A STUDY TO INVESTIGATE THE BARRIERS OF IMPLEMENTING SUSTAINABLE PROCUREMENT IN THE CHEMICAL INDUSTRY

by

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Dedication

This work is dedicated to my family whose unwavering support and encouragement have been the bedrock of my journey.

I also want to dedicate this to my mentor Dr Minja Boleskinov, who have encouraged me at each step and whose guidance and wisdom have shaped my academic path.

And to all the Procurement Leaders who believe in the power of sustainability to transform lives and future.

Acknowledgements

I extend my deepest gratitude to Dr Minja Boleskinov, my mentor, for his invaluable guidance, encouragement, and expertise throughout this research endeavor. His unwavering support has been instrumental in shaping this thesis.

I am indebted to my fellow DBA colleague Dr Shashank Agarwal for pushing me to finish my thesis and have contributed significantly to the completion of this research.

Furthermore, I would like to express my appreciation to my son Ashvith who patiently waited for me when I am working on the thesis, for my husband Ankit Gupta who took care of my new born Kaashvi while I was busy in the writing. I could not have done this without their unconditional love, understanding and patience during this academic journey.

Lastly, I am grateful to Swiss School of Business Management for giving me this opportunity to fulfil my dream of getting a Doctorate in front of my name.

Motivation

For more than ten years, I have devoted my professional life to the chemical sector, skilfully managing the complex network of procurement with steadfast commitment. As a recipient of an honours degree in Chemistry, my enthusiasm for the chemical industry has grown stronger over time. I am driven by a strong desire to make a meaningful contribution to its development and advancement. However, in the midst of the busy and active daily activities, a significant insight arose - a knowledge that genuine success is not solely achieved via efficiency and profitability, but also through sustainability.

The recognition of this fact has motivated me to embark on a novel endeavour - an exploration into the domain of sustainable procurement. Over the course of thirteen years, I have extensively studied the complexities of procurement methods in the chemical sector, directly observing the various difficulties and possibilities that exist. With a strong commitment to sustainability, I am now embarking on a journey to investigate the potential impact of sustainable buying on the chemical sector.

The question of sustainable procurement may arise. The answer is straightforward yet profound - as it holds significance. The significance of this topic extends to the globe, future generations, and the fundamental nature of our role as caretakers of the Earth. As time progresses, the imperative to confront environmental issues becomes increasingly evident, and the significance of the chemical sector in this pursuit cannot be exaggerated. The chemical industry, being a vital participant in the global economy, possesses

significant influence to facilitate beneficial transformations. Sustainable procurement serves as how this transformation can be actualized.

The impetus behind my exploration of this subject matter arises from a profound conviction in the transformative potential of sustainability to Mold a more promising future. It is a conviction derived from extensive experience, careful observation, and thoughtful contemplation - a conviction that sustainable procurement is not only a trendy term or a temporary fad, but rather a fundamental change in thinking and approach. Integrating sustainability into procurement procedures is believed to yield environmental, social, and economic benefits.

However, my motivation surpasses mere believing as it is driven by intense desire. An ardent dedication to sustainability that has been nurtured through years of delving into its complexities and subtleties. Sustainability has become deeply embedded in my work DNA, encompassing efforts to decrease carbon emissions and advocate for ethical sourcing. As I begin this research adventure, I am motivated by a strong desire to explore the intricacies of sustainable procurement and uncover valuable insights that can have a tangible influence in the real world.

This research is more than a mere professional pursuit; rather, it embodies a personal goal. An endeavour aimed at closing the divide between theory and practice, between ambition and implementation. The objective is to motivate transformation, ignite creativity, and establish the groundwork for a more environmentally friendly future. As I begin this journey, I am motivated and resolute, recognizing that each progress takes us

closer to achieving our shared vision of a world where sustainability is not merely an objective but a lifestyle.

Ultimately, my drive to do research on sustainable procurement in the chemical sector stems from a fundamental enthusiasm for sustainability and chemicals, as well as a strong conviction in its ability to bring about significant change. As I begin this endeavour, I am motivated by a strong passion to create a significant change, to have a long-lasting influence, and to contribute to a future where sustainability is not merely a goal but a tangible achievement.

ABSTRACT

THE BARRIERS TO SUSTAINABLE PROCUREMENT IN THE CHEMICAL INDUSTRY

The aim of this dissertation is to explore and analyse the challenges encountered by chemical industries during the implementation of sustainable procurement practices. The chemical industry plays a pivotal role in global economic development. However, it is also one of the major contributors to environmental pollution and social issues goals face challenges in transitioning towards sustainable procurement practices. In recent years, the concept of sustainable procurement has gained significant attention to address these challenges. This research aims to provide a comprehensive analysis of sustainable procurement and its implementation in the chemical industry. It explores the importance, benefits, challenges, and best practices associated with sustainable procurement, and offers insights into successful implementation strategies specifically tailored for the chemical industry. Through an extensive review of relevant literature, case studies, and expert insights, this dissertation aims to contribute to the knowledge base on sustainable procurement in the chemical industry. This dissertation examines these challenges, identifies potential solutions, and provide recommendations for the effective implementation of sustainable procurement in the chemical industry.

This study uncovers some interesting aspect of the sustainable procurement in the chemical industry from the prospective of the procurement decision makers and the executives involved in the process. This study also highlights some of the important information regarding principles, importance and need of sustainable procurement along

with the challenges and finally, the study suggests some recommendations based on the findings from the respondents.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Faced with mounting environmental issues and a tightening competitive environment, emerging markets, particularly Manufacturing sector, have recognized the necessity of integrating "Sustainable" concepts, particularly in the Chemical industry. The global chemicals business is one of the largest globally interconnected industries, employing more than 20 million people and generating yearly sales of $5 trillion. It provides materials and substances to industries like agricultural, automotive, construction, and medicines. This implies that a variety of other businesses will likely be impacted by developments in the chemicals industry. Sustainable procurement is an idea that has the potential to improve procurement procedures and the chemical industry's overall sustainability performance. In the chemical industry, sustainable procurement is currently under-utilized but in the past few years CPO's and global leaders are taking efforts to implement this path for the future.

There has been limited research done on the overall concept of sustainable procurement with none clearly stating the challenges faced while implementing the same and specifically when it comes to Chemical Industry, there was no much research done in this area thus this research can be an eye opener or an attempt to encourage more chemical and procurement enthusiasts to do further research on this topic.

This research studied and analyzed the challenges faced by the chemical industries in implementing the sustainable procurement practices and the impact and importance of Sustainable Procurement on the business. This is also offering solutions and recommendations for the challenges identified. Extant Literature Review was carried out and open data from UN, World Economic Forum and other Financial Reports from various industries were studied for understanding the impact of sustainable procurement

practices on other industries. Interviews with the industry leaders were carried out to understand and interpret the conclusion of the research.

The novelty of this research work stems from the lack of similar studies that use descriptive or technical analytic approaches to predict the impact and challenges faced while implementing the sustainable procurement practices in the industries focusing on Chemical Industry majorly. For the research to be effective, primary data has been collected and analysed to predict the same. It seems very important to explore the rationale behind implementing sustainable procurement over traditional purchasing methods which only focus on the prices is because of the efficient performance of many multinational companies who implemented them and are way ahead than those industries which did not. This has been done through case studies, their impact, and benefits on the industry.

This dissertation tries to provide a detailed exploration of sustainable procurement in the chemical industry, covering various aspects such as policy development, stakeholder engagement, supplier evaluation, and supply chain optimization. By highlighting best practices and successful case studies, it will serve as a valuable resource for industry professionals, policymakers, and researchers interested in advancing sustainable practices in the chemical industry.

CHAPTER I:
INTRODUCTION

1.1 Background

There is no doubt about the importance of the chemical industry's contribution to the creation of all goods and services. Chemicals are a crucial component in many industries, including agriculture, energy supply, and those related to health, hygiene, building, and mobility. Thus, it becomes one of the biggest industries worldwide. The global chemicals industry, which employs more than 20 million people and has annual sales of $5 trillion, is one of the most interconnected businesses in the world, providing products and materials to industries including construction, agriculture, automotive, and pharmaceuticals. This implies that a variety of other businesses will likely be impacted by developments in the chemicals industry. As a result, the chemical industry is crucial to sustaining growth and wealth as well as the shift to a sustainable society. Innovation is still essential to develop new ways for the sector to please its more affluent, demanding, and ecologically sensitive customers in the face of rising global competition.

The chemical business is among the most complicated. From the least dangerous to the thousands of different materials, it handles them all. In addition to raw materials, the industry requires a variety of equipment and accessories in different sizes and built from various materials.

The current state of the chemical industry serves as a precursor to the development tendencies of numerous interconnected sectors in the industrial ecosystem. Beyond apparent cost savings and stable material supply, the CPO's position in a crucial

industry like chemical is more complex. To capitalize on the enormous development potential in the sector, the modern CPO in the chemical industry must accept supply chain complexity, vendor consolidation, and innovations in packaging and distribution.

As the Chemical Industry has a good growth potential globally, firms are doing everything to make it sustainable not only economically but also socially and environmentally.

1.2 Research Objective

The objective of this study is to conduct a thorough investigation and analysis of the obstacles impeding the chemical industry's adoption and execution of sustainable procurement practices. The objective of this study is to ascertain, classify, and comprehend the many obstacles that procurement specialists confront in their endeavours to incorporate sustainability factors into their procurement procedures. By thoroughly analysing these obstacles, the study aims to offer significant perspectives and suggestions to promote the development of environmentally friendly purchasing methods in the chemical industry.

1. Identifying Obstacles: This study's main goal is to identify and catalogue the several obstacles that the chemical sector faces when attempting to implement sustainable procurement methods. Through an extensive assessment of the literature and consultation with procurement specialists, industry experts, and pertinent stakeholders, the study generates a detailed inventory of obstacles that include social, institutional, environmental, and economic aspects.

2. Dissection and Arrangement: Building on the hurdles that have been discovered, the research seeks to group them into discrete subject categories to enable a

systematic examination. The study aims to obtain a deeper understanding of the interconnection and complexity of difficulties related to sustainable procurement in the chemical sector by classifying obstacles based on shared traits and underlying causes.

3. Evaluation of Effect and Severity: Evaluating the influence and seriousness of the obstacles found on the adoption and application of sustainable procurement methods is one of the research's other main goals. The study will assess how much these obstacles prevent procurement professionals from incorporating sustainability concerns into their supply chain management procedures and decision-making processes through surveys, interviews, and data analysis.

4. Deep Root Cause Analysis: Apart from analysing the outward expressions of these obstacles, the study seeks to investigate the underlying factors that contribute to their continued presence in the chemical sector. Through an examination of several elements including market dynamics, regulatory frameworks, organizational culture, and resource limitations, the research aims to determine the fundamental causes of the obstacles found and how they affect sustainable procurement.

5. Examining Mitigation Techniques: One of the research objectives is to investigate possible strategies for mitigation and interventions that may be used to get over the obstacles that have been found in the chemical industry's way of sustainable procurement. The study provides practical suggestions and guidance to assist firms in addressing and mitigating the obstacles impeding their sustainability initiatives, drawing on best practices, case studies, and expert perspectives.

6. Combining Results and Sharing Knowledge: The study's final goal is to combine its findings into a cohesive framework that effectively conveys the subtleties and complexity of the obstacles to sustainable procurement in the chemical sector. By means of scholarly publications, conference presentations, and industry seminars, the

research aims to broadly distribute its findings and expedite the advancement of knowledge and practice about sustainable procurement.

To put it briefly, this study aims to give a thorough understanding of the obstacles to sustainable procurement in the chemical industry. It also seeks to evaluate the impact and severity of these barriers, examine potential solutions, identify underlying causes, and offer practical suggestions for improving sustainability performance in the industry. By fulfilling these goals, the study hopes to further the larger sustainability agenda and assist the chemical industry's shift to more ethical and sustainable purchasing practices.

1.3 Scope of the Study

Chemical Industry: Producers of chemicals, pharmaceuticals, petrochemicals, and specialty chemicals are the primary subjects of this study. Sustainability and procurement provide difficulties for this industry, despite its centrality to international supply chains.

Geographic Scope: The research primarily examines multinational chemical corporations, but it also considers the viewpoints of SMEs engaged in the chemical industry. Developed and emerging regions are included in the geographical scope to reflect varied settings and issues.

The study looks at how the chemical sector goes about its procurement processes, which include things like finding and working with suppliers, negotiating contracts, and optimizing the supply chain, among other things. There is an examination of the hurdles to efficient implementation of these processes and how sustainability considerations are incorporated into them.

Analysis of Barriers: This study examines the chemical industry's current practices for sustainable procurement and classify the factors that are preventing their widespread adoption and implementation. To give a thorough picture of the difficulties encountered by procurement experts, it covers a broad spectrum of obstacles, such as those pertaining to the environment, society, the economy, and institutions.

Strategies for Mitigation: Following the identification of barriers, the research investigates possible interventions and strategies for mitigation. This research looks at how top companies deal with sustainability issues in SCM and procurement by analysing case studies and best practices.

1.4 Significance of the Study

Tackling Global Issues: Pollution, resource loss, and social inequality are all greatly exacerbated by the chemical industry. The research could help achieve global sustainability targets, such as the SDGs set out by the United Nations, by determining what stands in the way of sustainable procurement and finding ways to remove them.

Improving Corporate Responsibility: Sustainable procurement is being acknowledged as an essential part of sustainability and corporate social responsibility (CSR) initiatives. The research can help organizations improve their CSR programs and meet their promises to ethical and responsible business practices by revealing the obstacles to sustainability integration in procurement operations.

Promoting Innovation and Competitiveness: Chemical businesses can gain a competitive edge and spur innovation by removing obstacles to sustainable procurement. Innovative solutions that boost organizations' competitiveness and market positioning

might be inspired by the study, which identifies potential for resource efficiency, waste reduction, and sustainable product creation.

A more resilient supply chain is possible with the help of sustainable procurement methods, which are integral to effective risk management and a resilient supply chain. Businesses can benefit from the study's findings in terms of supply chain resilience and sustainability by learning how to overcome obstacles to sustainability integration in procurement. These challenges include, but are not limited to, changes in regulations, fluctuations in the market, and natural disasters.

The results can help shape regulatory frameworks and policymaking efforts to encourage chemical companies to engage in more sustainable procurement practices. The research can help policymakers create effective interventions and incentives to encourage industry-wide transformation by offering evidence-based insights into the difficulties and opportunities connected with sustainable procurement.

In conclusion, the research on barriers to sustainable procurement in the chemical industry holds significant scope and importance for addressing global sustainability challenges, enhancing corporate responsibility, driving innovation and competitiveness, strengthening supply chain resilience, and informing policy and regulation. By investigating and overcoming these barriers, the research can pave the way for a more sustainable and responsible future for the chemical industry and contribute to broader efforts towards sustainability and environmental stewardship.

CHAPTER II:

UNDERSTANDING SUSTAINABLE PROCUREMENT

2.1 Sustainable Development and Sustainability

To understand concept of sustainability it is utmost important to understand what sustainability means and what is sustainable development.

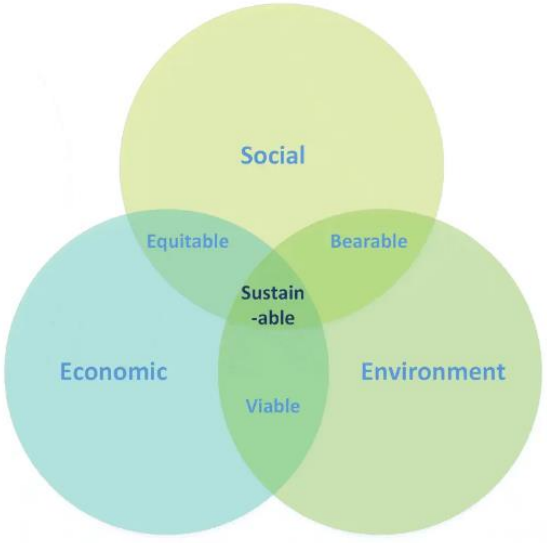
Both the idea of sustainable development and the definition of sustainability are far more complicated than they first appear to be. The fact that there are more than 200 definitions of what constitutes sustainable development serves as the best example of this.

Nonetheless, the Brundtland Commission's 1987 definition, which listed the following as the concept of sustainable development, is the most widely used.

"Development that is sustainable is that which satisfies current needs without jeopardizing the ability of future generations to satisfy their own needs."

This suggests that to ensure that one may live in a sustainable way, one must take care of our earth, our resources, and our population. Moreover, that one can leave our planet in a sustainable state for our future generation.

One may expand on the concept of sustainability and conclude that equal harmony between the economic, environmental, and social spheres is necessary to attain sustainability. A Venn diagram for sustainability could be used to explain this, as the one below:



These are also called the three pillars of sustainability

Therefore, one must equally balance the sustainability aspects of the economy, society, and environment to attain true sustainability. These could be described as:

Living sustainably within the limits of our natural resources is referred to as environmental sustainability. One must make sure that they are using natural resources like materials, energy fuels, land, water, etc. at a sustainable rate if they are to live in a sustainable way. Because certain resources are more plentiful than others, one must consider factors like material scarcity, the harm that comes from extracting these resources to the environment, and whether the resource can still be used in accordance with the circular economy. Aiming for net zero emissions, one must go above and beyond to eventually realize climate positive principles. It is important to distinguish between environmental sustainability and full sustainability, which also requires balancing social and economic aspects.

Economic Sustainability: To operate in a sustainable manner and continuously generate an operational profit, a business or nation must use its resources ethically and efficiently. An organization cannot continue operating without a profit. In the long run, a

corporation cannot remain viable if it does not operate properly and utilize its resources effectively.

The ability of a society or any social system to consistently attain a high level of social well-being is known as social sustainability. Achieving social sustainability guarantees the long-term maintenance of a nation's, an organization's, or a community's social well-being.

Expanding on these three sustainability pillars, if anyone only succeed in two of them, they get the following:

Economic + Environmental Sustainability = Manageable Economic + Environmental Sustainability = Viable

Social + Economic Sustainability = Equitable

Achieving a fully circular economy and true sustainability requires striking a balance between the social, environmental, and economic domains.

2.2 Defining Sustainable Procurement

The capacity to purchase raw materials is a critical component of any manufacturing industry's business plan, since it determines the profitability of operations.

In order to maximize the benefits to the purchasing organization, procurement, which is the process of awarding contracts for goods, works, and services on the best available circumstances, has historically been based on two criteria: price and quality.

Procurement is a persistent issue for companies across all sectors. The same is true for the chemical business. Companies in the chemical industry deal with extremely

challenging procurement situations. Using sustainable solutions is the best way for CPOs in chemical companies to handle urgent procurement challenges.

In today's astute corporate world, sustainability—also known as environmental, social, and ethical performance—is essential. Businesses are coming under more and more pressure to raise the bar for transparency and sustainability, which encompasses the sustainability of all stakeholders.

Globally, there is a great desire to integrate ecologically conscious choices into supply-chain management research and practice. Until a few decades ago, most environmental measures implemented by firms were temporary and inert; in reality, most of these acts were a response to government obligations. Anecdotal best practices for different supply chain phases were often used to justify fragmented approaches to sustainable initiatives.

Sustainable procurement seeks to foster long-term value creation and beneficial economic development while reducing the adverse effects on the environment and society caused by the production, use, and disposal of products and services. It aims to strike a balance between providing for the demands of the present and making sure that resources are preserved and made available for future generations.

Business CEOs have been under a lot of pressure lately to demonstrate their commitment to sustainability. Companies are under growing pressure from regulators, investors, and customers to measure and publish their progress toward publicly declared goals and to demonstrate the real benefits that these programs provide to society and the environment. Therefore, the time for "ambition" has past when it comes to addressing social inequality and climate change. "Impact" needs to be the keyword for corporate sustainability governance that works in 2022.

The integration of corporate social responsibility (CSR) principles into a company's procurement processes and choices while guaranteeing stakeholder needs are met is known as sustainable procurement.

Environmental and social protection is taken into consideration while developing specifications, standards, and criteria for sustainable procurement. It addresses a wide range of topics, such as the use of dangerous substances that can endanger people or the environment and child labor.

Throughout the life cycle of a product or service, a company's core sustainability values are ensured by sustainable procurement. The best course of action is to future-proof the business's sustainable investments and purchases by developing sustainable policies that increase its long-term viability. The foundation of sustainable procurement policies and strategies is the requirement to future-proof the system, particularly with regard to supplier shortages, the capacity to handle increased market demand, cost pressures, and the possibility of cost savings through waste and energy reductions. Sustainable procurement can help businesses safeguard their reputation because it demands the creation of efficient risk management. This makes it easier for companies to pinpoint troublesome suppliers and fix weak links in their supply chain that can spark disputes and bad press. Finally, sustainable procurement enables brand distinctiveness by encouraging companies to create more inventive and sustainable products.

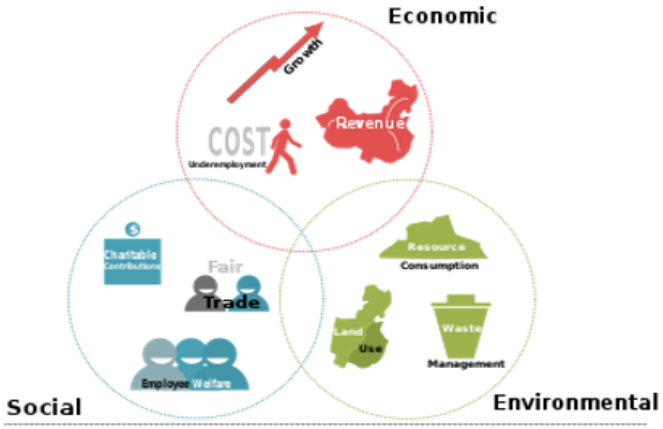
Even with the increased emphasis on "impact" that permeates ESG strategy and discourse, many businesses still find it difficult to define. It's true that there is a lot of misunderstanding around how executives measure the effects of sustainable procurement methods and how they apply them on the ground.

Although it seems that sustainable procurement is the first step toward a company's long-term sustainability, it is insufficient to establish a thorough and

organized system. These days, businesses are starting to integrate environmental factors into the supply chain management process as a whole. This approach is known as Green or Sustainable Supply Chain Management (GSCM).

Contrarily, sustainable procurement is a relatively new concept that expands this framework to take into account how decisions about procurement affect other parties, creating a "triple baseline" of external problems that the organization making the purchase needs to deal with.

(The triple bottom line is an accounting framework with three parts: social, environmental and financial.
Business writer John Elkington claims to have coined the phrase in 1994.)



Graph depicting Triple Bottom Line

Sustainable procurement, also known as green or responsible procurement, is the practice of incorporating environmental, social, and economic considerations into the procurement process. It goes beyond traditional procurement practices that solely focus on price, quality, and delivery, and considers the broader impacts of the goods and services being procured.

2.3 Key Principles of Sustainable Procurement

1. Environmental Considerations: Analyzing the possible lifecycle environmental effects of purchased goods and services is a key component of sustainable procurement. This entails assessing elements including pollution, waste production, greenhouse gas emissions, resource use, and energy use. The objective is to encourage resource efficiency and choose ecologically friendly substitutes. Environmental considerations include assessing the ecological effects of goods, services, and suppliers along the course of their whole life cycle, from the extraction of raw materials to the final disposal of the items when their useful lives are over. Sustainable procurement prioritizes the selection of products and suppliers with minimal environmental impact, such as those with lower energy, emission, waste, and resource consumption. Vital environmental aspects to take into account include waste management, energy efficiency, carbon footprint reduction, water use, pollution control, and biodiversity preservation.

2. Social Considerations: Decisions for sustainable procurement also take society into account. This entails taking into account elements like community involvement, diversity and inclusion, worker health and safety, human rights, labor rights, and ethical sourcing methods. Its goal is to uphold ethical and just business practices all along the supply chain. Ensuring suppliers follow labor laws and regulations, provide safe and comfortable working environments, and respect workers' rights and dignity are the goals of sustainable procurement.

Among the main components of social responsibility are labor rights, workplace health and safety, worker empowerment, diversity and inclusion, and community involvement.

3. Economic Considerations: By taking into account the long-term costs and value connected with purchased goods and services, sustainable procurement acknowledges the economic factor. This entails assessing the entire cost of ownership, taking into account elements like durability, energy economy, maintenance, and disposal at the end of life. It aims to reduce risk and optimize value over the course of the acquired items' life cycle. The notion of economic viability comprises the assessment of the long-term financial outcomes linked to procurement decisions, incorporating elements like total cost of ownership, return on investment, and achieving value for money. Achieving cost savings, improving productivity, and reducing risks are the goals of sustainable procurement, all of which are supported by long-term, steady economic growth and development.

Among the most important elements to take into account when evaluating economic viability are cost-effectiveness, market competitiveness, financial stability, supply chain resilience, and evaluations of the economic impact.

4. Ethical Sourcing: This technique entails obtaining goods and materials from vendors who exhibit a dedication to maintaining moral principles and implementing conscientious business conduct.

Sustainable procurement requires supply chain transparency and accountability because they guarantee suppliers follow moral standards including honesty, integrity, and respect for human rights.

Important ethical sourcing criteria include anti-corruption procedures, transparency of the supply chain, careful raw material acquisition, and adherence to international labor standards and ethical guidelines.

5. Stakeholder Engagement: This method involves relevant parties, such as suppliers, employees, consumers, and communities, actively participating in the procurement-related decision-making processes.

Sustainable procurement fosters cooperation, candid dialogue, and openness with stakeholders in order to understand their needs and concerns, build trust, and progress the creation of shared value.

When involving stakeholders, it's crucial to take accountability protocols, feedback channels, effective communication, and consultation into account. These steps are required to guarantee that procurement decisions reflect the preferences and interests of all relevant parties.

6. Continuous Improvement: A key element of continuous improvement is the ongoing assessment, monitoring, and improvement of procurement procedures, processes, and performance.

In order to accomplish sustainable procurement, goals must be set, performance must be assessed, and opportunities for improvement must be found in order to promote innovation, efficacy, and efficiency.

Monitoring performance, benchmarking against industry standards, learning from effective practices, and incorporating feedback to modify and improve procurement strategies over time are all crucial components of continuous improvement.

By adhering to five essential sustainable procurement principles, organizations can promote economic growth, social responsibility, and environmental care. Additionally, this will benefit their supply chains and help create a more sustainable future.

2.4 Relationship between Sustainable Procurement and Sustainable Development

Environmental Aspects: Analyzing the possible lifecycle environmental effects of the products and services that are acquired is a key component of sustainable procurement. In assessing these aspects include things like pollution, waste production, greenhouse gas emissions, energy use, and resource consumption. Prioritizing resource efficiency and choosing eco-friendly substitutes are the objectives. Ecological effects related to goods, services, and suppliers are assessed along the course of their whole life cycle, from raw material extraction to disposal at the end of useful life. This is what is meant by environmental issues. Selecting products and providers with minimal environmental impact—such as those that use less energy, emit fewer greenhouse gases, produce less waste, and use fewer resources—is emphasized in sustainable buying. Vital environmental considerations include reducing pollution, conserving biodiversity, water use, energy efficiency, waste management, and carbon footprint.

Social Aspects: The social effects of procurement decisions are taken into account in sustainable procurement. This involves taking into account elements like community involvement, diversity and inclusion, worker health and safety, human rights, labor rights, and ethical sourcing methods. Throughout the supply chain, it seeks to promote ethical and just business practices. Ensuring vendors respect workers' rights and dignity, provide safe and comfortable working environments, and comply with labor laws and regulations is the goal of sustainable procurement.

Principal social responsibility factors include labor rights, workplace health and safety, worker empowerment, diversity and inclusion, and community involvement.

3. Financial Aspects: Sustainable sourcing acknowledges the financial aspect by taking into account the value and long-term expenses of the products and services purchased. Examining the total cost of ownership, which takes into account elements like durability, energy efficiency, maintenance, and disposal at the end of life, is part of this. Over the course of the purchased products' life cycle, it aims to optimize value and minimize risk. Achieving value for money, return on investment, total cost of ownership, and other long-term financial effects are all included in the assessment of an acquisition decision's economic viability. In order to promote sustainable economic growth and development, sustainable procurement aims to reduce costs, increase efficiency, and reduce risks.

Economic impact analyses, financial stability, supply chain resilience, market competitiveness, and cost-effectiveness are all important aspects to take into account when evaluating economic viability.

4. Ethical Sourcing: Ethical sourcing is the process of obtaining goods and materials from vendors who avowedly adhere to moral principles and use ethical business methods.

In order to ensure that suppliers follow moral standards like honesty, integrity, and respect for human rights, supply chain transparency and accountability are crucial for sustainable procurement.

An ethical sourcing strategy's anti-corruption measures, supply chain transparency, careful raw material procurement, and adherence to international labor standards and ethical guidelines are all essential.

5. Stakeholder Engagement: This pertains to the process of involving relevant parties, such as suppliers, employees, consumers, and communities, in the procurement decision-making process.

The development of shared value can be accelerated via sustainable procurement by fostering cooperation, candid communication, and transparency with stakeholders to understand their needs and concerns.

When involving stakeholders, systems for feedback, accountability protocols, consultation, and effective communication are all important to take into account. Ensuring that procurement decisions are in line with stakeholder interests and preferences requires the implementation of these strategies.

6. Continuous Improvement: A key element of continuous improvement is the ongoing assessment, inspection, and refinement of procurement practices, protocols, and effectiveness.

Establishing goals, assessing performance, and determining areas for improvement in order to promote innovation, efficacy, and efficiency are all necessary for the realization of sustainable procurement.

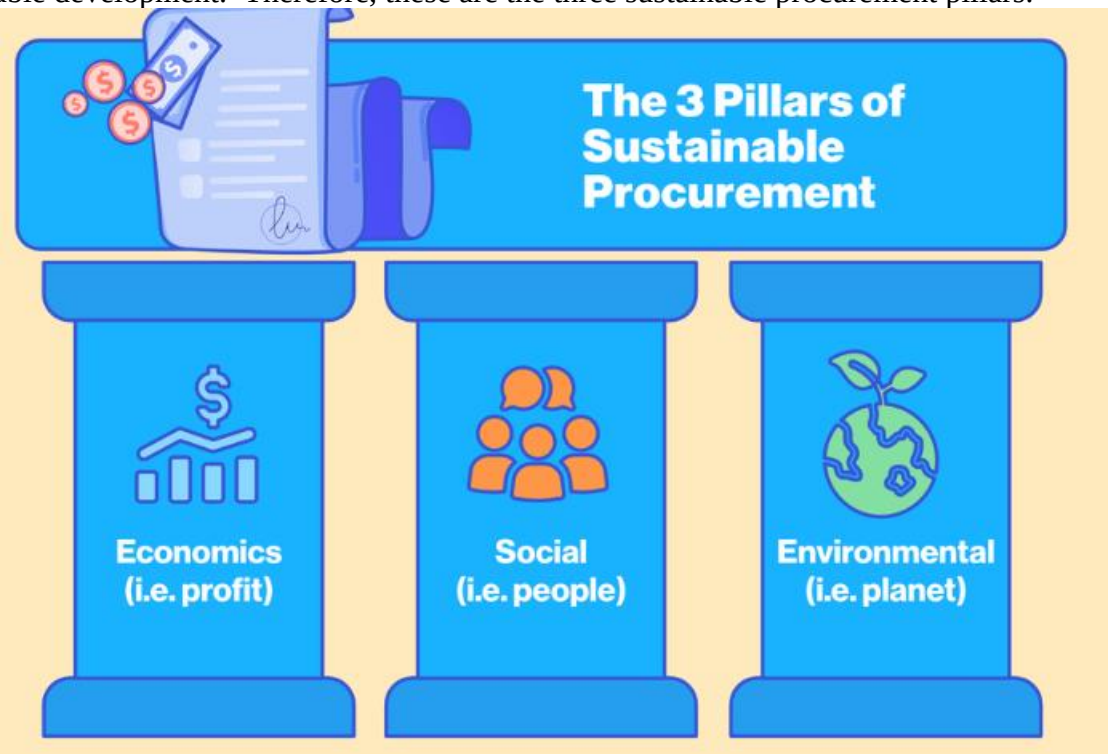
Continuous improvement involves a number of crucial elements, such as performance monitoring, benchmarking against industry norms, learning from effective practises, and incorporating feedback to refine and improve procurement strategies over time.

Following these essential guidelines for sustainable procurement can help organizations promote social responsibility, environmental stewardship, and economic prosperity. A more sustainable future will result from this, as well as positive changes in their supply networks.

2.5 Three Pillars of Sustainable Procurement

Just like three pillars of sustainability, there are three pillars or one can say three core principles of sustainable procurement as well. Sustainable development is supported by efficient sustainable procurement. Because it adopts a three-dimensional life cycle approach as opposed to a one-dimensional, economics-focused strategy, sustainable procurement is therefore smart procurement.

The implementation of a three-dimensional strategy does not inevitably result in a threefold increase in time or cost for the sustainable procurement process. Instead, it indicates that to achieve sustainable procurement, it follows the three pillars of sustainable development. Therefore, these are the three sustainable procurement pillars:



Examples of Sustainable Procurement's Economic Pillar:

The revitalization of the economy, Sustainable Economic Growth, Developing marketplaces, expanding small and medium-sized businesses, assessing the cost-effectiveness of overall expenses and product life cycles

Examples of sustainable procurement's environmental pillars include:

Conservation of Natural Resources, Planning for Cities, Reduction of Carbon Dioxide Exposure, Renewable Energy Sources: Solar, Wind, etc., Management of Water Resources, Eco-Friendly Farming, Management of Marine Resources, Preservation of Natural Environments, Waste and Pollution Control

Examples of Sustainable Procurement's Social Pillars include:

Protective labor laws and equitable compensation; civil liberties, safe drinking water, guaranteed access to nutrition, safeguards against forced labor and child labor, Fair trade practices, safeguarding the health and welfare of workers, providing equal opportunities for women and girls, including all students, promoting maternal and fetal health and reducing infant mortality, and promoting long, healthy lives and universal wellness

People (= social), Planet (= environmental), and Profit (= economic) are the three unofficial pillars of sustainable buying.

Sustainable procurement combines sustainability concerns at every stage of the procurement process to achieve developmental objectives and deliver the best value for the money. Strategic procurement is the epitome of sustainable procurement.

However, sustainable procurement is used at the borrower's discretion and adheres to its own set of standards for what qualifies as sustainable practices. While there isn't a single set of guidelines that companies need to abide by when it comes to sustainable procurement, the two main strategies that are most commonly combined and used are as follows:

1. The approach based on products

Any business can use this strategy to monitor the movement of products and services through the supply chain and keep track of your own and your suppliers' environmental certifications.

This method is most commonly used when your organization wants to understand the impact of a product or product range for marketing or strategic goals. This approach also offers a thorough version of the supplier procedures.

2. Provider-Oriented Method

Any business can use the supplier-based method to review the corporate social responsibility (CSR) policies of its suppliers and determine whether they adhere to your CSR rules and legal obligations. By doing this, they will be able to assess the environmental and social risks your supplier poses to them.

CHAPTER III:
SUSTAINABLE PROCUREMENT IN CHEMICAL INDUSTRY

3.1 Chemical Industry

According to Killheffer in Britannica (2021), a chemical industry is a complex system of procedures, enterprises, and groups involved in the production of chemicals and their derivatives. A chemical reaction, according to Treichel in Britannica (2021), is a process in which one or more substances, also referred to as reactants, are transformed into one or more different substances, also referred to as products; these substances are either chemical elements or compounds and undergo a rearrangement of constituent atoms of the reactants to create different substances as products. The chemical industry employs fossil fuels such as oil, natural gas, air, water, and minerals to generate over 60,000 chemical-based goods. It is diverse due to the variability of its processes and product classifications. (Katakojwala & Mohan 2021)

Over 4 trillion US dollars were made by the chemical sector worldwide in 2018; China accounted for 35.8% of this total revenue (Statista 2021).

The worldwide chemical industry is a vital component of contemporary society, driving a wide range of industries including manufacturing, agriculture, healthcare, and transportation. It has an all-pervasive effect on almost every facet of daily life. The chemical industry has a long history and a bright future as it develops, innovates, and propels global economic progress.

Context of History

The foundation of modern chemistry was laid by early advancements in metallurgy and

alchemy, which have centuries-long roots in the chemical industry. But the industry really took off during the Industrial Revolution of the 18th and 19th centuries, propelled by developments in science, technology, and production techniques. Innovation and widespread industrialization were made possible by breakthroughs like the synthetic polymer discovery and the Haber-Bosch process for ammonia production.

3.2 Economical Position of the Chemical Industry

Today, the chemical industry stands as one of the largest and most influential sectors in the global economy. According to the International Council of Chemical Associations (ICCA), the industry generates revenues exceeding $5 trillion annually and employs millions of people worldwide. Its significance extends beyond mere economic metrics, as chemicals serve as the building blocks for countless products and processes essential to modern life.

The chemical industry encompasses a diverse array of subsectors, including basic chemicals, specialty chemicals, agrochemicals, pharmaceuticals, and more. Each subsector plays a unique role in meeting the needs of various industries and consumers worldwide. From providing raw materials for manufacturing to developing life-saving pharmaceuticals, the chemical industry's contributions are indispensable. The chemical industry's capacity to comprehend and manipulate the interplay of many elements to generate desired commercial products has made a substantial contribution to the advancement of human existence. The industry plays a substantial role in various crucial aspects of human growth, including but not limited to food, healthcare, and energy. The sector has consistently addressed the demands of an expanding population, including various aspects such as food accessibility, medical care, and enhanced connectivity. This

has been achieved through the provision of advancements in fertilizers, pesticides, pharmaceuticals, plastics, insulation, wiring, battery chemicals, adhesives, and other related products.

Source: PwC research

Importance in the World

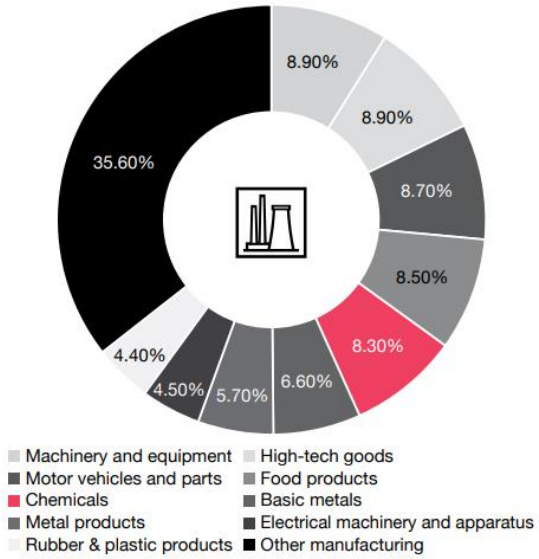
The importance of the chemical industry in the world cannot be overstated. Here are some key aspects highlighting its significance:

Contribution to GDP: The chemical industry contributes significantly to the gross domestic product (GDP) of many countries, serving as a key driver of economic growth and industrial development. Its products form the foundation of numerous value chains, creating multiplier effects across various sectors. The chemical sector has robust backward and forward linkages, serving as a fundamental driver of agricultural and industrial progress. The manufacturing sector in question has the position of the fifth-largest and encompasses over 95% of the total manufacturing sectors, so making a significant contribution to the overall economic development. According to estimates made in 2017, the contribution of this entity to the worldwide gross domestic product (GDP) amounted to USD 5.7 trillion, encompassing direct, indirect, and induced impacts. This figure represents around 7.1% of the entire global GDP.

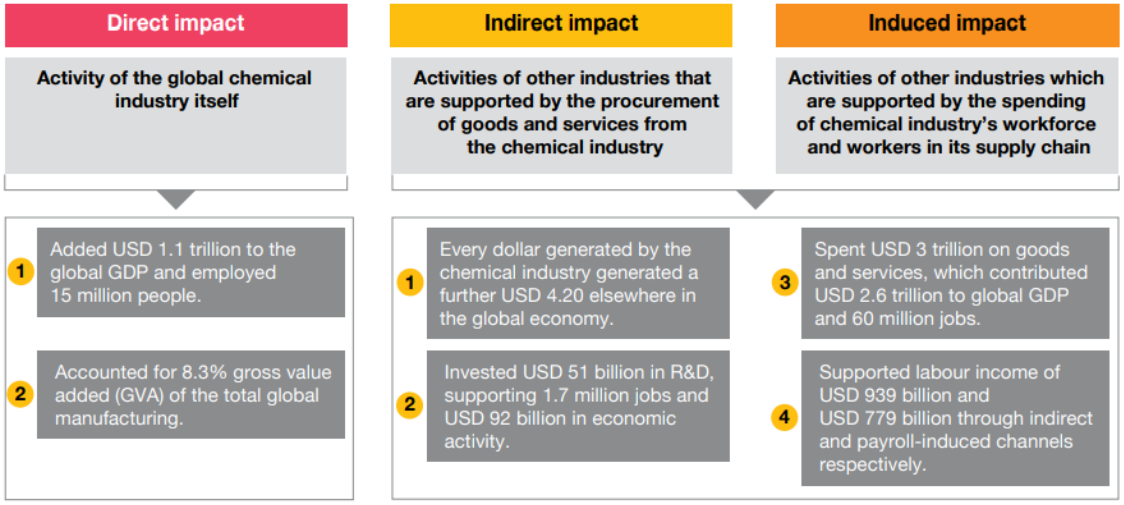
The primary goal of all nations has consistently been the pursuit of economic expansion. Nevertheless, an exclusive emphasis on expansion has led to the exploitation of natural resources and the deterioration of the environment.

Due to the unsustainable nature of this growth, global companies are currently seeking methods to prioritize both economic development and environmental protection.

The chemical industry has consistently played a leading role in addressing emerging global challenges, such as climate change and the energy crises. The development of ecofriendly products utilizing green resources and resource-efficient technologies has the potential to facilitate the establishment of a sustainable future. Moreover, the industrial manufacturing sector possesses the capacity to implement inventive climate and energy solutions along the entire value chain, thereby mitigating the environmental impact in terms of carbon emissions. There is an increasing emphasis on the implementation of decarbonisation and recycling technologies as necessary measures to attain climate-neutrality objectives and facilitate the shift towards a circular economy.



Source: https://icca-chem.org/wp-content/uploads/2020/10/Catalyzing-Growth-and-Addressing-Our-Worlds-Sustainability-Challenges-Report.pdf



Source: https://icca-chem.org/wp-content/uploads/2020/10/Catalyzing-Growth-and-Addressing-Our-Worlds-Sustainability-Challenges-Report.pdf

Research and Innovation: The chemical industry is known for its innovative practices, consistently pushing the limits of scientific understanding and technological growth. The industry's R&D initiatives have produced innovations in the fields of materials science, medicine, renewable energy, and environmental sustainability. Supporting Other Industries: The chemical industry is a key supplier to many downstream industries, such as the construction, automotive, electronics, agricultural, and healthcare sectors. Chemicals are used to produce fertilizer for agriculture and to make polymers for automobile components. These businesses run and perform better because of the chemicals they provide.

Pharmaceuticals and Healthcare: A vital component of the chemical industry, the pharmaceutical sector is essential to the provision of healthcare worldwide. Chemical synthesis produces pharmaceuticals, which are vital for curing illnesses, easing suffering,

and enhancing quality of life. Furthermore, continuing studies in pharmaceutical chemistry are what propel medical progress and deal with new health issues.

Environmental Sustainability: Although the chemical industry has traditionally been linked to environmental issues, it is becoming more and more concerned with sustainability and good stewardship. Positive change is being driven, the environmental effect is being reduced, and resource efficiency is being promoted by initiatives including green chemistry, circular economy practices, and sustainable sourcing.

The global chemical industry plays a pivotal role in the global economy by propelling innovation, providing support to many industries, and augmenting the standard of living around the globe. Its significance as a cornerstone of contemporary civilization is highlighted by its contributions to societal well-being, technical advancement, and economic expansion. The chemical industry continues to be in a position to pave the path for a more affluent and sustainable future as the globe encounters new possibilities and challenges.

3.3 Environmental Impact of the Chemical Industry

Significant environmental degradation has been attributed to the chemical sector, which has been subject to constant criticism. Still, growing concerns about sustainability have encouraged this industry to change how it goes about procurement and other processes, helping the world community reach its sustainability objectives. In order to create bio-based polymers, insecticides, and surfactants, the industry is looking at sustainable primary resources. Significantly contributing to the "bio-economy," the chemical sector is improving its environmental friendliness.

In all fields and industries, sustainability is the newest buzzword. Governments are being forced to impose strict laws across businesses to reduce pollution levels due to a growing global awareness of environmental degradation. There has been ongoing examination of the chemical sector, which is generally believed to be the main driver of the rising pollution levels in the air, soil, and water.

As a vital source of energy for numerous businesses vital to human progress, the chemical industry is a cornerstone of modern civilization. Every element of our lives is impacted by it, from manufacturing to consumer goods, from agriculture to the pharmaceutical business, and everything in between. Notwithstanding the undeniable benefits the chemical industry has made to human progress, its effects on the environment are a serious worry that have sparked criticism and requests for a sustainable change.

This discussion revolves around the delicate dance that occurs between growth and preservation. On the one hand, chemicals are the catalyst for invention, paving the way for advancements in technology, medicine, and agriculture. However, their production, use, and disposal may have detrimental consequences on the environment, including as contaminating the air and water, destroying habitats, and accelerating climate change.

Pollution is one of the biggest issues facing the chemical industry in terms of the environment. During the production process, it is usual for hazardous contaminants and waste byproducts to be released into the air, water, and land. These pollutants have the capacity to endanger human health, negatively impact ecosystems, and harm wildlife. Furthermore, as catastrophic events like the Bhopal tragedy in 1984 and the Deepwater Horizon oil disaster in 2010 demonstrate, chemical accidents and spills pose serious risks.

The exhaustion of natural resources is an additional pressing matter that needs attention. These activities contribute to habitat degradation, biodiversity loss, and forest destruction. They involve mining and processing minerals and fossil fuels, which are raw materials used in the production of chemicals. Furthermore, the production of chemicals is an energy-intensive process that exacerbates climate change. This is due to the fact that industrial activities generate greenhouse gas emissions, which disrupt already delicate ecosystems and are the main driver of global warming.

Concerns over these compounds' potential long-term impacts on human health and the environment are also raised by the widespread usage of synthetic chemicals in consumer goods. Certain materials, like plastics, pesticides, and medications, can linger in the environment for a long time and eventually build up in ecosystems like soil, water bodies, and food chains. They represent a hazard not just to endangered species due to their ability to bioaccumulate and biomagnify, but also to human populations that depend on ecosystem services for survival.

There is increasing pressure on the chemical industry to implement environmentally friendly methods in order to address these concerns. At the moment, initiatives are being undertaken to develop more ecologically friendly industrial methods, reduce waste generation, and switch to renewable energy sources. The objective of minimizing the industry's negative environmental effects and promoting resource management is also being pursued via international accords and legal frameworks like the Paris Agreement and the Stockholm Convention on Persistent Organic Pollutants.

But in order to truly achieve sustainability, a mindset shift that extends beyond technological fixes is unavoidable. An all-encompassing approach is required, one that takes into account the complete lifecycle of chemicals, starting with their creation and ending with their use and disposal. In order to do this, it is imperative to embrace the

tenets of green chemistry, which prioritize the employment of sustainable feedstocks, the mitigation of toxic substances, and the creation of naturally safe processes.

Additionally, cooperation between the many stakeholders is crucial to enacting meaningful change. Collaboration between governments, business executives, academic institutions, and civil society members is necessary to create innovative solutions, set firm regulations, and raise public understanding of the need of environmental stewardship. Only by working together will we be able to overcome the environmental challenges presented by the chemical industry and clear the path for a more sustainable future for coming generations.

In summary, even if the chemical industry has greatly aided in the advancement of humankind, its effects on the environment cannot be overlooked. The degradation of resources, risks to human health, and contamination of the environment are all grave issues that require prompt attention and decisive action. One can lessen the industry's negative environmental effects and ensure a better Earth for coming generations by embracing sustainability principles and encouraging teamwork.

3.4 Social Implications of the Chemical Industry

The social ramifications of chemical production are extensive, affecting workers, communities, and society as a whole. There are significant health and safety hazards because manufacturing procedures expose workers to dangerous substances, which can cause both acute and long-term health issues. Additionally, the emissions from chemical factories may cause health problems related to pollution in the surrounding communities; this emphasizes the need for strict environmental controls and community engagement initiatives to address these concerns.

Economic effects are also very important since the chemical industry generates income and jobs that support both the local and national economies. But there may be social and economic inequality as well as employment insecurity for workers, especially in areas with loose labor laws. Furthermore, because of market swings or environmental liabilities, communities dependent on the chemical production industry may go through economic downturns. This emphasizes the significance of encouraging sustainable economic development and social fairness.

The social landscape of chemical production is further complicated by environmental justice considerations, since the industry's pollution and environmental degradation disproportionately affect vulnerable populations. This problem, referred to as environmental injustice, highlights the unequal distribution of environmental benefits and burdens as well as structural disparities in decision-making processes. In order to address issues of environmental justice, coordinated action is needed to strengthen the position of impacted communities, encourage fair access to environmental resources, and lessen the negative effects of chemical manufacturing on disadvantaged groups of people.

3.5 The Chemical Industry's Sustainability Emphasis

The previous six to seventy years have seen the enforcement of stricter laws, which has led to an increasing emphasis on sustainability in the business. Though the concept of sustainability has gained importance in a number of industries these days, the chemical industry was one of the first to take an interest in it previously. Because of their inherent nature, chemicals have always been governed by laws. Moreover, sustainability plays a central role in the creation as well as the use of these things.

The 1960s saw the introduction and emphasis on safety precautions in chemical industrial processes. As the first worldwide gathering to give priority to environmental issues on a global scale, the 1972 United Nations meeting on the Human Environment in Stockholm was a historic occasion. The United Nations Environment Programme (UNEP) was consequently founded.

With the objective of assisting countries in achieving sustainable development, the World Commission on Environment and Development (WCED), often known as the Brundtland Commission, was founded in 1983. The panel developed the unique strategy of "sustainable development" in its 1987 report titled "Our Common Future."10- Priorities for sustainability shifted to safety, environmental concerns, and emission control as a result of the report's emphasis on the greenhouse effect as a crucial topic. In the course of working with several chemical companies across the globe to prepare the report for the Brundtland Commission, the Chemistry Industry Association of Canada (formerly the Canadian Chemical Producers' Association) started a voluntary initiative known as the "Responsible Care program" in 1985. Chemical companies voluntarily pledge to integrating environmental and safety measures into their corporate management policies and business principles as part of the program's current practice. Because of the expansion of the industrial sector, the chemical and allied industries have placed an increasing emphasis on income generation and cost reduction in compliance with applicable regulations.

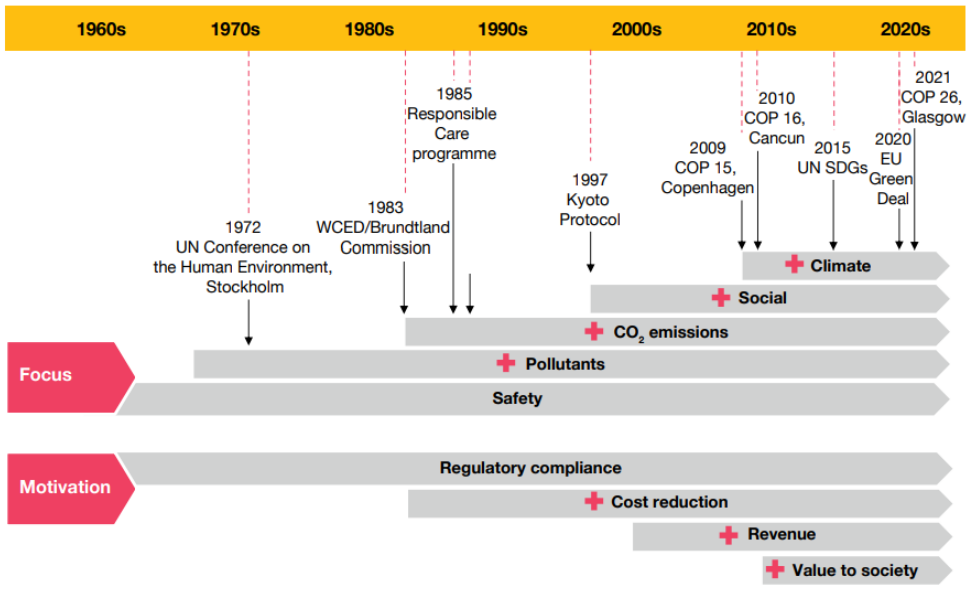
A number of things happened in the twenty-first century that made global warming a worldwide issue. The 1997 adoption of the Kyoto Protocol, the 2009 Copenhagen Conference of Parties (15th session) and the 2010 Cancun Conference of Parties (16th session) are notable events in this sector. All of the UN's member states overwhelmingly approved the Sustainable Development Agenda in 2015. Along with 169

other goals and policy indicators, this agenda featured 17 Sustainable Development Goals (SDGs).

One of the early adopters of environmental goals and programs addressing climate change was the chemical sector. Global chemical companies and industry groups have come to abide by the Sustainable Development Goals and the Responsible Care program as cornerstones of sustainability over time.

Following the adoption of the European Green Deal, the European Commission committed in 2020 to the goal of achieving net zero emissions inside the EU by 2050. A number of policy initiatives that took governance, social, and environmental (ESG) issues into account led to this commitment. Thus, businesses in the chemical and related industries, economies, and other bilateral and international organizations across the globe are leading the charge in tackling climate change, with initiatives like the Paris Agreement (COP 21) in the forefront.

The accord aims to limit global temperature rise to, at most, 1.5°C above pre-industrial levels by 2050.11, The chemical industry has shifted its focus to creating value for society and focusing on the needs of its customers.



Source: PwC research

3.6 Importance of Sustainable Procurement in the Chemical Industry

Environmental Protection: Sustainable procurement helps preserve natural resources, cut down on waste and pollution, and lessen the effects of climate change by taking the environment into account when making decisions about purchases. By encouraging the use of eco-friendly materials, energy-efficient products, and renewable resources, it helps to maintain the sustainability of the environment as a whole.

Social Responsibility: Throughout the supply chain, sustainable procurement promotes moral behavior and social responsibility. It encourages human rights, ethical work practices, and community involvement, all of which have a beneficial social impact both inside and outside the company.

Risk management: By implementing sustainable procurement strategies, companies can better detect and reduce risks associated with supply chain interruptions,

legal liability, regulatory noncompliance, and reputational harm. In order to ensure a more stable and sustainable supply chain, it encourages supplier diversity and resilience.

Innovation and Competitive Advantage: Organizations that practice sustainable procurement are more likely to look for cutting-edge and eco-friendly goods and services, which frequently results in breakthroughs in technology and a competitive edge. It enables businesses to establish themselves as pioneers in sustainability, drawing in stakeholders and clients who care about the environment.

Cost Savings: Because sustainable goods and services use less energy, produce less waste, and are more durable, they frequently save money over the long run, despite occasionally having higher initial prices. Sustainable procurement assists businesses in making more informed purchases and achieving long-term cost savings by taking the complete cost of ownership into account.

3.7 Advantages of Sustainable Procurement in the Chemical Sector

Organizations in all sectors now depend on sustainable procurement to lower their environmental effect, uphold social responsibility, and spur economic expansion. PwC's 23rd Annual Global CEO Survey found that 58% of CEOs in the chemical industry planned sustainability-focused projects for 2019–20.

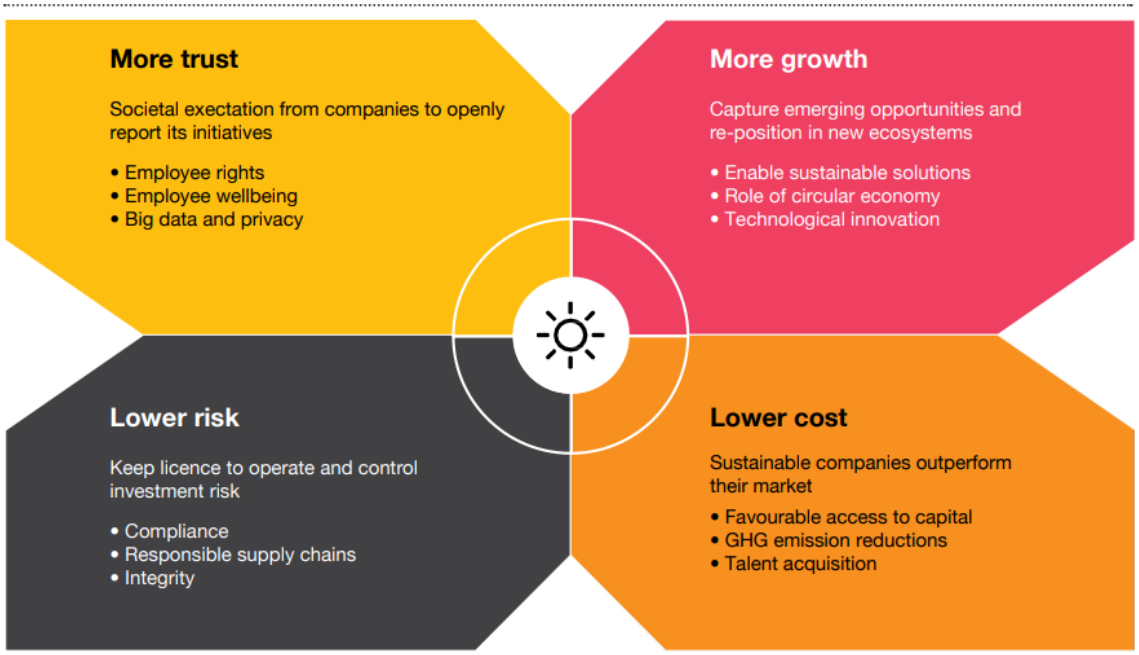
This development underscores the importance of sustainability in generating profit within the chemicals industry.

Increased Trust: Consumers are increasingly attempting to support companies that practice socially and ecologically responsible business practices, and this tendency also affects the companies' supplier chains. Customers are more likely to trust companies that are sustainable and have the right mindset and reporting. Generation Z is a fervent

supporter of organizations that work to better society and favors doing business with organizations that follow environmental, social, and governance (ESG) guidelines. Decreased cost: Sustainability helps to improve valuation. Sustainability is becoming more and more recognized as a differentiator in a capital market that is extremely competitive and marked by a recurring demand for significant returns. As a result, companies that put sustainability first have lower financing costs and are more likely to receive attention from investors—especially private equity investors. They are therefore frequently able to charge more for their goods or services.

Expanded: To support the shift to sustainability, it is essential to embrace circular business models, make use of renewable feedstocks, and put reuse and recycling procedures for end-of-life products into place. Businesses who take advantage of these chances will be able to strategically reposition themselves inside emerging business environments and have considerable development potential. Additionally, businesses will have a competitive edge in the market if they investigate digital technology solutions to increase resource productivity.

Lower risk: Businesses with strong sustainability principles have well-defined environmental, health, and safety regulations that align with their financial goals. Furthermore, compliance with regulations helps to reduce the risk of accidents, occupational hazards, and operational failure.



Source: PwC analysis

3.8 Challenges faced by the chemical industry while implementing sustainable procurement

1. Lack of Awareness and Understanding: It is possible that many organizations are unaware of the advantages of sustainable buying. Acquisition of support from stakeholders, including as employees, suppliers, and management, may be hampered by this ignorance. Programs for education and awareness are crucial for overcoming this obstacle and establishing a sustainable culture inside the company.

2. Collaboration and Engagement with Suppliers: It can be difficult to cooperate and engage with suppliers to implement sustainable practices. It is possible that suppliers lack the necessary funds, expertise, or knowledge of sustainable procurement standards. Furthermore, assuring compliance and incorporating sustainable criteria into supplier evaluation procedures might demand a significant amount of time and resources.

3. Limited Accessibility of Sustainable Goods and Services: In certain situations, the market may offer a restricted selection of sustainable goods and services. This might make it difficult for businesses to locate suppliers who satisfy their sustainability standards, particularly if those requirements include precise technical or quality standards. To meet this challenge, it is essential to collaborate with suppliers and stakeholders to find opportunities for sustainable innovation and development.

4. Cost Considerations: Because sustainable goods and services can occasionally have greater initial costs, convincing decision-makers that they are worth the money will be difficult. Organizations must consider the value creation, long-term cost savings, and environmental advantages of sustainable buying, though. This obstacle can be addressed by presenting success examples and carrying out thorough cost-benefit evaluations.

5. Integration with Current Procurement Procedures: It may be difficult to integrate sustainable criteria into current procurement procedures, particularly if they have been in place for a while. It could be necessary to review and update current protocols to incorporate sustainability considerations into the sourcing, evaluation, and contracting processes. To enable successful implementation, this needs training, clear rules, and support from stakeholders.

6. Data Availability and Tracking: It might be difficult to get and evaluate pertinent sustainability data from suppliers and to keep an eye on their performance. It is possible that suppliers lack reliable procedures for monitoring and reporting on sustainability parameters. For organizations to effectively gather, handle, and evaluate sustainability data, they might need to make investments in technologies and processes.

7. Balancing the Expectations of Diverse Stakeholders: Sustainable procurement entails striking a balance between the different interests and expectations of different stakeholders, such as consumers, investors, regulators, and communities. The

sustainability criteria and priorities of many stakeholders may differ, which can make it difficult to create a coherent and consistent strategy. To mitigate this difficulty, it is imperative to align with stakeholder expectations through engagement, collaboration, and transparency.

Notwithstanding these obstacles, manufacturing businesses can reap several advantages from sustainable procurement, such as better risk management, increased environmental performance, cost savings, innovation, and stakeholder involvement. To tackle these obstacles, an all-encompassing strategy, cooperation with relevant parties, and an enduring dedication to sustainability are necessary.

CHAPTER IV:

LITERATURE REVIEW

4.1 Problem Statement

- To understand the impact of Sustainable Procurement on Chemical Manufacturing Industries in the world.
- To understand the various roadblocks while implementing the sustainable procurement practices in the organization.
- To understand the challenges faced by the executive while implementing the sustainable procurement in their companies.
- To understand the challenges faced by the employees at the ground level by implementing the sustainable procurement practices.

4.2 Research Objective

- Identification: To investigate the impact of sustainable procurement and the barriers in implementing the same in the Chemical Industry.
- Operational Implementation: The research will be helpful for all the procurement professionals who are implementing sustainability initiatives in their supply chain.
- Offering Solutions: In this exploration, our goal is to look for solutions which can ease down the whole process of implementation of sustainable procurement and at the same time put forth this initiative of sustainability in the front row for any organization because it is the need of the hour.

4.3 Research Questions

As explained this dissertation seeks to investigate and evaluate the difficulties faced by the chemical industry in putting sustainable procurement strategies into effect. In today's corporate environment, sustainable procurement is becoming more and more important as organizations try to match their operations with goals related to social and environmental sustainability. The chemical industries, which have a substantial impact on the environment worldwide, encounter difficulties when attempting to adopt sustainable buying procedures. The present study aims to analyse the obstacles, pinpoint plausible remedies, and offer suggestions for the efficient execution of sustainable procurement within the chemical sector.

To understand the definition of Sustainable Procurement from the executives.

Q1. Do they believe in the concept of the Sustainable Procurement?

Q2. Is there sustainable procurement practice in the chemical industry? If yes, what are those based on?

Q3. How will it in short term and long term affect their company’s profitability/ economic development?

Q4. Do they think their organization procurement rules and regulations allow them to balance the differences between short-term/long-term financial considerations?

Q6. To understand the challenges/risks they face in implementing the same in their organization.

Q7. To illustrate any example given by them which has worked in Favor or against in implementing Sustainable Procurement.

Q8. What according to the industry is the practical definition of Sustainable Procurement?

Q9. Is there sustainable procurement practice in the chemical industry? If yes, what are those based on?

Q10. How would the idea of sustainable procurement impact the chemical business?

Q11. What are the challenges any chemical company face while implementing sustainable procurement?

Q12. What are the benefits they by adopting sustainable procurement practices in the long run?

Q14. If there is any risk in implementing sustainable procurement, are the companies willing to take that risk for the future betterment?

4.4 Significance of the Research

The significance of this research paper lies in its potential to address critical issues at the intersection of environmental sustainability, social responsibility, and economic viability. This research topic holds relevance for various stakeholders, including industry practitioners, policymakers, academics, and environmental advocates, due to the following reasons:

Pollution, resource loss, and global warming are among problems that the chemical industry exacerbates. Through the promotion of circular economy concepts, reduction of emissions, and conservation of resources, sustainable procurement methods present opportunity to lessen these environmental impacts. To build effective solutions to

reduce environmental damage, it is essential to understand the obstacles that are preventing sustainable procurement from being fully implemented.

Environmental justice, community effects, and worker safety are only a few of the social concerns that may arise from chemical manufacture, which raises questions of social responsibility. By placing an emphasis on ethical sourcing, community involvement, and fair labour standards, sustainable procurement techniques seek to resolve these societal issues. Corporate social responsibility (CSR) and social issues in the supply chain can be better understood by looking at the difficulties the chemical industry has encountered in adopting sustainable procurement practices.

Financial Sustainability: The chemical sector still faces obstacles in successfully implementing sustainable procurement methods, despite the increasing awareness of their financial benefits. Opportunities for cost savings, efficiency improvements, and market differentiation can be better identified by gaining a better understanding of the economic limits and hurdles that organizations have when trying to implement sustainable procurement practices. Organizational decision-making and the creation of new business models that factor sustainability into purchasing decisions can both benefit from this study.

Chemical production and supply chain management are governed by a complicated web of environmental rules and industry standards, which the chemical sector must comply with. To avoid legal trouble, keep goodwill intact, and keep access to markets intact, businesses must comply with these standards. In addition to showing their dedication to environmental stewardship, businesses can meet regulatory obligations with sustainable buying methods. Investigating the difficulties of sustainable procurement can help shed light on the areas where regulations are lacking, the obstacles to compliance, and the most effective methods for reaching regulatory compliance.

Sustainable procurement can boost innovation and competitiveness by promoting the creation of eco-friendly goods, procedures, and technology. Sustainable procurement strategies may help businesses stand out from the competition by satisfying customer demand for green products, drawing in eco-conscious investors, and establishing a reputation as an industry pioneer in sustainability. To overcome these obstacles, the chemical industry is working hard to develop sustainable procurement practices. By learning about these problems, people can work together to find innovative solutions.

This research paper on the challenges faced by the chemical industry in implementing sustainable procurement is significant because it addresses pressing environmental, social, economic, and regulatory issues within the industry. By examining these challenges in depth, the research can inform policy decisions, guide corporate strategies, and contribute to the advancement of sustainable practices in the chemical industry.

4.5 Literature Review

The literature review is an important element of the research process since it helps to build the fundamental structure of knowledge and to present prior studies and discoveries in our subject, which provides evidence and direction for the paper.

There does not exist sufficient literature which talks about the impact of sustainable procurement on chemical industries or talk about the challenges of implementing the same in the chemical industries while fortunately there are papers on the impact of Sustainable Supply Chain Management which is the broader picture of the Sustainable Procurement. Sustainable procurement in the upstream and sustainable

transportation/logistics in the downstream directions will support the notion. Both play an important role in core operations, and they strive to include all partners and operate on a long-term basis. The whole literature review here is categorized based on the output of each paper.

Literature Subjects	Literature Present and Research Outcome
Literature on History of Sustainable Procurement	Drumwright (1994) is usually credited with writing the first published article on sustainable procurement. In the early 1990s, some American companies adopted social responsibility (expressed by environmental criterion, according to the article. However, this preliminary study did not investigate the performance) as a new sort of sourcing challenges and benefits of sustainable procurement, nor did it provide examples of buyers using environmental criteria to choose suppliers.
	Handfield et al., (1997), a decade after the renowned sustainable development manifesto was published, describing the process as one that "meets the requirements of present generations without jeopardizing future generations' ability to fulfil their own needs" (Brundtland, 1987). The rise of sustainable procurement encourages procurement and supply chain professionals to evaluate a company's success not only in terms of traditional metrics (such as price, quality, and reputation), as well as its impact on the environment and society.

	Joe et al. (2012) defines sustainable procurement as "the consideration of environmental, social, ethical, and economic issues in the management of an organization's external resources in such a way that the supply of all goods, services, capabilities, and knowledge required for the organization's primary and support activities provide value not only to the organization but also to society and the economy." They also point out that nearly 70% of study on sustainable purchasing is concerned with environmental issues. As a result, the first section of this research dissertation will focus on environmental sustainability practices in the procurement process.
Literature on Definition of Sustainable Procurement	Muthugala, S. Nayagam, N (2012) define Sustainable procurement, according to the United Nations Environment Programme (UNEP), is "not only about being "green," but also about social responsibility, methods, and economically sound solutions in business purchasing practices" environmentally balanced buying
	Walker & Brammer (2009) also stated that sustainable procurement is consistent with the principles of sustainable development, such as ensuring a strong, healthy, and just society, living within environmental limits, and promoting good governance".
	Meehan & Bryde (2011) Due to the difficulty of translating sustainability into procurement, claim that sustainable procurement strategies focus solely on the environmental factor of TBL.
	Esfahbodi, Zhang, Watson, & Zhang (2017), The nature of sustainable procurement, according to is ecologically friendly, which aids in the development of environmentally friendly products and services.

	Ageron et al., (2012) has simplified sustainable procurement in three parts as resource reduction, product reuse, and recycling
	Kopp (2006) states that in accordance with the European Union's Sustainable Development Strategy (EU SDS), genuine sustainable procurement should consider economic, environmental, and social factors when analysing the implications of sustainable procurement for the purchasing and supply chain environment. Most of the debates, research, and activities have focused on environmental issues. This is understandable as a fundamental improvement, but any investigative framework must include the three pillars of long-term viability.
	Kwok Hung Lau, Aswini Yadlapalli, Muhammad Dan-Asabe Abdulrahman, Prem Chhetri & Vinh Thai (2023) in their paper on disclosure index development for sustainable procurement talks about sustainable procurement in Australian Securities Exchange.
Literature on Green Supply Chain Management and Allied Terms	Shukla Deshmukh & Kanda (2009) said that Green Supply Chain Management entails strategic steps taken by supply chain collaborators and stakeholders to reduce and/or eliminate the negative environmental effects of commercial activities across the chain, assuring the chain's long-term viability
	Shrivastava (2007) talked about GSCM as a subject which encompasses environmental activities such as product design, material sourcing and selection, manufacturing processes, final product delivery to consumers, and product end-of-life management after its useful life.

	Hervani, Helms & Sarkis (2005) said Green Purchasing, Green Manufacturing/Materials Management, Green Distribution/Marketing, and Reverse Logistics are all covered under one umbrella of GSCM.
	Rao (2002) describes GSCM that it entails weeding out suppliers based on their environmental performance and only doing business with those who meet regulatory requirements. The motivations for incorporating technology into business operations range from reactive legal requirements to proactive strategic and competitive advantages.
	Bowen, Cousins, Lamming, & Farukt (2001) defined GSCM as activities aimed at improving the environment Purchased item's environmental performance, or that of the companies that provide them with goods and services It could be in the form of greening supply chains or in the form of green provision in the form of a product.
	Beamon (1999) defined GSCM consists all elements of a traditional supply chain, along with recycling, re-use, remanufacturing activities related to production and packaging.
Literature on impact of Green Supply Chain Management adoption on business performance	Barari et al. (2012) talks about Establishing cooperation between the manufacturer and the retailer to adjudicate their plans to trigger green behaviors with a focus on maximizing economic profits by leveraging the product's greenness to find a synergetic alliance between the environmental and commercial benefits.
	Mirhedayatian, et al. (2014) says Companies' economic and environmental performance will be improved as they promote the GSCM, according to experts. For evaluating GSCM, they employ the Data Envelopment Analysis (DEA) method.

Literature on Sustainable Procurement Practices on Various Industries	Nyaga Irene Wanja & Achuora John Odoyo (2020) published a paper on Sustainable Procurement Practices and Performance of Procurement in Food and Beverages Manufacturing Firms in Kenya which was directed by four objectives: to determine the impact of reverse logistics, green specification, green inventory management, and green tendering on procurement performance in Nairobi County's food and beverage manufacturing enterprises. Organization theory, system theory, legitimacy theory, and stakeholder theory were all used to support the research. The study employed a descriptive cross-sectional survey research approach to survey 138 food and beverage manufacturing enterprises registered with the Kenya Association of Manufacturers in Nairobi County. As a unit of observation, procurement managers were used. The primary data was gathered via a standardized questionnaire. According to the conclusions of the study, green specifications have the greatest impact on procurement performance, followed by reverse logistics, green inventory management, and green tendering. Furthermore, the overall effect of sustainable procurement practices is greater than the effect of institutionalize sustainable procurement practices through the formulation and individual activities, according to the study. To manage their operational costs, comply with environmental regulatory authority requirements, and improve supply quality, manufacturing firms should implementation of green procurement policies and procedures, according to the study. Second, management should educate general staff about us interventions to encourage businesses to go green to preserve the environment sustainable practices, particularly in the procurement area, to foster a green culture with

	positive performance implications. Furthermore, the government should take active steps through policy manage natural resources sustainably to meet the needs of the country's future population. This will have a multiplier impact, enhancing business performance and making them Vision 2030 catalysts.
	William Rongxuan Zhao., (2017) in his paper titled Sustainable Procurement in British Dairy Supply Chain where the research aims to investigate the promotion of sustainable development in the British dairy sector and its supply chain through specific objectives, including: identifying the current penetration level of different sustainability practises on dairy farming and milk purchasing; investigating drivers, barriers, and benefits of implementing sustainability practises in the dairy sector; identifying different supply chain types existing in the dairy

	sector and their implications to sustainable development; and identifying different supply chain types existing in the dairy sector and their implications to sustainable development.
	Yujin Guo & Jing Zhang., (2018) in his paper Sustainable Procurement in Supply Chain focusing in Chinese Family Business in Manufacturing investigated the current situation of sustainable procurement specifically in a Chinese family-owned manufacturing business. The paper gave an interesting outlook which holds true for many other businesses also that most procurement employees in Chinese family businesses are relatives and friends of the owners, who lack systematic professional learning and training, implying a lack of long-term awareness in the procurement process and reluctance to learn as well. This is also a case with lot of Chemical Industries globally which are family-owned. Another shortcoming was lack of technology which again is a case even in current scenario at the ground level.
	Berry (2011) points out significant disparities in procurement approach and principles between the public and private sectors. Author focussed on typical public business organisations in this study; hence the research focus on private-sector sustainability adoption rather than public-sector sustainability adoption.

	Siqi Liu & Peijia Wang (2013) in their paper "From Green Purchasing to Green Supply Chain Management" talks about the influence of Green Supply Chain Management (GSCM) development caused by specific background in China. It is focussed on the manufacturing industries and the findings lack any implementation technique of sustainable purchasing. Also, the whole study revolves around the environment impact while the focus of our study will be finding a balance between the environment, economic and social impact of the sustainable procurement.
Literature on Sustainable Procurement Practices on Chemical Industry	Roberta Souza Piao & Mayara Sayuri Ide and Gabriela Scur and Willerson Lucal Campos and Sangeeta Khorana (2020) in their paper "Sustainable procurement practices in the Brazilian chemical industry" talks about the adoption of sustainable procurement in the Brazilian chemical industries

This research had five important components: Green Supply Chain Management or Sustainable Supply Chain Management, Green Procurement or Sustainable Procurement, Challenges in Implementation of Sustainable Procurement in any industry, Challenges in Implementation of Sustainable Procurement specifically in Chemical industry & Solutions or Suggestions for the challenges

4.6 Gaps and Limitations

The goal of sustainability has grown in importance as a concern for companies in a variety of industries in recent years. Sustainable procurement has become a critical

tactic to promote positive change across supply chains as businesses work to match their operations with environmental and social responsibility objectives. Still, there is a research vacuum concerning the chemical business that is particularly apparent when it comes to the difficulties associated with adopting sustainable procurement procedures. By highlighting these shortcomings and inadequacies, this paper hopes to encourage more study in this important field.

In order to reduce adverse environmental effects, advance ethical sourcing methods, and nurture long-term sustainability, sustainable procurement—which is defined as the integration of environmental, social, and economic issues into purchase decisions—has attracted a lot of attention. The chemical business is still comparatively underrepresented in academic literature and empirical investigations, despite the fact that research on sustainable procurement has blossomed in industries like manufacturing, construction, and retail.

There are a number of reasons why there is so little study on sustainable procurement in the chemical industries. First of all, in the larger context of supply chain management and procurement, sustainable procurement is still a relatively new idea. It has only become significantly more important and recognized as a strategic necessity for firms in the last two to three years. As a result, there hasn't been much opportunity for researchers to explore the complexities of sustainable procurement in the chemical industry and identify the particular difficulties that industry participants confront.

Furthermore, the chemical business has particular complexity and subtleties that need for focused investigation. Chemical processes and products can carry inherent dangers to the environment and human health, making strict adherence to regulations and ethical sourcing procedures necessary. Sustainable procurement initiatives are further

complicated by the worldwide scope of chemical supply chains and the variety of chemical goods and applications.

Progress in a number of important areas is hampered by the paucity of thorough research on sustainable procurement in the chemical industries. First of all, there is a lack of knowledge regarding the industry-specific difficulties and impediments to the implementation of sustainable procurement procedures. The creation of focused strategies and solutions to address issues unique to the industry is hampered by this lack of clarity.

Furthermore, procurement leaders and decision-makers in chemical businesses may find it difficult to traverse the intricacies of sustainable procurement in the absence of evidence-based guidance derived from research findings and best practices. This may make implementation difficulties worse and obstruct the achievement of sustainability objectives.

Prioritizing research projects that concentrate on sustainable procurement in the chemical industries is essential to filling in these gaps and constraints. Through empirical research on the obstacles, motivations, and results of sustainable procurement programs in chemical businesses, scholars can produce useful conclusions and useful suggestions to aid professionals in the field.

Academic institutions, business associations, and government organizations can work together on interdisciplinary research projects to exchange data, share information, and support capacity-building programs. Through the utilization of various stakeholders' combined skills and resources, researchers can make significant advancements in the direction of a more sustainable future for both society and the chemical industry.

In summary, although sustainable procurement has become increasingly important for businesses globally, there is still a dearth of study on the subject that specifically addresses the needs of the chemical sector. To improve our knowledge of the

opportunities, problems, and best practices related to sustainable procurement in the chemical industry, it is imperative that the gaps and limitations in the current study be addressed.

CHAPTER V:
METHODOLOGY

5.1 Scope

In general, the scope of a study helps to define the extent of the research which is to be analysed. It specifies certain parameters and boundaries. The scope defines the environment in which the actual study would take place, thereby describing its population, size, characteristics, geographical locations, etc.

For the study, focus is on the Chemical Industry, who are in the activities of manufacturing and selling chemicals. In terms of the target audience, this study is limited to professionals from the chemical industry only. While procurement is a broad topic, research will only focus on the sustainability aspects of procurement. Within the chemical firms, there were interviews of different stakeholders like Chief Procurement Officers, Vice President Procurement, Procurement Managers, Executives, Interns and Directors.

5.2 Organization of the Study

This study aims to understand barriers while implementing sustainable procurement in the chemical industry. The dissertation employs a mixed-methods approach, combining qualitative interviews and quantitative surveys to gather data from chemical industry procurement professionals. The data was gathered mostly through primary sourced like unstructured interviews and discussions with various management executives along with employees supplementing the data. The opinions of well-known

academics and experts in the subject of sustainable supply chains were also sought. A small part of the data for the research was collected by using the secondary sources of information that is already available in the websites of the companies.

Lastly but a very critical part of this research were case studies which are available online that shows the impact and challenges were also been used in the research.

To gather the necessary information, a worldwide questionnaire survey and semi-structured interviews were done. The population is a well-balanced mix of multinational and domestic chemical firms located at various locations around the globe, and the interviewees are professionals who are either the decision makers or the executives involved in day to day purchasing operations. The obstacles and benefits of sustainable procurement were ranked using statistical analysis. The results of semi-structured interviews were used to validate the statistical analysis' finding.

The overall timeline for this study has been two years which is comprehensive. The interviews were also conducted in this period to limit the time frame within a particular period.

5.3 Research Paradigm

Research can be defined as a deliberate and systematic endeavour of gaining deeper insights of social and physical occurrences in a scientific approach, thereby determining realistic values (Neuman & Robson 2014). Research Methodology is referred as a collection of such systematic approaches or methods to perform research (Kumar 2018). Research methodology is a guidance to scientifically reveal or establish new findings in a systematic manner, by using recommended methods or techniques. The

element of the research methodology is presented here to support us in preparing a detailed strategy for the study which is to be conducted in a systematic manner. The methodologies and procedures used here are at best relevant to the outcome of our study.

5.4 Research Approach

- Data collection approach

Promoting qualitative research in the area of study currently under investigation aids in the collection of data that forms a deeper understanding of real-world circumstances and patterns, improving research conclusions and findings. Furthermore, the research endeavors to comprehend the approaches employed in the present milieu to actualize sustainable procurement and to proffer remedies for the hindrances met in the course of implementation in the authentic system. Therefore, when using a qualitative research technique, it is easier to construct assumptions and interpretations to explain processes in specific situations.

- The reasoning approaches

For this research, an inductive reasoning approach is adopted. Inductive reasoning makes conclusions based on the analysis of particular data sets. This strategy, which was started with the study's main objectives, is not very related to the suggested research hypothesis. This approach also aligns with the research methodologies used. This way of thinking appears appropriate for the current investigation. An inductive data-collection strategy begins with specific measurements and observations, searches for patterns and regularities, forms some preliminary assumptions, and ends up with conclusions or hypotheses for the current study. Furthermore, the inductive reasoning technique can help

with scenario-based situation analysis based on prior events and conclusion supported by conveniently accessible facts.

5.5 Research Design

It is an essential part of the entire research process since it facilitates the integration of the results. Additionally, a well-designed study design helps ensure that the objectives and research questions are addressed correctly. The research design also makes sure that the collected data is carefully analyzed in order to determine the results.
The research design has a big impact on how reliable the results are. A descriptive research design is used in this investigation. In contrast to other research methods, the research uses a description strategy to group data into themes and patterns that show up during analysis when just a tiny percentage of cases require detailed narrative descriptions. When these patterns are followed, the mind finds it easy to comprehend the implications of a qualitative inquiry. Extensive descriptions are necessary due to the complex and multifaceted accounts of events that emerge from qualitative research, case studies, observational studies, interviews, and portfolio evaluations.

5.6 Data Collection and Methods

The data obtained via interviews in this study is considered to be the most dependable and relevant source of information related to the specified topic. To gather sufficient and relevant primary data, interviews were conducted with procurement leaders from the chosen chemical businesses. A semi-structured questionnaire, specifically designed for this purpose, was employed. The provided data serves as a valuable resource

for assessing the current state of sustainable procurement within the chemical industry. Obtaining primary data is crucial in this study since it serves as the first collection of information, which is based on human experience. Therefore, this study employs a hybrid approach that combines both observation and interviews. In order to address the existing research gap, it is imperative to acquire relevant findings from relevant studies. This can be achieved by using the data gathered through observations and open-ended interview questions. The study aims to comprehend the viewpoints and viewpoints of the professionals who represent these companies. The secondary data for this study was compiled by extracting relevant information from journal articles, research publications, and documents related to sustainable procurement in the chemical industry. The Reference section contains explicit citations for these sources.

5.7 Population and Sampling

Researchers often encounter difficulties when attempting to obtain data from all the companies they are targeting. Consequently, addressing the research issue and achieving the associated objectives becomes somewhat arduous. Hence, the selection of samples is crucial in this context. In the present context, the term "study population" encompasses all elements that will be encompassed inside the sample.

Due to constraints in time and money, it is not feasible to analyze the complete population simultaneously. Therefore, the research employ suitable sampling techniques to decrease the number of entities. The initial phase of the sampling process involves the visual categorization of the target population. The subsequent procedure involves the selection of the sampling frame, which comprises a collection of tangible elements that will serve as the fundamental basis for the sample. The utilization of a sample technique

can provide valuable insights into the complexities of a certain issue or the broader community. According to Taherdoost (2016), there exist two main categories of sampling procedures: probability or random sampling and non-probability sampling.

Both population and sampling methods

The inclusion criteria for most research topics encompass demographic, clinical, sector-specific, and geographical elements, along with other significant characteristics of the target group. The inclusion of a population in a study is contingent upon their adherence to the exclusion criteria. The firms were selected based on their regions and size, as the current study specifically focuses on the global chemical industry and the challenges, they face in implementing sustainable procurement. Seventy-five procurement leaders, representing 58 firms across various industries (small, medium, and big), were selected based on specific inclusion criteria. By conducting interviews with a limited number of representatives from these organizations, the research objectives were accurately established. The objective of our study was to gather accurate data pertaining to the procurement methods and challenges encountered by a representative from a corporate client group.

The present investigation utilizes a purposive sampling technique, which is a non-probability sampling approach. Purposeful sampling is a non-probability sampling technique wherein researchers employ their informed judgment and predetermined inclusion criteria to select individuals from the study population to participate in evaluations. The basic methodology employed in this study involved conducting interviews with a sample of 75 procurement leaders from the chemical sector. The selected representatives play a crucial role in facilitating the interview process for

effective data collection by offering unstructured comments regarding the study aims and the issue being investigated.

5.8 Data Analysis and Interpretation

Data analysis technique enhances the value of data by methodically presenting, elucidating, and scrutinizing it using statistical or manual analytical tools. In order to ensure the reliability of the data, it is imperative to conduct a thorough and appropriate assessment of the study's findings. The study is considered to be of utmost importance. Data analysis is a crucial component of any research endeavor as it enables the evaluation of the data. Upon collecting information, the researcher develops a perspective regarding the data analysis tool. Given the numerical character of the generated data, a range of statistical methods are utilized to assess the quantitative data. Data analysis plays a crucial role in mitigating statistical mistakes and addressing many data management challenges, including outliers, missing data, normality, data mining, and visual representation (Ott & Longnecker 2015).

5.9 Limitation and Ethical Considerations

The research upholds ethical standards by guaranteeing the confidentiality of the data acquired for the study and limiting access to third parties. The study has not overstated its explicit goals, and every attempt has been made to incorporate references and affiliations whenever material was acquired from secondary sources. All participants in the interview received instructions on what to expect and that they are not required to respond to any questions that are unrelated to their areas of interest. Their wish to

participate and the confidentiality of their responses were given top priority in the interview-based study. Seven days' notice preceded the interview, and participants were offered the choice to withdraw. Furthermore, if they bring up their choice to quit during the interview, it will be taken seriously. Following the interview, the last specifics of the research were examined, and consent forms acknowledging the participants' involvement were signed by them. Because the study's issue required careful consideration while evaluating the sample's validity and reliability, the study complies with all ethical and confidentially criteria.

CHAPTER VI:
DATA ANALYSIS

6.1 Introduction

The collected data is analysed to identify the major challenges faced by the chemical industry in implementing sustainable procurement and to understand their relative severity and frequency.

6.2 Familiarization of the Data

The first step in the analytical process is to become acquainted with the data. To become fully acquainted with the collected data, the researcher must analyse and assess it. This must be enhanced by obtaining preliminary data analysis results as well as potential study methodologies (Clarke & Braun 2014). The information gathered here is scrutinised and analysed to obtain critical conclusions

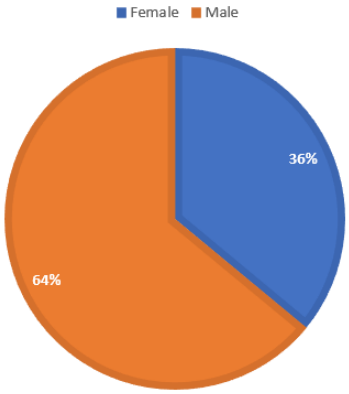
6.3 Demographics

The selection process for conducting the interviews was done with meticulous attention to ensure that the assembled group possessed the necessary breadth of expertise and knowledge in the fields of procurement and sustainability in the chemical industry. A total of 75 participants were interviewed. The demographics are:

1. Gender

64% of the respondents are males and 36% are females as can be observed from the chart and the table given below.

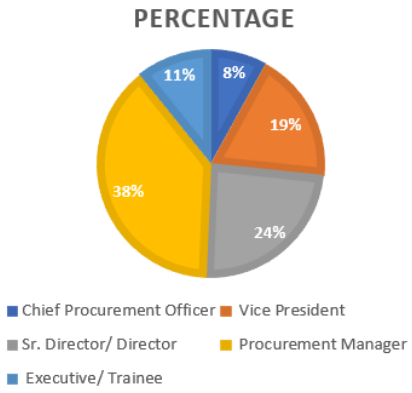
Gender	Percentage
Female	36%
Male	64%



2. Designation

Majority of the participants were holding the position of sourcing / procurement managers while combined population of decision makers which include directors, vice president and CPOs were 51% as can be observed from the chart and the table given below.

Current Designation	Percentage
Chief Procurement Officer	8%
Vice President	19%
Sr. Director/ Director	24%
Procurement Manager	39%
Executive/ Trainee	11%

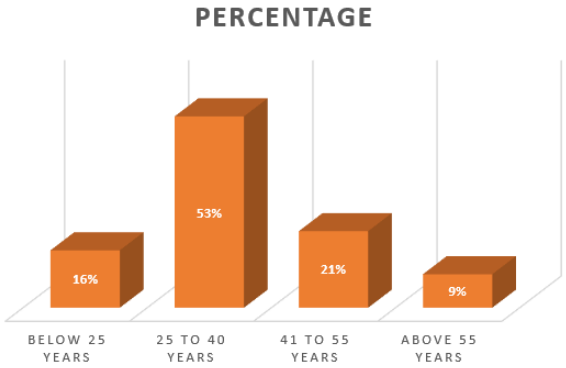


3. Age-Group

Additionally, majority of the respondents belonged to the age group of 25-50 years as the interviews were designed to get maximum inputs from the decision makers

and Executives who have the actual experience of the topic and could highlight the actual challenges and their severity at the ground level and same can be seen in the table and graph below.

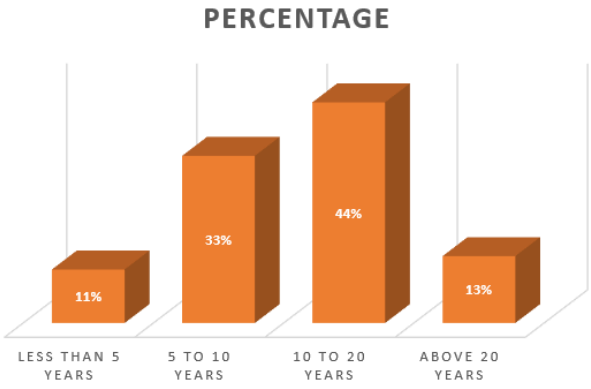
Age Group	Percentage
Below 25 years	16%
25 to 40 years	53%
41 to 55 years	21%
Above 55 years	9%



4. Experience

Also, majority of the respondents had an industry experience between 10-20 years.

Industry Experience	Percentage
Less than 5 years	11%
5 to 10 years	33%
10 to 20 years	44%
Above 20 years	13%

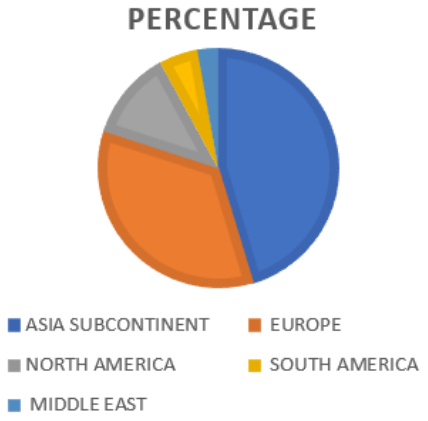


5. Geography

Participants are selected from various geographies to represent the global chemical industry and to see if the challenges faced are affected by the change in geography and surprisingly, it was the same for every procurement leader in the chemical industry irrespective of their geography and the only difference came is in the severity or frequency of the challenge faced. Additionally, because of the presence of majority of the

manufacturing plants in the Asian Subcontinent including developing countries and China and in Europe, so it can be seen that most of the participants also from the same region showcasing the actual representation of the global chemical industry.

Location of Participants	Percentage
ASIA SUBCONTINENT	45%
EUROPE	35%
NORTH AMERICA	12%
SOUTH AMERICA	5%
MIDDLE EAST	3%

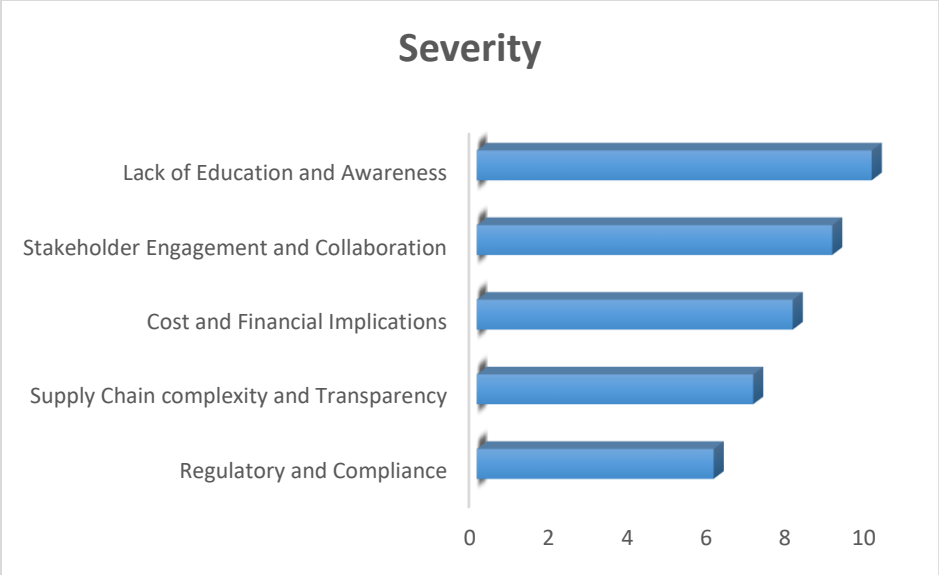


6.4 Data Analysis and Interpretation

This part of the study deals with the interpretation of the data collected from the broader and open-ended interview questions

- Severity of the Challenges

Challenge	Severity Rating (1-10)
Regulatory and Compliance	6
Supply Chain complexity and Transparency	7
Cost and Financial Implications	8
Stakeholder Engagement and Collaboration	9
Lack of Education and Awareness	10



To analyse the collected data, the following calculations were done:

Average Severity: Calculated the average severity score for all the challenges to understand overall level of challenge faced by the procurement leaders in the chemical industry in implementing sustainable procurement.

Average Severity= sum of all the severity rating divide by the total number of challenges which is: **(6+7+8+9+10) / 5 = 40 / 5 = 8**

So, the average severity of the challenges faced while implementing sustainable procurement in the chemical industry is 8 which is very high and which means that all the challenges are significant and need to be addressed to successfully implement sustainable procurement in the chemical industry.

Also, through the analysis it was found out that lack of education and awareness and stake holder engagement are the most challenging as they have the severity score above an average of 8 i.e., 9 and 10.

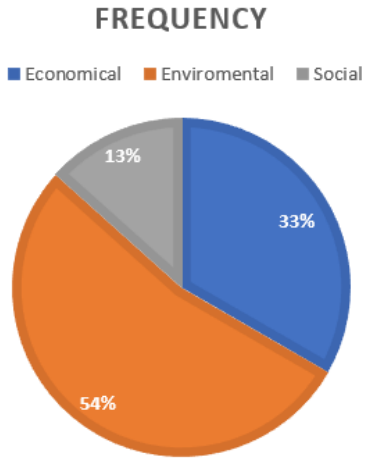
- Benefits Frequency from case studies of 11 companies who were benefitted by implementing sustainable procurement

Company Name	Measure Taken	Direct Benefit	Category of Benefits	Benefits
Company A	Started a major part of raw material purchasing from regional vendors/suppliers	Reduced transporation/operational expense and increased environmental sustinability	Enviromental & Economical	Carbon Emission Reduction
Company B	Vendor selection criteria- switched to vendors using less water during production	Improved company's sustinability credentials	Enviromental	Water Conservation
Company C	Switched a significant portion of their energy to solar panels	Lower Carbon emissions and got subsidiary from the government for switching to solar panel under a recent scheme run by the government.	Enviromental	Carbon Emission Reduction
Company D	Supplier Collaboration and partnership in decreasing packaging waste.	Significant cost saving and reduced environemntal impact	Enviromental & Economical	Reduced Wastage
Company E	Paid premium to suppliers adhering to ethical sourcing and fair labor standards	Boosted CSR, reduced supply chain risks, and bolstered the company's image.	Social Consideration	Ethical Sourcing Practices
Company F	Investing on technology and starting new sustainable product line	Increased market share and brand loyalty	Economical & Environmental	Future Growth
Company G	Set up of stricy regulatory complaince for vendor selection and proactively acquiring raw materials and ingredients that satisfied regulatory criteria.	This decreased the possibility of fines, penalties, and reputational damage.	Economical	Reduced Costs and risks.
Company H	During the pandemic H Pharma realised the importance of multiple suppliers thus they focussed on strengthening their supply chain and procuring material from multiple vendors.	Reduce the risks in its supply chain and improve its response time to unanticipated problems	Economical	Reduced Risks
Company I	Increase Collaboration with suppliers, consumers and local communities and encorage open communication and transparency	strengthened the company's social license to operate and ensured its continued success.	Social & Econimical	Future Growth
Company J	Commited to sustainability through open reporting and stakeholder involvement in public	Boosted company's image and reputation and gained trust of their consumers	Economical	Future Growth
Company K	Use of sustainable procurement techniques by mapping its supply chain and engaging with suppliers to disclose information on sourcing procedures and labor conditions.	Improved risk management and strengthen customer trust	Economical	Reduced Risks

This above data was further analysed to study the frequency of the three major benefits or pillars of sustainable procurement which is Social, Economic and Environmental Benefits.

Based on the case studies, below is the frequency of the benefits which signifies that the companies are keener and more encouraged to adopt sustainable procurement and practices if there is direct economic benefit.

Benefit	Frequency
Economical	5
Enviromental	8
Social	2



6.5 Summary

This section discusses the important conclusions from the analysis of qualitative data from interviews.

The findings revealed that a lack of education and awareness regarding sustainable procurement principles emerged as a fundamental challenge, with many stakeholders demonstrating limited understanding of its benefits and implications. Additionally, inadequate stakeholder engagement and collaboration within the industry hindered progress, highlighting the need for enhanced communication and collaboration platforms.

Cost and financial implications were identified as substantial barriers, with perceptions of high costs and uncertain returns deterring investment in sustainable procurement initiatives. Supply chain complexity and transparency issues further

compounded challenges, making it difficult to trace the origin of materials and assess sustainability risks effectively.

Furthermore, regulatory and compliance challenges posed significant hurdles, with evolving regulatory frameworks and fragmented requirements adding complexity and administrative burden to procurement processes.

Despite these challenges, the analysis provided insights into potential pathways for addressing them. Recommendations included enhancing education and awareness initiatives, fostering stakeholder engagement and collaboration, addressing financial barriers through cost-benefit analysis and financial incentives, improving supply chain transparency and traceability, and aligning with regulatory frameworks.

The analysis also showcases the benefits of the sustainable procurement which motivates the future leaders and companies to implement sustainable procurement and follow the path of sustainability.

CHAPTER VII:
CHALLENGES FACED BY THE CHEMICAL INDUSTRY WHILE IMPLEMENTING SUSTAINABLE PROCUREMENT

After meticulous examination and discussion with the group of procurement professionals, five major challenges were identified as the primary roadblocks while implementing sustainable procurement in the chemical industry which have sub challenges as well which are also explained.

7.1 Regulatory and Compliance Challenges

Regulation and compliance standards present significant challenges for the chemical industry when adopting sustainable procurement strategies. The complexity of regulations governing ethical sourcing, worker safety, environmental preservation, and product quality across numerous jurisdictions and places is the root cause of these challenges. Here is a detailed analysis of these challenges:

1. Diverse Regulatory Environment: The chemical industry operates in a highly regulated environment due to the plethora of international, national, and local regulations that impact it. These standards address a wide range of concerns, including worker safety, waste management, emissions, handling, transportation, labeling, and registration of chemicals. Maintaining compliance with sustainable procurement standards in this intricate regulatory environment requires a significant amount of skill and resources.

2. Evolution of Regulations: The laws governing the chemical industry evolve along with new health and environmental concerns, technological advancements, and shifts in public expectations. It can be difficult for chemical companies, especially those

with international operations, to keep up with these advancements and proactively adjust their procurement strategies to comply with new regulations.

3. Complex Supply Chains: Chemical supply chains are often multinational and multifaceted, including numerous suppliers dispersed over numerous countries and regions. Ensuring that all suppliers follow relevant rules, regulations, and certifications on social responsibility, environmental sustainability, and ethical sourcing is a challenging procedure. A deficiency of openness and visibility into suppliers' business activity makes regulatory compliance harder.

4. Verification and Certification: To verify compliance with legal requirements and sustainability norms, rigorous evaluation and certification procedures are required. However, obtaining accurate and reliable information from suppliers about their adherence to various laws and standards may prove to be challenging. Chemical companies must engage in robust verification techniques like audits, inspections, and third-party certifications to ensure supplier compliance.

5. Supply Chain Traceability: It is essential to monitor the origin and route of intermediates and raw materials along the supply chain. By using traceability protocols, chemical companies can assess the social and environmental impacts of every phase of production and distribution. However, achieving total supply chain traceability is sometimes hampered by insufficient record-keeping systems, fragmented data, and a lack of transparency among suppliers.

6. Cross-Border Compliance Difficulties: It is imperative to adhere to diverse legal frameworks, cultural norms, and regulatory standards when conducting business in many jurisdictions. Adhering to national legislation and standards while maintaining cross-border consistency in procurement techniques poses administrative, legal, and logistical challenges for chemical manufacturers. Variations in language, regulation

interpretation, and enforcement techniques further complicate cross-border compliance tasks.

7. Risk of Non-Compliance: Breaking the law or failing to follow regulations can have major consequences, including fines, legal ramifications, reputational damage, and disruptions to business operations. Chemical companies must implement robust compliance management systems in order to identify, assess, and mitigate compliance risks along the whole supply chain. A failure to address compliance issues promptly may jeopardize stakeholder trust and business continuity.

8. Emerging Sustainability Regulations: In recent years, it has become more and more crucial to include sustainability criteria into the regulatory frameworks that govern the chemical industry. Initiatives that support the circular economy and EU legislation such as REACH (Registration, Evaluation, Authorization, and Restriction of Chemicals) mandate that chemical businesses minimize their environmental impact, cut back on resource use, and encourage recycling and reuse.

9. Cost of Compliance: In order to comply with sustainability and regulatory standards, significant investments in infrastructure, technology, training, and documentation are usually required. Costs associated with compliance can be high, particularly for small and medium-sized enterprises (SMEs) with limited funding. Chemical companies have a tough time staying competitive in the market while having to pay for their compliance with sustainability goals.

To overcome these legal and compliance challenges, proactive measures, collaboration with regulators and industry stakeholders, investments in technology and data management systems, and the integration of sustainability considerations into supplier relationships and procurement plans are all essential. Chemical companies that

prioritize regulatory compliance and sustainability standards can increase operational efficiency, lower risks, and foster stakeholder confidence.

7.2 Supply Chain Complexity and Transparency

When implementing sustainable procurement methods, the chemical industry faces substantial obstacles due to supply chain complexity and transparency.

1. Complexity of the Supply Chain:
    - Global Nature: Chemical supply chains are frequently global, sourcing raw materials, intermediates, and finished goods from different parts of the globe. Because of this intricacy, it is more challenging to determine the materials' provenance and to comprehend the social and environmental effects of each stage of production.
    - Diverse vendors: Chemical firms get their raw materials, chemicals, equipment, and services from a variety of vendors. Sustainable procurement strategies become more complex when managing partnerships with multiple suppliers, each of whom has its own operating procedures, sustainability objectives, and compliance needs.
    - Product Diversity: From basic chemicals to specialty chemicals and formulations, the chemical industry generates a wide range of goods for various applications. The chemical composition, manufacturing method, and ultimate use of each product may give rise to sustainability considerations, which further complicates sustainability assessments and procurement choices.

- Interrelated Processes: The manufacturing of chemicals entails several phases, inputs, and transformations that are interrelated. Gaining a thorough grasp of these interde pendencies and their effects on the environment and society is necessary to spot chances for sustainability improvements.

2. Transparency:

- Limited Visibility: It is difficult for businesses to appropriately estimate the environmental and social effects linked to their products when chemical supply networks lack transparency. Identifying and addressing sustainability risks is hampered by a lack of visibility into the sourcing, manufacturing, and transportation processes of upstream suppliers.
- Data Availability: It might be difficult to find trustworthy information about suppliers' sustainability performance, including waste production, energy use, water use, and greenhouse gas emissions. Chemical businesses may find it challenging to evaluate suppliers' sustainability credentials if they are unwilling to divulge sensitive information or if they lack strong reporting systems.
- Information Exchange: To advance openness and spur sustainable improvements, supply chain partners must cooperate and share information. Open communication and cooperation throughout the supply chain, however, may be hampered by worries about intellectual property rights, secrecy, and competitive advantage.
- Confirmation and Confidence: Robust verification and assurance methods are necessary to guarantee the veracity and accuracy of sustainability-related information supplied by suppliers. Verifying suppliers' claims and

giving stakeholders confidence in the sustainability of sourced materials and products may need independent assessments, third-party audits, and certifications.

Chemical firms, suppliers, trade associations, and regulatory agencies must work together to address supply chain complexity and increase transparency. Transparency and visibility can be improved by putting technology and techniques for risk assessment, data collection, and supply chain mapping into practice. Furthermore, encouraging cooperation and forming alliances with suppliers to advance sustainability programs and information exchanges is essential for bringing about good change throughout the chemical supply chain.

7.3 Cost and Financial Implications

Companies in the chemical industry face a tremendous difficulty in implementing sustainable procurement strategies due to the substantial cost and financial implications involved.

1. Increased Initial Investment Expenses: Adopting sustainable procurement typically necessitates substantial initial expenditures in technology enhancements, process adjustments, and infrastructure enhancements. Investors may face significant capital costs when they choose to invest in energy-efficient equipment, renewable energy sources, or wastewater treatment facilities. The use of sustainable sourcing procedures may entail increased expenditures for the acquisition of environmentally-friendly raw materials, certified sustainable products, or ethically sourced ingredients in comparison to conventional alternatives.

2. Expenses related to operations: Implementing sustainable procurement activities might result in higher operational expenses because of modifications in production procedures, resource conservation strategies, and waste disposal methods. For example, the implementation of recycling and waste minimization initiatives, the reduction of energy usage, and the adoption of safer chemical handling protocols may necessitate the allocation of supplementary resources and result in continuous operational costs. Investments in monitoring, reporting, and compliance management systems may be required to ensure adherence to environmental rules and sustainability requirements, hence contributing to operational expenses.

3. Complexity of the supply chain: The consideration of sustainability within the supply chain might give rise to intricacies that have the potential to affect financial expenditures. One potential consequence of procuring sustainable raw materials or chemicals from certified providers is the potential for incurring supplementary transaction costs, certification fees, or shipping expenditures. Overseeing connections with several suppliers to guarantee adherence to sustainability standards may necessitate specialized resources and result in administrative expenses, especially in industries characterized by varied and worldwide supply chains such as chemicals.

4. The Costs of Risk Management: The failure to adequately handle sustainability concerns within the supply chain might potentially subject chemical businesses to a range of hazards, such as harm to their brand, penalties imposed by regulatory bodies, and disruptions in the supply chain. Implementing risk management techniques, such as conducting supplier audits, implementing due diligence processes, and developing contingency plans, can effectively reduce these risks. However, it is important to note that these strategies may incur additional expenses. The need for proactive risk management measures may arise due to uncertainty surrounding future regulatory

requirements and changing stakeholder expectations. This may involve allocating financial resources for scenario planning, impact assessments, and compliance methods.

5. Competitive forces: Chemical businesses often face challenges in reconciling sustainability aims with competitive pressures aimed at cost reduction and profitability enhancement. Investments in sustainable procurement techniques may be deterred in businesses characterized by fierce rivalry and narrow profit margins due to the perceived trade-off between sustainability and financial performance. In certain contexts where sustainability activities are not generally acknowledged or incentivized by customers, investors, or regulators, companies may encounter the need to prioritize immediate financial benefits at the expense of long-term sustainability objectives.

To effectively address the economic and financial consequences associated with sustainable procurement, it is imperative to adopt a strategic strategy that considers both immediate financial limitations and long-term sustainability goals. To examine the financial feasibility of sustainability efforts, companies can utilize cost-benefit analysis, lifecycle assessments, and return on investment estimates. Furthermore, the examination of potential avenues for enhancing efficiency, optimizing resources, and fostering innovation can effectively reduce expenses while simultaneously maximizing the environmental and social advantages associated with sustainable buying practices. The facilitation of cost-sharing, knowledge exchange, and collective action to solve common sustainability concerns across the chemical supply chain can be achieved through collaboration with suppliers, industry partners, and other stakeholders.

7.4 Stakeholder Engagement and Collaboration

Stakeholder engagement and collaboration in the chemical industry are notably inadequate, which poses considerable obstacles to the effective implementation of sustainable procurement practices. The following is an elaborate elucidation of these obstacles:

A fragmented supply chain is a common characteristic of chemical supply chains, which encompass an extensive array of participants such as manufacturers, distributors, suppliers, consumers, regulators, and non-governmental organizations (NGOs). An insufficiency of coordination and communication among these stakeholders may impede endeavours to adequately tackle sustainability concerns.

Supplier Resistance: Certain suppliers might exhibit resistance towards sustainability initiatives because of apprehensions regarding augmented expenses, disruptions in operations, or perceived threats to their competitive standing. It can be difficult to engage resistant suppliers and persuade them of the business benefits of sustainable procurement, particularly if their primary concern is immediate financial gains rather than long-term sustainability objectives.

Insufficient Knowledge and cognizance: A considerable number of chemical industry stakeholders may possess a restricted comprehension or cognizance regarding sustainability concerns, environmental ramifications, and social obligations. Insufficient educational and training initiatives may hinder the progress made towards sustainable procurement goals and impede stakeholder engagement endeavours.

Competitive dynamics can lead to a reluctance among companies to engage in sustainability collaborations with rivals. This reluctance stems from apprehensions regarding the disclosure of proprietary information, potential market share loss, and the

dilution of their competitive advantage. To surmount competitive dynamics and cultivate collaboration among industry rivals, it is imperative to establish unambiguous objectives, instil confidence, and emphasize the reciprocal advantages of working together.

Regulatory and compliance pressures can potentially divert attention away from voluntary sustainability initiatives, causing stakeholders to prioritize the fulfilment of minimum legal standards over the pursuit of more ambitious sustainability objectives. Enhanced collaboration and stakeholder engagement can be fostered through the alignment of regulatory frameworks with sustainability objectives and the surmounting of regulatory obstacles.

Institutional Inertia: The chemical industry's well-established organizational structures, processes, and cultures may impede innovation and change, thereby complicating efforts to galvanize stakeholders in support of sustainability goals. Addressing institutional inertia necessitates the collaboration of leadership, cultural revolution, and organizational nimbleness to accommodate emerging sustainability prospects and challenges.

Stakeholder Representation Limitations: Certain stakeholders, including indigenous groups, environmental advocates, and local communities, may experience marginalization or exclusion from decision-making processes pertaining to sustainable procurement. The absence of substantial stakeholder representation has the potential to erode the credibility and efficacy of sustainability endeavours, as well as worsen social discord and environmental inequities.

To mitigate the issue of insufficient stakeholder engagement and collaboration, it is imperative to adopt a proactive stance that cultivates trust, encourages discourse, and establishes alliances among a wide range of stakeholders operating in the chemical industry and beyond. By prioritizing participation, accountability, and transparency in

stakeholder engagement strategies, businesses can guarantee that all pertinent opinions are considered and acknowledged during the decision-making procedures. Collaborative platforms, industry associations, multi-stakeholder initiatives, and public-private partnerships have the potential to foster the exchange of knowledge, sharing of resources, and concerted effort required to promote sustainable procurement objectives and tackle common sustainability issues throughout the chemical supply chain.

7.5 Lack of Education and Awareness

When it comes to the implementation of sustainable procurement practices, the chemical industry faces a substantial obstacle in the form of inadequate education and awareness. Based on the interviews and information available on internet it can be said that it is one of the major challenges faced today in the industry while implementing sustainable procurement. A considerable number of individuals and entities involved in the chemical industry, encompassing suppliers, customers, employees, and investors, might possess a rudimentary comprehension of sustainability principles. These principles comprise sustainable sourcing practices, social responsibility, environmental impact assessment, and social accountability. Developing a fundamental comprehension of these principles hinders the ability to persuasively convey the significance of sustainable procurement and rally backing for associated endeavours.

1. Stakeholders frequently have a restricted understanding of the environmental and social consequences that are linked to the manufacturing and distribution of chemicals. For example, the ramifications of resource depletion, pollution, biodiversity loss, and human rights violations that are linked to traditional procurement methods might not be entirely comprehended by stakeholders. Deficit of knowledge can result in

apathy or complacency toward matters of sustainability, impeding endeavours to effectuate significant transformation.

2. Advantages of Sustainable Procurement: The benefits of sustainable procurement, which include cost savings, risk mitigation, brand improvement, and entry into untapped markets, might be overlooked by stakeholders. In the absence of understanding the business rationale behind sustainability, organizations might place greater emphasis on immediate financial benefits rather than enduring sustainability goals, thereby neglecting potential avenues to enhance their competitive edge and resilience via sustainable procurement strategies.

3. Technical Proficient Individuals with technical proficiency in domains including lifecycle assessment, green chemistry, renewable energy, and circular economy principles are frequently needed for sustainable procurement. Nevertheless, a considerable number of chemical industry stakeholders might be deficient in the requisite expertise and competencies to effectively evaluate the ecological and societal ramifications of procurement choices and pinpoint potential areas for enhancement.

4. The level of awareness among stakeholders regarding regulatory obligations and compliance requirements pertaining to sustainability may be restricted, especially in areas where regulatory frameworks are dynamic or intricate. Failure to adhere to environmental regulations, social standards, and reporting obligations may result from a lack of awareness, thereby subjecting organizations to potential legal and reputational hazards.

5. Cultural and organizational awareness: Additionally, organizational, and cultural factors can impact chemical industry sustainability education and awareness. Organizational cultures that are inflexible, isolated, and hierarchical may make it difficult for businesses to raise awareness and facilitate the exchange of information regarding

sustainability issues. Promoting a culture of sustainability and surmounting cultural obstacles necessitates the dedication of leadership, active involvement of employees, and ongoing endeavours to enhance knowledge and skills.

To rectify the dearth of knowledge and instruction concerning sustainable procurement, the chemical industry must implement focused initiatives to enhance understanding, develop capabilities, and cultivate a sustainable culture. To augment stakeholders' comprehension of sustainability principles, optimal methodologies, and prevailing trends within the industry, businesses may allocate resources towards training programs, seminars, and educational materials. By engaging in partnerships with academic institutions, industry associations, and non-profit organizations, it is possible to foster the exchange of knowledge and support capacity-building initiatives that aim to promote the implementation of sustainable procurement practices throughout the chemical supply chain.

CHAPTER VIII:

BEST PRACTICES AND STARTEGIES FOR SUSTAINABLE PROCUREMENT

8.1 Supplier Engagement and Collaboration

- Interact with suppliers to convey expectations and demands regarding sustainability.
- Identify opportunities for suppliers to enhance their environmental and social performance through collaboration.
- Develop enduring partnerships with suppliers who are dedicated to upholding sustainability objectives and principles.
- Promote the adoption of sustainable practices among suppliers and offer incentives and support to foster progress in this direction.

8.2 Supplier Selection and Evaluation Criteria

- Establish precise sustainability standards for the selection, assessment, and oversight of suppliers.
- Evaluate vendors' ethical, social, and environmental performance in detail.
- Assess suppliers' adherence to sustainability standards using instruments including sustainability scorecards, audits, and certifications.
- When evaluating suppliers, consider aspects like labour practices, waste management, resource conservation, and energy efficiency.

8.3 Risk Management and Due Diligence

- The supply chain poses environmental, social, and ethical concerns, which must be identified and evaluated.
- Make sure your suppliers are following all the rules and regulations as well as industry standards by doing your due diligence.
- Address possible social, ethical, and environmental hazards in the supply chain by implementing risk mitigation techniques.
- To keep operations running sm`oothly and prevent interruptions, it is a good idea to create backup plan`s and explore other sources of supply.

8.4 Innovation and Technology Adoption

- To create cutting-edge and environmentally friendly materials, systems, and products, spend money on research and development.
- Examine prospects in chemical manufacturing for resource efficiency, waste reduction, and renewable energy.
- Reduce your influence on the environment by implementing technologies like clean production techniques, bio-based materials, and green chemistry.
- Work together with government organizations, academic institutions, and business partners to advance sustainability and innovation in the chemical sector.

8.5 Transparency and Reporting

- Increase openness in the procurement process by sharing supplier performance information, sustainability standards, and the status of sustainability initiatives.
- Share sustainability accomplishments and initiatives with all relevant parties, such as the public, investors, and customers.
- Disseminate sustainability reports and engage in industry campaigns to show your dedication to sustainability and responsibility.
- To resolve issues and foster trust, engage stakeholders through communication, feedback channels, and stakeholder consultations.

8.6 Continuous Improvement and Evaluation

- Provide systems for assessing performance and making ongoing improvements to sustainable buying procedures.
- Track progress, pinpoint areas for growth, and compare performance to peers in the sector by keeping an eye on key performance indicators, or KPIs.
- To determine whether procurement procedures are complying with sustainability criteria and to spot areas for improvement, conduct routine evaluations and audits of the procedures.
- To promote ongoing development of sustainable procurement processes, cultivate a culture of learning, creativity, and cooperation among supply chain partners and procurement teams.

CHAPTER IX:
TOOLS AND FRAMEWORK FOR IMPLEMENTING SUSTAINABLE PROCUREMENT IN THE CHEMICAL INDUSTRY

To implement sustainable procurement in the chemical industry, several frameworks and techniques must be used to evaluate, track, and enhance the environmental, social, and economic performance of the supply chain.

9.1 Life-Cycle Assessments (LCA)

- LCA is a methodical technique for assessing how activities, goods, and services affect the environment at every stage of their life cycle—from the extraction of raw materials to the disposal of them at the end of their useful life.
- Hotspots and chances for environmental performance improvement, such as energy consumption, greenhouse gas emissions, water use, and waste generation, can be found with the aid of life cycle assessment (LCA).
- Businesses can reduce their environmental effect and advance sustainability by making educated decisions by performing life cycle assessments (LCAs) for chemical goods and processes.

9.2 Environmental Management Systems (EMS)

- An organized framework for handling environmental issues, putting environmental policies into practice, and accomplishing environmental goals and targets is known as an EMS.
- A popular standard for EMS implementation, ISO 14001 offers instructions for creating, putting into practice, maintaining, and enhancing an environmental management system.
- Chemical firms can better manage their environmental performance throughout their supply chains and operations by using EMS to detect environmental concerns and meet regulatory obligations.

9.3 Sustainable Procurement Guidelines and Criteria

- Companies can better incorporate environmental, social, and economic factors into their procurement processes by creating and executing sustainable procurement standards and criteria.
- Energy efficiency, resource conservation, waste management, labour practices, human rights, and ethical sourcing are a few examples of sustainable purchase criteria.
- Chemical businesses can evaluate suppliers' adherence to sustainable procurement standards by using instruments including sustainability scorecards, supplier self-assessment questionnaires, and sustainability certifications.

9.4 Chemical Footprinting

- Chemical footprinting is a technique used to measure and evaluate how chemicals affect the environment at each stage of their life cycle, from manufacture to use and disposal.
- Businesses may assess and manage the environmental footprint of chemicals, including their toxicity, emissions, and resource usage, with the use of chemical footprinting tools and databases.
- Businesses can find ways to lessen their influence on the environment, enhance product stewardship, and encourage the use of safer and more sustainable chemicals by carrying out chemical footprint assessments.

9.5 Supply Chain Mapping and Transparency

- Tools for supply chain mapping assist businesses in locating and visualizing the suppliers, subcontractors, and manufacturing sites that make up their supply chains.
- Transparency tools give businesses information on the ethical, social, and environmental performance of their suppliers. This information helps them evaluate risks, spot areas for development, and encourage accountability and transparency throughout the supply chain.
- Chemical firms may better identify and manage environmental and social risks, strengthen supplier relationships, and improve sustainability performance by mapping supply chains and increasing openness.

CHAPTER X:

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

10.1 Recommendations

Based on the study, it is advised to undertake sustainable procurement while overcoming the obstacles encountered by the chemical industry by following the guidelines listed below.

1. Capacity Building and Training: The largest obstacle to the implementation of sustainable procurement in the chemical industry is a lack of knowledge and education. To address this issue, professionals in the industry need to become more knowledgeable about sustainable procurement concepts, procedures, and instruments. Participants should also have access to thorough training programs and materials.

Offer Comprehensive Training Programs: Create specialized training sessions and lectures to educate employees at all organizational levels on the principles and advantages of sustainable procurement. These programs should cover subjects including social responsibility, ethical sourcing, environmental sustainability, and regulatory compliance.

Increase Knowledge via Internal Channels of Communication: Use internal communication channels including newsletters, intranet portals, and staff meetings to showcase industry and company success stories and best practices, as well as to increase awareness of the need of sustainable procurement.

2. Interaction with Stakeholders and Collaborative Measures: Since it has been discovered that the second main obstacle to the implementation of sustainable

procurement is a lack of stakeholder involvement and collaboration, taking the actions listed below can assist in overcoming the same.

Form Multidisciplinary Teams: To advance sustainable procurement initiatives, create organizational cross-functional teams comprising operations, sustainability, procurement, and any other relevant departments. To fully utilize each person's distinct abilities and perspectives, promote cooperation and knowledge sharing.

Work Together with Outside Parties: Assist in strengthening alliances with suppliers, trade associations, NGOs, governments, and local communities, among other outside parties. In order to address common sustainability challenges, discuss best practices, and collaboratively develop solutions, organize stakeholder gatherings, workshops, and cooperative projects.

Stakeholders or company management ultimately prioritize the financial benefits of sustainability over short-term investments and costs. Financial implications, such as higher raw material costs from sustainable sourcing methods, return on investment, etc., can impede the implementation of sustainable procurement in the chemical industry. For this reason, it's critical to consider both short- and long-term financial benefits.

A thorough cost-benefit analysis is necessary to demonstrate the potential return on investment and calculate the financial effects of sustainable procurement practices. Highlight the real and intangible benefits as well, such as the lowered risk and enhanced brand recognition, as well as the savings on energy, waste reduction, and operational efficiencies.

Financing options for sustainable procurement projects include grants, subsidies, tax credits, and low-interest loans, to name a few. Collaborate with banks, government agencies, and corporate partners to get funding and enable the implementation of sustainable procurement programs.

Lean concepts and process optimization approaches can be applied to improve the efficiency of the procurement process. These will streamline operations, save costs, and assist in locating and eliminating waste. Encourage a continuous improvement mindset in order to realize long-term cost savings and efficiency gains.

3. Improving the transparency and visibility of the supply chain

Boost Supply Chain Tracking Capabilities: Make investments in technology such as blockchain, RFID, and cloud-based supply chain platforms to enhance supply chain visibility and traceability. Take proactive steps to mitigate potential dangers and inefficiencies by using real-time tracking and monitoring technologies to identify them early on.

Collaborate with Suppliers to Increase Transparency: Collaborate with suppliers to increase information disclosure regarding product origins, manufacturing processes, and social and environmental performance. Encourage suppliers to adopt responsible sourcing practices and provide access to relevant data and documentation in order to guarantee compliance.

Simplify Supply Chain Structure: You may simplify and streamline the supply chain structure by eliminating unnecessary middlemen, consolidating suppliers, and optimizing logistics. Create closer relationships with significant suppliers in order to improve collaboration, communication, and alignment with sustainability goals.

4. Keep yourself updated on industry regulations and compliances.

Keep Learning and Taking Initiative: Keep abreast of the most recent local, national, and international laws, rules, and directives governing sustainable procurement. Keep an eye out for legislative developments and get in touch with regulatory agencies to

make recommendations and advance legislation that encourages environmentally conscious purchasing.

Invest in Compliance Management Systems: Investing in compliance management systems and tools will facilitate the tracking, monitoring, and reporting of regulatory compliance requirements related to sustainable procurement. Create robust internal controls and procedures to ensure regulatory compliance and lower the risk of noncompliance.

Collaborate with Trade Associations: To assist in navigating the regulatory challenges related to sustainable procurement, share information, tools, and best practices with trade groups, professional associations, and industry associations. Take part in industry-wide initiatives and lobbying campaigns to promote regulatory reform and alignment with sustainable development goals.

By tackling these main issues, the chemical industry can successfully adopt sustainable procurement practices: supply chain optimization, proactive regulatory compliance, stakeholder engagement and collaboration, education and awareness-building, and cost management strategies. This will assist a business in being robust, competitive, and respectable over time, in addition to having a positive impact on society and the environment.

11.2 Summary of the Findings

The study dissertation examined the difficulties the chemical sector encountered in putting sustainable procurement into practice, concentrating on five main difficulties.

Following thorough investigation and data gathering, the following important conclusions were made:

Lack of Education and Awareness: The chemical industry's biggest problem has been the lack of knowledge and understanding of sustainable procurement procedures. A considerable number of stakeholders, including procurement experts, suppliers, and management, exhibited a restricted comprehension of the fundamentals and advantages of sustainable procurement.

The implementation of sustainable buying techniques was hampered by this ignorance, which resulted in lost opportunities to improve social and environmental results.

Lack of Collaboration and Stakeholder Engagement: Regarding sustainable procurement activities, the research revealed a significant lack of collaboration and stakeholder engagement across the chemical industry. Insufficient cooperation among industry participants, such as vendors, authorities, and nearby communities, impeded the advancement of sustainable procurement methodologies. This problem was made more difficult by the lack of efficient lines of communication and collaborative platforms, which made it impossible to share resources and best practices.

Cost and Financial Implications: The chemical industry has found that adopting sustainable procurement methods is significantly hampered by cost and financial implications. Initiatives for sustainable procurement were seen by many companies as expensive and financially taxing, especially in the near run. The absence of evident cost reductions and unambiguous financial incentives linked to sustainable procurement procedures discouraged stakeholders' investment and dedication.

Supply Chain Complexity and Transparency: Putting sustainable procurement principles into effect was severely hampered by the chemical industry's supply chains'

complexity and opaqueness. The chemical business frequently has lengthy, international, multi-tiered supply chains, which makes it challenging to determine the source of raw materials and evaluate the dangers to the environment and society. Efficient identification and resolution of sustainability concerns were impeded by the supply chain's low visibility and transparency.

Regulatory and Compliance Issues: In the chemical business, regulatory and compliance issues have been identified as major roadblocks to sustainable procurement. Chemical businesses faced challenges in complying with various regulatory frameworks across different areas and jurisdictions due to their evolving and fragmentary nature. The adoption of sustainable procurement techniques was made more difficult by the increased administrative costs and difficulties that firms had to bear to comply with environmental, social, and ethical criteria.

The study also laid foundation on the benefits of implementing sustainable procurement in the existing setup of the chemical industry and key motivation is the economic benefit that encourage chemical companies or stakeholders to participate and implement the techniques of sustainable procurement seriously.

Overall, the results showed how critical it is that the chemical sector emphasize sustainable procurement as a strategic objective and solve these issues immediately. The relevance of financial incentives, supply chain transparency, regulatory alignment, stakeholder involvement and collaboration, education and awareness-building, and regulatory alignment were emphasized in the recommendations made to get over these challenges. To support larger environmental and social goals, the chemical industry must

overcome these obstacles to shift toward more ethical and sustainable purchasing practices.

11.3 Recommendations for the Future Research

This study sets the stage for further investigations into the field of sustainable procurement in various industries and their challenges. This encourages academics and professionals to investigate the hot topic of sustainable procurement further, examining how it can be applied in various organizational settings and its impact on environment and our future industry growth. Future studies may delve deeper into the core principles of the model, exploring how sustainable procurement can be included in our day-to-day operation using technology and other methods. Additionally, how these challenges differ in various industries and are these more innovative solutions available with other industries to tackle these challenges.

11.4 Conclusion

In conclusion, this research dissertation has shed light on the multifaceted challenges faced by the chemical industry in implementing sustainable procurement practices. Through an in-depth analysis of the five major challenges – lack of education and awareness, lack of stakeholder engagement and collaboration, cost and financial implications, supply chain complexity and transparency, and regulatory and compliance challenges – significant barriers to the adoption of sustainable procurement have been identified.

The findings underscore the urgent need for concerted efforts from all stakeholders within the chemical industry to address these challenges and drive progress towards more sustainable and responsible procurement practices. Despite the formidable obstacles, there are several key implications and recommendations that emerge from this research, offering pathways for industry stakeholders to navigate and overcome these challenges:

Firstly, enhancing education and awareness initiatives tailored to the needs of the chemical industry is imperative. By investing in comprehensive training programs and awareness campaigns, organizations can ensure that procurement professionals, suppliers, and management are equipped with the knowledge and understanding necessary to embrace sustainable procurement principles.

Secondly, fostering stakeholder engagement and collaboration is essential for overcoming silos and driving collective action towards sustainability goals. Establishing collaborative platforms and networks where industry stakeholders can share best practices, resources, and challenges will be instrumental in overcoming barriers and driving progress.

Thirdly, addressing perceptions of high costs and financial implications associated with sustainable procurement practices is crucial. Conducting comprehensive cost-benefit analyses and identifying financial incentives can help demonstrate the long-term value and return on investment of sustainable procurement initiatives, encouraging greater buy-in and commitment from stakeholders.

Fourthly, improving supply chain transparency and traceability is essential for identifying and addressing sustainability risks. Investing in technologies and tools that enable real-time monitoring and visibility across the supply chain will facilitate informed decision-making and risk management.

Lastly, aligning with evolving regulatory frameworks and compliance requirements is critical for ensuring sustainable procurement practices. By proactively addressing regulatory complexities and establishing compliance measures, organizations can mitigate risks and ensure adherence to environmental, social, and ethical standards.

In conclusion, while the challenges facing the chemical industry in implementing sustainable procurement are significant, they are not insurmountable. By embracing the implications and recommendations outlined in this research dissertation, industry stakeholders can chart a course towards a more sustainable and responsible future. Through collective action and commitment, the chemical industry can drive positive environmental, social, and economic outcomes, contributing to a more sustainable world for future generations.

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APPENDIX A

INTERVIEW STRUCTURE AND QUESTIONS

1. Introduction and Background

- Can you provide a brief overview of your role within the procurement department of your organization?
- How long have you been involved in procurement within the chemical industry?

2. Understanding Sustainable Procurement

- How do you define sustainable procurement within your organization?
- What are the key objectives or goals your organization aims to achieve through sustainable procurement practices?
- What are the current procurement practices in your organization related to sustainability?

3. Current Challenges in Implementing Sustainable Procurement

- What are the major challenges your organization faces in implementing sustainable procurement practices?
- Can you identify any specific challenges unique to the chemical industry in adopting sustainable procurement?-

Rate the following challenges on the rating of 0-10 based on their severity.

Regulatory and Compliance

Supply Chain complexity and Transparency

Cost and Financial Implications

Stakeholder Engagement and Collaboration

Lack of Education and Awareness

6. Regulatory and Compliance Issues

- How do regulatory requirements impact your procurement decisions, especially concerning sustainability?

- Have you encountered any compliance challenges related to sustainable procurement?

5. Supplier Engagement and Evaluation

- How do you engage with your suppliers to ensure they adhere to sustainable practices?

- What criteria do you use to evaluate the sustainability performance of your suppliers?

- What obstacles do you encounter when attempting to collaborate with suppliers on sustainability initiatives?

7. Technology and Innovation

- Are there any technological solutions or innovations you've implemented to support sustainable procurement efforts?

- How do you leverage technology to track and monitor the sustainability performance of your suppliers?

- Have you encountered any challenges or limitations in adopting new technologies for this purpose?

8. Cost and Return on Investment (ROI):

- How do you balance the costs associated with sustainable procurement against the potential benefits?

- Can you provide examples of ROI or cost-saving initiatives resulting from sustainable procurement efforts?

-Have you encountered any challenges related to cost implications when implementing sustainable procurement?

9. Internal Stakeholder Alignment

- How do you ensure alignment between procurement goals and the broader sustainability objectives of your organization?

- Are there any internal barriers or challenges that hinder collaboration on sustainable initiatives?

- What strategies do you employ to foster collaboration with other departments, such as sustainability or environmental health and safety?

10. Continuous Improvement and Best Practices

- How does your organization approach continuous improvement in sustainable procurement practices?

- Are there any best practices or lessons learned that you can share from your experience in implementing sustainable procurement?

11. Outlook and Trends

- What do you envision as the future of sustainable procurement within the chemical industry?

- Are there any emerging trends or developments you anticipate will impact sustainable procurement practices soon?

11. Closing Remarks

- Is there anything else you would like to add or highlight regarding sustainable procurement challenges in the chemical industry?

LIST OF TABLES, FIGURES, CHARTS AND GRAPHS