Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/AF6.20250141
Published: April 8, 2025

Crafting Measurable, Sustainable Supply Chain and Logistics in Oman's Oil and Gas Sector for Further Improvement In line with Oman's Vision 2040

Jacob Pratabaraj, Maryam Rahman, and Meilinda Maghfiroh
Faculty of Transport and Logistics
Muscat University, Muscat
Sultanate of Oman
jpratabaraj@muscatuniversity.edu.om
maryam.rehman0555@gmail.com
mmaghfiroh@muscatuniversity.edu.om

Ahmed Maher Mohammed
Department of Management, Birmingham Business School
University of Birmingham
Dubai International Academic City
Dubai, P.O. Box 341799
United Arab Emirates
amm.alhamdany@gmail.com

Abstract

The research investigates how green supply chain and logistics management (GSCM) functions in Oman's oil and gas sector by evaluating present operations alongside the challenges and opportunities that exist for better practices. The research applied a mixed-methods approach through surveys, focus groups, and benchmarking analysis to discover major deficiencies in sustainability initiatives specifically related to reverse logistics and circular economy integration. Green procurement has become a standard practice thanks to regulatory pressure but sustainable transportation and waste management systems still need development. Evaluating against global best practices demonstrates that the absence of enforcement systems and financial motivators combined with insufficient awareness among supply chain managers constitute the main obstacles to successful GSCM implementation.Research demonstrates that targeted policy changes along with technological progress and improved corporate environmental responsibility will enable Oman's oil and gas industry to boost its sustainability performance. The research study presents a practical framework that combines green supply chain strategies with digital tracking technology and AI logistics optimization alongside workforce training to drive successful implementation. The research identifies economic and environmental gains from moving towards a sustainable supply chain model that corresponds with the sustainability targets of Oman's Vision 2040. The study delivers practical recommendations that serve both academic research and industry application by supporting sustainable transformation efforts in Oman's oil and gas field.

Keywords
Green supply chains, sustainable supply chains, responsible supply chains, eco-supply chains, eco-logistics, green logistics, green transportation management, emission control, forward and reverse logistics, green performance

1. Introduction

While countries are moving towards increasing green performance of their oil and gas sector there are several deterrents that bring a downfall to these efforts. Specifically incidents like oil spills, pipeline breakages, transportation accidents, equipment failures, etc., cause inestimable negative reversal to these works. Oman boasts of over 40 registered oil and gas companies including multinational organizations. Successful implementation of green supply chain management practices involves identifying gaps where green performance can be improved and executing effective and critical practices that aims to conserve scare resources and energy (Ayuso et al. 2013).

Green supply chain is broadly divided into 3 areas. The first being, green procurement, which deals with obtaining and using products that are environmentally friendly and has a re-usability scope. The process ensures that the materials procured possesses attributes that point to 'go green' and can be reused, recycled and is non-toxic. In addition to this, reduction of waste, finding appropriate source of raw materials, reducing and safe disposal of hazardous waste form a part of green supply chain management (Sarkar 2012). The second area relates to green manufacturing that encourages usage of input materials that have a lesser environment impact. Another way to see it is to that the process may entail lesser usage of high impact materials. Optimizing usage of materials is another way to improve green performance. Finally the third area, reverse logistics, which deals with recovery of unused or used products for recycling or safe disposal. Assemblage and return of used-products to manufacturers where distributors play an eminent role forms the framework of reverse logistics (Xie and Breen 2012).

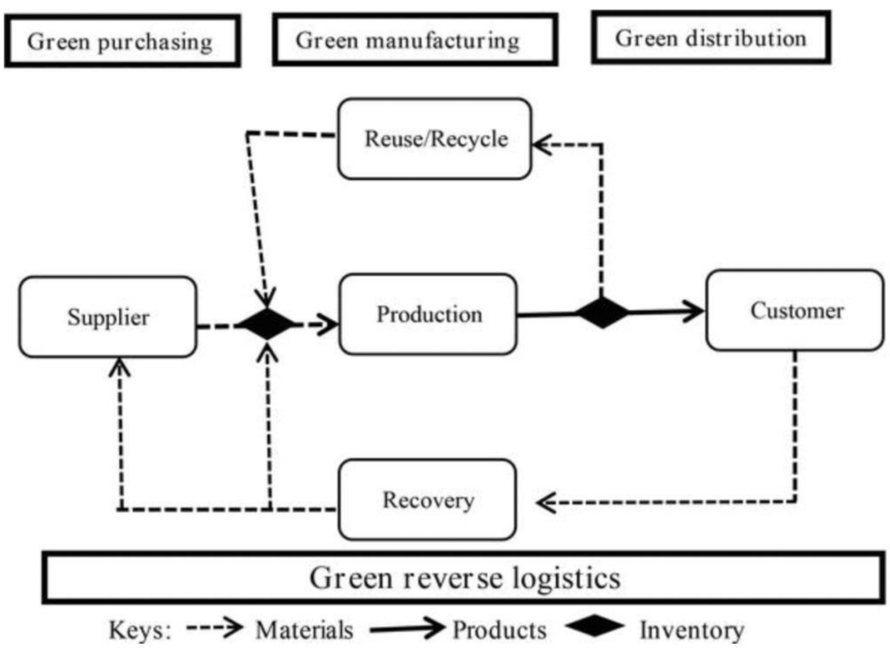

Figure 1. Simple GSCM Model

The purpose of this research is to explore the various green supply chain and transportation management strategies employed in Oman, specific to the Oil and Gas sector, by breaking them down sector-wise. These initiatives are then benchmarked against those followed in similar line of work around the world. For this research, the leaders who oversee the supply chain processes in their respective companies and the employees working in the supply chain and transportation sector were taken as the main intelligence centers to assess the overall state in the country.

1.1 Objectives

The main objectives of the research will revolve around the following:
To study the green supply chain and logistics practices undertaken by the oil and gas sector in Oman
To do a comparative study of the practices in Oman versus the practices handled world- wide
To identify the gaps and recommend course correction on the green supply chain practices for the oil and gas sector in Oman.

2. Literature Review

Today, it is interesting to note that environmental sustainability has become more of a supply chain mandate than an organization's imperative (Rezaee 2017). It is surprising to understand that the oil and gas sector' supply chain undergoes plethora of issues pertaining to environmental sustainability (Sharma 2017). Firms have begun extensively using green supply chain model and green supply chain management technology to create that competitive edge to stay ahead of the market curve. Even if not initiated from their end, stakeholders are increasingly pressuring companies to adopt green supply chain practices in order to ensure their environmental responsibilities (Go ̈lgeci and Kuivalainen 2020). The purpose of green supply chain is to minimize negative impact on the environment while increasing operational efficiency (Plambeck et al. 2011). Studies clearly evidenced that firms' transition to green supply chain resulted in increased efficiency, energy and cost saving, and improved competitiveness for the firm (Cousins et al. 2018).

Therefore there is an unprecedented spike in the outlook of green supply chain linkage with not only environmental protection but also a firm's competitive performance (Balon, 2020). With the increased awareness among people, manufacturers have begun implementing green supply chain and are visibly noticing traction in the way the companies are being perceived. Chen, X, et all (2022). This warrants innovation and benchmarking at all levels, right from procurement to delivery. These sometimes have to be coupled with newer business model. In order to make these processes more cost effective and budget friendly, business innovation processes are important (Silva et al. 2019). Yet there is very little research in the performance of green supply chain and its impact in the oil and gas industry. Specifically data with relation to Oman or the GCC is sparse and the study intends to fill in these gaps by providing more insights into the sustainable practices in the sector.

3. Methods

The study was performed in multiple stages. The first phase being the quantitative method and the second phase focusing on qualitative method of research. A diagrammatic representation of the approach is as shown below

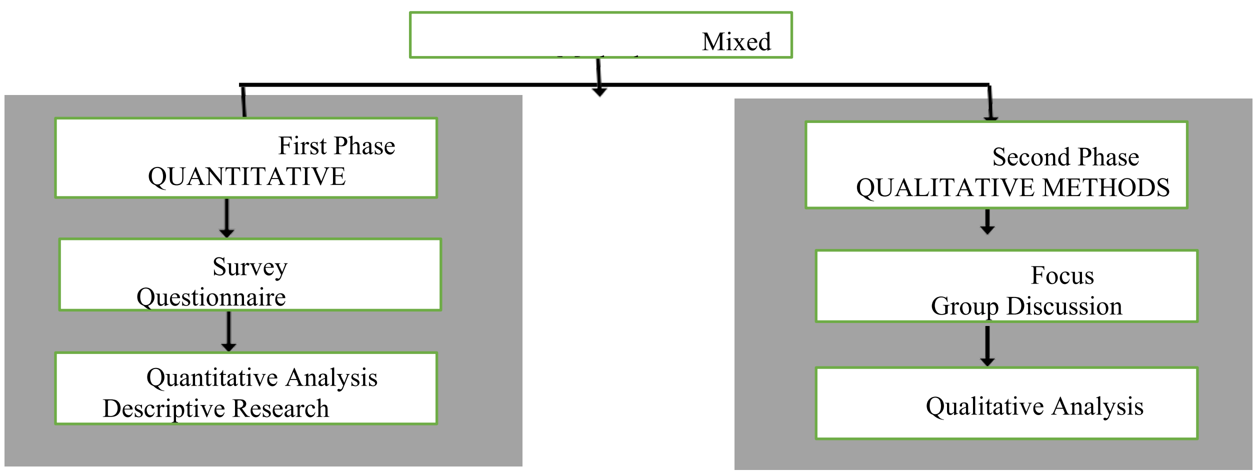

Figure 2. Mixed Research Methodology

4. Data Collection

Phase 1: Quantitative Methods

Descriptive research design will be used to analyze information and apply benchmarking techniques. A 15-item questionnaire will be circulated among the Supply chain managers to collect data, guided by the objectives of the study for quantitative research study. The questionnaire will focus on indicators including maintenance and compliance of supplier standards, packaging quality, recycling standards, contribution to circular economy, contribution to environmental and community sustainability building, etc. Time to fill in the survey questionnaire was limited to a time duration of 15 to 20 minutes. The survey questionnaire was made available in English and Arabic for user ease. The questionnaire is designed with a 5-point Likert scale. Appaiah et al. (2021) argue that the 5 point Likert scale demonstrates as much as predictive accuracy as a 7 scale or a 9 scale questionnaire.

Phase 2: Qualitative Methods

Qualitative research was undertaken to analyze the barriers, perceptions, enablers of green supply chain and logistics management. The administration of qualitative research was in the form of focus group discussions with different sets of people from different geographical spread among Oman. To ensure the discussions were adequately monitored, the number of participants per group was limited to 8.

Another important method that is an invaluable research instrument is the document analysis and is used as part of the study. This method makes use of top level examination also called skimming, reading through in detail, and interpretation. It is an established research method that utilizes pragmatic inferences that connect data to the context which come together to make a representation of facts. Considering the aim of the study, content analysis is used for the research.

The research will be conducted over a period of 22 months. The schedule of which is detailed below:

Research Study 1: Scoping studies/ identification of sample/ connection with research problem

In this research phase, green supply chain and logistics management in Oman in studies to derive the following (months 1-14):
To expand horizon of knowledge of GSCM and transportation management in the oil and gas sector
To understand the best practices in the industry with respect to GSCM and transportation management
To identify the need for prospective improvisations in the sector with regard to the field of study
In this study, literature review and cross analysis serve as a mainstream qualitative data technique for research.

Research Study 2: Data Collection and Model Development (months 8-15)

To do a comparative study of the practices in Oman versus the practices handled world- wide
To identify the gaps on the green supply chain practices for the oil and gas sector in Oman.
To suggest improvement areas and the model in which they can work for better performance and efficiency.

Research Study 3: Recommendations and dissemination of findings (months 16-18)

- To suggest improvement areas and the model in which they can work for better performance and efficiency.
- To suggest best practices within the industry to increase the green supply chain and logistics management standing of Oman in the global arena.
- To validate the findings with industry professionals and scholars

Research Study 4: Recommendations and dissemination of findings (months 18-22)
- To prescribe suitable techniques of global supply chain and logistics management practices for other nations who intend to incorporate these steps for environmental health and operational efficiency.
- To improvise on the prescribed model

5. Results and Discussion

5.1 Academic significance

This project aims to provide a new approach and a renewed model of looking at green supply chain and logistics management. The recommendations provided in the research work provides supply chain managers and practitioners a flexible framework that can be plugged into their supply chain system, without much hassle according to their pre- existing or workable budgets. It is predicted that this research work is bound to evoke significant discussions in the area of GSCM not only within Oman but also across the world.

5.2 Benefits to Oman

There is no doubt that green supply chain and transportation management will transform the business of any company towards better performance and environmental sustainability. This study in specific can serve as a foundation for higher research in the area of green supply chain and transportation management. This study also benefits Oman, by benchmarking the world- wide green SCM practices and brings in areas where the oil and gas sector can improve is sustainability practices and leverage the benefits of such implementation. Oman's standards with respect to DPS's quality standards and its stand with respect to projects like Detox and Greenpeace are analyzed. Oil and gas sector's application of reverse logistics and its contribution to circular economy is checked which in turn supports organizations in course correcting its stand to the betterment of its green supply chain.

In addition, sustainability principles thus developed can be applied to the entire value chain right from the design stage to the packaging and distribution. A complete overhaul and re- engineering of the sector while carefully integrating ecofriendly, reverse logistics practices can serve as a profit center in itself. Apart from this, the initiatives thus formed will also serve to reduce and control the harmful outcome of the supply chain to the environment.Trained employees in the area of green supply chain can serve as the ambassadors of sustainability tomorrow and can help in creating better management practices in Oman.

The research shows green supply chain and logistics management (GSCM) adoption in Oman's oil and gas industry but demonstrates inconsistent and fragmented deployment across companies. Companies mainly value sustainable logistics but many continue to place economic efficiency above environmental responsibility according to survey data. The analysis shows different implementation levels for green procurement, manufacturing, and reverse logistics with procurement leading because of regulatory demands. The underdevelopment of reverse logistics stems from inadequate infrastructure together with missing financial incentives which discourage circular economy practices in the industrial sector.

Benchmarking Oman's sustainability practices against international best practices identifies significant areas for improvement. Norway and Canada represent countries with advanced Green Supply Chain Management systems because they have both strong regulatory frameworks and incentives that encourage sustainable initiatives. Oman provides supportive sustainability policies but fails to enforce them strictly which results in environmental responsibility remaining an optional activity instead of a regulated requirement for all businesses. Supply chain managers reveal that most companies encounter obstacles in adopting green logistics due to financial constraints as well as restricted access to green technology and insufficient awareness. The qualitative analysis demonstrates that corporate leadership plays a vital role in change management since organizations with sustainability-focused executive teams achieve greater success in adopting green supply chain practices.

The research study recognizes multiple growth drivers which can expedite the implementation of sustainable supply chain approaches in Oman. Digital tracking systems and AI-driven logistics optimization represent technological progressions that enable carbon emission reduction while improving supply chain efficiency. The participation of regulatory bodies and investors stands as a vital component for promoting sustainable business practices. The study demonstrates that workforce training programs which integrate GSCM concepts help organizations implement green supply chain management better because employees understand its benefits and operational impacts.

According to research findings Oman's oil and gas industry can achieve regional leadership in sustainable logistics provided essential obstacles are resolved. The proposed framework alongside policy recommendations calls for enhanced government regulations together with financial incentives and industry collaboration as essential factors for speeding up the adoption of green supply chains. The research shows that moving towards sustainable logistics will help Oman achieve its Vision 2040 goals while simultaneously improving business resilience, cutting long-term costs and boosting international competitiveness in the energy market.

6.Conclusion

The research examines green supply chain and logistics management within Oman's oil and gas industry by evaluating current practices alongside existing challenges and potential opportunities for progress. Through benchmarking global best practices the study identifies implementation gaps while offering a structured framework for sustainable supply chain integration. Research shows that multiple companies understand sustainability's value but face substantial obstacles including regulatory constraints and resistance to change which obstruct its complete implementation. Structured interventions such as policy changes, corporate strategy development and workforce education enable businesses to achieve quantifiable progress in environmental sustainability and economic performance.

The research advances both scholarly understanding and industrial procedures through its empirical findings related to sustainable supply chain management practices in Oman. The research demonstrates how green logistics adoption delivers significant economic and environmental advantages through decreased emissions and cost savings while boosting operational efficiency. The study provides policy advice for regulatory agencies to enforce sustainable standards and motivates businesses to actively pursue green supply chain practices. The framework operates with adaptability to allow businesses of different scales to adopt sustainable practices seamlessly into their current operations. The study outcomes support Oman's Vision 2040 sustainability objectives by establishing the oil and gas industry as a principal force in driving both environmental and economic changes within the country. Oman will become more competitive on the international stage by supporting sustainable supply chain practices while also making significant contributions to climate protection and resource preservation. The research provides essential groundwork that supports continued study and sector-wide improvements through collaborative efforts between policymakers and industry leaders alongside academic institutions which aim to establish durable supply chain systems.

References

Abdul-Rashid, S., Sakundarini, N., Raja Ghazilla, R. and Thurasamy, R., The impact of sustainable manufacturing practices on sustainability performance. International Journal of Operations and Production Management, 37(2), pp.182-204, 2017. .

Adesanya, A., Yang, B., Bin Iqdara, F. W., & Yang, Y. , Improving sustainability performance through supplier relationship management in the tobacco industry. Supply Chain Management: An International Journal, 25(4), 413- 426, (2020).

Ayuso, Silvia & Rodríguez, Miguel & Garcia-Castro, Roberto & Ariño, Miguel. , Does stakeholder engagement promote sustainable innovation orientation?. Industrial Management and Data Systems. 111. 1399-1417, (2011) . 10.1108/02635571111182764.

Bratt, C., Sroufe, R., & Broman, G. , Implementing strategic sustainable supply chain management. Sustainability, 13(15), 8132, 2021. https://doi.org/10.3390/su13158132

Daddi, T., Testa, F., Frey, M., Iraldo, F., , Exploring the link between institutional pressures and environmental management systems effectiveness: an empirical study. J. Environ. Manage. 183, 647–656,2016.

Farrukh, Amna, Sanjay Mathrani and Priyadarshinee Sajjad. , "A natural resource and institutional theory-based view of green-lean -six sigma drivers for environmental management." Business Strategy and the Environment 31 (3): 1074-1090, 2022.

Mahroof, Kamran, Amizan Omar and Berk Kucukaltan. , "Sustainable food supply chains: overcoming key challenges through digitaltechnologies." International Journal of Productivity and Performance Management 71 (3): 981-1003.

Mathiyazhagan, K., Govindan, K., Haq, A. N., & Geng, Y. (2013). An ISM approach for the barrier analysis in implementing green supply chain management. Journal of Cleaner Production, 47, 283-297, (2022) . doi:10.1016/j.jclepro.2012.10.042

Nayal, Kirti, Rakesh D. Raut,Vinay Surendra-Yadav, Pragati Priyadarshinee and Balkrishna E. Narkhede. , "The impact of sustainable development strategy on sustainable supply chain firm performance in the digital transformation era." Business Strategy and the Environment 31(3): 845-859, (2022) .

Ninlawan, C. & Papong, Seksan & Tossapol, K. & Pilada, W.. , The Implementation of Green Supply Chain Management Practices in Electronics Industry. Lecture Notes in Engineering and Computer Science. 2182,(2010). .

Sarkar, Jayati and Sarkar, Subrata and Sen, Kaustav, A Corporate Governance Index for Large Listed Companies in India (May 9, 2012). Pace University Accounting Research Paper No. 2012/08, Available at SSRN: https://ssrn.com/abstract=2055091 or http://dx.doi.org/10.2139/ssrn.2055091

Vanpoucke, E., Vereecke, A., & Muylle, S. , Leveraging the impact of supply chain integration through information technology. International Journal of Operations & Production Management, 37(4), (2017). . https://doi.org/http://dx.doi.org/10.1108/IJOPM-07-2015-0441

Xie, Ying & Breen, Liz. (2012). Greening community pharmaceutical supply chain in UK: A cross boundary approach. Supply Chain Management: An International Journal. 17. 40-53. 10.1108/13598541211212195.

Zhu, Z., Piao, S., Myneni, R. et al. Greening of the Earth and its drivers. Nature Clim Change 6, 791–795(2016). https://doi.org/10.1038/nclimate3004 Add references here. Make sure to follow IEOM reference format. See details at the end. (10 font)

Biographies

Dr. Jacob Pratabaraj is working as a lecturer in the Faculty of Transport and Logistics at Muscat University, Oman. He obtained his PhD in Supply Chian performance from the Karunya University. In addition to teaching and leadership, Jacob Pratabaraj is deeply engaged in supply chain management research, focusing on the intersection of sustainability, technology, and resilience. Fascinated by the dynamic challenges of global supply chains His research interests span supply chain, sustainable networks, supply chain resilience, and supply chain performance management. He has secured several research grants from various institutes and across different regions, published in top-quality journals, and participated in various conferences and technical committees. He is an academician and has 10 years of teaching and research experience and also engaged himself in various consultancy across both public and private sectors.

Maryam Rahman is a master's graduate in Operations and Supply Chain Management from the College of Sultan Qaboos University in Oman. She is currently pursuing her PhD. With over seven years of industry and research experience, she has contributed significantly to various projects as a research assistant, focusing on logistics and supply chain resilience. Her academic journey has been marked by a dedication to understanding the complexities of supply chain networks, particularly in the context of Oman's evolving logistics landscape. In addition to her academic work, Maryam has collaborated on projects that align with Oman's Vision 2040, aiming to enhance the country's logistics and supply chain infrastructure through innovative research and practical applications. She is also actively engaged in reviewing academic papers for esteemed journals, ensuring the dissemination of quality research in the field.

Dr. Meilinda Maghfiroh is a seasoned researcher and lecturer specializing in Global Logistics and Supply Chain Management, Humanitarian Logistics, and Sustainable Transportation. Currently serving as a Lecturer and MSc Program Coordinator at Muscat University, she holds a Doctorate in Global Engineering and Development for Environment and Society from the Tokyo Institute of Technology. Dr. Meilinda has considerable research expertise in Indonesia, Japan, and Thailand, including electric vehicle readiness and agricultural optimization studies. As a lecturer and researcher, she is passionate about shaping the next generation of logistics and supply chain professionals while contributing to impactful research that addresses sustainability and global interconnectedness

Ahmed Mohammed is an Associate Professor of Supply Chain Management and Program Director for the MSc SCM program at the University of Birmingham (Dubai Campus). Before this position, Ahmed was the Dean (Acting) of the Faculty of Transport and Logistics (530 students) and Associate Professor in Logistics and Supply Chain Management at Muscat University. Ahmed has been listed in the top %1 scientist in the world based on the Standard-Elsevier annual report.

Ahmed Zainul Abideen is a Lecturer in Sustainable Supply Chain and Analytics, BSc Program Coordinator, and Academic Advising Focal Point at the Faculty of Transport and Logistics, Muscat University, and a Thesis Instructor at Liverpool John Moores University, U.K. With extensive experience in academia and research, he has held positions as a Senior Lecturer at Universiti Malaysia Pahang, Post-Doctoral Associate at the Institute of Business Excellence, UiTM, Malaysia, and Research Associate at MISI, part of the MIT Global Scale Network. Dr. Zain is currently leading a Ministry of Higher Education-funded project in Oman on developing Logistics 4.0 maturity levels in freight logistics. He has also secured federal grants for projects such as designing an integrated vaccination ergonomic model to reduce operational lead time and also modeling disruptions in Malaysia's retail food supply chain. His accolades include winning the Simulation Competition at IEOM Dubai 2024 and the CITREX 2019 National Innovator in Research Award, Malayaia. Dr. Zain specializes in simulation modeling (discrete event), green field analysis, supply chain network optimization, scenario planning, and bibliometric analysis.