Evaluating Strategic Risk Management in Petrochemical Operations: A Case Study of QAFAC's Utility and Methanol Units

Contents

Chapter 1: Introduction

1.1 Background of the Study

The petrochemical sector is an important part of the global economy because its products are needed to feed other industries, such as the manufacturing, energy, and consumer goods sectors. Being one of the industrialisation foundations, petrochemical corporations contribute to the economic growth and satisfy the demand for chemicals in common consumer products (Al-Khori, 2020). The high-risk element in the industry is, however, also present since the industry is a volatile, risky business to work in. The origin of such threats lies in the multifaceted nature of industrial processes, unstable chemicals at the plant, and the interdependence of the systems in the plants. Operational failure may have disastrous effects such as environmental degradation, loss of safety and loss of finances, even when it is minor. Sawaly et al. (2024) discuss that petrochemical companies ' Strategic Risk Management (SRM) has become a vital tool in mitigating such risks in order to allow continued efficiencies. SRM is a proactive approach to risk identification, evaluation, and control that allows organisations to align their activity with long-term goals and objectives. SRM frameworks are essential in risky industries such as petrochemical manufacturing, where safety will rank as top priority, to precisely avoid accidents, regulatory pressure, and safeguard human as well as environmental resources.

QAFAC (Qatar Fuel Additives Company) is among the leading petrochemical companies in Qatar that deals specifically in the production of methanol and methyl tertiary butyl ether (MTBE). Its plant, which is based in the Mesaieed Industrial City, comprises two very important units, i.e. Methanol Unit and the Utility Unit. Such units are central to the manufacture of high-demand petrochemical products that can be found all over the globe (Al-Yaeeshi et al. 2019). The Methanol Unit uses natural gas to produce methanol, which is a highly combustible and volatile chemical that has high pressure and temperature levels during its production. The Utility Unit supplies the vital services needed to ensure smooth functioning of the Methanol Unit, which consists of steam, electricity and other utilities (Karami, Samimi & Jafari, 2020). Due to the risky nature of such processes, QAFAC is required to adopt strict SRM practices in order to avoid accidents, reduce disruption to its operations and safeguard the bank financially and in terms of reputation. The SRM structures on issues that the company currently possess are actively reviewed to guarantee that

they help to resolve the developing issues of the petrochemical industry and meet the international safety and environmental norms.

1.2 Aim and Objectives

The main objective of the present research is to assess the effectiveness of the strategic risk management processes that are applied by Methanol and Utility Units of QAFAC. The aim of the study is the identification of any gaps or areas to be improved in the existing risk management processes and the implementation of recommendations to increase safety, efficiency and reliability of these units. The research also seeks to determine the extent to which the SRM practices are aligned with the strategic/business objectives, operational goals and regulatory requirements of QAFAC.

Research Objectives

1. To identify and evaluate the current risk management practices at QAFAC's Utility and Methanol Units.
2. To assess the effectiveness of these practices in mitigating operational risks.
3. To propose improvements to the existing risk management strategies based on research findings.

1.3 Research Questions

1. What are the current strategic risk management practices employed at QAFAC's Utility and Methanol Units?
2. How effective are the existing risk management strategies in mitigating operational risks at QAFAC?
3. What improvements can be proposed to enhance risk management practices in these units?

1.4 Problem Statement

The Methanol and Utility Units of QAFAC are characterised by several strategic risks, most of which are associated with the instability of the feedstocks used, the high temperatures and pressures characterising the processes, and the proximity of key utility systems. Such hazards

involve failures across equipment, process failures, human failures and supply chain failures. The systems within these units are quite complex and interrelated, such that it is difficult to keep a uniform and effective practice of risk management. Audit reports, near-misses, and old utility equipment indicate that risk management efforts are not always consistent or incorporated within the decision-making system of the organisation (Jaderi, Ibrahim, Nikoo & Nikoo, 2019). This unilateral effort towards SRM can turn small mishandlings into big hazards, leading to accidents, production disruptions, and implementation of environmental breaches and great loss of finance. Also, the risk management processes at QAFAC might go away with the strategic goals and performance objectives, thus complicating the retention of operational resilience and the realisation of long-term objectives. Consequently, it is necessary to assess SRM strategies used by QAFAC and work out recommendations to enhance risk management processes, enhance safety, and engage operations with the strategic vision of the company.

1.5 Rationale and Significance of the Study

This study is significant for both theoretical and practical reasons. The importance of this study lies in both theoretical and practical grounds. Theoretically, the study will broaden the academic literature of SRM within the petrochemical industry (especially Qatari operations). Although there have been published international standards, e.g., ISO 31000 and COSO ERM, little information has been researched with regard to the application of such frameworks within the Qatari system due to its regulatory, cultural and operational peculiarity (Karami, Samimi & Jafari, 2020). In specialising in QAFAC, this research will address this gap and present information on the pitfalls and opportunities of creating SRM in the Qatari petrochemical corporations. In practical terms, the results of this study are crucial to QAFAC because they enable the company to make wise conclusions regarding its SRM frameworks. The enhancement of the approaches in risk management can help QAFAC make its operations safer, minimise risks of any accidents, eliminate the chances of shocks in the production process, and guarantee the quality of safety and environmental standards according to the worldwide requirements. Moreover, the effective SRM will help QAFAC to enhance its resource optimisation, optimise operations as well and that the extraction of the overall improvement in its competitive powers in the whole of the petrochemical industry around the world.

1.6 Structure of the Study

The structure of this research is organised into several chapters, each addressing different aspects of the study:

1. **Chapter 1 -Introduction:** This chapter gives the background, the aim of the research, the objectives, questions, the problem statement, the rationale and significance of the study.

2. **Chapter 2- Literature Review:** It is the review of what can be found in the literature regarding the Strategic Risk Management (SRM) theories, models and their utilisation in the petrochemical industry and this case, the petrochemical industry in Qatar.

3. **Chapter 3- Research Methodology:** It describes the research philosophy, approach, methodology, and data collection methods that were employed in this research. It describes the rationale of the selected research design and the reasoning of the selected instruments of data collection and analysis.

4. **Chapter 4 -Data Analysis and Results:** This chapter provides the results of the data collection efforts and analyses the efficiency of the current SRM practices of QAFAC and the areas that need improvement.

5. **Chapter 5 – Discussion and Recommendations:** In this chapter, the findings will be discussed about the reviewed literature and a practical set of recommendations will be offered as to how QAFAC can improve its SRM procedures**.**

6. **Chapter 6 -Conclusion:** Final Chapter concludes the most important findings of the research, the contributions of the study, and the ways of further research.

Chapter 2: Literature Review

2.1 Introduction

Strategic Risk Management (SRM) plays an imperative role in high-risk industries, i.e. petrochemicals, where any failure of operation may portray overwhelming results. SRM is safe, environmentally compliant, efficient, and helps to support the long-term strategic objectives. This chapter examines the theoretical background of SRM and the use of SRM, especially in petrochemical plants, as well as the applicability of SRM in QAFAC, one of the largest Qatari-based petrochemical industries. It also examines major SRM models, evaluates their relevance concerning the QAFAC and determines current literature gaps related to SRM practices in the petrochemical industry in Qatar.

2.2 Key Concepts of Strategic Risk Management (SRM)

Achumie et al. (2022) discussed that the SRM is undertaking such practices as the identification, evaluation and addressing the risks that might hurt the capacity of an organisation to realise its strategic goals and the attainment of the long-term objectives. It is not comparable with Operational Risk Management (ORM), which deals with the management of risks which have an impact on everyday operations. SRM is more strategic and wider in perspective in that it takes into account internal and external risks that can impact the sustainability, profitability, and growth of the organisation in the future.SRM is a broad area that encompasses threats relating to financial performance, reputation, regulatory compliance, technological improvements, as well as operational interruptions. Annamalah et al. (2018) highlighted that SRM-based industries of high concern, such as petrochemical industries, need to be risk-safe. Their environmental performances should also be risk-safe as well, and they should also see angstrom adjustment practices about the whole business strategy of the organisation. Risk can be generated by a number of sources in the petrochemical industry, such as equipment failure, variations in a process, supply chain failures, human error and alterations to regulatory structures. Additionally, SRM frameworks should not merely point out these risks but also work out the effective strategies that will help alleviate them and continue the functioning of the organisation without having to rearrange its long-term goals.

2.3 SRM in the Petrochemical Industry

The petrochemical sector has a highly hazardous environment given the nature of its processes that commonly include the use of hazardous chemicals, high temperatures and high-pressure systems. Besides risks associated with the functioning of the companies (malfunctioning equipment or negligence), the industry is also exposed to certain risks connected to the environmental impact, security, and geography issues. SRM is essential in controlling such risks and in ensuring companies achieve the required safety and environmental requirements (Jaderi, Ibrahim, Nikoo & Nikoo, 2019).

Risks in the Petrochemical Industry

Al-Yaeeshi (2020) presents various risks inherent in petrochemical plants, which may cause disaster and must be appropriately dealt with. Accidental release of chemicals, leaks or fires, which may result in loss of life, environmental degradation and penalties, are also some of the key risks that are associated with chemical hazards. Equipment reliability is of great concern as failure of equipment in complex systems results in operational shutdown, delays in production, and accidents. Ranjan (2021) examines risks to the environment through improper disposal of chemicals, emission or spillage, which causes serious environmental harm and legal penalties. Production can be greatly affected by a change in the supply chain, in terms of insufficient supply or failure to transport in time. Also, there are geopolitical and regulatory risks, such as political instability or shifting regulations, that may interfere with the operations, especially in the case of companies operating internationally.

Case Studies in SRM Implementation

Al-Yaeeshi et al. (2020) explored that some petrochemical firms have been able to practice SRM to alleviate such risks as well as improve the resilience of their operations. As an example, Shell and ExxonMobil have invested in risk management strategies which turned towards predictive maintenance issues, process safety and on-time monitoring. Such companies employ superior technologies to monitor the operational data and detect possible threats even before they cause serious issues. Additionally, Bouafia et al. (2020) analyse the BP Deepwater Horizon tragedy to

help understand the devastating effects of an inability to employ effective SRM practices. In 2010, the explosion led to a lot of loss of life, environmental damage and losses. One of the factors that led to the disaster is poor risk management habits, such as poor safety measures and failure to eliminate hazards that are identified. The case points out the reliance on solid SRM structures in accident prevention and operational safety.

2.4 SRM Practices at QAFAC

QAFAC, is one of the largest petrochemical firms in Qatar with two key units which include the Methanol Unit, and the Utility Unit tasks that have the mandate of producing methanol and producing crucial utilities like steam and electricity. Reported by the Bureau of Labour Statistics (BLS), 5,283 fatalities occurred in 2023 due to work injuries and the rate of workplace injuries that resulted in deaths was set to 3.5 per 100,000 full-time equivalent (FTE) workers(Scher and Bassett, 2025). Since the production of methanol can be considered quite hazardous, QAFAC employs strict SRM structures that keep the operations safe, reducing both harsh environmental impact and the number of harmed workers. Sawaly (2022) showed the state of the SRM practices, as is the case at QAFAC, which includes regular risk assessments, safety audits, maintenance schedules and constant monitoring of critical systems. The firm adheres to both the domestic and international safety standards. Nevertheless, these practices have loopholes; they involve old equipment, unreliability of audit outcomes, and a lack of synchronisation with the SRM and decision-making perspective. Such problems prevent efficient mitigation of the risks. To enhance the current situation, QAFAC ought to assimilate SRM with its strategic goals, via embracing universal frameworks, such as ISO 31000 and COSO ERM. Also, it is important to pay more attention to employee training, the development of safety culture, and real-time data analytics to enhance risk identification and mitigation processes.

2.5 Theoretical Models and Frameworks for SRM

There are a number of established frameworks that can guide the implementation of Strategic Risk Management (SRM) in high-risk industries, such as in petrochemicals, where risks are properly identified, assessed and mitigated. Al-Khori (2020) discussed the ISO 31000, risk management is presented as all-rounded, and the focus has been on building a risk management process into the

organisational processes and integrating risk management with strategic goals. This model is also helpful in the case of QAFAC since it helps the business to integrate risk management efficiently in combination with the long-term business objectives. According to Achumie et al. (2022), although the COSO ERM Framework does not provide any specific recommendation on how rapidly QAFAC works on the alignment process, it has emphasised the need to connect risk management with strategic planning and has introduced a framework fit of identification, assessment, and reaction to risks, a framework that can guide QAFAC to identify with its strategic goals. HAZOP (Hazard and Operability Study) is the systematic process of detecting hazards in complicated processes. HAZOP in QAFAC may assist the company in reviewing operations and establishing mitigation measures to minimise the probability of the occurrence of accidents. Bow-Tie Analysis is a very visual way of representing risks since it displays the mapping of hazards, causes, and consequences, which allows QAFAC to prioritise risks and install preventive measures. Finally, the first weakness associated with the Safety Culture Theory is that it emphasises the need to develop an organisational culture that is focused on safety. Through facilitating a healthy safety culture, the QAFAC company may guarantee employee involvement in risk identification and management and, hence, increase its safety and extend the risk mitigation measures.

2.6 Research Gap

SRM in the petrochemical industry is heavily studied, but there is minimal research on how global SRM frameworks can be customised to the unique regulatory, cultural and operational environment of the petrochemical industry in Qatar. The lack of SRM practices is more specifically noticed in the example of QAFAC, where there was not much research conducted about such practices. The purpose of this research is to fill this gap by evaluating how well QAFAC does with its SRM activities and suggesting ways to improve them in order to align with one of the worldwide SRM frameworks.

2.7 Conclusion

In this chapter, major SRM concepts and theories were reviewed with a focus on how they are applied in ensuring that petrochemical industry risks are avoided and the operations are safe. It

analysed the SRM practices of QAFAC together with the points of improvement. The research will appraise the risk management approaches of QAFAC by implementing universal standards of SRM, including the ISO 31000, COSO ERM, HAZOP, Bow-Tie Analysis, and Safety Culture Theory, to recommend improvements. The study will also address the literature gap on the adaptation of SRM frameworks in the petrochemical industry in Qatar, which further contributes towards the knowledge on how high-risk industries can employ SRM.

References

Achumie, G.O., Oyegbade, I.K., Igwe, A.N., Ofodile, O.C. and Azubuike, C. (2022) 'A conceptual model for reducing occupational exposure risks in high-risk manufacturing and petrochemical industries through industrial hygiene practices', *Industrial Hygiene and Safety Journal*.

Al-Khori, K.M. (2020) *Sustainability Assessment for the Integration of Solid Oxide Fuel Cell (SOFC) Technologies in Natural Gas Processing Plant*, Doctoral dissertation, Hamad Bin Khalifa University.

Al-Yaeeshi, A.A. (2020) *An Integrated Process and Network Solution for CO2 Utilisation*, Doctoral dissertation, Hamad Bin Khalifa University.

Al-Yaeeshi, A.A., Al-Ansari, T. and Govindan, R. (2019) 'A network model-based optimisation analysis for the utilisation of CO2 in Qatar's chemical industries', *Computer Aided Chemical Engineering*, 46, pp.295-300.

Al-Yaeeshi, A.A., Govindan, R. and Al-Ansari, T. (2020) 'Techno-economic-based dynamic network design for optimum large-scale carbon dioxide utilisation in process industries', *Journal of Cleaner Production*, 275, p.122974.

Annamalah, S., Raman, M., Marthandan, G. and Logeswaran, A.K. (2018) 'Implementation of enterprise risk management (ERM) framework in enhancing business performances in oil and gas sector', *Economies*, 6(1), p.4.

Bouafia, A., Bougofa, M., Rouainia, M. and Medjram, M.S. (2020) 'Safety risk analysis and accidents modeling of a major gasoline release in petrochemical plant', *Journal of Failure Analysis and Prevention*, 20(2), pp.358-369.

Jaderi, F., Ibrahim, Z.Z., Nikoo, M. and Nikoo, M. (2019) 'Utilizing self-organization systems for modeling and managing risk based on maintenance and repair in petrochemical industries', *Soft Computing*, 23(15), pp.6379-6390.

Jin, J. (2024) 'A prominent future fuel: methanol & risk assessment of methanol fuel system of tanker as a case study'.

Karami, M., Samimi, A. and Jafari, M. (2020) 'The necessity of risk management evaluations in petrochemical industries', *Advanced Journal of Chemistry-Section B*, 2(3), pp.151-158.

Ranjan, R. (2021) 'Optimizing Risk Management with Data Analytics: Innovations in the Oil and Gas Sector'.

Sawaly, R. (2022) *Applying Carbon Tax Within CO2 Utilization Networks Including Enhanced Oil Recovery Operations in Qatar*, Master's thesis, Hamad Bin Khalifa University.

Sawaly, R., Alherbawi, M., Abd, A.S., AlNouss, A., Abushaikha, A.S. and Al-Ansari, T. (2024) 'Strategic CO2 management in the energy and petroleum sector for the production of low-carbon LNG: A Qatar Case Study'.

Scher, A. and Bassett, M. (2025) 'Which industries have most workplace injuries in the U.S.?', *Scher and Bassett*.