regulated the private oil and gas companies to a greater extent by means of offering incentives, promotional policies, that enables more cost reduction and also access to low interest rate, especially when shifting to clean technology deployment (Peng, 2021). The research grants, for the entire green industry promotion is a welcome move, for the oil and gas industry (Brusino, 2019). By means of deploying appropriate, strict regulations the overall environmental standards for all the products and the stakeholders is multiplied. The literature to greater extent, highlights the inclusion of certifiable environmental management, especially by deploying standards of ISO 14,001 and ISO 9000 across oil and gas companies. As a result of the pressure, from consumers as well as the government companies or witnessing mandatory deployment of green logistics. To greater extent, the collaboration and partnerships between the oil and gas companies and consultants is a credit that advances green logistics initiatives across supply chain (Bremner, 2019).

The Ministry of Energy and minerals to greater extent has requested all the oil and gas companies in Oman to accomplish 30 percentage renewable energy adoption in 2030 (Shearer, 2019). This equally calls for inclusion of subject matter expertise so that the companies will be able to comply with framework that is mandatory to attend the subjective. Failure to adhere such benchmarks will lead to more penalties as well as restricted operations for the oil and gas companies (Peng, 2021).

Petroleum development Oman has introduced more stringent operations through introduction and training on ISO 14,001 over environmental management. This is about the company has also trained and deployed ISO 50,001 which is associated with energy management (Giese, 2019). Oman to a greater extent, has deployed multiple policies, which has enabled the inclusion of carbon capture, solar powered, enhanced oil recovery systems, wherever possible (Shearer, 2019). The solar plant in mirror is one of the appreciable project in Oman which is reflection of strategic cooperation between petroleum development Oman and glass point solar company. As a result of such strategic partnership the enhanced oil recovery system has contributed to a carbon reduction of estimated 300,000 tons per year.

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Factor	Description
Regulatory frameworks	Refers to the extent, of which the government is setting guidelines for reducing and implementing green practices across the entire oil and gas sector. The objective to accomplish 30 percentage renewable energy by 2030 as a part of Oman Vision 2040 is a reflection of regulatory framework.
Standards	This refers to the use of Oman zero flat initiative, shedding the 60 percentage of flowering and also adhering to the Paris climate agreement.
Policy support, Collaboration and partnerships, awareness and communications	The partnership can either exist between the government oil companies or also with the non-governmental environmental organizations that intends to promote sustainable supply chain practices. As a part of the audit systems, majority of the oil companies or expected to report their spending and emission numbers which helps in arriving at ESG scores (Bremner, 2019).

The collaboration and partnership, is also extending further particularly under the green hydrogen interventions with Aramco - Amal West leading the initiatives. The government, also launched the green economy awareness campaign, that to a greater extent has outreached the aims and education on oil companies, to be able to promote sustainable development goals across the contractors (Small, 2021).

Financial Assessments and Benefits

Multiple studies have highlighted the importance of financial consideration, especially while deploying green logistics in the supply chain management. Financial feasibility comprises multiple dimensions, these range from initial investment cost, the ability to gain access to return on investment, tangible long term cost saving evaluation of cost benefit assessment, alongside financial risk evaluation.

To a greater extent research highlights, the financial ability, of an organization promotes technological innovation. But then the willingness of the consumer to pay for eco-friendly products, source of driving green supply chain practices. Obviously, the cooperation and collaboration, between suppliers and consumers will have positive effects on consumption behaviour. Since individuals are not highly satisfied, with the internal combustion engines there is increased chances the oil and gas industry can be a crucial source of sustainable fuels (D'Silva, 2020). Of course, there are more number of barriers, associated with implementing green logistics, in supply chain for oil and gas. Poor communication, lack of coordination, especially in financial department, can hinder companies to be able to deploy green logistics practices.

Factor	Description
Investment cost, long term benefits, Financial risk assessment.	Petroleum development Oman, have consistently invested in green technologies especially for enhanced oil recovery. There is an increased need for the company to have a strong financial framework, that will assess the cost benefits especially with reference to cost of procuring green technologies and evaluating, any form of market risk technology obsolescence, under the risk category. Failure to evaluate the risks, with finance, can influence the financial stability including poor cash flows.

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Reduction of Environmental impact, Promoting the corporate image, satisfying the stakeholders.	Majority of the oil and gas companies, are concerned about the cost savings, that they are able to yield as result of reducing waste and utilising the resources (Khalizani, 2017). The personality benefits, also will contain another intangible assessments, such as enhanced efficiency, as well as reduced environmental impact, by reducing waste production and energy consumption. The corporate image, is highly synchronised with the performance of the company, amongst the stakeholders especially in the view of consumers investors and other subject matter experts.

Petroleum development Oman has increased its budget to 600 million especially towards the green projects. This has obviously helped the company, to gain access to operating cost efficiency overtime (Buchholz, 2020). PDO have been able to promote investment, in green technology that has helped the company to be able to allocate 300 million in the projects which also helped it to yield subsidies accordingly the sustainability initiatives and reporting has been strong for companies like accidental and PDO, as they have completely retained the corporate image including benefits of employee retention and investor confidence, as per the survey by Ministry of Energy and mineral in Oman. The cost benefit analysis, cannot be ruled out as the study being conducted by Ministry of energy, highlighted the fact majority of oil and gas companies, have realised 20 percentage return on investment in green projects investment in supply chain (Mohammad, 2019).

The Intention to Deploy Green Logistics:

The overall willingness of the company, to have the green logistics integrated with the supply chain has been evaluated in a very limited number of studies. Obviously, the maturity level of the organization, will reflect their extent to which it is ready to be environmental friendly in the logistics practices (Dekhtyar, 2020). The readiness is also influenced by the competitive pressure, requirement from consumers behaviour of the associates in a direct and indirect manner. In situations where there is limited government support and black of stringent environmental regulation the intention of companies to adopt green logistics has been lower. Variables such as training and development, access to resources, the overall quality of human capital, change management, has said the foundation for implementing green logistics. There are multiple sub variables, associated with the intention of companies to deploy green logistics. These range from corporate social responsibility initiatives, readiness to make use of tax breaks incentives, a growing need in the market amongst consumers for environmental friendly products. The top management being ready to accept this particular shift to green supply chain management as a source of competitive advantage (Giese, 2019).

Factor	**Description**
Cost Saving	There is more potential for companies, to reduce the operational cost especially in lower utilization of fuels, waste reduction and also complying with the laws. Daleel petroleum and Orpic, have been focusing their intention to streamline supply chains and transportation system in reducing fuel cost and shedding environmental impact. 18%, reduction has been witnessed by Orpic especially by shifting to green packaging for their chemical transport. Equal credit also been realised by Daleel petroleum especially in waste disposal and management.

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Incentives from government	Al Shawamikh Oil Services, have been able to shift their attention towards making use of the economic incentives and there by shifting to the eco-friendly fuel alternates.
Consumer demand and CSR	Tethys Oil, that has consistently focused on oil exploration did witness a growing consumer interest in the operations. It has been able to yield zero waste, wherever possible and thereby reducing environmental impact and gaining access to consumer confidence as part of the CSR activity.
Source of Competitive advantage.	Oman Drilling Services, witnessed a 10% hike in the contract conversion ration as a result of shifting to investment being made in the sustainable logistics practices.

Conclusion

The logistics industry, to a greater extent is going, to play a crucial role in the day-to-day activities for oil and gas companies. But they have higher proportion of scope, to degrade the environment and also lead to increased resource consumption (Isaak, 2023). Oil and gas sector, as a whole is going to face stringent regulations, especially because of traffic conditions higher pollution and increasing demand for sustainable logistics solutions (Khalizani, 2017). The above study to a greater extent, has contributed to filling the gap in literature by analysing the variables such as awareness towards environment, organizational culture in oil and gas, readiness towards technology, regulation over government, financial considerations benefits and most importantly the overall intention to deploy green logistics. There is more scope for future research that we focus on the extent to which Internet of Things, artificial intelligence, machine learning, big data, can play approval role in enhancing the adoption of green supply chain in oil and gas sector (Ndlovu, 2018). The higher level of awareness amongst the stakeholders, the need for developing decentralised decision making systems to encourage decision making, stronger policy support as a part of Oman Vision 2040, are some of the crucial takeaways from this research driving adoption of green supply chain management.

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