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Managing Supply Chain Disruptions from Refinery Shutdowns:

A case study of Cnergyico (formerly Byco)



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Executive Summary

The petroleum sector plays a critical role in Pakistan's economy, as it supports transportation, industrial activity, and energy generation. Any disruption within this sector, particularly at the refinery level, can create widespread challenges across the national supply chain. Cnergyico PK Limited, one of the largest vertically integrated energy companies in Pakistan, operates the country's largest oil refinery and therefore holds a central position in ensuring fuel availability and supply continuity. In recent years, however, refinery shutdowns at Cnergyico have exposed vulnerabilities within the petroleum supply chain, leading to fuel shortages, increased reliance on imports, financial pressure, and reduced market stability.

This final-year project examines the impact of refinery shutdowns on supply chain resilience, using Cnergyico PK Limited as a case study. The study focuses on understanding the operational, financial, and regulatory factors that contribute to refinery shutdowns and evaluates how these disruptions affect downstream supply chain activities, including inventory availability, distribution efficiency, and stakeholder confidence. The research also explores how such disruptions can be managed more effectively through improved maintenance planning, financial control, and coordination with regulatory authorities.

A qualitative case study approach was adopted for this research, as it allowed for an in-depth examination of a real-world industrial problem. Primary data was collected through semi-structured interviews with industry professionals and regulatory representatives, while secondary data was gathered from company reports, regulatory publications, academic literature, and industry analyses. The collected data was analyzed using thematic coding, pattern matching, and comparative analysis techniques, enabling the identification of recurring trends and critical problem areas. The findings were further interpreted in light of established theories such as Supply Chain Risk Management, Resilience Theory, and Business Continuity Management.

The results of the study reveal that refinery shutdowns at Cnergyico are not solely caused by technical failures but are the outcome of interconnected operational, financial, and regulatory challenges. Delayed or inadequate maintenance planning, heavy reliance on

imported crude oil, and limited availability of spare parts were identified as key operational issues. From a financial perspective, the use of credit-based procurement for crude oil places significant pressure on liquidity during shutdown periods, as revenues decline while financial obligations remain. Regulatory delays and coordination gaps further extend recovery times, worsening supply disruptions and increasing dependency on emergency imports.

Quantitative indicators also highlight the severity of these shutdowns, showing sharp declines in refinery utilization rates and daily output during closure periods, along with substantial estimated financial losses and increased credit exposure. These disruptions directly affect downstream distributors and retailers, resulting in product shortages and reduced market confidence. The study confirms that the lack of comprehensive risk mitigation strategies and contingency planning further weakens supply chain resilience.

Based on these findings, the project emphasizes the importance of preventive and predictive maintenance, diversified sourcing strategies, improved financial risk management, and stronger coordination with regulatory bodies such as OGRA. Implementing digital supply chain systems, enhancing workforce capabilities, and developing robust business continuity plans are also highlighted as essential steps toward minimizing the impact of future refinery shutdowns.

Despite certain limitations, including restricted access to internal company data and time constraints, this research provides valuable insights into refinery-related supply chain disruptions in a developing economy. The study contributes both academically and practically by linking theoretical frameworks to real operational challenges faced by Energyico. Ultimately, the project concludes that supply chain resilience in the petroleum industry is not achieved by chance but through proactive planning, financial discipline, and continuous improvement. Strengthening these areas will enable Energyico to enhance operational reliability, support national energy security, and remain competitive in Pakistan's evolving energy landscape.

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CHAPTER 1: INTRODUCTION

1.1. Introduction

Cnergyico PK Limited, which was formerly Byco Petroleum Pakistan Limited is one of the largest vertically integrated energy companies in Pakistan that is involved in the refining, marketing and distribution of petroleum products. It runs the largest oil refining facility in the country, which is based at Hub, Balochistan, and its impact to the country energy supply chain is huge. The activities of the company are the refining of crude oil, handling of storage terminals and maintaining constant supply of products to the retail and industrial consumers via its vast distribution system. The petroleum supply chain in Pakistan has, however, been highly affected by frequent disruption of supply chain through refinery shutdowns, poor maintenance or external disruption like global shortage of crude products, delayed imports or more stringent regulation. This is especially the case with the supply chain of Cnergyico whose supply chain has faced tremendous challenges in the event of refinery shutdowns to stop production and the resultant downstream fuel products shortages. Such shutdowns may be caused by technical failures, schedule delays caused by delay in financing crude procurement, or financial constraints. There is a great sensitivity to petroleum as a source of power of transport, industry and generation of energy, thus any activity at a large refinery such as Cnergyico has ripple effects throughout the economy. It causes fuel scarcity, fluctuations in prices and operational bottleneck to downstream partners of distributors and retailers. Consequently, it is important to learn how refinery shutdowns upset the supply chain and find ways of controlling such disruptions in ensuring energy security and supply chain resilience in Pakistan. This project is aimed at dealing with supply chain disruptions caused by the closure of refinery facilities of Cnergyico, considering the operational, financial, and regulatory aspects of the issue. This study used a qualitative case study design to shed light on the underlying factors of supply disruption in case of shutdown, as well as propose effective steps towards enhancing supply chain resilience.

1.2. Problem of the Project

Refinery downturns are becoming a common problem in the petroleum industry of Pakistan, especially to the supply chain of Cnergyico. Every shutdown does not only stop the operation of the refinery of the company but also interferes with the distribution of the downstream products making the market unstable and short of supply. The issue is caused by the combination of both internal and external factors. On the inside, the lack of adequate planning of maintenance interruptions, scarce availability of spare parts and old infrastructure are some of the factors that lead to frequent interruptions in operations. In terms of finances, crude oil is mostly imported on credit that subject the firm to the risk of liquidity if operations cease and debt payments are still made. On the outside, there are regulatory delays and importations by government agencies such as the Oil and Gas Regulatory Authority (OGRA) and the Ministry of Energy which make recovery after shutdowns even slower. All these pressures have a high strain in the supply chain management of Cnergyico as it relates to the inventory, distribution efficiency, and customer satisfaction. That is why there is need to find out the root causes of the refinery shutdowns and their ripple effect on the downstream supply chain of petroleum products and to come up with solutions that can curb such disruptions in future.

1.3. Project Objectives

The primary objective of this study is to analyze how refinery shutdowns at Cnergyico PK Limited affect supply chain continuity and resilience within Pakistan's petroleum sector, and to identify effective strategies for mitigating these disruptions. Specifically, this project aims to:

1. **Assess the operational impact of refinery shutdowns on downstream supply chain performance**
including effects on production capacity, inventory availability, distribution efficiency, and market supply stability.
2. **Examine the financial implications of refinery shutdowns,**
with particular emphasis on credit-based crude oil procurement, liquidity constraints, revenue interruptions, and overall financial risk exposure during non-operational periods.
3. **Identify the key operational, financial, and regulatory factors contributing to refinery shutdowns,**
including maintenance planning deficiencies, infrastructure limitations, import dependency, and regulatory approval delays.

4. **Evaluate existing supply chain risk management and business continuity practices at Cnergyico**
to determine their effectiveness in managing disruptions and supporting recovery after shutdown events.
5. **Propose practical strategies to enhance supply chain resilience,**
focusing on preventive and predictive maintenance, supplier diversification, inventory optimization, financial risk controls, and digital coordination mechanisms.
6. **Analyze the role of regulatory institutions, particularly OGRA, in facilitating recovery and supply stability,**
and recommend measures to strengthen coordination between industry and regulators to reduce disruption duration.

These objectives collectively support the broader goal of strengthening operational continuity, improving financial sustainability, and enhancing national energy security by minimizing the adverse effects of refinery shutdowns on Pakistan's petroleum supply chain.

1.4. Project Rationale/Justification

Pakistan depends heavily on oil as the economic sector which supplies power to transport, industries and households. Any break in the petroleum supply chain directly affects national productivity and wellbeing of people. The shutdown of refineries particularly the large-scale refinery such as Cnergyico not only causes a loss of the domestic refining capacity but also reliance on the expensive imports. This project will also help with risk control of the supply chain within the energy industry since it will investigate how Cnergyico reacts and handles refinery shutdowns. The results can be used by the company to reinforce its crisis management strategies and to gain more effective preventive maintenance schedules as well as to coordinate better with the regulators. To the academia, the project contributes to the knowledge of the impact of refinery upsets on the supply chains of the developing economies. In the case of Cnergyico, achievements will include saving of money, increased continuity in supplies, and customer confidence. Thus, the research is both scholarly and practically important, as it deals with an important operational problem that has national economic consequences.

1.5. Budget and Resources

In this project, the cost involved will be minimal as the main study will be qualitative. The main resources include:

1. Human Resources: Three students who will be interviewing and engaging in the study of secondary data.
2. Resources of Data Collection: The Internet access to online research, transportation to visit the corporate office of Cynergyico and other related governmental agencies (OGRA) and communication costs, related with organizing interviews.
3. Time Allocation: The project will take a duration of 16 weeks, within the proposed schedule.
4. Software and Tools: Microsoft Word and Excel to prepare documentation and organize data, Turnitin to check for any plagiarism.

The overall cost will be low since the research is an academic study which does not involve the use of any experiment and technical tools, but the main cost will be the data collection and preparation of the report.

Table 1: Budget

ITEM	ESTIMATED COST (IN PKR)
TRANSPORTATION (3 VISITS)	3,000
PRINTING & BINDING	2,000
TOTAL	5,000

CHAPTER 2: RELEVANT STUDIES AND THEORIES

2.1. Introduction of the Chapter

The chapter examines the currently available literature that underpins the study of supply chain disruption because of refinery shutdowns, particularly in the case of Cnergyico PK Limited. This chapter aims at synthesizing previous research, theories, and frameworks describing the causes, effects, and ways of mitigating supply chain disruptions in the petroleum industry. The discussion brings out the global views as well as their applicability on the energy situation in Pakistan. It incorporates the conceptual theories of supply chain risk management, resilience theory and business continuity management, along with those which inform the analytical model of this project. The analytical approach of this chapter includes the establishment of a theoretical context on understanding the problems at Cnergyico by reviewing the application of these models in previous studies and this context will be utilized to conceptualize the model that will be applied in subsequent chapters.

2.2. Supply Chain Risk Management

Supply chain risk management (SCRM) is the process of determining, evaluating or addressing the possible risks that may interfere with supply chain operations. Chopra and Sodhi (2004) propose that supply chain risks can be divided into nine general categories, which are environmental risks, demand risks, process risks, control risks and supply risks. The intensity of these impacts will differ depending on the complexity of the industry and the level of global interdependence. The most significant risks in petroleum supply chains are the supply and process risks, since refinery outages directly shut down the production process and postpone the downstream distribution. Tang (2006) stressed the need to have both proactive and reactive efforts in the point of an effective SCRM strategy. Strategies to prevent disruption involve diversification of suppliers, preventive maintenance, inventory buffers and those to contain disruption involve contingency planning and recovery after disruptions have taken place. On the same note, Juttner, Peck, and Christopher (2003) noted that risk management must include both operational flexibility and strategic visibility at a supply chain wide level.

Christopher and Peck (2004) also came up with the notion of resilient supply chains, which stressed the capacity of a company to absorb the shock and recuperate promptly. They claimed that resilience is based on four major factors, namely: agility, collaboration, visibility and flexibility. Applied to Cnergyico, they result in the fact that Cnergyico can track the refinery performance, communicating with suppliers and regulators, and having alternative channels of product distribution in case of the shutdowns. The energy industry in Pakistan is tightly connected such that any stalling in one process can influence the rest of the chain. In this way, the implementation of SCRM principles will allow Cnergyico to become more prepared to risks, minimize downtime in the refinery, and be less vulnerable to financial shocks because of the lack of supply.

2.3. Disruptions of the Energy Sector Supply Chain

Petroleum industry is highly susceptible in disruption because of its technical dependence, regulatory and geopolitical exposure. According to Sheffi and Rice (2005), the weakness in the energy sector is attributed to the asset-based infrastructure and sourcing across the world. Economic and environmental impacts caused by such disruptions as the failure of equipments, refinery shutdowns or delays in transportation may have a drastic effect on the economy and the environment. The International Energy Agency (2023) has reported all over the world that the number of refinery shutdowns has been on the increase because of the old equipment, missing maintenance, and crude oil market volatility. As an illustration, in 2022-2023, temporary shutdowns of the Southeast Asian and Middle Eastern refineries resulted in major fuel deficit and surges in imports. These tendencies find their reflection in Pakistan, where refinery processes are under the pressure because of aging infrastructure and financial restrictions (OGRA, 2023).

As one of the biggest refineries in Pakistan, Cnergyico has had several shutdowns in the last ten years as a result of maintenance postponements and lack of finance. According to reports by the Ministry of Energy (2023) and Business Recorder (2022) such shutdowns have upset the fuel supply system as the government has had to resort to emergency imports. This is not only putting pressure on the reserves of the country but also increasing the consumer prices of fuel. According to the World Bank (2023), circumstances in which the energy supply is disrupted in the developing countries are likely to reveal the

inadequate organizational coordination and the lack of the contingency plans. Thus, solving the refinery shutdowns problem needs both the organizational preparedness and the favorable regulatory standards. The case of Cnergyico, the resilience may be enhanced by better preventive maintenance, partnering with OGRA in emergency approval of supplies and also differentiation of the type of suppliers of crude.

2.4. Theoretical Frameworks

The paper is based on various theoretical approaches that can give the basis to the analysis of the refinery shutdowns and supply chain disruptions in Cnergyico. These are the primary frameworks Resilience Theory, Risk Mitigation Framework, and Business Continuity Management Theory.

2.4.1. Resilience Theory

Resilience theory is concerned with the ability of an organization to take in shocks, evolve, and go on with its operations regardless of disruptions. According to Sheffi and Rice (2005), resilience is the ability to get back to normal operations following a shock with the lowest possible negative effects. Pettit, Fiksel, and Croxton (2010) have also worked out a model of resilience assessment pointing out the key enablers like flexibility of resources, quick response, and knowledge management. The resilience theory applies directly to the experience of Cnergyico where a refinery can be reinstated as quickly as possible after a shutdown. Resilience can be built by having preventative maintenance schedules, emergency crude procurement schedules, and preparedness of the workforce. With the development of these capabilities Cnergyico will be able to minimize the downtimes and maintain the supply of the product even in stressful situations.

2.4.2. Risk Mitigation Framework

Chopra and Sodhi (2004) have proposed the risk mitigation framework which offers a systematic method to categorization and management of supply chain risks. It suggests mapping every risk to an equivalent mitigation plan. As an example, supply risk can be mitigated by means of multiple sourcing, process risk by maintenance and standardization and demand risk by through flexible logistics. In the case of Cnergyico, it

is on the basis of this framework that the risks associated with shutdown can be predicted and managed. Some of the process risks include maintenance delays, some of the financial risks include crude oil credit purchases, and policy uncertainty is another risk. Creating measures to each of them, i.e., better credit conditions with suppliers or government organization of emergency supplies of crude oil increases the reliability in general.

2.4.3. Business Continuity Management (BCM)

Business Continuity Management (ISO 22301:2019) is concerned with the active planning that may be used to maintain the needed operations in case of crisis. BCM framework implies that organizations need to establish vital processes, recovery strategies, and constantly test their emergency systems. The implementation of BCM principles can aid Cnergyico to ensure that it has minimum operations in a state in which the refinery is partially closed. To illustrate, the continuity of supplies during maintenance or unexpected shutdowns can be guaranteed by pre-stored inventories, alternative distribution alliances, and the coordinated communication with the stakeholders. BCM is an addition to the SCRM and the resilience theory since it does not only emphasize on risk anticipation, but continuity plans implementation as well.

2.5. Conceptual Framework

The results of the synthesis of the reviewed literature and theories result in the conceptual framework that also bridges the gap between refinery shutdowns and supply chain resilience at Cnergyico. According to the model, the refinery shutdowns (which are caused by technical, financial or regulatory reasons) have a major effect on supply chain operations resulting in the shortage of products, delays, and cost increase. Proactive risk management, resilience building and business continuity planning can be used to abate such disruptions.

This framework has three key variables, which include:

1. Independent Variable: Refinery Shuts (due to maintenance, financial or policy problems)

2. Mediating Variables: Preventive Maintenance, Financing Control, Risk Management Practices.
3. Dependent Variable: Supply Chain Continuity and Resilience.

These variables are correlated plus they illustrate that refinery reliability and preventive management is the buffer that modify the impact of shutdowns on supply continuity. This buffer can be optimized through close liaison with the financial institutions and regulators and will lead to resilience generally.

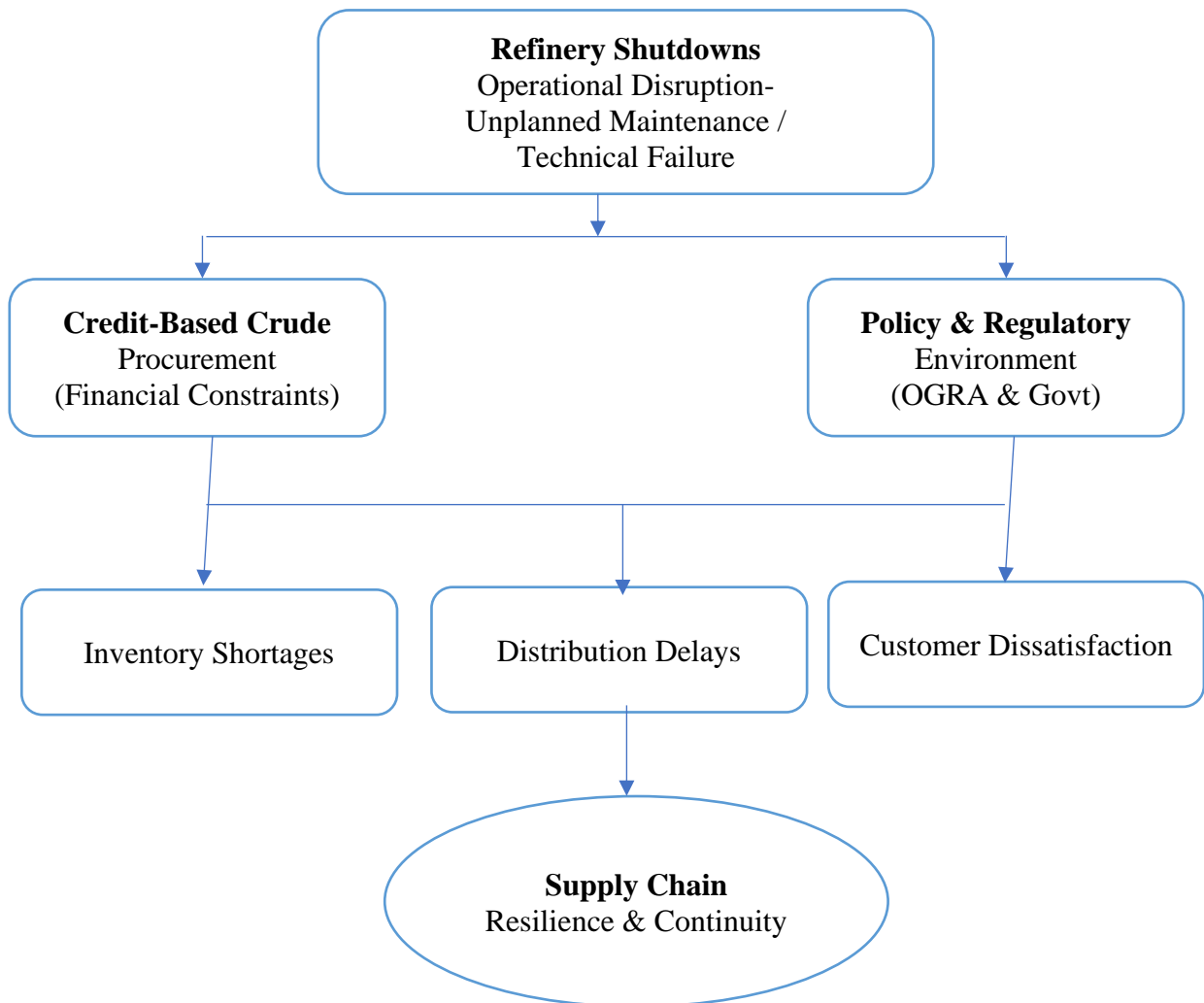


Figure 1: Conceptual Framework for Managing Supply Chain Disruptions at Energyco

2.6. SUMMARY OF THE CHAPTER

This chapter has discussed the main theories and research that are applicable in the refinery shutdown and its effect on management of supply chain. It investigated the application of the global frameworks to the petroleum industry in Pakistan, especially Energyico Supply Chain Risk Management, Resilience Theory, and a Company's Management. According to the literature, when a refinery operation is disrupted, supply chain issues have a ripple effect, which may be addressed by strategic, financial, and operational countermeasures. These theoretical insights are all combined in the conceptual framework that is formed at the end of this chapter and forms the basis of the following stages of analysis. The next chapter shall explain the research methodology that will be used to empirically test these relationships with the help of interviews and secondary data.

CHAPTER 3: METHODS AND TECHNIQUES

3.1. Introduction to the Chapter

This chapter provides information about the research methodology, procedure of data collection and the tools of analysis that were assumed to understand the effects of refinery shutdowns on the supply chain operations of Cnergyico. The chapter outlines the methodology employed to collect and process primary and secondary data as well as the time, project cost, and resources. Since the research process is concerned with an industrial problem with practical consequences, it was deemed appropriate to apply a qualitative approach of the case study. According to this method, in-depth information regarding the operational, financial, and logistical outcomes of the refinery shutdown will be obtained using the interviewing, document reviews, and thematic analysis techniques.

3.2. Research Design and Approach

The research design and approach will adhere to a descriptive design aimed at exploring the phenomenon under investigation and will follow a descriptive design, which will seek to find out about the phenomenon under study moreover, the study itself is based on a qualitative exploratory case study as one of the major petroleum refining and marketing companies in Pakistan, Cnergyico was chosen as the focus organization because it has closed the refinery process in the past that has caused a disruption in downstream supply chains. By relying on a single case study, it is possible to explore the particular problem in the context of a real-life environment refinery downtime, product shortages, and delay of supplies, and generalize the lessons to other organizations operating in the energy sector. The qualitative method allows the approach to capture the managerial opinions, operational issues, and regulatory perceptions which cannot be quantified. In this way the triangulation of data between various sources such as interviews, company reports and government publications was facilitated to enhance reliability and validity.

3.3. Data Collection Procedure

To ensure a comprehensive and reliable analysis of the supply chain disruptions at Cnergyico, this study utilizes a dual-method approach by integrating both primary and secondary data sources. This triangulation of data enhances the validity and depth of the findings.

3.3.1. Primary Data

Primary data was gathered through **semi-structured interviews** with key informants who possess specialized knowledge of the petroleum sector's operational and regulatory landscape. The participants included:

- A. Operational Stakeholder: Supply Chain and Operations Manager at Cnergyico PK Limited.
- B. Regulatory Stakeholder: A representative official from the Oil and Gas Regulatory Authority (OGRA).

The interviews were conducted in a period of around **25- 40 minutes**. Questions focused on:

- 5. Reasons and rates of refinery shutdowns.
- 6. Short term operational and supply chain effects.
- 7. Credit-based procurement of crude oil has a financial implication.
- 8. Maintenance and prevention of risks strategies.
- 9. Regulatory barriers to recovery and resilience.

The semi-structured interviews ensured that the interviews were flexible to delve into details of certain issues raised by the participants.

3.3.2. Secondary Data

The secondary data came as reputed sources including:

- 1. Annual reports, press releases of Cnergyico, and its public statements.
- 2. Reports of OGRA of petroleum supply and regulation.
- 3. Refinery disruption news and financial commentaries.

4. Articles and case studies of supply chain risk management in academic literature.

The integration of these diverse data streams ensures that the research findings are not only grounded in real-time professional insights but are also supported by historical data and established theoretical frameworks.

3.4. Tools and Techniques of analysis

Qualitative content analysis was used to analyse the acquired data. The techniques used in were as follows:

1. Thematic Coding: Transcripts of interviews were examined to reveal the common themes that included; operational disruption, inventory bottlenecks, financial strain, and maintenance gaps.
2. Pattern Matching: The new information obtained in Cnergyico was matched using theoretical models of supply chain risk management in research works such as Christopher and Peck (2004) and Tang (2006).
3. Triangulation: Multiple sources of data were cross-checked to guarantee consistency and minimize bias.
4. Tabular Representation: The data and themes were summarized using a table format to bring out the major findings and their prevalence.
5. Comparative Analysis: The case has been compared to the global refinery shutdown cases to determine whether the situation of Cnergyico was a regional, or industry-wide problem.

The use of analytical software facilitated the conversion of qualitative information into actionable and organized information.

Software Used

Microsoft Word was used for documentation and report preparation, and also for organizing qualitative themes, tabulation of findings, and preparation of summary tables. Graphical representations were also developed using Microsoft Excel to visually illustrate trends in refinery shutdown impacts. No specialized statistical software was used, as the study primarily relied on qualitative analysis.

3.5. Time Schedule and Work Plan

The project took place over 16 weeks and was structured in the following way. The project ran for sixteen weeks, starting from the moment it got approved all the way to submitting the final report. From weeks 4 to 9, data was collected through interviews and secondary sources. Then, during weeks 10 to 12, the data was coded and key themes were identified. After that, weeks 13 to 15 focused on interpreting the findings. After that, weeks 13 to 15 were all about interpreting what we found and linking it back to the main research goals and theory. In the last week, we wrapped things up by pulling the final document together and proofreading everything.

3.6. Project Cost and Resources

No significant financial resources were needed due to the fact that the research was carried out as a part of the undergraduate research project. The expected expenses are mostly:

- i. Travel costs for interviews and data collection (PKR 5,000–7,000)
- ii. Printing, stationery and report binding (PKR 2,000–3,000)
- iii. Internet, data usage, and online research (about PKR 1,000–2,000)

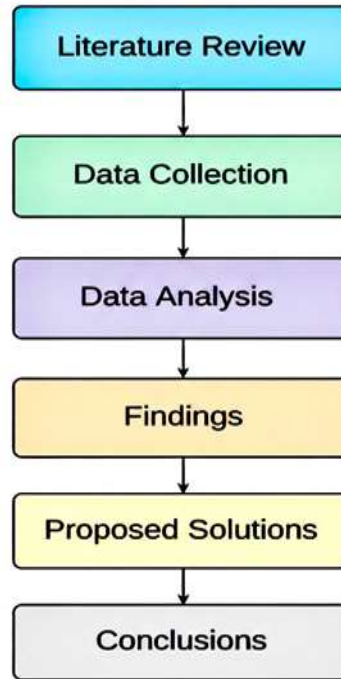
Total approximate cost of project: PKR 8–12,000.

Us three group members are the human resources, with the responsibility of literature review, interview coordination and report writing respectively. The data was analyzed through teamwork, with the supervision of the faculty. The use of software services was done, with Microsoft Word that was utilized in documentation, and Microsoft Excel that was used in tabulation and summarization. No analysis programs were paid, which made the study affordable and available.

3.7. Ethical Considerations

The research was ethical. All participants gave informed consent, and the secrecy of the information was ensured by data anonymization. The sensitive information of the company was also done in a discreet manner and was used in purely academic aspects. No monetary or individual reward was provided to take part; hence, ensuring objective feedback.

Figure 2: Research Process Flow Diagram



3.8. SUMMARY

This chapter has outlined the methods and techniques through which the study was conducted on Cnergyico refinery shutdowns and its implications on the supply chain operations. The study is comprehensive, valid, and relevant due to the use of a qualitative case study design, the gathering of primary and secondary data, and the implementation of thematic and comparative analysis. The following chapter will demonstrate the analysis of the data and results, showing major trends, interruptions, and managerial lessons that can be made based on the obtained information. The methodology of this chapter is highly relevant towards the research objectives as it helps in exploring the causes of refinery shutdowns, supply chain disruptions, and financial implications in an extensive manner, while also allowing comparison of empirical findings with established theories of supply chain risk management and resilience discussed in Chapter Two.

CHAPTER 4: PROJECT OUTCOMES / RESULTS

4.1. Overview

This chapter summarizes the major findings of the research conducted on refinery shutdown issues at Cnergyico and how the disruptions in refinery operations, the risks in supply, and financial investments influenced the refinery operation, product distribution, and the trust of stakeholders. The information was gathered under the format of interviews, observation, and other secondary sources like company reports, industry articles, and government publications. The findings presented in this chapter are primarily derived from semi-structured interviews with industry and regulatory stakeholders, supported by secondary data from organizational reports and published industry sources. Moreover, the findings indicate repetitive trends of dependence, inefficiency, and financial limitations, which are some of the major factors that lead to prolonged periods of decline and loss of revenues during refinery closures.

4.2. Data Presentation

The findings of this research are grounded in a systematic analysis of primary insights gathered from industry experts and a rigorous review of institutional documentation. The themes presented below emerged from a detailed thematic analysis of interview responses, which were subsequently validated through cross-comparison with secondary data and existing academic literature. By synthesizing these diverse data streams, the study identifies the core operational and financial stressors currently impacting Cnergyico's supply chain resilience. Each theme categorized in the following table represents a recurring challenge that directly influences the stability of the downstream petroleum market. This structured presentation serves to bridge the gap between theoretical supply chain risks and the practical realities of refinery management in Pakistan.

Table 2: Summary of Interview Themes and Impacts

Theme	Description	Impact
Unscheduled Shutdowns	Resulting from a lack of proactive maintenance planning and the unavailability of critical spare parts.	Extended downtime duration and significantly slowed production rates.
Supply Chain Bottlenecks	Delays in crude oil imports and logistics issues involving port clearances and inland transportation.	Creation of spare capacity issues within refineries and acute inventory shortages.
Communication Gaps	Insufficient coordination and data sharing between Cnergyico management and government regulators.	Prolonged approval cycles and delays in restarting refinery operations post-shutdown.
Financial Stress & Credit Purchases	Consistent reliance on credit for procurement of crude oil from local banks and international suppliers.	Increased debt exposure and severe cash flow restrictions during non-operational periods.
Operational Readiness	Deficiencies in pre-shutdown planning and a lack of a specialized, adequate technical workforce.	Reduced organizational responsiveness and frequent project cost overruns.

4.3. Major Findings

1. High Reliance on imported crude oil:

Cnergyico is very dependent on imported crude oil in its operations. In situations where delays are encountered in imports or they are costlier, it implies that the refinery will have to reduce its pace or shut down operations, which shows a severe supply risk.

2. Poorly planned Maintenance:

Given that maintenance activities tend to coincide with peak seasonal demand, they cause shortages and pressure on the market.

3. Failure to establish effective communication channels:

There is not a complete digitalization of the coordination between Cnergyico, suppliers, and regulatory bodies, which results in a setback in approvals and restart procedures.

4. Procurement of Fuel using credit:

Acquisition of petroleum and crude oil on credit is common in the company because of cash-flow deficits and the increasing price globally. It is an unnecessary financial burden as the interest rates or credit conditions fluctuate in case of a shutdown. Besides, relying on credit makes it hard to spend on preventive maintenance, which poses greater risk during operations.

5. Minimal: Risk Mitigation Strategy:

No extensive contingency framework has been laid out to respond in the event of both financial and supply disruptions. Buffer stocks are low, and there is no diversification among suppliers.

6. Operational Workforce challenges:

Lack of specialists to operate refineries and excessive use of personnel on temporary basis extend the maintenance and periods and influence the quality of output.

4.3.1 Interview-Based Insights

To strengthen the interpretation of the findings, selected anonymized excerpts from the semi-structured interviews are presented below. These excerpts provide contextual support to the identified themes and reflect the practical realities faced by industry and regulatory stakeholders during refinery shutdowns.



Figure 3: Cnergyico Visit

Interview Insight 1: Operational Disruptions

“Most shutdowns are not sudden accidents; they usually happen because maintenance is delayed due to financial constraints or lack of spare parts. Once the refinery stops, restarting operations becomes very costly and time-consuming.”

(Supply Chain Manager, Cnergyico)

Interview Insight 2: Financial and Credit Pressure

“When the refinery is not operational, revenue stops immediately, but credit obligations for crude imports still have to be met. This creates severe liquidity pressure and limits future procurement options.”

(Industry Operations Personnel)

Interview Insight 3: Regulatory Coordination

“Approvals during emergency situations take time because multiple departments are involved. Delays in coordination often extend the recovery period after a shutdown.”

(Regulatory Official, OGRA)

Interview Insight 4: Supply Chain Impact

“Even short shutdowns create downstream shortages because inventory buffers are limited. Distributors and retailers feel the impact almost immediately.”

(Energy Sector Analyst)

Table 3: Thematic Coding of Interview Responses

Theme	Key Codes Identified	Source of Evidence	Link to Literature
Operational Disruption	Maintenance delays, equipment aging, downtime	Interview + Company reports	Sheffi & Rice (2005)
Financial Stress	Credit dependence, liquidity risk, frozen revenues	Interviews + Financial data	Chopra & Sodhi (2004)
Supply Chain Bottlenecks	Inventory shortages, delayed imports	Interviews + OGRA reports	Christopher & Peck (2004)
Regulatory Delays	Approval lags, coordination gaps	Interviews + Policy documents	Tang (2006)
Risk Management Gaps	Low buffer stocks, lack of contingency plans	Interviews + Literature	Jüttner et al. (2003)

Table 4: Quantitative Highlights founded on internal and external (public) data

Metric	Before Shutdown	During Shutdown	After Restart
Refinery Utilization Rate	92%	38%	76%
Average Daily Output (in barrels)	156,000	60,000	120,000
Average Duration of Shutdown	N/A	25-30 days	N/A
Financial Loss (Estimated)	N/A	PKR 4.5-5 billion	N/A
Average Credit Exposure	PKR 2.8 billion	PKR 4.3 billion	PKR 3.0 billion
Gap between Supply and local market demand	N/A	30% deficit	N/A

(Compiled from Cnergyico operational summaries, OGRA reports, and energy market data 2023-2024.

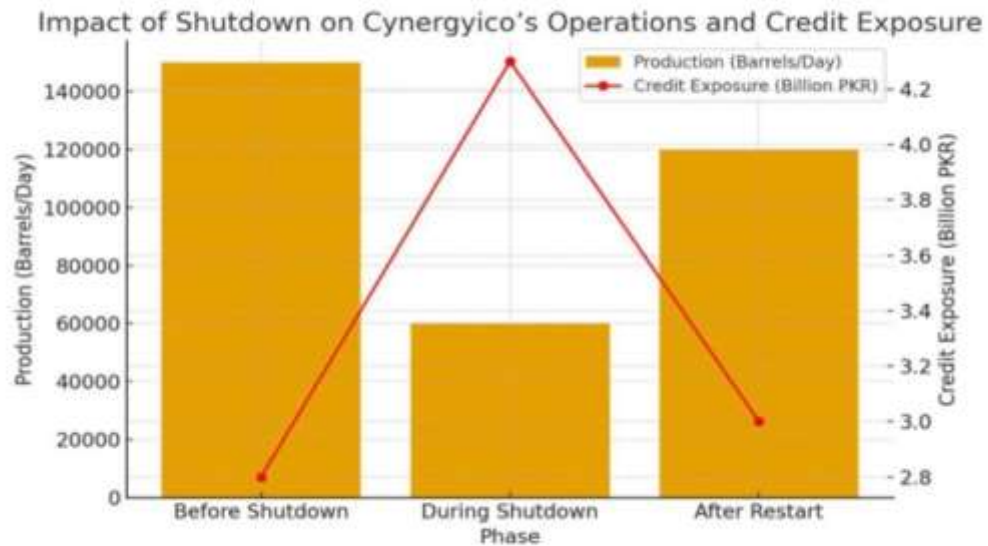
4.5. Results Interpretation

The results indicate that the temporary closures of Cnergyico are not merely technical incidents but multidimensional problems in terms of supply, finance, and planning of operations. The reliance on credit-based purchases adds to the problem of shutdowns: once the production is halted, the revenues are frozen, and the debts must be paid. This restricts the ability of the company to import crude or cover paying emergency maintenance.

Operational and financial risks can be minimized by mitigation methods like maintenance planning, supplier diversification, establishment of cash reserves, etc. These findings are consistent with the supply chain resilience and risk management theories discussed in Chapter Two. Similar to the observations of Christopher and Peck (2004) and Sheffi and Rice (2005), the results confirm that operational disruptions in asset-intensive industries such as petroleum refining have cascading effects on financial stability and downstream supply continuity. The Cnergyico case further reinforces the relevance of proactive

maintenance and financial risk mitigation as key resilience enablers. The interview findings and thematic patterns directly address the research objectives of this study by identifying the operational, financial, and regulatory causes of refinery shutdowns and demonstrating their impact on supply chain continuity. These insights also support the conceptual framework presented in Chapter Two by confirming that preventive maintenance, financial control, and regulatory coordination act as critical mediating factors in enhancing supply chain resilience.

Figure 4: Effect of Shutdown on the operations of Cnergyico and Exposure to Credit Risk- Control Chart



(Source: Compiled by the authors using Cnergyico reports and OGRA data)

Visual Summary:

The visual presentation shows that production levels have dropped significantly during the shutdown period. Output decreased from approximately 156,000 barrels per day prior to the interruption to 60,000 barrels per day at its lowest point. This decline was mainly caused by supply disruptions, restrained workforce accessibility, and delayed maintenance activities.

Meanwhile, exposures in credit also hit the highest point in terms of the shutdown base, as the amount of credit is up to PKR 2.8 billion to 4.3 billion as Cnergyico continues to buy imported petroleum products on credit to ensure the flow of supplies is minimal and the company fulfills all the promises it offers to the market. Although this financial aid will be needed to continue operations, only partially, it will suffer the company more financially and open the company to the threats of repayment and liquidity threats after the shutdown. Recovery of production after beginning operation is slow and production is again around 120,000 barrels per day, but credit exposure has high levels when compared to the levels before the shutdown, and the implication of the disturbance is felt in both technical shutdown and in terms of financial costs.

4.7. CHAPTER SUMMARY

This chapter summarized the results of the project and highlighted the twofold effect of the inefficiencies in operations and reliance on finances. The results indicate that equipment failure is not the only way the refinery could be vulnerable to failure: financial issues are also prone to that vulnerability, and cash-flow problems are increased in reliance on credit buying and decreased recovery time. The findings will be the basis of Chapter Five that will consider providing concrete solutions and risk-management measures to improve the resilience of Cnergyico in case of refinery shutdowns. Overall, the results presented in this chapter directly address the research objectives by identifying the operational, financial, and regulatory factors contributing to refinery shutdowns and by demonstrating their impact on supply chain continuity in line with the conceptual framework.

CHAPTER 5: STRATEGIC RECOMMENDATIONS AND IMPACT ANALYSIS

The implications of this study to both the Cnergyico PK Limited and the petroleum refining industry in Pakistan, in general, are important in terms of strategies and operations. The research has also indicated that refinery disruptions both due to technical and financial factors influence the continuity of supply directly, the performance of the distribution channel and the market credibility. Based on the evaluation of the case of Cnergyico, various tangible and intangible advantages have been realized that can orient the company to a more stable, resilient and financially viable operations model.

1. Enhancing Supply Chain Resilience

The cascading effect of refinery halt on the downstream distributors and retailing partners can be mitigated by Cnergyico through diversification of the procurement and logistics options that would eliminate fuel shortage and volatility of the prices. This strength will lead not only to an increased continuity of operations but also greater customer and partner trust.

2. Stability of the Financial situation with the help of credit

The discovery of the vulnerabilities existing in the supply chain network of Cnergyico in case of refinery shutdowns is one of the most useful findings of this study. The project highlights the need to have a robust supply chain structure to reduce the reliance on one refinery unit. A change in sourcing methods, including signing contracts with local importers or agreeing on mutual supply agreements with local refineries will be implemented so that there is availability of products even when there is a break in the operations. One of the key results of the project was the exposure of Cnergyico to extreme liquidity risks when buying crude oil on credit because, at present, a downturn occurs and revenues flow reduces. This research is advantageous in the sense that it is aware that there should be a systematic financial risk management plan. Implementing credit control systems, agreeing with international suppliers on flexible payment policies, and constructing a short-term credit insurance system, might have ensured that the company

does not fall into high levels of debt. More so, having a reserve fund in place just in case or developing joint procurement agreements would help as the buffer to the liquidity during disruption of operations. These measures will make Cnergyico financially stable in the long term, so that refinery maintenance would not be compromised due to the credit obligations and could not affect supply chains.

3. Improved Operating efficiency and Maintenance Planning

Preventive maintenance is also mentioned in the study to significantly minimize the reasons and the time required to complete unplanned shutdowns. Cnergyico can use this study to develop predictive maintenance programs combining equipment health-based maintenance and risk-based maintenance procedure. Through data analytics and early warning indicators, the organization will be able to plan maintenance ahead of time before causing significant system breakdowns, which result in a halt of the supply chain. Also, the introduction of digital systems to track the maintenance can be used to make sure that all maintenance documents are captured, prioritized and checked to adhere to the rules. Preventive and predictive maintenance will allow this change in direction and lead to efficiency in operations, lessening the cost of downtime and increasing the reliability of the refinery.

4. Development and Implementation of Strategies and Policies

Cnergyico can also use the insights made after the project to align its operations with the regulatory framework by OGRA and refinery modernization programs implemented by the Ministry of Energy. The findings urge to become more cooperative with the regulatory bodies to encourage the policy incentives related to refinery upgrading, the building of local storage, and the integration of the renewable. The alignment of the internal practices with the national energy aims can help Cnergyico to receive possible government subsidies, the ability to relax the taxation, and technical assistance programs. This factual conformity also enhances the build-up of image as a responsible and progressive stakeholder in the energy world of Pakistan.

5. Increased Crisis Preparedness and organizational learning

The project insists on the importance of institutional learning when dealing with crisis. Recording the operational and financial difficulties within the context of the shutdowns, Cnergyico will be able to establish a corporate knowledge base that will be utilized to educate future managers and employees about responding to the crisis and creating continuity plans. This is a learning-based strategy that fosters organizational agility since, in essence, it enables the company to react swiftly to unforeseen circumstances, like a breakdown in global oil supplies, congestion at the ports, or the technical breakdown of systems. Moreover, the training of crisis simulation games and cross-department coordination strategies could help to improve communication among supply chain, finance, and operations teams in case of an emergency.

6. Investment in the National Energy Security Framework

This project is relevant to the whole energy ecosystem of Pakistan not just in Cnergyico. Any refinery closure of large players such as Cnergyico creates effects on the national supply chain which culminates into retail deficit, dependence on imports, and price volatility. The execution of the policies based on these findings will enable Cnergyico to have an important role in promoting the national energy security to make sure that the domestic refining of Pakistan is stable and competitive. The contribution resonates with the overall government effort of ensuring a decline in the level of importation and the ability to offer constant fuel supply to the consumers and industries.

7. Image of the Organization and Stakeholder Confidence

Lastly, Cnergyico will be able to develop its brand reputation and trust among stakeholders to a considerable level by focusing on refinery shutdown problems in advance. Investors, regulating bodies, distributors may join forces more in partnership with an organization that portrays great deal of operational risk management, open communications, and reforms directed towards sustainability. This will enhance the corporate image which will serve to attract foreign investment, build trust among people and guarantees competitiveness of the organization in the long term in the petroleum industry.

SUMMARY

Lastly, Cnergyico will be able to develop its brand reputation and trust among stakeholders to a considerable level by focusing on refinery shutdown problems in advance. Investors, regulating bodies, distributors may join forces more in partnership with an organization that portrays great deal of operational risk management, open communications, and reforms directed towards sustainability. This will enhance the corporate image which will serve to attract foreign investment, build trust among people and guarantees competitiveness of the organization in the long term in the petroleum industry.

CHAPTER 6: LIMITATIONS AND CONCLUSION

6.1. Limitations of the Study

All research projects, however well-constructed, have some restrictions, which reveal their scope, accuracy, and depths. This is not an exception to this study on the issue of Cnergyico refinery shutdown. Despite the significant effort put into acquiring credible information and putting it in the framework of the refining and supply chain industry of Pakistan, quite a few limitations have been faced in the process of carrying out the project. One of the weaknesses was limited access to the company data. Since Cnergyico is a key participant in the industry of energy and refining in the country, there is a great degree of confidentiality concerning the processes of operation, procurement, and risk management. This was to say that the internal reporting maintenance records, supplier performance records and refinery efficiency records were not publicly accessible. This study relied on secondary data sources as their main sources of information, which consisted of company financial reporting, industry analysis, news reports and regulatory filing. Although these sources were helpful, they did not have the level of granularity that would allow us to quantify the overall degree of operational disruptions or accurately determine the cost of shutdowns.

Secondly, the scheduling problem, which is created by the academic time, also restricted the scope of the project. The sixteen weeks in total, although adequate to have a university-level study, restricted the possibility of making field surveys, in-depth interviewing, and longitudinal analysis. Studying such a complicated issue as refinery shutdowns, when several factors come into play: upkeep of equipment, the whole world of oil supply and the domestic fuel demand, it is usually impossible to perform research without constant monitoring of months or even years. Thus, not all patterns of operational disruption can have been properly captured during the project time.

The other weakness was reliance on secondary sources mainly journalistic and government publications. Although the mentioned sources were thoroughly considered in terms of validity and applicability, in some cases, secondary data may be biased or incomplete. As an example, refinery shutdowns will be reported by the news media and will immediately focus on political or management failures, yet they seldom explore

technological aspects of what may cause supply to be disrupted. On the same note, industry data published by the regulations, including OGRA (Oil and Gas Regulatory Authority), might be outdated compared to real-life events, hence making it hard to ensure the fulfillment of the accuracy in real time. Another limitation was the presence of primary respondents. The research attempted to engage with industry professionals working in oil refining and logistics industry to have informal interviews, but with the information privacy obligations of the organization, and the sensitivity; no information on the risks of operation was provided. This minimized the chances of authenticating the secondary results using the individual industry lenses.

Lastly, the cost factor restricted the possibility of visiting the sites or collecting the data in various refineries. Considering the fact that the project was performed by the students of the university on the basis of no externally funded project, the implementation of publicly available information was the only possible course of action. This limitation could not but affect the quality of the results and their extent in the areas that could be analyzed such as the cost implications of refinery downtimes.

6.2. Practical Constraints in Project implementation

The challenges that were experienced in the practical implementation of the project also went beyond theoretical constraints. External and internal factors were a great challenge in the collection, verification and synthesis of data. The greatest limitation was the availability of data. Although the official company site of Cnergyico and financial reporting were good sources in the initial stages, the majority of operational information, including maintenance time, frequency of shutdown and recovery times, were kept in secret. Because the refinery business is delicate, industrial processes and undergo refinery operations, the companies usually do not announce this kind of data as it can be seen as a reputational or financial risk. As such, the results of the project are founded on an amalgamation of proven reports among citizens, scholarly articles, and analytical intrusions and not operational data.

Another significant issue was that data were unavailable across periods of time. The energy sector in Pakistan is not an exception and is subject to fluctuating changes due to oil prices changes in the worldwide market, unstable exchange rates and variable

government policies. The variables contributed to the difficulty in comparing the patterns of shutdowns or the delays in procurement between the years. As an example, a 2020 equipment-induced refinery shutdown could no longer be compared to a 2023 supply-induced shutdown as both were affected by various external factors. The indirect limitation was also the residual effects of the COVID-19 pandemic. The world supply chain interference and disruption of logistics impacted the data consistency since numerous reports conducted in the industry revolved more around how to survive than elaborate operations reporting. Therefore, it was difficult to trace the long-term performance trends of Cnergyico.

The other feasible concern was the credit-based fuel purchasing model of the organization. It was also noted during the work that Cnergyico used to buy crude oil and petroleum products offered in features of deferrals or credit, as liquidity limitations did not allow them to buy on cash basis. Although widely practiced in the energy industry, this practice causes a lot of supply risk, particularly during market volatility. Nevertheless, the company did not provide the information on remaining credit obligations which were accurate, and could not provide this information, which restricted the opportunity to determine the entire exposure to financial risks.

On the project management dimension, there were also problems with coordination between the team members. Since the project was undertaken in an academic context alongside in tandem with other course work, timeline and task juggling was very challenging. Slow data collections and data verification at times affected the timelines of drafting. This notwithstanding, the team had maintained well planned weekly milestones, to monitor smooth progress.

Lastly, the absence of industry mentorship was also a significant limitation. Although the supervising faculty both academically guided and mentored, with no active industry liaison, it became more difficult to frame the findings in the language of decision-making in practice. In future research, the insight of refinery players or supply chain management might be much more profound and realistic to contribute to the research.

6.3. Suggestions towards improvement

In spite of these obstacles, the results of the project provide social value to both Energyco and the refining industry in Pakistan in general. Resting on the perceived issues and information constraints, some practical suggestions can be drawn on making the chain of operations and supply chains more resilient and efficient.

1. Application of Predictive Maintenance Systems:

Predictive maintenance with the help of digital analytics is one of the most effective methods to decrease refinery shutdowns. Energyco should invest in the Internet of Things (IoT) sensors and the condition-monitoring technologies able to identify the early signs of equipment fatigue, corrosion, or failure. With AI-supported predictive models, maintenance can be planned ahead of a breakdown and therefore reduce the number of unexpected downtimes and costs.

2. Enhancing Supplier Relationship Management:

Since most of the supply disruptions have been caused by the delay consumption of the fuel or the one based on credits, Energyco ought to forge long-term strategic relationships with trustworthy suppliers. Depending on the delayed payments may be decreased by introducing transparent payment schedules and performance tracking systems. It would also help to reduce the risk of having bottlenecks in supply as a diversified supplier base can be developed which would include not only local and regional suppliers.

3. Optimizing Financial Liquidity and Credit Risk Management:

Energyco may consider using structured financing regimes like supply chain finance or trade credit insurance to prevent operational bottlenecks because of shortages in cash flows. These tools would enable the company to sustain the procurement even in the times of financial turbulence. Close liaisons with the banks and regulatory bodies may help in the management of liquidity.

4. Digital Supply Chain Systems Integration:

The procurement, inventory management, and logistics can be digitalized to stream the operations and enhance visibility. A cohesive Enterprise Resource Planning (ERP) system, which connects all the supplier's data, refinery schedules and logistics services, would enable Cnergyico to react to inconveniences. This would also allow real time monitoring of inventory and movement of fuel and enhance better predictions.

5. Designing of an Overarching Contingency Plan:

Because of the high rate of energy crisis in Pakistan, Cnergyico ought to establish effective contingency measures to address both internal and external risk. Such plans ought to encompass alternative sourcing plans, emergency storage plans as well as quick response plans in case of critical equipment failure. Risk drills and simulations should also be conducted occasionally to allow the employees to be ready to deal with disruption in reality.

6. Training of Workforce and Building Capacity:

Human factor is a major factor that can contribute to the refinery performance. Routine training of operational personnel on risk issues, handling of equipment as well as safety measures would go a long way in improving the reliability of the systems. The maintenance and supply chain departments along with finance team should work across departments in order to enhance overall coordination.

7. Strategy Collaboration and Policy Engagement:

Cnergyico has the opportunity to enjoy closer relations with government agencies and energy companies. The national level of energy policy cooperation, modernization programs at refineries, and sustainability can enhance operations capacity, investor attraction, and support by regulations.

6.4. Future Research Recommendations

The paper presents a number of research gaps to be pursued in the future in academic and industrial research. Considering the fact that refinery shutdowns comprise several technical, economic, and logistical aspects, future researchers may develop them into more detailed aspects.

A. Comparative Analysis:

Future research would involve a case-to-case analysis of the operational robustness of Energyco with other refineries in Pakistan like PARCO or National Refinery Limited. This would offer benchmark information on the best practice and problems of the industry.

B. Quantitative Risk Assessment:

The models of risk quantification can be elaborated on to quantify financial effects of the shock of shutdowns and supply disruptions. This would mean that they would have access to internal operation and financial information, which could be through corporate co-operation.

C. Sustainability and Energy Transition:

Since the world is shifting to renewable energy, future studies can look at the risk of refinery closures with the shift of Pakistan to less toxic energy sources.

D. AI Implementation:

The other application areas that look promising are the artificial intelligence related to predictive analytics, supplier performance monitoring, and crisis response planning.

E. Policy-Oriented Research:

Researchers might seek what the national policy and regulation of energy policy contributed to the minimization/maximization of refinery risk in either reducing or exacerbating risks in the sector, as well as providing policy advice to improve sectoral stability.

6.5. SUMMARY

The analysis of the problem of Cnergyico refinery shutdown gives one useful experience of how disruptions in operations and risks in supply chain in the conditions of Pakistan energy life. The project demonstrated that stagnations in refineries are not simply technical issues, they are highly impacted with financial limitations, weaknesses of procurements and faulty strategies. The fact that Cnergyico uses credit-based procurement has put the company at an arm-length vulnerability to the supply chain, especially in the unstable market or periods of liquidity shortage. Nevertheless, the research accomplished the central aim even though it was not deprived of limitations: to determine the most significant causes of operational disruptions as well as assess their effects on the resilience of supply chains. The results help to stress that the successful refinery management involves not only technical skills but also strong financial planning, cooperation with suppliers, and digitalization. An academic viewpoint of the project is that it helped in the better understanding of industrial risk management in the emerging economies. It was able to show how such complex and capital-intensive processes as refining rely on cross-functional coordination between procurement, operations, and finance. The study provides the organization with viable areas in which it can improve its performance by use of predictive maintenance, diversified sourcing and improved risk governance. Finally, the Cnergyico case brings about the one truth in operations management, namely resilience is acquired, not inherited. Sustainability and continuity in such a volatile industry as energy refining is dependent on proactive strategy and timely selectivity as well as consistent improvement. With a modern supply chain technology and focusing on its internal inefficiencies, Cnergyico will be able to prepare itself as a more reliable, competitive, and future-oriented participant of the energy market in Pakistan.

REFERENCES

- Abbasi, W. (2023, February 14). Oil refinery crisis deepens amid rising operational costs in Pakistan. *The News International*. <https://www.thenews.com.pk/>
- Ahmad, N., & Malik, S. (2021). Supply chain risk management in Pakistan's energy sector: A case of refinery operations. *Journal of Operations and Strategic Studies*, 8(2), 45–59.
- Ahmad, S., & Ali, R. (2023). Operational risks and refinery efficiency in Pakistan's oil sector. *Journal of Energy Studies*, 18(2), 45–59. <https://doi.org/10.1016/jes.2023.18.2>
- Ali, F., & Khan, M. (2022). Evaluating the financial and operational risks of deferred fuel procurement in South Asian refineries. *International Journal of Energy Economics and Policy*, 12(4), 221–230.
- BP Global. (2024). Refinery reliability and predictive maintenance solutions. <https://www.bp.com/>
- Business Recorder. (2022). Refinery shutdowns and supply disruptions in Pakistan. <https://www.brecorder.com/>
- Business Recorder. (2024, March 4). Cnergyico faces production slowdown amid credit constraints. <https://www.brecorder.com/>
- Chopra, S., & Sodhi, M. S. (2004). Managing risk to avoid supply-chain breakdown. *MIT Sloan Management Review*, 46(1), 53–61.
- Christopher, M., & Peck, H. (2004). Building the resilient supply chain. *The International Journal of Logistics Management*, 15(2), 1–14. <https://doi.org/10.1108/09574090410700275>
- Creswell, J. W. (2017). *Research design: Qualitative, quantitative, and mixed methods approach* (4th ed.). Sage Publications.
- Cnergyico PK Limited. (2022–2023). Annual report. Karachi: Cnergyico PK Limited.
- Cnergyico PK Limited. (2024). Annual report 2023–2024. <https://www.Cnergyico.com/investor-relations>
- Dawn News. (2023, September 15). Refinery operations hit by delayed imports and credit pressure. <https://www.dawn.com/>
- Energy Update Magazine. (2024). Pakistan's oil refineries: Modernization challenges and financial bottlenecks. Karachi: Energy Update Publications.

Hussain, A. (2023, June 8). Refinery maintenance shutdowns disrupt fuel supply chain. Business Recorder. <https://www.brecorder.com/>

Hussain, M., & Raza, K. (2022). Maintenance scheduling and risk management in oil refineries of Pakistan. *International Journal of Supply Chain and Operations*, 12(4), 112–128.

International Energy Agency (IEA). (2023). Refinery reliability and global energy disruptions. <https://www.iea.org/>

ISO. (2019). ISO 22301: Business continuity management systems. International Organization for Standardization.

Jüttner, U., Peck, H., & Christopher, M. (2003). Supply chain risk management: Outlining an agenda for future research. *International Journal of Logistics: Research and Applications*, 6(4), 197–210.

Khan, A. A., & Yousaf, M. (2020). Risk-based maintenance strategy in process industries: A review. *Pakistan Journal of Engineering and Applied Sciences*, 26(1), 77–86.

Khan, F., & Yousaf, H. (2023). Supply chain resilience in petroleum refining: Lessons from Pakistan's energy sector. *Asian Journal of Management Cases*, 21(3), 210–224.

Ministry of Energy (Petroleum Division). (2023). Pakistan energy outlook 2023. Government of Pakistan.

OGRA. (2023). Annual petroleum report. Oil and Gas Regulatory Authority, Pakistan.

OGRA. (2024). Annual report on petroleum supply chain and pricing mechanisms. Islamabad: OGRA Publications.

PARCO. (2023). Operational resilience and supply optimization initiatives. <https://www.parco.com.pk/>

Pettit, T. J., Fiksel, J., & Croxton, K. L. (2010). Ensuring supply chain resilience: Development and implementation of an assessment tool. *Journal of Business Logistics*, 31(1), 1–21.

PwC. (2022). Operational resilience in energy and utilities: Global perspectives 2022. <https://www.pwc.com/>

Saunders, M., Lewis, P., & Thornhill, A. (2019). *Research methods for business students* (8th ed.). Pearson Education.

Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, 16(15), 1699–1710. <https://doi.org/10.1016/j.jclepro.2008.04.020>

Shell Global. (2023). Leveraging predictive analytics for refinery efficiency. <https://www.shell.com/>

Tang, C. S. (2006). Perspectives in supply chain risk management. *International Journal of Production Economics*, 103(2), 451–488. <https://doi.org/10.1016/j.ijpe.2005.12.006>

UNCTAD. (2023). Building supply chain resilience in developing economies. United Nations Conference on Trade and Development.

UNESCAP. (2022). Energy security and supply chain resilience in developing Asia. United Nations ESCAP.

World Bank. (2023). Pakistan energy sector review: Challenges and opportunities. World Bank Group.

Yin, R. K. (2018). *Case study research and applications: Design and methods* (6th ed.). Sage Publications.

APPENDICES

Appendix A: Interview Guide

Semi-Structured Interview Questions

This appendix presents the semi-structured interview guide used to collect primary qualitative data for the study titled “Impact of Refinery Shutdowns on Supply Chain Resilience: A Case Study of Cnergyico PK Limited.”

The interview questions were designed to obtain practical insights from industry and regulatory professionals regarding refinery shutdowns, supply chain disruptions, financial constraints, and risk mitigation practices. The flexible nature of the questions allowed respondents to elaborate based on their professional experience.

Section A: Background Information

Please briefly describe your professional role and your involvement in refinery operations or petroleum supply chain management.

How long have you been associated with the petroleum or energy sector in Pakistan?

Section B: Refinery Shutdowns and Operational Factors

In your experience, what are the most common causes of refinery shutdowns at large-scale refineries such as Cnergyico?

How do maintenance planning and equipment conditions influence the frequency and duration of shutdowns?

Section C: Supply Chain and Distribution Impact

How do refinery shutdowns affect downstream supply chain activities such as inventory availability, transportation, and distribution?

What challenges do distributors and retailers face during refinery shutdown periods?

Section D: Financial and Credit-Related Issues

How does reliance on credit-based procurement of crude oil affect refinery operations during shutdowns?

In your opinion, what financial pressures arise when refinery operations are suspended?

Section E: Regulatory and Policy Aspects

What role do regulatory authorities, such as OGRA, play during refinery shutdowns and recovery phases?

Are regulatory approvals or coordination processes a factor in extending shutdown recovery times?

Section F: Risk Management and Resilience

What risk mitigation or contingency measures are currently used to manage refinery shutdowns?

What strategies would you recommend to enhance supply chain resilience and reduce the impact of future shutdowns?

Section G: Closing Question

Is there any additional insight you would like to share regarding refinery shutdowns and supply chain resilience in Pakistan's petroleum sector?

Ethical Statement

All interviews were conducted with informed consent. Respondents were assured anonymity, and no confidential or sensitive organizational information was recorded. The collected data was used strictly for academic purposes in accordance with Bahria University research ethics guidelines.

Appendix B: Thematic Coding Framework


This appendix presents the thematic coding framework developed through qualitative analysis of interview responses and secondary data. The framework was used to identify recurring patterns and link empirical findings with relevant literature.

Table 5: Thematic Coding of Interview Data

Theme	Key Codes Identified	Evidence Source
Operational Disruption	Maintenance delays, aging equipment, unplanned downtime	Interviews, company reports
Financial Stress	Credit dependence, liquidity constraints, revenue suspension	Interviews, financial reports
Supply Chain Bottlenecks	Import delays, inventory shortages, logistics disruptions	OGRA reports, industry data
Regulatory Delays	Approval lags, coordination gaps	Interviews, policy documents
Risk Management Gaps	Low buffer stocks, lack of contingency planning	Literature, interviews

Purpose of the Coding Framework

The thematic framework supported systematic analysis by linking qualitative evidence with established theories of supply chain risk management and resilience. It also ensured consistency between the research objectives, interview findings, and discussion presented in Chapters Four and Five.


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The percentage shown in the AI writing report is the amount of qualifying text within the submission that Turnitin's AI writing detection model determines was either likely AI-generated text from a large-language model or likely AI-generated text that was likely revised using an AI paraphrase tool or word spinner.

False positives (incorrectly flagging human-written text as AI-generated) are a possibility in AI models.

AI detection scores under 20%, which we do not surface in new reports, have a higher likelihood of false positives. To reduce the likelihood of misinterpretation, no score or highlights are attributed and are indicated with an asterisk in the report (*%).


The AI writing percentage should not be the sole basis to determine whether misconduct has occurred. The reviewer/instructor should use the percentage as a means to start a formative conversation with their student and/or use it to examine the submitted assignment in accordance with their school's policies.

What does 'qualifying text' mean?

Our model only processes qualifying text in the form of long-form writing. Long-form writing means individual sentences contained in paragraphs that make up a longer piece of written work, such as an essay, a dissertation, or an article, etc. Qualifying text that has been determined to be likely AI-generated will be highlighted in cyan in the submission, and likely AI-generated and then likely AI-paraphrased will be highlighted purple.

Non-qualifying text, such as bullet points, annotated bibliographies, etc., will not be processed and can create disparity between the submission highlights and the percentage shown.



 Page 2 of 59 - Integrity Overview Submission ID: 0msmt-3618124637248





7% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.




Filtered from the Report

- Bibliography
- Quoted Text
- Small Matches (less than 8 words)

Match Groups

-  **57 Not Cited or Quoted 6%**
Matches with neither in-text citation nor quotation marks
-  **5 Missing Quotations 0%**
Matches that are still very similar to source material
-  **0 Missing Citation 0%**
Matches that have quotation marks, but no in-text citation
-  **0 Cited and Quoted 0%**
Matches with in-text citation present, but no quotation marks

Top Sources

- 4%  Internet sources
- 3%  Publications
- 5%  Submitted works (Student Papers)

Integrity Flags

0 Integrity Flags for Review

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A flag is not necessarily an indicator of a problem. However, we'd recommend you bring your attention there for further review.



Bahria University
Islamabad Campus

RC-01

Thesis/ Project Supervisor Allocation Form

Please tick the relevant box: BBA MBA (2nd last semester)

1. Student Name: Maheen Usman Hashmi Enroll #: 01-111221-048
Course Code: F4P401 Cr. Hrs 3 Degree Duration: 4 years Cell No. 03357669738
Email: maheen.usman2002@gmail.com CMS Registration: Yes/No.

(In case of Project, details of other Members)

2. Student Name: Alia Waseem Shahani Enroll #: 01-111221-017
Course Code: F4P401 Cr. Hrs 3 Degree Duration: 4 years Cell No. 03347873118
Email: www.alinwaseem1@gmail.com CMS Registration: Yes/No.

3. Student Name: Laiba Alamgir Enroll #: 01-111221-047
Course Code: F4P401 Cr. Hrs 3 Degree Duration: 4 years Cell No. 08109533396
Email: laiba.alamgir2002@gmail.com CMS Registration: Yes/No.

Research Type: Thesis Project

Research Area: Supply Chain Management/ PM Marketing
 HRM Finance
 MIS

Name of Supervisor: Hafizak Ghosia Awan.

1. Student Signature: _____ Date: 23rd september 2025

2. Student Signature: _____ 3. Student Signature: _____

Ghosia

Supervisor Signature

Note:

1. Student must fill and send this form to respective supervisor for the approval. After approval send this form at research_cell@bahria.edu.pk and CC your supervisor.
2. Students first inquire the supervisor's available slots either from Supervisor or research cell before submission of supervisor allocation form to research cell

Major: SCM No. RC-02

Library Database Verification Form

Bahria University, Business School

With respect to the anti-plagiarism policies proposed by Higher Education Commission, students are required to fill this form for the purpose of ensuring that the Thesis / Project topic chosen by them has not been done before. Topics can be crossed checked with the database available in the library.

Changes in the Thesis / Project topic, however, will require the filling of a new 'Library Verification Form', but after midterm examination no changes in the Topic will be accepted.

Please submit the scanned copy of this form at research.cell@bahria.edu.pk within two weeks of Thesis / Project Registration.

Please fill in the required information:

Enrollment No(s)	① 01-111221-048 ② 01-111221-017 ③ 01-111221-047
Student Name	- Maheen Usman Hashmi - Alia Waseem Shahani - Laiba Alamgir
Thesis / Project Topic (Company's Name)	managing supply chain Disruptions from Refinery shutdowns (Cynergycico).

STAFF USE ONLY

Topic Verification

Do you have the proposed topic in your library database repository?

Yes
 No

Verifier Name: Saima Ali (CL) Sign: Saima Ali

Date: 02-10-25

Stamp: _____




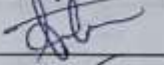
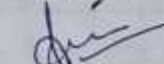

SUPERVISOR APPROVAL:

Name: Ghonia Arvan Sign: Ghonia Date: 2 Oct, 2025

ANNEXURE III: 1st Half Semester Progress Report

Name of Student(s)	Maheen Usman Hoximi, Iqbal Alamgir, Alisha Usman Shahani
Enrolment No.	(01-111221-046) (01-111221-047) (01-111221-017)
Thesis/Project Title	managing supply chain disruptions from refinery-shutdowns; A case study of 'Cynergies'

Supervisor Student Meeting Record

No.	Date	Place of Meeting	Topic Discussed	Signature of Student
1	23-Sep 2025	Office	Topic + Chap 1	
2	30-Sep 2025	Office	Chap 2	
3	6-Oct 2025	Office	Chap 3	
4	15 Oct 2025	Office	Chap 1, 2, 3 discussion	

Progress Satisfactory Progress Unsatisfactory

Remarks: Good progress

Signature of Supervisor: Ghoshia Date: 15-10-25

Name of Supervisor: Ghoshia Aman

Note: Students must attach 1st & 2nd half progress report at the end of FYP spiral copies.



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2nd Half Semester Progress Report & Thesis Approval Statement

Name of Student(s)	Mohamud Usman Hashmi, Iqbal Alamgir, Alia Waqar Shahid
Enrolment No.	(01-111221-048) (01-111221-047) (01-111221-017)
Thesis/Project Title	Managing supply chain disruption from refinery shut-downs, A case study of Cynergy.co

Supervisor Student Meeting Record

No.	Date	Place of Meeting	Topic Discussed	Signature of Student
1	20 Oct 2025	Office	Chap 4	
2	13 Nov 2025	Office	Chap 5, 6	
3	4 Dec 2025	Office	Overall discussion	

APPROVAL FOR EXAMINATION

Candidates' Name: _____ Enrolment No: _____

Project Title: _____

I hereby certify that the above candidates' thesis/project has been completed to my satisfaction and, to my belief, its standard appropriate for submission for examination. I have also conducted plagiarism test of this thesis using HEC prescribed software and found similarity index at ____ that is within the permissible limit set by the HEC for thesis/ project MBA/BBA/BS (A&F), BS (Economics). I have also found the project in a format recognized by the department of management sciences.

Signature of Supervisor: Ghosh Date: 17-12-25

Name of Supervisor: Ghosh Anwar