ADDIS ABABA UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

SCHOOL OF COMMERCE

Assessment of Supply Chain Disruption Risk Management Practices Among Pharmaceutical Manufacturers in Ethiopia

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts in Logistics and Supply Chain Management

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June 2025

Addis Ababa, Ethiopia

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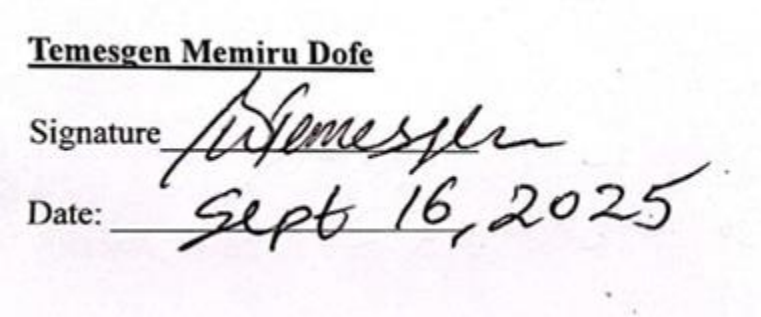
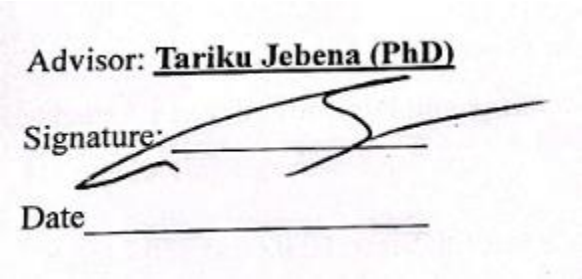
DECLARATION

I, **Temesgen Memiru Dofe,** hereby declare that the work presented in this thesis entitled "Assessment of Supply Chain Disruption Risk Management Practices Among Pharmaceutical Manufacturers in Ethiopia" is my original work, carried out with the guidance and support of my research advisor. This thesis has not been submitted, in whole or in part, for a degree or diploma at any other university or institution. All sources of materials used in the preparation of this thesis have been properly cited and duly acknowledged. I also acknowledge that AI assistance was utilized to enhance the language and consistency of the thesis report, without compromising the originality or integrity of the research. I fully understand that any form of plagiarism will result in the automatic cancellation of this thesis.



ADVISOR'S APPROVAL

This is to certify that the thesis entitled "Assessment of Supply Chain Disruption Risk Management Practices Among Pharmaceutical Manufacturers in Ethiopia" submitted by Temesgen Memiru Dofe has been carried out under my supervision. It is hereby approved for submission to the School of Graduate Studies for the Examination.



ACKNOWLEDGMENTS

First and foremost, I wish to express my sincere gratitude to **the Almighty God** for granting me the strength, health, and perseverance to undertake and complete this MA thesis.

I am profoundly grateful to my academic advisor, **Dr. Tariku Jebena**, for his invaluable guidance, and constructive feedback throughout the research process. His expertise and encouragement were instrumental in shaping the direction and rigor of this thesis.

My sincere appreciation also goes to the faculty and staff of the School of Commerce at Addis Ababa University for providing a stimulating academic environment and the resources necessary for conducting this research.

I would like to extend heartfelt thanks to all the respondents—pharmaceutical manufacturers — who generously participated in the survey and interviews. They shared their time and insights during the empirical phase of this study, and their candid reflections greatly enriched the depth and relevance of this work. Special thanks to **Dr. Daniel Waktole,** President of the Ethiopian Pharmaceutical Manufacturers Association. Thank you, Dani.

I wish to express my heartfelt gratitude to my wife, **Meaza Zemedkun,** whose unwavering support made this academic journey possible. Her patience, understanding, and sacrifices sustained me through long hours of study and research. I am equally grateful to my beloved daughters, **Eliyana, Ruth, and Yoadan,** for their love and the family time I missed while pursuing this goal. This accomplishment is as much theirs as it is mine. I am also deeply grateful to Tsehaye, Mekdi/Worku, Kefe, Yeshi/Biratu, Salayish, and Richo for their kindness and support over the years. **Tsehaye and Mekdiye, your support has been truly exceptional.**

Last but not least, I extend my heartfelt thanks to my friends who provided unwavering moral and financial support, as well as steadfast companionship throughout this demanding journey. I am especially grateful to Tsegaye Legesse, Alemayehu Tadesse, Zelalem Negussie, Yeshitla Tesfaye, and Messay Gelaye for their consistent companion. **A very special thank you goes to Tsegish (Chu) for the unique companionship throughout the years.**

ABSTRACT

The COVID-19 pandemic and persistent global shocks have highlighted the fragility of pharmaceutical supply chains, particularly in low- and middle-income countries (LMICs) such as Ethiopia. This thesis assesses the supply chain disruption risk management (SCDRM) practices among pharmaceutical manufacturers in Ethiopia. Using a descriptive survey complemented by qualitative key informant interviews, the study provides a mixed-methods analysis that enriches both breadth and depth of insight. Quantitative data were obtained from 89 respondents across pharmaceutical firms (80.9% response rate), while qualitative interviews with 6 senior executives yielded context-specific understanding and validated the survey findings. The study further incorporates another layer assessment; evaluating the perceived effectiveness of risk mitigation strategies. Findings reveal that forex shortages, regulatory constraints, and logistics disruptions are the most frequently cited and severe risks. However, firms' mitigation approaches remain largely fragmented and reactive. While practices are emerging, widespread implementation is hampered by financial, institutional, and technological limitations. Perceptions of strategy effectiveness vary widely, with gaps in strategies adoption. The study concludes that enhancing pharmaceutical supply resilience in Ethiopia's manufacturing sector requires integrated policy support, and organizational capacity-building. This research contributes to the scarce empirical literature on SCDRM in LMICs and offers practical insights for industry leaders, regulators, and development partners committed to strengthening pharmaceutical manufacturing supply chains.

Keywords: Supply chain disruption, disruption risk, SCDRM, perceived effectiveness, implementation challenges.

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LIST OF ABBREVIATIONS

AfCFTA: African Continental Free Trade Area

API: Active Pharmaceutical Ingredient *(plural, APIs)*

ASCM: Association for Supply Chain Management

BCP: Business Continuity Plan *(plural, BCPs)*

EFDA: Ethiopian Food and Drug Authority

EPMSMA: Ethiopian Pharmaceuticals and Medical Supplies Manufacturers' Association

ERP: Enterprise Resource Planning

EU: European Union

FBPIDI: Food beverage and pharmaceutical industry development institute

FDI: Foreign Direct Investment

GMP: Good Manufacturing Practice

GSC: Global Supply Chain *(plural GSCs)*

LMIC: Low- and Middle-Income Country

PE: Perceived Effectiveness

PSC: Pharmaceutical Supply Chain

QA/QC: Quality Assurance / Quality Control

RDT: Resource Dependence Theory

RMMs: Risk Management Maturity Models

SC: Supply Chain *(plural, SCs)*

SCD: Supply Chain Disruption *(plural, SCDs)*

SCDR: Supply Chain Disruption Risk *(plural, SCDRs)*

SCDRM: Supply Chain Disruption Risk Management

SCM: Supply Chain Management

SCN: Supply Chain Network

SCRM: Supply Chain Risk Management

SD: Standard Deviation

SSA: Sub-Saharan Africa

UNIDO: United Nations Industrial Development Organization

USAID: United States Agency for International Development

WHO: World Health Organization

CHAPTER ONE:

INTRODUCTION

1.1. Background of the Study

The concept of supply chain disruption (SCD) has markedly attracted the attention of both academics and practitioners during and since the COVID-19 pandemic (Abdallah et al, 2024). In today's globalized, interconnected, and interdependent economy, supply chains (SCs) have become increasingly complex, multi-tiered, and vulnerable to a wide range of disruption risks. This vulnerability is particularly pronounced in the pharmaceutical manufacturing sector, where the continuity of supply is not only economically significant but also critical to public health outcomes. The COVID-19 pandemic, geopolitical conflicts, and recurring global trade disruptions have all underscored the fragility of pharmaceutical supply chains (PSCs). These factors highlight the need for effective supply chain disruption risk management (SCDRM), not only as a business concern but also as a public health imperative (Duay, 2023; Asamoah et al., 2023; Tabatabaeia et al., 2024; Jean, 2024; Kaloyanova, 2024). Both global literature and domestic assessments underscore that countries with limited local production and excessive import dependence experienced the most severe supply disruptions during COVID-19 pandemic and its aftermath (Kulkarni, 2025; Marew et al., 2024).

Pharmaceutical manufacturers depend heavily on a global network of suppliers for active pharmaceutical ingredients (APIs), excipients, and packaging materials. This dependency, combined with limited local sourcing and underdeveloped emergency preparedness, exposes the sector to significant operational and strategic risks (Bilal et al., 2024; Brobbey, 2024). In developing countries like Ethiopia, these risks are compounded by contextual challenges including chronic foreign exchange shortages, inadequate port and customs infrastructure, limited digital traceability, and institutional coordination gaps (Neguse, 2019; FBDIPI & EFDA, 2020; Fentahun, 2022). In recent years, particularly in the post-Covid-19 era, the importance of SCDRM for pharmaceutical manufacturers has grown substantially. Globally, firms are increasingly adopting proactive SCDRM strategies to mitigate and recover from disruptions (Katsaliaki et al., 2021; Moosavi et al., 2022; Hashemi et al., 2023; Ramsköld, 2024; Soni & Patel, 2024).

A study by Arowosegbe et al (2024) outlined a comprehensive framework for risk identification, assessment, and mitigation, emphasizing the importance of proactive strategies in addressing potential disruptions. It highlighted key mitigation measures such as diversification of suppliers and transportation routes, technological investments, insurance coverage, and enhanced collaboration. On the other hand, a prior study by Katsaliaki et al (2021) confirmed that despite growing global awareness of the benefits SCDRM strategies offer in enhancing firms' capacity to prevent, absorb, and recover from disruptions, a significant implementation gap persists.

The PSC in Ethiopia is particularly vulnerable to a range of risks that undermine its efficiency and resilience. In developing contexts like Ethiopia, persistent structural challenges—including limited local pharmaceutical manufacturing capacity—have resulted in heavy dependence on imports, thereby exposing the system to foreign currency volatility and global supply disruptions (Gobachew & Haasis, 2023). This dependency strains national resources and increases exposure to international shocks. Furthermore, proactive risk management practices remain underdeveloped across much of Africa's manufacturing sector, leaving firms inadequately prepared to respond to SCDs. This lack of preparedness significantly hampers the sector's ability to ensure consistent medicine availability and operational continuity during crises (Mose et al., 2024).

A joint assessment by the Food beverage and pharmaceutical industry development institute (FBPIDI) and Ethiopian Food and Drug Authority (EFDA) confirmed that this concern is especially acute in the Ethiopian context. The firms are heavily dependent on imported raw materials, including APIs, excipients, and packaging components. In addition, these inputs are typically sourced from a narrow set of international suppliers—predominantly India and China—leaving supply chains highly exposed to external shocks. Additionally, Ethiopia's chronic foreign currency shortages, inefficient customs procedures, and regulatory barrier significantly exacerbate disruption risks. The limited domestic capacity for input production, coupled with weak institutional coordination and infrastructural deficits, further undermine supply reliability. As a result, many pharmaceutical manufacturers operate well below their installed capacity, frequently experiencing stockouts, inflated production costs, and delays in delivery performance (FBPIDI and EFDA, 2020).

Moreover, most Ethiopian manufacturers encounter regular disruptions that impair production continuity, raise operational costs, and undermine supply chain efficiency. These effects are further intensified by irregular lead times, customs bottlenecks, poor inter-organizational visibility, and minimal adoption of technological systems. Such conditions severely constrain the capacity of firms to anticipate, coordinate, and respond effectively to disruption events, both upstream and downstream in the supply network (FBPIDI and EFDA, 2020).

The general Supply Chain Risk Management (SCRM) broadly refers to the identification, assessment, and mitigation of a wide range of risks— spanning routine operational, financial, environmental, and strategic domains. In contrast, SCDRM is a specialized subset of SCRM that focuses on low-frequency, high-impact disruptions—such as pandemics, geopolitical shocks, foreign exchange crises, regulatory delays, and critical input shortages—that can severely destabilize supply chain continuity (Ibrahim & Deghedi, 2012; Khojasteh, 2018). Unlike the conventional SCRM, SCDRM targets systemic, often external shocks that extend beyond firm-level control and have cascading effects across entire networks. This distinction is particularly critical in fragile supply chain environments like Ethiopia, where structural weaknesses—import dependency, limited local manufacturing, foreign currency shortages, and regulatory inefficiencies—amplify vulnerability. In such contexts, generic SCRM approaches fall short, necessitating tailored SCDRM frameworks that address macro-level risks. However, the extent to which SCDRM is understood, institutionalized, and practiced within Ethiopia's pharmaceutical sector remains largely unexamined, with little empirical evidence on local implementation, challenges, and alignment with global practice.

This study therefore responds to that gap by explicitly focusing on disruption risks, rather than generic operational risks, and by evaluating how Ethiopian pharmaceutical manufacturers recognize, prepare for, and respond to these threats.

1.2. Statement of the Problem

Local pharmaceutical manufacturing plays a vital role in ensuring access to essential medicines and public health security (Tirivangani et al., 2021; Marew et al, 2022).

In recent years, particularly post COVID 19, amidst increasing demand for medicines, enhancing PSC at local level has become a national security issue. Demonstrated by GSC disruptions, there is therefore a pressing need for building local capabilities to meet local needs for essential medicines. The local pharmaceutical manufacturers in Ethiopia, though few in number and working below capacity, have the capability to produce significant amount (80%) of the priority medicines identified by the Ministry of health. This would be a substantial contribution in the supply of essential medicines for addressing key public health priorities (FBPIDI & EFDA, 2020).

In Ethiopia, despite growing policy efforts to support local pharmaceutical manufacturing, the sector continues to face persistent supply disruptions, largely due to external shocks, foreign currency limitations, regulatory and infrastructural bottlenecks (FBPIDI & EFDA, 2020; Fentahun, 2022). The COVID-19 pandemic revealed that most companies around the world were not prepared to effectively respond to disruptions in their SCs (Abdallah et al, 2024). These disruptions have direct implications for medicine availability, production continuity, and patient outcomes.

Empirical evidence shows that most manufacturing firms lack formalized and institutionalized SCDRM frameworks. Risk identification, assessment, and mitigation efforts are often reactive, fragmented, and inadequately supported by data-driven systems or contingency protocols (Neguse, 2019; Brobbey, 2024). Many firms continue to adopt confined firm-specific risk mitigation strategies. These efforts are rarely integrated into holistic SCRM systems (Baz & Ruel, 2021).

In Ethiopia, there is a critical knowledge gap regarding how pharmaceutical firms perceive, institutionalize, and manage disruption risks. Without such evidence, it is difficult to design targeted interventions to strengthen resilience and ensure sustainable pharmaceutical production in Ethiopia.

One relevant SCRM study in the Ethiopian pharma manufacturing sector, the case study by **Sime (2019)** offers limited insights, as it focused on general SCRM elements in a small number of firms without specific emphasis on disruption risk management. The study concluded that the SCRM practices of the examined firms were inefficient and recommended adopting contingency planning to manage demand fluctuations, developing formal SCRM procedure manuals, and implementing proactive strategies to mitigate SCDs. Specific measures proposed include maintaining buffer inventories, addressing foreign currency shortages through supplier credit or export activities, collaborating with customs to reduce clearance delays, leveraging collective procurement through government agencies to lower input costs, and exploring local sourcing for domestically available inputs. More importantly, the study emphasized the need for broader research using contextualized variables and involving all pharmaceutical manufacturers to provide a comprehensive solution for the sector.

This study builds upon the limited existing literature by specifically addressing the knowledge gap in SCDRM. It assesses awareness, strategic approach, and institutional integration of disruption risk management practices across all pharmaceutical manufacturers in Ethiopia.

1.3. Research Objectives

1.3.1. General Objective

The general objective of the study is to assess the SCDRM practice among pharmaceutical manufacturers in Ethiopia.

1.3.2. Specific Objectives

The specific objectives of the study are:

1. To identify the major sources of supply chain disruption risks (SCDRs) encountered by Ethiopian pharmaceutical manufacturers.
2. To assess the adoption of SCDRM strategies by these firms.
3. To examine the perceived effectiveness of these SCDRM strategies.
4. To identify the challenges affecting the implementation of SCDRM strategies.

1.4. Research Questions

The study was initiated to seek answers to the following questions:

1.4.1. General Research Question

What is the current state of SCDRM practice among pharmaceutical manufacturers in Ethiopia?

1.4.2. Specific Research Questions

1. What are the key sources of SCDRs encountered by pharmaceutical manufacturers in Ethiopia?
2. What SCDRM strategies have been adopted by these firms to manage disruption risks?
3. How do pharmaceutical manufacturers in Ethiopia perceive the effectiveness of their SCDRM strategies?
4. What challenges hinder the effective implementation of SCDRM strategies among these manufacturers?

1.5. Scope of the Study

This study is ***geographically*** confined to large-scale pharmaceutical manufacturers licensed in Ethiopia. It does not cover firms outside the country or those engaged solely in import or distribution. ***Thematically,*** the research focuses on the assessment of SCDR exposures, the strategies employed for risk identification and mitigation, the perceived effectiveness of these strategies, and the challenges associated with implementing formalized SCDRM practices. The study does not aim to examine causal relationships or statistical correlations between SCDRM maturity and supply chain or operational performance outcomes. In terms of ***sectoral scope,*** the study is limited to firms engaged in the manufacturing of human medicines, excluding those involved in the production of medical devices, as well as importers, wholesalers, distributors, and retailers. Small-scale manufacturers are also excluded from this assessment.

This focused delimitation enables a rigorous, in-depth analysis of SCDRM practice within the core pharmaceutical manufacturing segment, which plays a strategic role in Ethiopia's health sector and is uniquely vulnerable to GSC shocks.

1.6. Significance of the Study

This study contributes significantly to both academic literature and policy practice. For researchers, it offers one of the few empirically grounded assessments of SCDRM maturity within the Ethiopian pharmaceutical manufacturing context, addressing a recognized gap in both African and global supply chain risk scholarship. For practitioners and firms, it provides a diagnostic overview of their current capabilities, strengths, and weaknesses in disruption preparedness and response. For policymakers and regulatory bodies, the findings highlight institutional bottlenecks and inform targeted interventions for enhancing pharmaceutical resilience.

A key distinction of this study lies in its focus on **disruption-specific risks**—such as foreign currency shortages, API import delays, and global supply shocks—rather than routine operational risks.

1.7. Definition of Terms

- **Supply Chain Disruption (SCD)** refers to any unplanned, unforeseen event that significantly interrupts the normal flow of goods, materials, or information across the supply chain, adversely impacting one or more entities involved in the production, distribution, or sales of goods and services. It involves both a triggering event—such as a natural disaster, geopolitical shock, or operational failure—and its consequential effects, which may jeopardize material flow and disrupt business continuity (Schmitt & Singh, 2011; Szuster & Lotko, 2022; Kaloyanova, 2024; Abdallah et al., 2024).

- **Supply chain disruption risks (SCDRs)** refer to unexpected events or conditions that interrupt the normal flow of goods, services, or information across supply chain nodes, with potential consequences including production delays, financial loss, reputational harm (Tang, 2006b; Ho et al., 2015; Revilla & Saenz, 2017; Szuster & Lotko, 2022). Disruption risks involve low-probability but high-impact unexpected events that can cause a breakdown in supply chain operations, including natural disasters, pandemics, political unrest, cyberattacks, and trade restrictions. In most cases, *disruption risks* have far greater impacts on businesses than operational risks (Sodhi & Tang, 2012; Wagner & Bode, 2008a; Szuster & Lotko, 2022; Nazemi & Parragh, 2022).

- **Supply Chain Disruption Risk Management (SCDRM):** The process of systematically identifying, analyzing, and dealing with disruption risks in supply chains through coordination or collaboration among the supply chain agents. SCDRM thus focuses on minimizing the probability and/or impact of risks, with the ultimate goal of maintaining supply chain continuity (Ibrahim & Deghedi, 2012).

- **Perceived Effectiveness (PE)s:** The extent to which an individual believes that the use of a system or practice will enhance their job performance. It reflects the user's belief in a positive relationship between using a strategy and achieving desirable outcomes. The effectiveness is measured by the perceived experience. It's about how someone feels about the *potential effectiveness* of something, rather than *the actual results* or measurable outcomes (Xie et al, 2017). In this study's context, *perceived effectiveness* refers to the subjective assessment of how well a firm believes its risk management strategies are performing.

1.9. Organization of the Paper

This thesis is organized into **five chapters:**

- **Chapter One: Introduction** – This chapter outlines the background and context of the study, states the research problem, formulates the objectives and research questions, and defines the scope, limitations, and significance of the study. Key terms are also defined to establish conceptual clarity.
- **Chapter Two: Review of Related Literature** – This chapter critically examines existing theoretical frameworks, relevant global and regional literature on SCDRs and risk management practice. It also highlights gaps in the literature that justify the present research.
- **Chapter Three: Research Methodology** – This chapter describes the methodological approach employed in the study. It covers the research design, study population, data sources, sampling techniques, data collection instruments, data analysis procedures, and ethical considerations. It also includes methodological enhancements such as qualitative triangulation, and assessment of PE.

- **Chapter Four: Results and Discussion** – This chapter presents and discusses the empirical findings of the study, drawn from both quantitative survey responses and qualitative key informant interviews. It includes analysis of disruption risks, strategy adoption patterns, perceived effectiveness of risk management strategies, implementation challenges.
- **Chapter Five: Summary of Key Findings, Conclusions, and Recommendations** – This chapter presents the key findings in light of the research questions, theoretical foundations, and existing literature. It presents overarching conclusions, and provides actionable recommendations for manufacturers, policymakers, and development partners. It also suggests directions for future research and offers final reflections.

CHAPTER TWO:

REVIEW OF RELATED LITERATURE

2.1. Introduction

A global PSC is typically structured as a network comprising multiple part suppliers across diverse geographical regions, alongside various production facilities and distribution centers, which collectively convert inputs into finished products and deliver them to end-users (Sawik, 2018). In the generic pharmaceutical industry, the SC encompasses a series of interconnected stages that ensure the transformation of raw materials into finished medicinal products and their delivery to end-users. It typically begins with the procurement of inputs, including APIs and excipients (inactive materials), which are essential for drug formulation (Moosivand et al., 2019).

This chapter thus presents a comprehensive review of the literature relevant to the assessment of SCDRM practices in the pharmaceutical manufacturing sector, with a particular focus on Ethiopia. The purpose of this chapter is to establish a solid theoretical and empirical foundation for the study by critically analyzing scholarly contributions, global frameworks, and sector-specific challenges related to SCDRs and management strategies. The chapter also identifies key knowledge gaps, contextual constraints. In line with the study's research questions, the literature is reviewed ***thematically*** across five ***core constructs***. It begins with a discussion of theoretical and conceptual foundations, including SCRM theory, resource dependence theory (RDT), and Risk management maturity models (RMMs). It then explores the sources of **disruption risks**, followed by a detailed review of **SCDRM practices**—both proactive and reactive. Subsequent sections examine the **perceived effectiveness** of these strategies, identify the **challenges** to their implementation.

2.2. Theoretical Foundations

A theoretical review involves examining the body of accumulated theory relevant to a particular issue, concept, or phenomenon. It helps identify what theoretical frameworks exist, the relationships between them, and the extent to which they explain the phenomenon under investigation. Such reviews also reveal gaps in existing theory or the inadequacy of prevailing models in addressing new or emerging problems (Saunders, Lewis, & Thornhill, 2023).

2.2.1. SCRM Theory

As defined by the Association for Supply Chain Management (ASCM) Supply Chain Dictionary, SCRM is the systematic **identification**, **assessment**, and **mitigation** of potential supply chain disruptions with the objective of reducing their negative impacts on the supply chain's performance (ASCM, n.d.). Overall, risk management in SCs involves ongoing assessment and strategic planning to manage SC networks in order to reduce vulnerabilities and enhance resilience. While some risks are common across SCs, others are specific to particular sectors. The overall strength of a SC depends on its weakest link, with longer chains typically facing higher risks of failure (Gurtu & Johny, 2021).

A foundational contribution in the emergence of SCRM theory was offered by Kleindorfer and Saad (2005), who distinguished between disruption risks (caused by external events such as natural disasters, pandemics, or geopolitical instability) and operational risks (arising from internal issues such as demand variability, process failures). They discussed three main tasks that need to be practiced continuously and concurrently as the foundation of disruption risk management. The three tasks are: specifying sources of risk and vulnerabilities, assessment, and mitigation. This also aligns with the definition provided by ASCM.

SCRM theory is particularly relevant to the Ethiopian pharmaceutical sector, which is characterized by high levels of supply risk due to import dependency, logistical challenges, and foreign currency constraints. These systemic vulnerabilities necessitate the adoption of formalized and well-structured SCDRM practices—especially following global shocks such as COVID-19.

2.2.2. Resource Dependence Theory

Resource Dependence Theory (RDT) explains how SCDs intensify organizational reliance on external partners for critical resources, creating power asymmetries and coordination challenges. Limited resource access, shifting demand, and regulatory constraints disrupted traditional relationships, often shifting power to suppliers and intermediaries. These dynamics hindered firms' ability to adapt through localization, agility, and digitalization, emphasizing the importance of managing external dependencies to maintain resilience during crises (Khuan et al, 2023).

RDT posits that organizations are interdependent and offers a theoretical lens to explain how organizations must manage external dependencies to secure essential resources, and environmental uncertainties to ensure survival and performance. In SCs, this translates to strategies like diversifying suppliers and fostering collaborative relationships to mitigate risks associated with resource scarcity. The theory is grounded on the premise that organizations are not self-sufficient but are instead embedded in networks of interdependencies, relying on external entities for vital resources such as raw materials, components, knowledge, and financial capital. This dependency inherently generates vulnerabilities that firms must actively manage to minimize power asymmetries, mitigate supply risks, and secure operational continuity (Hillman et al, 2009).

The relevance of RDT to SCDRM practice in the Ethiopian pharmaceutical manufacturing sector is particularly significant. These firms operate in a developing economy marked by high dependence on imported APIs, excipients, packaging materials, and machinery. This external dependency is further exacerbated by macroeconomic constraints such as foreign currency shortages, logistical inefficiencies, regulatory volatility, and geopolitical risks. Within this environment, pharmaceutical manufacturers face elevated exposure to supply disruptions. RDT posits that such high levels of dependency force organizations to develop strategic responses aimed at reducing their exposure to uncertain and powerful external actors. As such, firms may engage in strategies—such as maintaining safety stock, diversifying suppliers, or localizing input sources (Hillman et al., 2009; Kalaitzi, 2016).

Empirical studies reinforce the applicability of RDT in explaining firms' responses to SC vulnerabilities. Kalaitzi (2016), for instance, developed an RDT-based framework to examine how manufacturing companies respond to natural resource scarcity. Her findings confirmed that contingent factors such as supplier substitutability, resource criticality, and regulatory discretion significantly influence firms' adoption of buffering and bridging strategies to mitigate risk and enhance performance. Likewise, Kim et al (2020) applied RDT to examine logistics integration strategies in Korean manufacturing firms, demonstrating that inter-organizational trust and commitment enhance overall SC performance.

In Ethiopia, where pharmaceutical manufacturers operate under constrained institutional support, limited technological infrastructure, and underdeveloped supplier networks, the predictive capacity of RDT becomes even more salient.

2.2.3. Risk Management Maturity Models in Supply Chains

Risk management maturity models (RMMs) offer structured frameworks to assess and improve how organizations handle risks across their SCs (Correia et al., 2017; Dellana et al., 2022). Fundamentally, RMMs define progressive stages through which a firm evolves in its risk management capabilities—from informal, reactive responses to strategic, proactive, and integrated systems. Guerra et al. (2024) emphasize that such models help SCs overcome ad hoc practices and build systematic, replicable risk governance processes, which are critical in today's increasingly complex and vulnerable global networks.

Dellana et al. (2022) developed a validated SCRM Maturity Model that operationalizes maturity along three interdependent dimensions: risk management orientation, enterprise risk integration, and risk collaboration. Their scale-based model enables classification of organizations as leaders, followers, or laggards in terms of maturity. Feitosa et al. (2021) extend this by integrating multi-criteria decision-making methods to improve objectivity and sensitivity in maturity classification. Their prescriptive model bridges theory and practice, offering diagnostic value for performance enhancement. Similarly, Oliva (2016) proposes a maturity assessment framework derived from empirical data and grounded in enterprise risk and institutional economics theories, emphasizing that maturity reflects not only technical implementation but also strategic alignment and internal cultural readiness.

Critically, despite the diversity of models, the literature reflects convergence around core attributes of maturity: structured risk assessment, formal governance structures, integration into enterprise strategy, inter-organizational collaboration, and continuous improvement mechanisms (Hansali et al., 2022; Scopel et al., 2023). However, gaps persist, especially in sector-specific adaptation and cross-organizational applications. Guerra et al. (2024) highlight that many models fail to incorporate the dynamics of real SC relationships, which are essential for understanding how maturity manifests in practice.

This theory aligns with core insights from the literature (e.g., Dellana et al., 2022; Oliva, 2016; Guerra et al., 2024) that SCDRM practice is not merely about tool adoption or documentation, but about strategic alignment, inter-organizational integration, and continuous learning mechanisms. It also reflects the diagnostic utility of maturity models in descriptive research, which maps the current practices and challenges without aiming to establish causality.

2.3. Empirical Studies on Supply Chain Disruption Risks

2.3.1. Classification of Supply Chain Disruption Risks

The classification of SCDRs is a critical foundation for effective risk identification, prioritization, and the design of targeted mitigation strategies. In both academic literature and practical applications, these risks are commonly categorized by their **source** (i.e., whether they originate within or outside the firm or supply chain).

SCDRs may arise from factors **internal to the firm** (e.g., operational failures, inaccurate forecasting), **external to the firm** but **within the supply network** (e.g., unreliable suppliers, transport breakdowns), or external to both **the firm** & **the supply network** (e.g., pandemics, regulatory constraints, geopolitical shocks) (Jüttner et al., 2003; Chopra & Sodhi, 2004; Chopra & Sodhi, 2014; Kamalahmadi & Parast, 2016; Ivanov, 2021; Rinaldi et al., 2022; Duay, 2023; Mulla, 2024). These risk categories serve as the analytical basis for evaluating SCDRs in this thesis.

This classification is also expanded to upstream, midstream, and downstream sources of risk, corresponding respectively to supplier-related risks (e.g., unreliable sourcing), in-facility production risks (e.g., workforce shortages), and distribution-related risks (e.g., customs delays or last-mile delivery failures) (Guerra et al., 2024). In fragile contexts such as Ethiopia, additional external risks include macroeconomic instability and dependency on imported raw materials, which amplify the vulnerability of local pharmaceutical firms (UNCTAD, 2022).

2.3.2. Disruption Risks in Pharmaceutical Supply Chains

The PSC is uniquely complex, with critical implications for public health outcomes. Its intricate stems from the need to efficiently and collaboratively meet patient and healthcare system demands through a network of interdependent stakeholders. Unlike other SCs, PSCs carry heightened significance due to their direct impact on human life. This importance is shaped by distinctive features such as urgency of delivery, strict regulatory requirements, and the sensitive nature of storage and distribution. Consequently, pharmaceutical supply chain management (SCM) must ensure the continuous, safe, affordable, and high-quality flow of medicines. Achieving this requires every actor in the network to contribute effectively to maintain reliability and system-wide efficiency.

However, the sector faces persistent challenges, including inadequate demand forecasting, poor warehouse and storage practices, and over-reliance on human resource). Regulatory compliance is essential across all supply chain stages—from raw material sourcing to distribution and marketing—to guarantee medication safety, efficacy, and quality. These regulatory demands further necessitate robust information-sharing mechanisms and coordinated action to meet end-user needs effectively (Abdallah et al, 2024).

In the context of pharmaceutical manufacturing, critical **disruption sources** include shortages of APIs, quality inspection failures, port congestion, pandemic lockdowns, and foreign exchange shortages (UNIDO, 2021; Khuan et al., 2023). Such disruptions directly affect production continuity and public health delivery, emphasizing the need for effective SCDRM capabilities in the pharmaceutical sector.

The literature highlights that demand **forecasting failures** often arise from limited visibility into consumption trends and poor-quality health system data (Sodhi & Tang, 2012). **Supplier unreliability**—manifested through delivery delays and quality lapses—became especially pronounced during the COVID-19 pandemic (Khuan et al., 2023).

In the Ethiopian context, transport disruptions are exacerbated by the country's landlocked geography, underdeveloped infrastructure, and bureaucratic customs procedures (UNIDO, 2022). **Forex shortages** significantly hinder manufacturers' ability to procure essential imports such as APIs and production equipment, with currency volatility emerging as a persistent constraint. In addition, both pandemic and conflict-related disruptions are increasingly viewed as systemic risks that necessitate continuous scenario analysis and long-term resilience strategies (Tang & Musa, 2011). In this study, SCDRs refer to unplanned, unexpected events or conditions that interrupt the normal flow of materials particularly in the pharmaceutical manufacturing sector. The study uses a survey-based descriptive approach to measure: respondents' awareness and experience with different types of disruptions; the frequency and perceived severity of each disruption type. Respondents are asked to rate how frequently each type of disruption and how severely it affected operations (Likert scale). Categorization follows Duay (2023) and Rinaldi et al. (2022).

2.3.3. Regional Risks: Focus on Sub-Saharan Africa and Ethiopia

The empirical literature on SCDRs and their management strategies has grown significantly in recent years, driven by increasing supply chain complexity, globalization, and the intensifying frequency of external shocks. Firms across both developed and developing economies face mounting vulnerabilities due to outsourcing, regulatory hurdles, lean operations, and interdependence within global supply networks (Zhao et al., 2013; Ajalie et al., 2024). This is particularly critical in the pharmaceutical sector, where SCDs can directly impact public health outcomes due to the essential nature of the products involved (Kulkarni, 2025; Sivalingam & Hussin, 2024). In low- and middle-income countries (LMICs) such as Ethiopia, these vulnerabilities are exacerbated by structural constraints, including foreign exchange shortages, heavy reliance on imports, logistical bottlenecks, and underdeveloped risk management capacity (WHO, 2021; UNIDO, 2023).

PSCs in Sub-Saharan Africa (SSA) are acutely vulnerable to a range of systemic and structural risks, which often compound existing global supply chain disruptions. Among the most critical challenges are infrastructural inadequacies, fragmented regulatory frameworks, and a deep dependence on imported inputs and finished pharmaceutical products (Schöpperle, 2013; Bwire et al., 2022). Furthermore, the absence of harmonized procurement and regulatory processes has weakened cross-border coordination and delayed emergency responses to health crises such as COVID-19, Ebola, and routine disease burdens (Guyassa et al., 2024; Bwire et al., 2022).

In Ethiopia, these regional risks are further intensified by localized macroeconomic and operational constraints. A prominent issue is the country's persistent foreign exchange (forex) shortage, which severely limits the ability of local pharmaceutical manufacturers to access APIs, raw materials, and essential technologies (African Development Bank, 2024; Tegegne, 2022). Ethiopia’s PSC is also constrained by a weak industrial base, with limited backward integration and domestic production capacity, making the sector highly dependent on imports (Bilal, Bititci, & Fenta, 2024). Regulatory and customs inefficiencies, particularly delays at entry points and unpredictable procedural changes, introduce additional bottlenecks (Tegegne, 2022; Eshetu, 2020). Forecasting and demand planning challenges further exacerbate supply instability in the Ethiopian context.

A broader study on the Ethiopian public PSC similarly revealed challenges including finance-related constraints, workforce shortages, and data quality issues as the key hindrances to pharmaceutical forecasting (Bilal et al, 2024). In addition, a case study of **Zaf Pharmaceuticals** revealed that there were no documented suppliers selection criteria. Foreign supplier product market authorization processes, fluctuation of currency exchange rate, and waiting for Ethiopian shipping vessels were mentioned as the leading challenges affecting the GSC management practice of the company intensively (Liknaw & Shimels, 2020). These systemic weaknesses render the SC reactive rather than resilient, particularly in crisis situations such as pandemics or geopolitical shocks that affect trade routes or shipping costs (Straube et al., 2023; UNCTAD, 2022).

Local pharmaceutical manufacturing is a priority sector in Ethiopia's industrialization agenda, and the government has demonstrated this commitment through substantial investments, including the establishment of the Kilinto Pharmaceutical Industrial Park. However, the sector is characterized by challenges such as limited access to foreign currency and appropriate technology, management inefficiencies, erratic supply of input materials, low-capacity utilization, financial constraints, shortage of qualified experts, infrastructural bottlenecks, and weak R&D (Marew et al, 2022). Additionally, resource constraints, regulatory complexities, inadequate collaboration across government tiers, policy inconsistencies & inadequate implementation, and weak sector harmonization exacerbate the systemic risk, limiting market access and disrupting the GSC for local manufacturers (Waktole & Negera, 2024).

The study by **Neguse Sime (2019)** offers useful insight into the SCRM practices and challenges faced by pharmaceutical manufacturers in Ethiopia, making it a critical reference point for the present research. Conducted across three Good manufacturing practice (GMP)-certified pharmaceutical manufacturing firms, the study classified SCRM risks into four major categories: **internal risks** (including poor planning, capacity gaps, and process inefficiencies), **external risks** (such as political instability and customs-related delays), demand risks, and supply risks. Among the most significant disruption factors identified were raw material quality variations, foreign exchange limitations, and the short shelf-life of products, all of which are also pertinent to the importation and management of APIs. This classification strengthens the thematic foundation of the current study by confirming that Ethiopian PSCs are exposed to multi-dimensional disruption risks, with many challenges rooted in external operating conditions.

2.4. SCDRM Strategies and Implementation Practices

SCDRM is a structured process of identifying, assessing, mitigating, and monitoring risks to maintain operational continuity. Empirical studies generally categorize SCDRM strategies into proactive, reactive, and passive acceptance approaches (Paul et al., 2015; Hosseini et al., 2019; Jean, 2024). Given the vulnerabilities of modern supply chains, SCDRM has emerged as a strategic imperative for manufacturers. Disruptions are no longer isolated incidents but systemic threats that can jeopardize continuity, financial stability, and market credibility. Without risk identification, scenario planning, and proactive resilience-building strategies, firms struggle to recover from even modest shocks. The interdependencies within modern supply networks mean that any failure can propagate across the chain, causing cascading delays and economic losses. As such, SCDRM must be embedded not only as an operational function but as a core strategic capability that ensures agility, responsiveness, and long-term competitiveness in an increasingly uncertain global manufacturing landscape (Tang & Musa, 2011).

The COVID-19 pandemic marked a pivotal turning point in how SCDRs are perceived and managed, revealing deep vulnerabilities that had been long overlooked despite decades of globalization and interconnected trade. Historically marginalized in both practice and scholarship, disruption risk management gained renewed urgency as the pandemic exposed the fragility of GSCs (Szuster & Lotko, 2022). The pandemic lockdowns heavily disrupted the operations of GSCs, causing unprecedented impact (Khuan et al, 2023; Nel, 2024). This shock, compounded by subsequent geopolitical crises such as the Ukraine-Russia war, catalyzed a shift toward more resilient and adaptive supply chain strategies (Ramsköld, 2024; Passarelli et al., 2023). Post-COVID-19 discourse has increasingly emphasized the necessity of proactive, data-driven disruption management approaches, including diversification, localization, and digital integration (Moosavi et al., 2022).

Literature emphasizes that effectively responding to SCDs requires firms to implement robust mitigation strategies tailored to manage risk and uncertainty. Effective SCDRM strategies involve a dynamic and integrated approach to risk identification, assessment, and mitigation. At the core of resilient PSCs are practices such as systematic risk identification through audits and assessments, the use of risk mapping tools and matrices, and the application of probabilistic assessments to prioritize critical vulnerabilities (Ponis & Koronis, 2012; Abdallah et al., 2024).

Categorizing and ranking risks by potential severity enables proactive planning and focused resource allocation. A key strategy widely endorsed in both global and regional literature is **supplier diversification**—especially relevant in pharmaceutical contexts where firms are often dependent on limited-source suppliers for APIs, typically from China or India. To reduce exposure, resilient manufacturers employ buffer stocks, multi-sourcing, and multi-modal routing to mitigate logistical disruptions. Emergency procurement frameworks and flexible contract terms also contribute to rapid response capabilities during crisis periods (Takawira et al, 2024; Abdallah et al, 2024). **Technological tools** further strengthen these mitigation efforts. The adoption of advanced demand forecasting technologies, including AI-based analytics, has been shown to significantly enhance planning accuracy, prevent stockouts, and reduce overstocking (Dolgui & Ivanov, 2021). However, such technologies remain underutilized in many low- and middle-income countries (LMICs), including Ethiopia, where limited institutional capacity and infrastructure constraints persist. **Collaborative practices** across the supply chain—both vertically (e.g., manufacturer-supplier partnerships) and horizontally (e.g., inter-firm alliances)—are equally important for enhancing resilience (Osei & Asante-Darko, 2023; Khuan et al, 2023; Nel, 2024).

2.4.1. Proactive Strategies for Managing Supply Chain Disruptions

Proactive SCDRM strategies involve taking preventative measures to anticipate and mitigate potential risks before they disrupt operations. They aim to avoid disruptions by proactively identifying vulnerabilities and implementing preventative measures. According to Passarelli et al. (2023), pre-disruption strategies are critical for reducing supply chain vulnerabilities and attenuating the ripple effects of disruptions. Proactive tactics include transportation rerouting options, inventory optimization, and selective outsourcing to prevent overdependence on single nodes. Additionally, Katsaliaki et al. (2022) emphasize two main categories of proactive strategies: redundancy and flexibility. Redundancy refers to the deliberate maintenance of high **safety stocks**, excess production capacity, and **multiple sourcing** arrangements to buffer against unforeseen events. Flexibility involves the deployment of alternative suppliers, adaptive transportation depots, and multimodal delivery systems to maintain operational continuity during disruptions. Furthermore, proactive strategies also entail better demand forecasting and coordinated planning across supply chain echelons.

Contingency planning—such as securing backup suppliers and pre-designating alternative logistics routes—reinforces the organization's ability to respond promptly and effectively. Katsaliaki et al. (2022) note that while firms recognize the importance of information sharing and collaborative planning to enhance visibility, such efforts are often limited in practice.

To address SC failures, literature supports the focus on proactive risk management. Proactiveness refers to being prepared in advance, either by applying existing strategies or developing new approaches to achieve the desired outcome. It is crucial to ensure uninterrupted services during unexpected events. As proactiveness is a critical element in the risk management process, understanding it from both theoretical and practical perspectives is essential (Ganesh and Kalpana, 2023). The success of a supply chain heavily relies on a proactive approach to risk assessment and management (John et al, 2023). Nowadays, organizations are placing greater emphasis on introducing proactiveness to manage sudden disruptive events. The current data-driven era is witnessing a significant rise in the adoption of proactive approaches to enable rapid recovery and support accurate decision-making. Proactive risk management starts with evaluating the possible risks and detecting drivers linked to their root causes (Ganesh & Kalpana, 2023).

2.4.2. Reactive Strategies for Managing Supply Chain Disruptions

Reactive strategies in SCDRM are implemented after a disruption has occurred and are primarily focused on damage control, recovery, and business continuity. These strategies are crucial in minimizing the impact of unanticipated events and restoring operations as efficiently as possible. Passarelli et al. (2023) highlight the importance of post-disruption strategies, including transportation rerouting to bypass affected nodes, dynamic reallocation of inventory to meet fluctuating demand, and leveraging outsourcing to substitute temporarily unavailable internal capabilities. These actions are typically part of a broader post-disruption contingency plan.

Katsaliaki et al. (2022) similarly identify reactive practices such as deploying buffer stock, activating backup suppliers, and shifting production to redundant capacity sites. These measures enable firms to continue fulfilling customer demand and stabilize supply chain functions in the aftermath of disruptions. However, their research also reveals that most firms exhibit a reactive posture due to limited upstream-downstream visibility and a lack of coordination across the supply

chain network. This reactive behavior is often necessitated by the absence of robust pre-disruption planning. While reactive strategies are indispensable in responding to updated disruptions, their effectiveness is significantly enhanced when embedded within a broader risk management framework that includes proactive planning and real-time data visibility.

2.4.3. Empirical Evidence from Pharmaceutical Manufacturing Firms

Multiple empirical studies emphasize the growing importance of resilience-building, characterized by absorptive, adaptive, and restorative capacities (Rinaldi et al., 2022; Xu et al., 2020). As emphasized by Wagner & Bode (2008a) and Ganiyu et al. (2020), the effective management of SCDRs not only mitigates operational threats but also enhances firm performance and resilience. Moreover, enterprises with dedicated SCRM structures tend to outperform competitors, highlighting the importance of developing adequate risk registers and management strategies (Ganiyu et al., 2020). Yet, evidence suggests that firms in resource-constrained settings, including Ethiopia, often default to reactive strategies due to weak infrastructure, limited digitalization, and insufficient institutional support (Sime, 2019). Recent studies have explored the role of digital technologies in enhancing real-time visibility and responsiveness (Soni & Patel, 2024).

In Ethiopia, few pharmaceutical firms have formalized SCRM systems, with existing practices often limited to informal contingency responses. The study by **Neguse Sime (2019)** found that selected Ethiopian pharmaceutical manufacturers, included in the study, widely employed supply chain collaboration and risk avoidance practices. However, the study's regression analysis revealed that collaboration was negatively associated with performance, potentially due to poor alignment or inefficiencies in its practical application. Notably, supply base rationalization and flexibility scored lowest among the SCRM practices, despite being crucial for adapting to disruptions. Furthermore, the study revealed that most companies lacked formal SCRM frameworks or documented procedures, instead treating risk mitigation as an ad hoc component of general operations. This finding supports the current research's objective to assess not just the presence of SCDRM strategies, but their formalization, institutional integration, and strategic alignment with resilience goals.

2.5. Perceived Effectiveness of SCDRM Strategies and Practices

The perceived effectiveness (PE) of SCDRM strategies reflects stakeholder judgments regarding how well such interventions mitigate disruption impacts, ensure operational continuity, and enhance long-term supply chain resilience. Literatures emphasize that PE is closely tied to how well a strategy addresses the frequency, severity, and unpredictability of disruptions. PE reflects the extent to which key actors believe their disruption management strategies are achieving desired outcomes—such as production continuity or reduced supply interruptions (Xie et al., 2017). It is shaped by subjective assessments of practicality, success, and operational value rather than strictly quantitative performance metrics.

Wagner & Bode (2008a) and Ganiyu et al. (2020) highlighted that effective management of SCDRs contributes significantly to mitigating operational threats while simultaneously enhancing organizational and supply chain performance. Firms that establish dedicated SCRM structures and implement robust risk registers and strategies are more likely to outperform their competitors, reinforcing the perceived value of proactive risk management systems (Ganiyu et al., 2020).

Empirical findings suggest that mixed strategies—blending proactive and reactive mechanisms—are generally perceived as more effective (Ganesh & Kalpana, 2023; John et al, 2023). In contexts like Ethiopia, firms' perceptions of effectiveness may influence whether strategies are sustained, adapted, or abandoned. For example, backup suppliers and inventory buffers may be seen as valuable even if they incur higher upfront costs. Case studies reveal that organizations employing comprehensive SCDRM frameworks experience fewer disruptions and recover more swiftly, highlighting the importance of a balanced approach.

Objectively, effectiveness of SCDRM practices is assessed through metrics such as reduction in downtime, cost savings, and improved service levels. But subjective assessment involves capturing insights into the efficacy of implemented strategies. This study adopts a perception-based metric, following the **IndiKit indicator framework** (People in Need, 2025), to assess the perceived effectiveness of identified SCDRM strategies among pharmaceutical firms in Ethiopia.

2.6. Implementation Challenges

Despite the growing recognition of the conceptual and practical significance of SCDRM as a strategic necessity, numerous implementation challenges persist, particularly in LMICs such as Ethiopia. Core challenges include financial constraints, shortages in skilled human capital, and low prioritization by top management. These limitations are further compounded by weak interdepartmental collaboration, poor supplier integration, and technological underdevelopment (Gereffi & Lee, 2012).

In LMICs, the capacity to transition from reactive coping mechanisms to proactive, embedded resilience strategies remains weak. Interlinked constraints at different levels, and significant implementation gaps persist, including resource constraints, institutional fragmentation, lack of technical capacity, weak data systems, and insufficient risk governance mechanisms (Pettit et al., 2010; Kamalahmadi & Parast, 2016). Budgetary limitations and insufficient technical expertise are among the most frequently cited obstacles in implementing SCDRM frameworks. In Ethiopia, the situation is aggravated by systemic challenges such as fragmented organizational structures, lack of proactive leadership engagement, and policy misalignment across regulatory institutions (USAID, 2021). These gaps diminish the internal resilience needed to withstand external shocks. Moreover, forex inaccessibility represents a unique and persistent challenge. The unavailability of foreign exchange delays critical transactions, threatening supply continuity for time-sensitive therapeutics (World Bank, 2022).

In addition to structural and financial constraints, cultural resistance to change, low digital readiness, and a lack of real-time SC visibility remain prevalent challenges. Organizations often treat risk management as a compliance task rather than a strategic imperative, resulting in fragmented and reactive practices. The World Bank (2022) and WHO (2020) emphasize that without adequate investment in digital systems and collaborative leadership, even well-formulated SCDRM strategies are unlikely to yield effective outcomes. WHO and UNIDO have both highlighted that addressing these implementation gaps requires systemic reforms, including capacity-building initiatives, stronger inter-agency coordination, and the integration of digital supply chain solutions (WHO, 2020; UNIDO, 2022). Strengthening institutional capabilities and fostering a culture of preparedness are essential to bridge the gap between strategy and execution in SCDRM within Ethiopia’s pharmaceutical sector.

Sime (2019), in a study of three Ethiopian pharmaceutical firms, found that risk management was largely reactive and lacked structured protocols. The absence of formal SCDRM frameworks and contingency plans was attributed to limited awareness, inadequate training, and regulatory gaps. International literature corroborates these findings, pointing to similar constraints in other LMICs (Ganiyu et al., 2020; Moosivand et al., 2019).

2.6.1. Organizational Constraints

Organizational readiness is a fundamental determinant of effective SCDRM implementation. However, many firms in LMICs operate under severe resource constraints, lacking both the financial capital and human resource capacity required to adopt robust risk management frameworks.

According to Aman-Ullah et al. (2022), human capital—comprising knowledge, skills, and competencies—exerts a direct and positive influence on organizational performance, yet firms in LMICs often underinvest in skill development and leadership capacity. Similarly, Hidayat and Widodo (2022) emphasize that sustained investment in human capital is essential for long-term competitiveness, yet such investments are typically deprioritized in resource-constrained settings. Furthermore, Marlina et al. (2022) highlight that adaptive and innovative capabilities are central to dynamic resilience, but are often underdeveloped among firms in developing contexts. This deficiency not only weakens strategic agility but also undermines the integration of digital tools necessary for risk visibility and scenario planning. Adebayo et al. (2024) further affirm that continuous upskilling—particularly in digital and analytical competencies—is critical for aligning supply chain operations with evolving disruption scenarios, but this imperative is often neglected due to competing priorities.

Compounding these capacity deficits is ineffective change management. Bateh (2024) and Kanyepe et al. (2025) show that organizational inertia—manifested through resistance to new technologies, poor communication, and weak leadership—often obstructs the internalization of SCDRM principles. In such settings, risk management is seen as a compliance requirement rather than a strategic imperative.

Hajarath & Vummadi, 2024 further elaborated that deficiencies in change management—such as lack of training, unclear roles, and absence of a culture of continuous improvement—impede the internal adoption of SCDRM strategies. This limits the organization's ability to transition from reactive to proactive disruption management approaches and hinders strategic transformation.

2.6.2. External and Regulatory Constraints

LMICs also face considerable external impediments to SCDRM. Weak regulatory frameworks, volatile macroeconomic conditions, and limited access to foreign exchange create barriers to resilience-building investments.

Lopes et al. (2022) observe that firms in less-developed countries tend to suffer disproportionate impacts during crises due to high import dependency and fragmented supply networks. The inability to source materials, adapt procurement systems, or coordinate with cross-border partners in times of disruption severely limits supply chain agility. In Zimbabwe, for instance, Kanyepe et al. (2025) identify regulatory uncertainty, poor logistics infrastructure, and unstable financing environments as key inhibitors of SCDRM among manufacturing SMEs. These findings resonate with Shahzad and Irfan (2024), who demonstrate that traditional financing systems in LMICs rarely support resilience investments, as collateral requirements and high costs of capital deter firms from investing in safety stocks, multi-sourcing arrangements, or technology upgrades. The lack of policy coherence—especially across customs, import/export regulations, and local compliance mechanisms—further disincentivizes long-term risk planning (Zhai et al., 2025).

2.6.3. Institutional Capacity and Cultural Resistance

The final tier of constraints relates to institutional capacity and cultural dynamics. Guo et al. (2025) emphasize that the resilience of supply chains is not merely a function of strategic tools but also of the institutions that govern and support their implementation. In LMICs, fragmented governance structures and siloed operations across agencies weaken the feedback loops necessary for coordinated risk response.

Lopes et al. (2022) note that in countries like Guinea-Bissau, the absence of formalized and diversified supply chain institutions exacerbates vulnerability and hinders adaptive learning.

Furthermore, resistance to change—rooted in traditional hierarchical cultures, mistrust, and rigid decision-making structures—undermines collaborative risk management. As shown by Marlina et al. (2022), digital competence and innovative capability are key enablers of resilience but require deliberate institutionalization through training, role redefinition, and cross-functional integration. When these enablers are absent or underutilized, even well-designed SCDRM frameworks fail to gain traction at the operational level.

2.6.4. Insights from Ethiopian Firms and Institutions

Ethiopian pharmaceutical firms face unique challenges, including dependency on imports and regulatory bottlenecks, which exacerbate supply chain vulnerabilities.

The thesis by **Fantahun Tegegne (2022)** provides critical insights into the external challenges confronting private pharmaceutical importers—challenges that are highly relevant for understanding SCDRM implementation gaps among local pharmaceutical manufacturers in Ethiopia. Several of the challenges highlighted in that study—such as foreign exchange shortages, regulatory inefficiencies, customs delays, and supplier-related instabilities—are not only systemic but also shared by local manufacturers, as they are dependent on API imports for production.

Firstly, Fantahun identifies **foreign exchange shortages** as a major disruption factor. This risk directly affects local pharmaceutical manufacturers too, as API procurement is import-dependent and requires substantial foreign currency. When 83% of Fantahun's respondents confirmed that forex shortages disrupted their relationships with international suppliers, it underscores how fragile the import environment is—making forex scarcity a common SCDRM implementation barrier for both importers and manufacturers. Evaluating how manufacturers manage or mitigate this risk becomes essential for this current study's objective to identify implementation challenges and effectiveness gaps.

Secondly, customs delays, regulatory bottlenecks, and supplier reliability issues, all mentioned in Fantahun's findings, are equally relevant for the manufacturing sector. Local manufacturers importing APIs and excipients must navigate the same EFDA regulatory system, the same customs procedures at ports, and the same forex regime.

Therefore, this current research is justified in examining whether the challenges faced by importers mirror or differ in practice for manufacturers—and how well manufacturers have implemented SCDRM strategies to address them. Since both actors operate in the same market environment but with different supply chain configurations (finished product vs. raw material import), a comparative understanding could help identify sector-wide policy gaps and firm-level preparedness disparities. Fantahun's study, while focused on importers, thus offers a critical reference point that supports the relevance, timeliness, and necessity of your investigation into SCDRM implementation gaps among local manufacturers.

More particularly, the thesis study by **Neguse Sime (2019)** provides valuable insights into SCRM practices and challenges among pharmaceutical manufacturers in Ethiopia, making it a critical reference for the present study. Crucially, **Neguse** identified several implementation challenges that mirror those outlined in Fantahun's work—particularly foreign exchange scarcity, regulatory and customs inefficiencies, and limited risk management capacity. These systemic barriers, compounded by shortages of skilled personnel and insufficient risk visibility across SC tiers, justify the present study's focus on implementation gaps in SCDRM among pharmaceutical manufacturers. Furthermore, Neguse recommended that firms should adopt documented SCRM frameworks, enhance flexibility, and build internal capacity for proactive risk identification and planning. However, his study was limited in scope—covering only three firms, lacking international alignment test, and excluding API-specific disruption dynamics—highlighting a research gap that this current thesis seeks to fill.

2.7. Research Gaps

The literature review reveals a critical set of gaps in both empirical knowledge and practical application within the Ethiopian pharmaceutical manufacturing context—particularly regarding the management of disruption-specific risks. Existing studies in Ethiopia and similar developing economies tend to adopt a generic SCRM perspective, primarily focused on routine operational risks. This thesis distinguishes itself by specifically targeting SCDRM—a focused subdomain of SCRM that deals with low-frequency, high-severity events.

These disruptions are especially relevant in the Ethiopian pharmaceutical sector, which is heavily dependent on imports and operates under chronic institutional and infrastructural constraints.
The following research gaps have been identified:

1) **Limited empirical studies** on the sources, frequency, and impact of systemic SCDs in Ethiopia's pharmaceutical manufacturing sector.
2) **Scarce analysis** of how local firms identify, assess, and mitigate disruption risks.
3) **Neglect of perceived effectiveness** as a critical evaluative lens, despite its central role in determining the institutionalization and continuity of risk management practices.

By addressing these multidimensional gaps, this study offers a context-sensitive, theoretically informed, and empirically grounded assessment of SCDRM practices in Ethiopia's pharmaceutical manufacturing sector.

CHAPTER THREE:

RESEARCH METHODOLOGY

3.1. Introduction

This chapter presents the research methodology adopted for assessing the SCDRM practices among pharmaceutical manufacturing firms in Ethiopia. Given the critical role of supply chain resilience in ensuring pharmaceutical availability, especially in the wake of global shocks such as the COVID-19 pandemic, a methodologically sound approach is necessary to examine how firms perceive, implement, and evaluate SCDRM strategies. This chapter outlines the study setting, population, research approach, design, sampling techniques, data sources, data collection and analysis methods, and ethical considerations. The methodology is structured to ensure empirical validity and contextual relevance through a mixed-methods design that integrates a quantitative census survey and qualitative multiple interviews. These complementary approaches facilitate both breadth and depth in understanding disruption risks, mitigation practices, perceived effectiveness, and implementation challenges within Ethiopia's pharmaceutical manufacturing landscape. Finally, the chapter presents the mechanisms employed to enhance the descriptive methodology.

3.2. Study Setting and Population

3.2.1. Study Setting

The study was conducted within the Ethiopian pharmaceutical manufacturing sector, specifically targeting firms licensed by the EFDA to manufacture human medicines. Ethiopia's pharmaceutical industry is strategically positioned as a priority sector under the country's health and industrial development agendas, yet it remains heavily reliant on imported inputs and vulnerable to GSC disruptions. This makes the sector an appropriate context for examining SCDRM practices. The setting is characterized by a small number of active manufacturers—twelve in total as of April 2025—operating under diverse ownership structures, product portfolios, and geographic locations within and in the vicinity of Addis Ababa. These firms include fully local enterprises, joint ventures, and foreign direct investment (FDI) firms. Their operational contexts range from decades-old legacy firms to recent entrants with modern supply infrastructures.

3.2.2. Firm-Level Study Population

The study population included all twelve human medicine manufacturers licensed by the EFDA and operate in Ethiopia (data, as of April 2025). To ensure methodological rigor, contextual relevance, and the reliability of collected data, firm-level inclusion and exclusion criteria were applied. These criteria required that firms possess sufficient operational history (>5 years), maintain active status, demonstrate exposure to external risks, and express a willingness to participate in the study.

Of the twelve EFDA-licensed manufacturers, **ten** met the eligibility requirements and formed the final study population. One manufacturer, **Africure,** is excluded due to its non-operational status at the time of data collection. Another, **Glocare Pharma,** failed the inclusion criteria, having less than 5 years of operational history. **Table 3.1** below provides a detailed profile of these firms, categorized by year of establishment, location, and ownership structure.

Table 3.1. Profiles of Human Medicine Manufacturers in Ethiopia **(see a three-point note below the table)**

S.No.	Manufacturer's Name	Location	Year of Establishment	Ownership Structure
1	Ethiopian Pharmaceuticals manufacturing share company	Addis Ababa City	1964	Fully Local
2	Addis Pharmaceutical Factory S.C	Tigray & Addis Ababa	1992	Joint Venture
3	East Africa Pharmaceuticals PLC	Addis Ababa	1996	Joint Venture
4	Pharmacure PLC Parental Solution Manufacture	Addis Ababa City	1998	Fully FDI
5	Sino-Ethiop Associate (Africa) PLC	Oromia Region, Gelan Town	2001	Joint Venture
6	Cadila Pharmaceuticals (Ethiopia) PLC	Oromia Region, Gelan Town	2003	Joint Venture
7	Julphar Pharmaceuticals PLC (Ethiopia)	Addis Ababa	2013	Joint Venture
8	Humanwell Pharmaceutical Ethiopia PLC	Amhara Region, North Shoa Zone	2015	Fully FDI
9	Sansheng Pharmaceutical PLC	Oromia Region, Dukem Eastern Industrial Park	2018	Fully FDI
10	Africure Pharmaceuticals Manufacturing Ethiopia PLC	Addis Ababa, Kilinto Industrial Park	2019	Joint Venture
11	Kilitch Estro Biotech PLC	Oromia Region, Sheger city administration, near to Sendafa.	2020	Joint Venture
12	Glocare Pharma Manufacturing PLC	Addis Ababa, Kilinto Industrial Park	2021	Fully FDI

(i). This list includes only those firms licensed to manufacture human medicines in Ethiopia, at the time of data collection.

(ii). The List was Generated By eRIS /Ethiopian Food and Drug Authority Database. Generated at : 04/04/2025 05:27:04 AM

(iii). Additional information such as Location, Year of Establishment, Ownership Type, and Formulations produced by each firm is compiled from: (1) a **Brochure** by the Ethiopian Pharmaceuticals and Medical Supplies Manufacturers Association (EPMSMA, n.d.) and (2) Company Profile of Large Scale Local Pharmaceutical Manufacturers (FMOH, June 2024).

3.2.3. Role Mapping and Respondent Selection

SCDRs are multidimensional and rarely confined to a single department, making a multi-departmental approach to risk management essential (Sinaga et al., 2024; Kleindorfer & Saad, 2005). Various departments hold differentiated ownership of specific risk categories—for example, quality assurance managers oversee compliance-related risks, while logistics and operations managers handle transport and distribution vulnerabilities. Given this role-specific distribution of risk responsibility, **a census strategy** was adopted in this study. By targeting all relevant functional roles within each firm, the research achieves triangulation and a more comprehensive understanding of firm-level SCDRM practices. This approach is particularly relevant in the pharmaceutical manufacturing context, where regulatory sensitivity, quality control, and production are critical for SC continuity. Consequently, including all the relevant functional roles ensures that the study captures the full scope of disruption preparedness and response mechanisms (Nel, 2024; Oke & Gopalakrishnan, 2009).

Therefore, in order to accurately assess the SCDRM practices within pharmaceutical manufacturing firms in Ethiopia, it is essential to identify the **specific functional roles** responsible for or involved in such practices. These roles form **the primary unit of analysis** for this study's survey. The selection of functional roles included in the survey instrument is theoretically grounded in the literature on SCRM (and SCDRM), which highlights that risk-related decisions and disruption response mechanisms are typically distributed across various managerial and operational positions.

As supported by a breadth of empirical and theoretical literature (Emrouznejad et al., 2023; Kleindorfer & Saad, 2005; Nel, 2024; Patrashkov & Suresh, 2020), disruptions can emanate from diverse sources and therefore demand coordinated actions among multiple internal stakeholders. Consequently, a multiple-role perspective would be necessary to capture the multidimensional nature of SCDRM practices within each firm.

In this thesis study, to ensure the appropriateness of respondents and accurate role-based data collection, **a telephone-based pre-assessment exercise** was conducted to map out the functional roles involved in SCDRM across pharmaceutical manufacturing firms. The researcher contacted senior managers and technical leads from **five firms**, selected through **convenience sampling**, to understand organizational structures and role distributions. The assessment revealed that while firms varied in their internal organizational arrangements, five roles were consistently present and mandatory as per EFDA regulations: Technical Manager, Production Manager, Quality Assurance (QA) Manager, Quality Control (QC) Manager, and Engineering Manager. These roles were automatically included in the study's target population. To address discrepancies in nomenclature of the other functional roles across the firms, functionally equivalent roles were grouped using operational definitions and, where necessary, additional qualifiers. This ensured role equivalence and data validity across companies.

These roles were selected based on two key criteria: (i) their strategic, tactical, or operational involvement in SCDRM activities such as risk identification, mitigation planning, resource allocation, and performance monitoring; and (ii) evidence from the literature that these positions bear functional responsibility for decision-making or execution under supply chain risk scenarios (John et al., 2023; Poberschnigg et al., 2020; Oke & Gopalakrishnan, 2009).

Based on this mapping and corroborated with literature, the study identified a total of eleven (11) key functional roles involved in SCDRM. These roles formed the basis of **the census frame.** With ten local pharmaceutical manufacturers participating, the target respondent pool consisted of:

11 roles × 10 firms = 110 functional and senior-level managers

At the strategic level, **Chief Executive Officers** and **General Managers** provide overall direction, approve contingency frameworks, and allocate resources for risk mitigation (Kleindorfer & Saad, 2005; Emrouznejad et al., 2023).

Operational roles such as **Supply Chain, Logistics, and Operations Managers** are central to identifying and mitigating end-to-end risks related to sourcing, transportation, and distribution. These professionals oversee contingency planning, supplier coordination, and flow stability (Nel, 2024; John et al., 2023; Sinaga et al., 2024).

Procurement Managers address upstream risks through sourcing diversification, audits, and contractual mitigation mechanisms (Oke & Gopalakrishnan, 2009), while **Technical, Production, and Engineering Managers** ensure internal operational continuity, address equipment failures, and enhance process resilience (Patrashkov & Suresh, 2020; Roberschuigg et al., 2020).

Quality assurance /control **(QA/QC) Managers** ensure compliance and minimize quality-related disruptions, whereas **Warehouse Managers** manage inventory risks and buffering strategies. **Finance Managers** play a pivotal role in funding resilience responses and hedging disruption costs, and **Marketing Managers** contribute by anticipating demand shifts and managing customer-related risks (Emrouznejad et al., 2023; Nel, 2024).

3.2.4. Sampling Strategy and Justification

Given the relatively small and well-defined population (N = 110), this study adopted **a census-method** as the most appropriate**,** aiming to collect data from all identified functional and managerial roles without sampling.

As noted by Asenahabi and Ikoha (2023), a census strategy is recommended for populations below 200 and eliminates sampling error. Asenahabi and Ikoha (2023) further stress that determining an appropriate (i.e., representative) sample size is critical for empirical research that intends to generalize findings. It requires technical judgment, consideration of study objectives, population size, complexity, and available resources. Among widely accepted sampling strategies are: **full census,** reference to prior studies, use of **published sampling tables**, application of **formulas** such as Yamane 1967.

To validate the adequacy of the census for this study and for potential use in non-response analysis, **Yamane's formula (1967)** was applied as a **comparative reference** for sample size estimation:

$$n = \frac{N}{1 + N(e)^2} \quad \text{where } N = 110,\ e = 0.05$$

$$n = \frac{110}{1 + 110(0.0025)} = \frac{110}{1.275} = 86.28$$

This suggests that **a minimum of 87** valid responses would be sufficient to ensure representativeness. Likewise, published sample size reference tables, such as that of Adam (2020), indicate a minimum return of **86 responses** for a population of 110 at 95% confidence interval (see **Table 3.2** below).

Table 3.2. Table for determining minimum returned sample size for a given population size for continuous and categorical data **(Source: Adam, 2020)**

Popula-tion size	Sample size					
	Categorical data (margin of error=.05), ρ=2			Continuous data (margin of error=.03), ρ=4		
	90% confidence Level $t = 1.645$	95% confidence Level $t = 1.96$	99% confidence Level $t = 2.58$	90% confidence Level $t = 1.645$	95% confidence Level $t = 1.96$	99% confidence Level $t = 2.58$
10	10	10	10	10	10	10
15	15	15	15	14	15	15
20	19	20	20	19	19	20
25	23	24	25	23	23	24
30	28	28	29	26	27	29
35	31	33	34	30	31	33
40	35	37	38	33	35	37
50	43	45	47	40	43	46
60	50	52	56	46	49	54
70	56	60	64	52	56	61
80	62	67	72	57	62	69
90	68	73	80	61	68	76
100	74	80	87	66	73	83
110	79	86	95	70	78	89
120	84	92	102	74	83	96
130	88	98	109	77	88	102
140	93	103	116	81	92	108
150	97	108	123	84	97	114
160	101	113	129	87	101	119
170	105	118	136	90	104	125
180	109	123	142	92	108	130
190	112	128	148	95	111	135
200	116	132	154	97	115	140
220	122	140	166	102	121	150
250	130	152	182	108	130	163
300	143	169	207	116	142	182
350	153	184	230	123	152	200
400	162	196	250	128	161	215

3.3. Research Approach

This study adopted **a mixed-methods research approach**, combining **a structured quantitative survey** with **semi-structured qualitative interviews.** This approach was chosen to enable both a broad assessment of SCDRM practices and a deeper understanding of their implementation and contextual challenges.

In support of this approach, Rinaldi et al (2022) and Ajalie et al (2024) suggest the use of empirical studies such as descriptive survey research with structured questionnaire and semi-structured interviews for conducting risk management studies. In addition, as guided by Taherdoost (2021), qualitative method is employed to enrich understanding, capture perception, and complement the quantitative findings.

3.4. Research Design

According to Strydom (2013), more than one design can be employed for the same study, but one will normally dominate a particular study. How much of the elements of each design can be combined depends on the nature of the research problem and the state of knowledge in the field. This study employed a **descriptive-evaluative survey design,** supplemented by **exploratory** interviews. The design was in such a way that the descriptive purpose dominated throughout the study.

- The **descriptive component** aimed to capture the status, sources, and extent of supply chain disruption risks and risk mitigation practices.
- The **evaluative component** used to assess the perceived effectiveness and implementation challenges faced by the firms.
- The **exploratory interviews** provided contextual depth and helped to triangulate survey findings – on what disruption risks firms experiencing, how they manage the risks, how they perceive effectiveness of SCDRM strategies, what implementation challenges they do face. Semi-structured information were collected in order to explore the study themes presented in logical order.

3.5. Sampling Techniques and Sample Size

3.5.1. Quantitative Study

The quantitative study targets **all ten eligible** firms and roles **included** in the research. The study employed **a census approach,** which is particularly appropriate when the target population within each unit (i.e., each firm) is small and functionally differentiated, and when complete data are both feasible and desirable (Asenahabi and Ikoha, 2023). In this context, every individual identified within the functional role categories was invited to participate in the survey. The objective was to capture a full-spectrum view of disruption risk management practices as exercised across departments, thereby enhancing the internal validity and richness of the dataset.

- **Sampling Technique:** Census strategy
- **Sample Size (by firm):** All **10** firms that meet inclusion criteria make the study population for the quantitative study.
- **Sample Size (by Respondents):** All **11** staff per firm from relevant functional roles, identified in the 'study population' section.
- Therefore, for the **ten** manufacturers included in the study, **the study population** of respondents will be: **11 respondents × 10 firms = 110 respondents**

3.5.2. Qualitative Interviews

The qualitative interviews were conducted after the quantitative (survey) findings had been summarized and analyzed. The objective of the interviews was to validate the survey findings, and to deep dive into some of the extreme or significant findings from the survey.

For the qualitative study, **a purposive sampling technique** was used to select **six** experienced *senior managers* to ensure information-rich interviews (Selam et al., 2022). Six interviews were adequate because participants were homogenous (i.e. same profession /pharmacists/ & similar functional roles), and the goal was exploratory (i.e. to enrich understanding, rather than to build theory) (Suresh et al, 2024). Moreover, data saturation was reached by answering the study's themes and fulfilling the validation goal (Ahmed, 2025).

3.6. Data Sources and Instruments

This thesis is based on the following quantitative and qualitative **primary data sources:**

- Structured questionnaire with Likert-scale and close-ended items
- Semi-structured interviews with general managers and supply chain heads

3.6.1. Instrument Design

The primary data collection tool for this study was a structured survey questionnaire designed to assess SCDRM practices among pharmaceutical manufacturers in Ethiopia. The instrument was developed following an extensive literature review of SCRM frameworks (Tang, 2006a&b; Pettit et al, 2010; Waters, 2011, Wieland & Wallenburg, 2012; Heckmann et al, 2014; Kamalahmadi & Parast, 2016; Baz & Ruel, 2020; Abdallah et al., 2024), global SCDRM frameworks, (WHO, 2021; UNIDO, 2022; UNCTAD, 2023), and empirical studies in similar contexts (Ganiyu et al, 2020; Khuan et al., 2023).

The questionnaire incorporated **five major constructs,** each operationalized through multiple Likert-scale items and supplemented with optional open-ended questions.

- **Section 1: SCDRs** – Measures both the frequency and severity of **8** specific disruption events.
- **Section 2: SCDRM Strategy Adoption** – Captures how frequently firms apply **13** recognized mitigation strategies, both proactive and reactive.
- **Section 3: Perceived Effectiveness** – Assesses the perceived utility of each SCDRM strategy in managing disruptions.
- **Section 4: Challenges to Implementation** – Investigates the presence and impact of **10** challenges to strategy execution.
- **Section 5: Respondents' and Firm Profile** – Gathers contextual information on respondents' roles, experience, and sourcing origins.

Each item was measured on **a 5-point Likert scale** appropriate to the construct (e.g., frequency, impact, effectiveness). The final instrument included **52 core Likert items,** alongside three profiling questions and three optional open-ended items.

3.6.2. Instrument Refinement and Pilot Testing

An initial version of the survey instrument was validated through expert review and pilot testing in **three** non-sample supply chain experts (academia) and **five** industry experts – in order to assess clarity, redundancy, and practical relevance. Feedback informed the rephrasing of vague or ambiguous items (e.g., general references to "resilience" were replaced with more specific references to "business continuity plans" and "risk forecasting tools"). Three items were dropped due to conceptual overlap. Based on this pilot, the questionnaire was refined to enhance internal consistency and construct validity. The updated instrument reduced semantic redundancy and aligned more closely with theoretical frameworks.

3.7. Data and Methods of Collection

3.7.1. Methods of Collecting Primary Data

Primary data collection is essential in empirical research, particularly when direct insights from participants are required. As emphasized by Mazhar et al. (2021), the choice of data collection method must align with the research design and objectives. Inaccurate or biased data can compromise research validity, while systematically gathered data enhances statistical reliability and empirical interpretation. Whether via interviews, questionnaires, or observation, data collection remains the foundation upon which robust research is built.

3.7.1.1. Quantitative Data Collection

A common method for survey research is use of questionnaire, where respondents complete a set of standardized questions. It is advantageous for its scalability, anonymity, and cost-efficiency. The questionnaire method consists of a fixed sequence of questions, often mailed or distributed electronically, allowing respondents to complete the form independently. Questionnaires are efficient in terms of cost and time, and suitable for both descriptive and correlational research. A good questionnaire is characterized by brevity, clarity, logical flow, ethical compliance, and a mix of closed and open-ended questions (Mazhar et al., 2021).

To generate reliable and structured primary data, this study employed a **structured questionnaire** incorporating both **closed-ended** quantitative items and **open-ended** qualitative prompts. As emphasized by Taherdoost (2021), questionnaires are widely recognized as efficient and practical tools for collecting standardized data in survey research. While closed-ended items facilitate statistical analysis and cross-case comparison, open-ended questions allow respondents to reflect on issues not captured by predefined categories—offering limited but valuable contextual insights.

The questionnaire was administered via **Google Forms** and **physical hard copies** across the **ten** eligible firms and 110 functional roles. **A census approach** was used to capture all relevant functional roles, ensuring wide coverage across key decision-making categories. The tool was self-administered, and participation was voluntary and anonymous, reducing social desirability bias. **Data was collected during 15th of April 2025 to 15th of May 2025.**

Completed responses were exported to **Excel** and **SPSS** for coding and quantitative analysis. Open-ended reflections were manually extracted and thematically coded to capture additional perspectives. These qualitative insights were particularly helpful in identifying context-specific disruptions, implementation challenges, and firm-level mitigation practices not fully covered by the structured items.

3.7.1.2. Qualitative Data Collection

To further complement and validate the survey results, **semi-structured interviews** were conducted with purposively selected **six** industry experts and decision-makers. These interviews were transcribed during or immediately after the sessions and analyzed thematically to deepen the interpretation of survey patterns, clarify ambiguous findings, and identify practical gaps in policy and firm-level risk governance.

The interview method is a versatile and interactive technique of data collection. It involves verbal questioning, either in face-to-face or telephone formats. Structured interviews follow a predetermined format, ensuring consistency across respondents. Unstructured and focused interviews provide deeper insights into respondent behaviors, motives, and experiences, especially during exploratory research. This method is particularly beneficial when probing sensitive or nuanced issues (Mazhar et al., 2021).

3.8. Data Analysis Techniques

3.8.1. Quantitative Data Analysis

- Descriptive statistics (mean, frequency, percentages, SD) via SPSS and excel. Findings were presented on tables.
- Alignment matrix comparing findings against global SCDRM frameworks.

3.8.2. Qualitative Data Analysis

- Thematic analysis based on a structured coding framework
- Manual coding to cluster quotes, identify patterns, and to aid in the validation of survey findings and deep diving into some of the extreme or significant findings in the survey.

3.9. Validity and Reliability Measures

- **Content validity:** An instrument is valid if it measures what it is intended to measure. This study achieved validity by aligning items with literature. Moreover, the study employed respondent feedback (or member checking), inviting the participants to comment on the study conclusion via follow-up interviews; and conducting peer checking (Nha, 2021).
- **Instrument reliability:** In quantitative research, reliability is consistency in measurement over repeated measures. This study ensured through pre-testing and consistent item wording. Pretesting is the only way to evaluate in advance whether a questionnaire causes problems for interviewers or respondents (Presser et al., 2004). Providing reliability estimates for data is not a common practice in qualitative research. Many qualitative researchers focus on describing techniques to improve the reliability of their method instead (Nha, 2021).
- **Triangulation:** Triangulation means using different sources of data for cross-checking. There are different types of triangulations such as method, data, investigator, and theory triangulation. This study triangulated its method and findings by using different methods for collecting data, e.g. employing a questionnaire, followed by interviews (Nha, 2021).

3.10. Ethical Considerations

The research was conducted under the authorization of the Department of Logistics and Supply Chain Management, School of Commerce, Addis Ababa University.

In line with ethical guidance from **Wisker (2008),** the study observed the following safeguards:

- Informed consent: Verbal consents were obtained from all participants before data collection.
- Anonymity and confidentiality were assured by coding firm and respondent identities. No personally identifiable information were collected and participant identities anonymized in reporting as well.
- Voluntary participation: Participants were informed that they could withdraw at any stage

3.11. Methodology Enhancement Mechanisms

To address methodological concerns about the limitations of descriptive survey designs, this study incorporated several enhancement mechanisms aimed at improving analytical depth, empirical validity, and practical relevance.

First, a qualitative component was integrated through key informant interviews with experienced executives across selected firms. These interviews yielded context-rich insights that validated, reinforced, and in some cases nuanced the survey findings.

Second, the study included an assessment of the perceived effectiveness of implemented SCDRM strategies, allowing for an evaluative lens that goes beyond mere adoption frequency.

Additionally, data triangulation between quantitative and qualitative strands enhanced the study's internal validity.

These measures collectively augmented the **descriptive core** of the study with interpretive rigor and contextual grounding, ensuring both academic robustness and policy relevance.

CHAPTER FOUR:

RESULTS AND DISCUSSIONS

4.1. Introduction

This chapter presents the **empirical findings** and **analysis** derived from both quantitative data (survey responses from 89 participants) and qualitative insights (interviews with six senior industry experts), triangulated with international best practice alignment. The data are organized around the **four core research themes:** SCDRs, SCDRM Strategies, Perceived Effectiveness (PE), and Implementation challenges.

The findings are primarily reported through **descriptive statistics** and are contextualized using respondent profiles to enhance reliability and relevance. The scholarly contribution of this thesis is further strengthened by the inclusion of the **PE** dimensions, which enrich the interpretation and significance of the results.

4.2. Response Rate

In this study, **response-enhancing measures**—such as reminders, multi-wave follow-up, personalized invitations, institutional endorsement by the pharma manufacturers association, and defined response windows—were applied to encourage participation. Despite the substantial effort made to reach **all units** in the study population and make a full-population census approach, the final response rate achieved was **80.9%** (89 responses out of 110 respondents).

Table 4.1. Response Rate for this Thesis

Source: Researcher's Survey Data (2025)

Response	**Total**
No. of questionnaires distributed	110
No. of responses achieved	89
Response Rate	**80.9%**

In **a census survey,** the researcher attempts to gather data from every member of a defined population, unlike **a sample survey** which estimates based on subsets. In such designs, nonresponse becomes a direct threat to **coverage, validity,** and **generalizability.** Hence, establishing what constitutes **an "acceptable response rate"** is crucial.

The response rate of this study (80.9%) meets the benchmark threshold of 80%, established for census surveys by institutions such as the U.S. Office of Management and Budget (OMB, 2016). While higher response rates are desirable for **census-based designs,** rates **above 60%** are often still considered **scientifically acceptable,** particularly if the response group is representative of the target population (Fincham, 2008; Baruch & Holtom, 2008). The functional role characteristics of the respondents in this study were analyzed and found to mirror the broader target population, thereby minimizing the likelihood of significant nonresponse bias and lending credibility to the generalizability of the findings.

Furthermore, multiple meta-analyses and empirical reviews have established that representativeness often outweighs mere numerical response thresholds in evaluating survey validity. Wu et al. (2022) conducted a meta-analysis of over 1,000 published online survey studies and reported an average response rate of **44.1%,** while Baruch & Holtom (2008) reported a mean response rate of **52.7%** for individual-level surveys in organizational research. These findings support the argument of Cook et al. (2000), who contended that response rates are only problematic to the extent that they threaten representativeness. Consequently, in this study, the achieved response rate meets the traditional "gold standard" levels and the study also meets empirically grounded thresholds for academic acceptability in quantitative research. The methodological rigor applied in this study further supports the robustness and validity of the findings. The survey successfully captured a diverse and strategically representative cross-section of roles across the organizational hierarchy of pharmaceutical manufacturing firms, providing a robust basis for analyzing SCDRM practices.

4.3. Respondent and Firm Profile

4.3.1. Functional Roles of Respondents

A diverse set of managerial and technical professionals participated, as listed in the **Table 4.2.** below. Respondents included top-level executives as well as mid-level managers from operational and technical departments, reflecting participation across strategic, tactical, and operational functions. This role diversity enhances the internal validity of the study, as it incorporates perspectives from those responsible for formulating SCDRM strategies (executive leadership), implementing risk mitigation actions (supply chain, operations, and production managers), and supporting with oversight, compliance, and control functions (quality assurance, finance, and warehousing).

Executive-level respondents, representing **20.2%** of the total, provide essential insights into the strategic and policy dimensions of SCDRM. Their perspectives are particularly valuable in interpreting findings related to investment decisions, organizational prioritization, and institutional barriers to risk management implementation. These high-level roles are also instrumental in shaping a firm's overall risk culture and determining the allocation of resources toward supply chain resilience initiatives. A particularly strong representation emerged from the supply chain, logistics, and operations management group, which comprised **25.8%** of respondents. Given the study's thematic focus on SCDRM, this is both expected and desirable, as these roles are centrally positioned to respond to disruptions in sourcing, transportation, and production flows. In parallel, technical and factory managers accounted for **22.5%** of the sample, contributing insights on production continuity, equipment redundancy, and process resilience. Combined, these three groups represented nearly half **(68.5%)** of all survey participants, underscoring the operational relevance and contextual alignment of the study's findings.

Overall, the distribution of responder roles ensures that the findings are grounded in organizational realities and supported by the perspectives of those who design, execute, and oversee supply chain risk management strategies in Ethiopia's pharmaceutical manufacturing sector.

Table 4.2. Functional Roles of Respondents. Source: Researcher's Survey Data (2025)

Respondent's role	No. of respondents (n=89)	% of Total
Chief Executive Officer / General Manager / or Deputy	18	20.2%
Supply Chain / Logistics / Operations Manager	23	25.8%
Technical Manager / Factory Manager / Plant Manager	20	22.5%
Procurement Manager	5	5.6%
Production Manager	5	5.6%
Quality Assurance Manager	5	5.6%
Quality Control Manager	3	3.4%
Engineering Manager	3	3.4%
Warehouse Manager	3	3.4%
Finance Manager	2	2.2%
Marketing Manager	2	2.2%

4.3.2. Respondents' Experience in the Pharmaceutical Industry

The level of professional experience among respondents is a critical indicator of the reliability, contextual depth, and validity of the data collected in this study. In research focusing on complex and multidimensional topics such as SCDRM, experienced respondents are more likely to possess informed perspectives, historical insights, and applied knowledge derived from real-world practice. Therefore, analyzing the experience profile of respondents has implications for data quality and research validity. It helps determine the robustness of the study's empirical foundation.

Table 4.3. Respondents' Experience in the Pharma industry. Source: Survey Data (2025)

	No. of responses (n=89)	**% of Total**	**Interpretation**
Less than 5 years	3	3.4%	New entrants
5–10 years	10	11.2%	Early-career professionals
10–15 years	25	28.1%	Mid-career professionals
15–20 years	26	29.2%	Experienced professionals
More than 20 years	25	28.1%	Senior-level experts

4.3.2.1. Strong Experience Base Across Respondents

The dataset reveals that the majority of respondents (76 out of 89, or **85.4%**) possess **more than ten years** of experience in the pharmaceutical industry. This indicates that the study has drawn from a highly knowledgeable and seasoned responder base, well-versed in both the operational complexities and the strategic dimensions of pharmaceutical supply chains. From a methodological standpoint, this level of professional maturity enhances the **internal validity** and **contextual richness** of the data. Experienced respondents are more likely to have encountered systemic and recurring supply chain disruptions, enabling them to offer grounded assessments of risk identification, mitigation practices, and long-term planning approaches. Their input lends **credibility** to the study's empirical findings and ensures that the reported challenges and successes in SCDRM are derived from practical, informed perspectives rather than speculative or surface-level understanding. The experiential maturity of the sample strengthens the **validity** and **reliability** of the study's findings. It enhances confidence in the disruption typologies, risk mitigation patterns, and implementation challenges reported in this thesis. The experience-rich respondent pool reinforces the **relevance** of its conclusions for both academic analysis and policy formulation. Furthermore, it provides a solid empirical foundation for the development of pragmatic recommendations in the concluding chapters.

4.3.2.2. Balanced Distribution Across Career Stages

The data further show a balanced distribution across the 10–15 years (28.1%), 15–20 years (29.2%), and 20+ years (28.1%) experience categories. This even spread across career stages is analytically significant, as it captures a diverse range of experiential insights from professionals at different points in their careers. Such a distribution enhances the study's ability to triangulate insights between mid-level managers and senior executives or technical veterans. These individuals are likely to have both historical insight into the evolution of Ethiopia's pharmaceutical manufacturing ecosystem and first-hand exposure to major disruption events such as the COVID-19 pandemic, forex shortages, and regulatory changes. Their involvement in both routine operations and long-term strategic planning adds depth and credibility to their responses concerning supply chain risk, resilience-building, and implementation constraints.

4.3.2.3. Minimum Low-Experience Bias

Only **3.4%** of respondents (3 out of 89) reported having less than five years of industry experience. This is a methodologically reassuring feature of the dataset, as it significantly reduces the potential for low-experience bias, which can compromise analytical depth in studies dealing with complex organizational practices like SCDRM. Although early-career professionals (10 respondents, **11.2%,** 5–10-year range) are also relatively small, their inclusion is still important. While less experienced professionals may offer valuable fresh perspectives into current operational practices, training adequacy, and the clarity of existing SCDRM procedures, a disproportionate number of such respondents could undermine the empirical robustness of strategic-level insights. The negligible share of low-experience respondents in this study supports the inference that the data reflects long-term, experience-driven understandings of risk exposure and resilience planning.

4.3.3. Source Countries for Inputs and Raw Materials

The data in ***Table 4.4*** below reveals significant dependencies on a narrow set of international supply sources for pharmaceutical inputs among Ethiopian manufacturers. A striking **96.6%** of respondents reported sourcing from India, followed closely by China at **94.4%,** underscoring the overwhelming reliance on these two Asian economies for APIs, excipients, reagents, and spare parts.

European countries were also cited by **37.1%** of respondents, while 68.5% reported sourcing locally within Ethiopia. Additionally, **9.0%** indicated sourcing from "other" countries, with **5.6%** specifically naming the United States.

Overall, these findings reinforce a central thesis argument: that Ethiopia's pharmaceutical supply chain is structurally vulnerable due to overdependence on a few foreign supply sources. The empirical evidence supports both the need for firm-level risk diversification and policy-level supply base development. Furthermore, the presence of some local sourcing suggests that progress is underway but requires scaling, policy reinforcement, and infrastructure investment to become a reliable risk buffer.

Table 4.4. Source Countries for Inputs and Raw Materials

Source: Researcher's Survey Data (2025)

Source Country	**No. of Responses (n=89)**	**% of Total**
India	86	96.6%
China	84	94.4%
European countries	33	37.1%
Local (Ethiopia)	61	68.5%
Other (specify)	8	9%
USA (subset of 'Other')	5	5.6%

4.3.3.1. High Dependency on India and China

The survey data clearly indicates an overwhelming dependency on India (96.6%) and China (94.4%) as the main suppliers of APIs, excipients, intermediates, and packaging materials. This sourcing pattern represents a structurally embedded vulnerability in Ethiopia's pharmaceutical manufacturing sector. Such reliance on **geographically concentrated** supply sources can severely undermine production continuity. Any geopolitical tension, factory closures, export restrictions, container shortages, and port congestion in these countries can have direct and widespread disruption effects on Ethiopian firms (Emrouznejad et al., 2023; Kleindorfer & Saad, 2005).

This finding strongly supports one of the core premises of the study—that import dependency is a critical driver of supply chain disruption risk in the Ethiopian pharmaceutical sector. It also aligns with global observations during the COVID-19 pandemic, where overreliance on limited suppliers exacerbated medicine shortages (Emrouznejad et al., 2023; Nel, 2024). This finding is also reinforced by **qualitative responses,** which highlighted repeated occurrences of shipment delays, originating from India or China. Also reinforced that the current sourcing structure acutely vulnerable to exogenous disturbances.

The finding reveals a critically underdiversified and externally dependent **input sourcing structure.** Overdependence on India and China, while historically cost-effective, exposes Ethiopia's pharmaceutical manufacturers to compound risks involving delays, shortages, and macroeconomic shocks. The lack of diversification magnifies the impact of these risks and limits the system's adaptive capacity—fundamentally weakening SC resilience. The overall sourcing structure therefore presents a classic case of **geographic concentration risk**—a well-documented phenomenon in SC literature (Tang, 2006a; Christopher & Peck, 2004).

4.3.3.2. Local Sourcing

A relatively encouraging 68.5% of firms reported some level of local sourcing, indicating a nascent shift toward input substitution and supply base localization. However, a deeper examination—particularly of the **qualitative responses**—reveals that these locally sourced materials are often low-value (e.g., packaging, basic excipients) and water (considering it as a formulation input) for large volume parenterals and oral liquid formulations. These locally sourced materials also include IV bags (for fluid manufacturers) and empty gelatin capsules (for oral capsule manufacturers). Other than these two EFDA licensed manufacturers, other materials sourced locally are sporadically available and inconsistent in quality. This suggests that local inputs are currently *complementary* rather than *strategic*, serving to *support* rather than *replace imports.* The practical implication is clear: local sourcing in its current form does little to buffer Ethiopia's supply system against external shocks. Instead, it reflects an **underutilized opportunity.** This has two implications: (i) It reinforces Ethiopia’s exposure to external shocks, and (ii) it highlights the need for strategic investment in local API production, excipient manufacturing, and quality packaging infrastructure. Without such structural reforms, local sourcing will remain marginal and fail to contribute meaningfully to national SC resilience.

4.4. Frequency and Severity of Supply Chain Disruption Risks

4.4.1. Frequency

This section assessed the extent to which pharmaceutical manufacturers have encountered various types of supply chain disruption risks over the past five years. Respondents were asked to indicate the perceived frequency of each risk category using a five-point Likert scale (1 = Never, 5 = Very Frequently). The aim was to capture firm-level exposure to both internal and external disruptions, forming the basis for further analysis of mitigation strategies and preparedness levels. A total of 89 respondents provided data. Descriptive statistical tools, in SPSS V25, were applied to examine percentage frequencies, and estimated means to uncover patterns in disruption exposure and operational vulnerability. The results, presented in **Table 4.5** below, underscore a hierarchy of exposure, where macroeconomic and regulatory factors consistently rank as the most frequent, followed by operational and internal disruptions.

Table 4.5. Survey Result for Frequency of SCDRs (n=89).Source: Survey Data (2025)

Disruption Risks	**FREQUENCIES: Total no. of responses (n=89) under each Likert Scale (1 to 5)**				
	1	**2**	**3**	**4**	**5**
Forecasting failures	3	12	50	18	6
Unreliable suppliers	3	13	35	30	8
Transport/logistics breakdowns	0	11	24	46	8
Pandemic-related disruptions	5	19	16	43	5
Geopolitical shocks	3	16	13	49	8
Forex shortages	0	0	3	22	65
Regulatory/customs delays	0	8	22	54	5
API shortages	0	13	51	24	0

The descriptive statistics (below, **Table 4.6**) clearly illustrates the relative severity of each disruption risk as experienced by Ethiopian pharmaceutical manufacturers. Forex shortages remain the highest concern (mean = 4.69), far above others. Regulatory/customs delays, logistics breakdowns, and geopolitical shocks form the second tier of critical risks. Forecasting failures and API shortages appear to be the least frequent but still warrant monitoring due to their strategic implications.

Table 4.6. Descriptive Statistics for Frequency of SCDRs. Source: Researcher's SPSS Analysis

Disruption Risk	**%Frequent +Very Freq**	**mean**	**min**	**max**	**mode**	**std**
Forex shortages	97.75	4.69	3	5	5	0.53
Regulatory/customs delays	66.29	3.63	2	5	4	0.73
Transport/logistics breakdowns	60.67	3.57	2	5	4	0.82
Geopolitical shocks	64.04	3.48	1	5	4	1.00
Unreliable suppliers	42.70	3.30	1	5	3	0.95
Pandemic disruptions	53.93	3.27	1	5	4	1.05
Forecasting failures	26.97	3.13	1	5	3	0.86
API shortages	26.97	3.13	2	4	3	0.64

4.4.1.1. Forex Shortages

Forex shortages emerged as the most frequently reported disruption, with an exceptionally high mean score of 4.69 and 97.75% of respondents rating this risk as occurring "Frequently" or "Very Frequently." Notably, no respondents rated this risk below "Moderate" (i.e., scores 1 or 2), signifying complete consensus on its persistent nature. These findings reconfirm that currency-related constraints are not only frequent but chronic and structurally embedded in Ethiopia's pharmaceutical supply chain, affecting procurement, production schedules, and contract fulfillment. This chronic exposure elevates forex access to a top-tier strategic concern, requiring policy-level interventions such as forex allocation prioritization, local sourcing incentives, or alternative trade settlement arrangements. Therefore, forex access must be treated as a strategic supply chain **enabler**, not merely a financial issue.

4.4.1.2. Regulatory and Transport Disruptions

Regulatory and customs delays (mean = 3.63; 66.29% frequent/very frequent) and transport/logistics breakdowns (mean = 3.57; 60.67%) were the next most cited disruptions. These results highlight institutional and infrastructural bottlenecks as systemic challenges for supply chain continuity. Delays in customs clearance, document verification, and regulatory approvals create friction at key nodes in the supply chain, compounding other disruptions such as supplier delays or port congestion. Transport disruptions, meanwhile, reflect the logistics fragility of Ethiopia's landlocked geography and dependence on the Djibouti port. These findings support recommendations for inter-agency coordination, digitalization of import systems, alternate transport corridors (e.g., Berbera corridor), infrastructure investment, and supplier geo-diversification as part of national SCDRM planning.

4.4.1.3. Forecasting and API Shortages

The frequency results reveal that Forecasting/Demand Planning Failures and API Shortages are among the least frequently encountered risks by Ethiopian pharmaceutical manufacturers. Each registered a mean frequency score of 3.13, with only 26.97% of respondents rating them as "Frequent" or "Very Frequent." These figures suggest that both risks are perceived as intermittent or situational, rather than chronic. For **forecasting,** this perception may stem from overconfidence in intuitive or reactive planning systems, or a lack of real-time performance feedback loops. It is also plausible that the impact of poor demand planning is often masked by emergency purchasing, informal stock buffers, or supplier flexibility—thus reducing its visibility in day-to-day operations.

For **API shortages,** the relatively low frequency rating contradicts long-standing structural dependencies on a narrow international sourcing base—primarily India and China. The lower frequency scores may reflect a normalization of lead-time volatility, or a limited awareness of the upstream vulnerabilities inherent in complex supply networks. This suggests that firms may underestimate the recurrence risk of API disruptions, especially given rising global competition for raw materials and tightening export policies from major producers. Addressing this requires greater emphasis on risk awareness training, forecasting systems, and buffer inventory policies. The strategic focus therefore should include demand planning tools, capacity building, API diversification, regional sourcing and local production.

4.4.1.4. Geopolitical Shocks

With a mean score of 3.48 and 64.04% of respondents reporting high frequency, geopolitical shocks remain a significant external risk. These shocks—such as border closures, regional conflict, or cross-border trade bans—disrupt supplier reliability, freight movements, and cross-jurisdictional sourcing agreements. The sustained frequency rating indicates that geopolitical instability is normalized in the operational environment, necessitating adaptive strategies such as multi-corridor logistics, local partnerships, and resilience-building at the regional level. These risks are indicative of both instability in the Red Sea region and infrastructure deficits, such as limited access to the Sea, unreliable freight networks, and port congestion.

4.4.1.5. Supplier Reliability and Pandemic Disruptions

Unreliable suppliers (mean = 3.30; 42.7%) and pandemic-related disruptions (mean = 3.27; 53.93%) occupy mid-tier positions in the frequency rankings. The moderate score for supplier unreliability suggests exposure to procurement-side fragility, likely due to lack of formal performance metrics, dependence on sole suppliers, or weak supplier relationship management systems. Although lower than macro and infrastructure risks, these disruptions are controllable and thus suitable targets for firm-level interventions such as supplier audits, scorecards, and multi-sourcing policies. **Pandemic-related disruptions** specifically refer to disruption during and after COVID-19, suggesting that the Ethiopian pharmaceutical supply chain lacks sufficient pandemic preparedness mechanisms. This highlights a gap in long-term risk planning. It also suggests that firms have yet to fully internalize pandemic-related contingency protocols (i.e. business continuity planning), such as stockpiling, alternate supplier mapping, and workforce continuity strategies. It also requires regulatory flexibility.

4.4.1.6. Variation in Frequency of Supply Chain Disruption Risks

The standard deviation scores associated with the frequency of disruption risks provide critical insights into the extent of consensus or divergence among pharmaceutical manufacturers in Ethiopia.

Higher standard deviations (e.g., pandemic-related disruptions and geopolitical shocks) indicate greater divergence in firm-level experiences, while lower values (e.g., forex shortages and API shortages) reflect high consensus across the sector.

As illustrated in the ***Table 4.6,*** pandemic-related disruptions (std = 1.05) and geopolitical shocks (std = 1.00) exhibited the highest variation in responses, indicating that firms experienced these risks in markedly different ways. This heterogeneity likely stems from differences in international exposure, supply network diversity, and location-specific vulnerabilities. Unreliable suppliers (0.95), forecasting failures (0.86), and transport/logistics breakdowns (0.82) reflected moderate levels of variation, suggesting operational disparities across firms, possibly due to differences in sourcing strategies, logistics capabilities, and inventory practices.

In contrast, forex shortages (std = 0.53) and API shortages (std = 0.64) had the lowest standard deviations, pointing to a high degree of consensus among respondents. These findings reinforce the notion that such risks are systemic and sector-wide, consistently affecting the entire pharmaceutical manufacturing landscape in Ethiopia. The implications of these patterns are significant: while high-variance risks may require firm-level adaptive capabilities such as scenario planning and supply diversification, low-variance risks necessitate coordinated national interventions—including policy reforms on forex allocation and increased support for local production of critical inputs like APIs. This differentiation in response variability highlights the importance of designing tailored risk management strategies that account for both the frequency and the variability of disruptions across the industry. Therefore, the findings provide insight into which risks are systemic versus context-specific, informing both national policy interventions and firm-level SCDRM strategies.

4.4.1.7. Interpretation of the Findings: Frequency of Supply Chain Disruption Risks

The study identifies foreign exchange (forex) shortages and regulatory/customs delays as the most frequently encountered and operationally severe disruption risks among Ethiopian pharmaceutical manufacturers. These findings strongly align with previous assessments by UNIDO (2022), WHO (2021), and Tegegne (2022), which collectively point to macroeconomic instability and bureaucratic inefficiencies as structural bottlenecks that threaten continuity in pharmaceutical supply chains across LMICs.

While less frequent, API shortages, supplier unreliability, and geopolitical transportation disruptions were found to cause disproportionate operational delays and cost escalations when they do occur. These results reinforce the insights of Rinaldi et al. (2022) and Kulkarni (2025), who emphasized the persistent vulnerability of LMIC supply chains to upstream shocks, particularly due to import dependency, mono-sourcing patterns, and foreign currency volatility. These conditions are particularly acute in Ethiopia, where over 90% of pharmaceutical inputs—such as APIs, excipients, and packaging materials—are sourced from a narrow group of countries, primarily India and China.

The observed risk patterns also lend empirical support to the Resource Dependence Theory (RDT), which heavily posits that firms reliant on external entities for critical inputs are more susceptible to systemic disruptions unless they proactively manage such dependencies (Kalaitzi, 2016; Hillman et al., 2009). Forex shortages and API procurement failures exemplify this dynamic: while not always the most frequent risks, they are among the most destabilizing due to Ethiopia's limited domestic production capacity and constrained access to international financing instruments. The identification of internal risks such as forecasting failures aligns with empirical observations by Moosivand et al. (2019) and Sime (2019), who highlighted poor demand planning as a silent yet recurring disruptor. Furthermore, the study's qualitative data expanded the traditionally recognized SCDR typologies by revealing underreported and emerging risks such as:

- Human capital instability, including high staff turnover and cross-functional skills gaps;
- Logistics monopolies, particularly rigid shipping mandates via Ethiopian Shipping Lines;
- Financial policy-related disruptions, such as TT (telegraphic transfer) restrictions and unpredictable Franco valuta approvals.

These nuanced disruptions are rarely captured in conventional SCDRM frameworks but are of high relevance in fragile and resource-constrained contexts like Ethiopia. They highlight the need for context-sensitive SCDR taxonomies that account for institutional, infrastructural, and geopolitical realities. As such, effective SCDRM in Ethiopia's pharmaceutical sector must move beyond imported best practices and be rooted in a locally grounded understanding of both chronic and episodic risks.

4.4.2. Severity

This section presents and discusses the findings of the **severity** of key SCDRs experienced by pharmaceutical manufacturers in Ethiopia, based on **89 responses** rated on a 5-point Likert scale (1 = No effect, 5 = Very severe effect). The results reveal differentiated levels of operational disruption severity experienced by the firms. Descriptive statistics were used to calculate weighted mean scores and the percentage of respondents reporting "Severe" (4) or "Very Severe" (5) effects. The findings help prioritize risks not only by **frequency** (as discussed in Section 4.4.1), but also by their **impact** magnitude, providing essential input for SCDRM strategy development.

Table 4.7. Ranked Severity of SCDRs Reported by Pharma Manufacturers in Ethiopia

Source: Survey Data (2025), Researcher's SPSS Analysis

Disruption Risk	**SEVERITY: Total no. of responses under each Likert Scale (1-5)**					**Mean Score**	**% Severe +Very Severe**
	1	**2**	**3**	**4**	**5**		
Forex shortages	0	0	0	13	76	4.85	100
Transport/logistics breakdowns	0	8	26	39	16	3.71	61.8
Regulatory/customs delays	0	11	24	46	8	3.57	60.7
Geopolitical shocks	8	8	16	45	13	3.52	65.2
Pandemic-related disruptions	5	10	13	55	5	3.51	67.4
API shortages	0	8	42	26	13	3.49	43.8
Unreliable suppliers	3	8	45	24	10	3.33	38.2
Forecasting failures	5	45	21	5	13	2.73	20.2

4.4.2.1. Forex Shortages

Forex shortages remain the most severe disruption, with a near-maximum mean score of **4.85** and **100%** of respondents classifying the effect as either "Severe" or "Very Severe." This indicates unanimous agreement on its devastating impact, reinforcing that access to foreign currency is not just a firm-level financial issue, but a systemic constraint with national-level policy roots. It is a critical supply chain survival factor for the firms.

Notably, no respondents reported any moderate or low impact (scores 1–3), confirming the consensus around its catastrophic impact on procurement timelines, production scheduling, supplier trust, and overall operations. The implications call for urgent national forex policy reform, with the pharmaceutical sector prioritized as a strategic industry, and also local input development strategies.

4.4.2.2. Transport and Regulatory Disruptions

Transport and logistics breakdowns were rated second highest with a mean of **3.71** and **61.8%** of respondents reporting severe or very severe effects. This risk reflects infrastructural weaknesses—delays, road closures, port congestion—often aggravated by Ethiopia's landlocked status. Closely following is regulatory/customs delay with a mean of **3.57** and **60.7%** high-severity responses. These delays, often linked to fragmented oversight and import clearance procedures, magnify risks that originate externally (e.g., geopolitical shocks) or upstream (e.g., API procurement).

Both findings point to bottlenecks that are institutionally or infrastructurally addressable. They validate the policy need for streamlined regulatory coordination (especially between EFDA and Customs), digital import platforms, and logistics corridor diversification.

4.4.2.3. Geopolitical and Pandemic Disruptions

Geopolitical shocks and pandemic-related disruptions rank closely with mean scores of **3.52** and **3.51**, and severe impact rates of **65.2%** and **67.4%** respectively. The results reflect respondents' experience with regional instability, border closures, war-induced supplier failures, and COVID-era shutdowns. While pandemic-related disruptions may decline over time, their ongoing relevance underscores a lack of institutionalized business continuity planning and poor risk memory consolidation. Similarly, geopolitical risks—although external and hard to control—require long-term trade and logistics strategy adjustments, including building supply corridors through Somaliland or Kenya and regional mutual support pacts.

4.4.2.4. API Shortages and Supplier Failures

The findings present a subtle but concerning picture of API shortages and supplier unreliability as downstream disruption risks in Ethiopia's pharmaceutical supply chains. Although **API shortages** were reported as relatively infrequent—mean frequency score of 3.12, with only 27.3% of respondents citing them as frequent or very frequent—their severity remains high, with a mean score of **3.49** and **43.8%** rating them as severe or very severe. Similarly, **unreliable suppliers** recorded a moderate frequency (mean = 3.30; 42.7%) and notable severity (mean = 3.33; 37.8%).

This **low-frequency, high-severity profile** indicates a latent vulnerability that may not manifest routinely but carries major operational consequences when triggered. API shortages, in particular, reflect Ethiopia's overdependence on a **narrow global sourcing base**—primarily India and China. This concentrated exposure makes local manufacturers highly susceptible to **external supply shocks,** such as export restrictions, geopolitical tensions, or upstream manufacturing disruptions. The complete absence of local API production capability further magnifies this risk, leaving firms with limited fallback options. Supplier unreliability—while slightly more frequent—is often rooted in the absence of formalized supplier performance management systems. The lack of contractual enforcement mechanisms, supplier scorecards, and multi-sourcing strategies exacerbates the risk of lead time variation, quality failures, or non-compliance with regulatory standards. These upstream failures directly affect downstream manufacturing stability, product release schedules, and market supply continuity.

In summary, while API shortages and supplier failures may not top the frequency charts, their high disruptive potential highlights their strategic importance in pharmaceutical supply chain risk management. Neglecting these risks could leave firms structurally exposed to cascading operational failures, especially under stress scenarios like pandemics, geopolitical shifts, or forex constraints.

4.4.2.5. Forecasting Failures

The results reveal that forecasting and demand planning failures are perceived as among the least frequent and least severe disruption risks in the Ethiopian pharmaceutical sector.

With a mean frequency score of **3.13** and only **27.0%** of respondents rating them as "Frequent" or "Very Frequent," this risk type appears to receive relatively low operational attention. Its mean severity score of **2.73,** the lowest among all disruption types, and only **20.2%** of respondents considering it "Severe" or "Very Severe," reinforce this perception of limited criticality. However, this dual underestimation raises important red flags. **Forecasting failures** are rarely experienced as acute events—but when they do occur, their impact tends to be diffuse, systemic, and financially cumulative. In pharmaceutical manufacturing, inaccurate demand planning leads to stockouts of essential medicines, overproduction of low-demand inventory, or product expirations—all of which carry hidden costs in lost revenue, capital lock-up, or regulatory penalties.

The relatively low severity ratings may be attributed to the prevalence of compensatory workarounds—such as manual reordering, buffer stocks, or informal distributor feedback loops. Yet such coping mechanisms are inherently reactive, unreliable, and unsustainable, especially in volatile post-pandemic conditions or amid forex shortages. What this suggests is a maturity gap in demand planning systems across firms. The underreporting in both frequency and severity may stem from the absence of structured forecasting models, limited use of historical sales data or predictive analytics, and a general underappreciation for the strategic function of demand planning in overall supply chain resilience.

4.4.3. Qualitative Insights

To triangulate the structured survey data and uncover underreported vulnerabilities, qualitative inputs were gathered from two complementary sources: (i) open-ended responses obtained from **20** of the 89 survey participants (22.5%), and (ii) **6** in-depth interviews with senior managers and policy-facing experts in Ethiopia's pharmaceutical manufacturing sector. These inputs served both **exploratory** and **confirmatory** functions—uncovering emerging risks not previously captured and validating survey findings through expert reflection. Thematic analysis of the qualitative responses revealed several critical disruption risks (as listed and described below) that were either absent from the structured questionnaire or underemphasized in quantitative findings. These emerging risks illustrate a broader-than-expected risk landscape, requiring attention to both internal organizational vulnerabilities and systemic, cross-border supply chain dynamics.

Qualitative triangulation is essential in revealing hidden risks, validating quantitative trends, and uncovering root causes often invisible to rating scales. The integration of all three data sources yields several converging themes. **Structural risks dominate** the pharmaceutical supply chain landscape in Ethiopia, particularly those tied to forex policy, shipping regulation, and regulatory rigidity. **Internal capabilities,** especially around forecasting and human capital, remain underdeveloped and contribute to fragility even in the absence of external shocks. These findings form the empirical and conceptual bridge to the next sections of the thesis, which assess how firms respond to these SCDRs and propose a pathway for system-wide improvement.

The integration of open-ended and expert interview findings reinforces the breadth and depth of Ethiopia's pharmaceutical SCDRs. The qualitative data expands the taxonomy of disruption types and illuminate root causes that were otherwise underreported in structured responses. They also validate the severity and frequency ratings of key risks while introducing new lenses of analysis—most notably internal workforce stability and localized conflict vulnerability. These insights will be further synthesized in **Chapter 4** and translated into targeted recommendations in **Chapter 5.**

- **Human Resource Disruptions:** Staff turnover and cross-functional skills gaps were frequently cited as contributing to delays in procurement, production, and emergency order fulfillment. While such disruptions may not cause a complete shutdown of internal operations, they place significant pressure on organizational performance and responsiveness. This finding expands the scope of SCDRs beyond material and logistical flows to include the internal workforce, underscoring the strategic importance of human capital stability in sustaining operational continuity and resilience.
- **Logistics Bottlenecks and Shipping Monopolies:** Respondents emphasized ongoing container shortages, and rigidities caused by the state-enforced use of Ethiopian Shipping Lines. These issues extend the previously reported transport/logistics disruptions to include structural and policy-induced constraints that limit firms' routing and cost flexibility.
- **Financial Policy-Related Disruptions:** Several respondents—both from the open-ended survey and expert interviews—highlighted key financial policy constraints as critical contributors to supply chain disruptions. Specifically, the absence of supplier credit arrangements, rigid foreign exchange regulations, particularly on telegraphic transfer (TT) limits, and the unpredictability of franco valuta approvals were cited as major impediments.

Respondents emphasized that more flexible and transparent financial policies in these areas could significantly alleviate the supply chain challenges currently facing the pharmaceutical manufacturing sector.

- **Regulatory Delays and Lack of Regional Regulatory Harmonization:** Regulatory delays—particularly those related to dossier assessments—were identified as key factors contributing to a limited supplier pool. Some respondents also cited prolonged delays in product release approvals, noting that all local manufacturers are required to undergo batch testing and obtain regulatory clearance prior to releasing products into the domestic market. These procedural bottlenecks not only disrupt downstream supply chain continuity but also place considerable strain on firms' financial flows and inventory management. Furthermore, the lack of regional regulatory harmonization was highlighted as a missed opportunity. Respondents argued that mutual recognition of approved vendors from neighboring countries, even if not yet approved in Ethiopia, could serve as a practical solution to expand sourcing options and mitigate supplier-related disruptions.

The interviewees also reaffirmed several dominant themes from the structured questionnaire, most notably:

- **Foreign Exchange Shortages** as the most persistent and severe systemic constraint;
- **Regulatory delays** as a major barrier to sourcing resilience;
- The critical role of **transport infrastructure** and **customs inefficiencies** in amplifying lead-time variability.

This convergence enhances the credibility, internal consistency, and contextual robustness of the overall findings. The qualitative data thereby serve not merely as anecdotal extensions, but as confirmatory evidence and **diagnostic depth** for the survey's statistical trends.

Crucially, many qualitative responses went beyond naming risk sources to explicitly linking them to performance losses. These accounts provide causal depth, supporting a more granular disruption–impact–response model.

For example, below are quotes from some of the respondents:

> *"Frequent internal conflicts severely disrupting downstream domestic supply chain."*
> *"Shortage of containers; That is why ships load once monthly both from China & India"*
> *"Only Ethiopian shipping lines allowed…leads to long delays."*

Such reflections underscore the cumulative and cascading nature of disruptions in regulated industries like pharmaceuticals, where every delay can trigger quality risks, contractual penalties, or regulatory non-compliance. In respect of contractual penalties, local manufacturers winning EPSS tenders could not meet delivery timelines, and many forfeiting their performance bond (in most cases, huge money). More than its financial consequences, this means that EPSS (the public pharma supplier) cannot supply enough to the public; sometimes unnecessary stockouts occur in public hospitals & health centers.

Moreover, the qualitative insights were used to integrate the findings. The consolidated and triangulated evidence from the structured survey (n = 89), open-ended responses (n = 20), and six in-depth interviews with senior-level pharmaceutical industry professionals, yield a multi-dimensional understanding of the types, frequency, severity, and underlying dynamics of SCDRs and the management strategies employed by the local pharma manufacturers.

1. A consistent finding across all sources is the centrality of **forex shortages**, **regulatory/customs delays,** and **geopolitical shocks** as dominant, high-impact risks.

- The survey showed **forex shortages** as both the most frequent (96.7% rated "frequent" or "very frequent") and most severe (mean = 4.85, with 100% rated "severe" or "very severe"). This perception was echoed in qualitative accounts referencing the rigidity of TT payment processes, delayed foreign approvals, and chronic backlog in currency access. Interviewees characterized forex-related disruptions as "structural" and "beyond the firm's mitigation capacity," reinforcing the need for macro-policy reform.
- Similarly, **regulatory delays** and **geopolitical shocks** were rated as highly frequent and severe in the survey and were expanded upon qualitatively as being caused by slow supplier registration process, customs procedural bottlenecks, and recurrent local conflict and unrest. These findings highlight that while some risks originate in global or market dynamics, many are embedded in domestic regulatory and governance frameworks.

2. The integration of data sources reveals important discrepancies between perceived frequency and actual severity, especially for **API shortages** and **forecasting failures.** While both risks were rated as infrequent (mean frequency scores of 3.12 and 3.13, respectively), their impact—particularly for API shortages (mean severity = 3.49)—was disproportionately high when they occurred. Interviews confirmed this pattern, with experts citing the lack of domestic API production, overreliance on India and China, and long procurement lead times as amplifiers of risk exposure.

- Although forecasting failures were perceived by **survey respondents** as both relatively infrequent and less severe (mean severity = 2.73), they were critically highlighted by **expert interviewees** as underestimated yet strategically consequential risks. These failures often carry **long-tail operational effects,** including not only stockouts and shortages, but also overstocking, product expiries, and capital lock-up. One expert cited a concrete case in which a manufacturer had procured an excessively high volume of API that ultimately remained unused and expired; underscoring the material and financial costs of inaccurate demand planning. This observation is consistent with broader SCRM literature, which warns against misjudging internal planning failures—as they can be deeply disruptive, particularly in regulated, demand-volatile industries like pharmaceuticals.

3. The qualitative data significantly enriched the risk taxonomy. Open-ended responses and interviews surfaced additional disruption sources not included in the original structured questionnaire:

- **Shipping and routing constraints,** especially the mandatory use of Ethiopian Shipping Lines and global container shortages;
- **Human resource disruptions,** such as turnover and weak cross-functional competencies;

These findings highlight the importance of localized, context-specific risk assessment frameworks and support calls in the literature for hybrid approaches that combine quantitative ratings with experiential narratives (Emrouznejad et al., 2023; Sinaga et al., 2024).

4.5. Adoption Patterns of SCDRM Strategies

This section explores the extent to which each firm adopts various strategies aimed at managing supply chain disruption risks. Respondents (n=89) were asked to indicate the frequency of implementation for each listed 13 SCDRM practice, based on their firm's current operational experience. Responses were captured using a 5-point Likert scale, from **1 : Never; up to 5 = Very Frequently.** The empirical findings were critically analyzed using both descriptive statistics and rankings to assess strategy adoption levels, providing insights into the preparedness and risk maturity of the sector. The results **(Table 4.8)** reveal significant implementation gaps, inconsistent adoption across firms, and a general reliance on informal or underdeveloped resilience mechanisms. The data collected here supports the assessment of adoption patterns, strategy effectiveness, and areas where capacity building or policy support may be required.

Table 4.8. Survey Findings on Strategy Adoption (n=89). Source: Survey Data (2025)

SCDRM Strategy	ADOPTION OF STRATEGIES: Total no. of responses Likert Scale				
	1	2	3	4	5
SCDRM System	3	14	46	20	6
Supplier diversification, or multi-sourcing	0	51	21	9	8
Supplier risk audits	0	10	51	18	10
Safety stock, or buffer inventory	0	46	22	13	8
Local sourcing	10	44	25	5	5
Advanced Forecasting tools	10	48	18	10	3
Supply chain collaboration	3	41	27	13	5
Long-term contracts	15	46	15	8	5
Global best practices	15	48	10	13	3
Business continuity plans (BCPs)	0	55	20	11	3
Emergency procurement or supplier credit	5	56	18	10	0
Pre-identified back-up suppliers or transporters	0	58	15	10	5
Rescheduling or rerouting	0	41	25	23	0

The descriptive statistics presented in **Table 4.9** summarize the adoption levels of various SCDRM strategies among pharmaceutical manufacturers in Ethiopia. Among the strategies assessed, supplier risk audits recorded the highest adoption rate (31.46%) and the highest mean score (3.31), indicating relatively strong implementation and perceived importance.

Conversely, strategies such as global benchmarking (17.98%, mean = 2.34), advanced forecasting (14.61%, mean = 2.42), and local sourcing (11.24%, mean = 2.45) were among the least adopted, reflecting either contextual constraints or limited organizational capacity. Although nearly 30% of firms reported having some form of an SCDRM system (mean = 3.13), other foundational practices—such as business continuity planning (BCP), backup supplier arrangements, and emergency procurement protocols—showed limited adoption, each scoring below a mean of 2.6.

Table 4.9. Descriptive Statistics for on Strategy Adoption. Source: Researcher's SPSS

Strategy	% Frequent + Very Freq	mean	min	max	mode	std
SCDRM System	29.21	3.13	1	5	3	0.88
Supplier diversification	19.1	2.71	2	5	2	0.98
Supplier risk audits	31.46	3.31	2	5	3	0.82
Safety stock	23.6	2.81	2	5	2	1.00
Local sourcing	11.24	2.45	1	5	2	0.97
Advanced Forecasting	14.61	2.42	1	5	2	0.95
SC collaboration	20.22	2.73	1	5	2	0.95
Long-term contracts	14.61	2.35	1	5	2	1.05
Global best practices	17.98	2.34	1	5	2	1.03
BCPs	15.73	2.57	2	5	2	0.84
Emergency procurement	11.24	2.37	1	4	2	0.76
Backup suppliers	17.05	2.57	2	5	2	0.91
Rescheduling/Rerouting	25.84	2.80	2	4	2	0.83

Table 4.10 presents a ranked summary of the adoption levels of selected SCDRM strategies among Ethiopian pharmaceutical manufacturers based on mean Likert scores and frequency of use.

Supplier risk audits (mean = 3.32) and SCDRM systems (mean = 3.14) rank highest, indicating relatively greater institutional uptake and integration. In contrast, strategies such as global best practices (mean = 2.34), long-term contracts (2.35), and emergency procurement (2.37) ranked lowest, reflecting limited routine application. The distribution suggests a fragmented adoption pattern where a few strategies show moderate implementation, while most remain underutilized—highlighting strategic and operational gaps in SCDRM maturity across the sector.

Table 4.10. Ranking of strategies adoption based on mean Likert score (adoption level (n=89).
Source: Survey Data (2025), Researcher's SPSS Analysis

Ranked Position	Strategy	Mean Score	% Frequent + Very Frequent	SD
1	Supplier risk audits	3.32	31.5	0.82
2	SCDRM System	3.14	29.2	0.88
3	Safety stock	2.81	23.6	1.00
4	Rescheduling or rerouting	2.80	25.8	0.83
5	Supply chain collaboration	2.73	20.2	0.95
6	Supplier diversification	2.71	19.1	0.98
7	BCPs	2.57	15.7	0.84
8	Pre-identified back-up suppliers	2.57	17.0	0.91
9	Local sourcing	2.45	11.2	0.97
10	Advanced Forecasting tools	2.42	14.6	0.95
11	Emergency procurement	2.37	11.2	0.76
12	Long-term contracts	2.35	14.6	1.05
13	Global best practices	2.34	18.0	1.03

4.5.1. Overall Implementation Landscape

The aggregated results indicate that SCDRM practices are generally underdeveloped and fragmentedly applied across firms. Only two strategies surpassed a mean adoption score of 3.0—namely, supplier risk audits (mean = 3.32) and SCDRM systems (3.14). The overall mean scores for most other practices fell between 2.3 and 2.8, reflecting partial or ad hoc implementation, rather than full integration into firm-wide supply chain management processes.

4.5.2. Leading Practices

At the top of the ranking was supplier risk audits—focused on vendor evaluation and reliability—with 31.5% of respondents rating its adoption as frequent or very frequent. This suggests that firms are beginning to take upstream risk profiling seriously. Similarly, the adoption of a SCDRM system—encompassing structured risk identification, assessment, treatment, and monitoring—ranked second overall (mean = 3.14), with 29.2% reporting frequent or higher use. These findings signal growing institutional awareness of the need for structured risk management capabilities, although implementation remains uneven. The relatively strong performance of safety stock strategies (mean = 2.81; 23.6% frequent+) and rescheduling or rerouting (2.80; 25.8%) reflects a tactical rather than strategic orientation, wherein firms compensate for systemic weaknesses (e.g., delays, shortages) using adaptive stopgap measures rather than long-term resilience planning.

4.5.3. Underdeveloped and Reactive Practices

Conversely, several critical strategies showed alarmingly low levels of adoption. For instance, advanced forecasting tools—essential for demand predictability and inventory planning—had a mean score of just 2.42, with only 14.6% of firms implementing them frequently. Similarly, emergency procurement frameworks, long-term contracts, and pre-identified backup suppliers scored poorly on both adoption level and usage consistency. These findings are particularly concerning, given the high exposure of Ethiopian manufacturers to forex volatility and global shipping uncertainties. Furthermore, business continuity plans (BCPs)—both in terms of design and execution—received mean scores of 2.57 and implementation rates of just 15.7%. This suggests that even though disruptions are common, firms often lack formalized recovery protocols, exposing them to protracted losses during crisis episodes.

4.5.5. Implications for Risk Management Maturity

These findings suggest that Ethiopian pharmaceutical manufacturers are in a transitional phase of SCDRM maturity: moving from reactive, fragmented responses toward more structured, but still under-institutionalized strategies. While awareness of disruption risks is evident—particularly in supplier vetting and stock-based buffering—the sector lacks the systematic risk governance structures, forecasting infrastructure, and policy-aligned sourcing flexibility required for full resilience.

4.5.6. Interpretation of Findings: Adoption of SCDRM Strategies

The findings of this study reveal a limited and uneven adoption of structured SCDRM strategies among Ethiopian pharmaceutical manufacturers. While supplier risk audits and the existence of basic SCDRM systems were reported at moderate levels of adoption, most other critical practices—such as demand forecasting tools, backup supplier frameworks, emergency procurement protocols, and BCPs—remained minimally implemented across firms. This pattern aligns with previous studies by Hasan (2021) and Sime (2019), who similarly reported a lack of formal risk management infrastructure in the Ethiopian manufacturing sector, noting a continued reliance on ad hoc and reactive responses to disruption events. Furthermore, these results reinforce findings from Nguyen et al. (2020), who argue that firms in resource-constrained environments often operate without preemptive risk protocols, not due to lack of awareness, but because of organizational capability gaps, financial limitations, and insufficient institutional support.

Critically, the data also confirms the core assumptions of RMMs, particularly those articulated by Guerra et al. (2024) and Dellana et al. (2022). These frameworks propose that firms in LMICs often operate at early maturity levels, where basic awareness of risk exists, but implementation remains informal, fragmented, and uncoordinated. The study's findings reveal that most firms have not integrated risk management into strategic decision-making processes, nor have they established cross-functional SCDRM governance structures—a key criterion for reaching higher levels of maturity in such models. Notably, the limited alignment with international guidance from WHO, UNIDO, and ISO 31000/31010 further underscores the early-stage nature of SCDRM maturity in Ethiopia.

Recommended global practices were rarely adopted. Even low-cost, high-impact interventions like benchmarking or local sourcing were underutilized, suggesting that institutional gaps, regulatory fragmentation, and digital infrastructure deficits continue to inhibit systemic uptake.

These implementation shortfalls illustrate not only operational constraints but also strategic misalignments. The absence of matured risk frameworks restricts firms' ability to anticipate disruptions, adapt proactively, or recover efficiently—all hallmarks of high SCDRM maturity.

4.6. Perceived Effectiveness of Supply Chain Disruption Risk Management Strategies

This section investigates respondents' perceptions of how effective various SCDRM strategies have been in reducing SCDRs within their firms. The questions aim to assess not only whether a strategy is being used, but also how well it has performed in practice. Respondents were asked to rate the perceived effectiveness of each strategy only if it had been applied by their firm, using a 5-point Likert scale where: 1 – Not Effective at All; to 5 – Highly Effective. These insights help identify which strategies are perceived as most impactful in the local pharmaceutical context and can inform future prioritization, policy support, and capacity-building efforts. This section was included to enhance the study's practical contribution by complementing the descriptive research findings with evaluative insights into the real-world effectiveness of disruption management strategies.

Table 4.11. Firms Perceived Effectiveness of Strategies **(n=89)** Source: Survey Data (2025)

SCDRM Strategy	**Perceived Effectiveness: No. of responses for each Likert Scale**				
	1	**2**	**3**	**4**	**5**
SCDRM System	1	9	22	53	5
Supplier diversification, or multi-sourcing	0	8	20	56	5
Supplier risk audits	0	8	23	51	8
Safety stock, or buffer inventory	3	5	23	51	8
Local sourcing	5	15	10	56	3
Advanced Forecasting tools	3	10	25	48	3
Supply chain collaboration	0	10	28	43	8
Long-term contracts	5	18	13	41	13
Global best practices	5	13	20	41	10
Business continuity plans	0	11	34	46	9
Emergency procurement or supplier credit arrangements	8	18	15	43	5
back-up suppliers or transporters	0	13	20	48	8
Rescheduling or rerouting	3	5	28	46	8

The descriptive statistics for the Perceived Effectiveness of SCDRM Strategies were computed using SPSS v25 and presented in the table below (**Table 4.12**). The results include:

- **% Frequent + Very Frequent:** Percentage of respondents who rated strategy as 4 or 5.
- **Mean:** Average perceived effectiveness score on a 5-point Likert scale.
- **Min/Max:** Minimum and maximum effectiveness ratings received.
- **Mode:** Most frequently selected rating.
- **Standard Deviation (std):** Degree of variation in responses—higher values indicate greater disagreement among respondents.

Table 4.12. Descriptive Statistics for effectiveness of strategies perceived by respondents

Source: Survey Data (2025), Researcher's SPSS Analysis

Strategy	% Effective + Highly effective	mean	min	max	mode	std
SCDRM System	66.29	3.58	1	5	4	0.79
Supplier diversification	68.54	3.65	2	5	4	0.72
Supplier risk audits	65.17	3.66	2	5	4	0.77
Safety stock	66.29	3.62	1	5	4	0.86
Local sourcing	62.92	3.42	1	5	4	1.00
Advanced Forecasting tools	61.80	3.43	1	5	4	0.86
Supply chain collaboration	57.30	3.55	2	5	4	0.81
Long-term contracts	61.80	3.43	1	5	4	1.13
Global best practices	53.93	3.43	1	5	4	1.05
BCP existence	60.67	3.53	2	5	4	0.81
BCP execution	57.30	3.53	2	5	4	0.81
Emergency procurement /Supplier credit	60.67	3.21	1	5	4	1.11
Backup suppliers	66.29	3.57	2	5	4	0.85
Rescheduling or rerouting	57.30	3.57	1	5	4	0.86

Table 4.13. Ranked effectiveness of each strategy as perceived by respondents (n=89)

Source: Researcher's SPSS Analysis

Ranked Position	Strategy	mean
1	Supplier risk audits	3.66
2	Supplier diversification	3.65
3	Safety stock	3.62
4	SCDRM System	3.58
5	Backup suppliers	3.57
6	Rescheduling or rerouting	3.57
7	Supply chain collaboration	3.55
8	BCP existence	3.53
9	BCP execution	3.53
10	Advanced Forecasting tools	3.43
11	Long-term contracts	3.43
12	Global best practices	3.43
13	Local sourcing	3.42
14	Emergency procurement /Supplier credit	3.21

4.6.1. Overall Perception of Strategy Effectiveness

The data reveals generally favorable perceptions of the effectiveness of most SCDRM strategies, with mean scores ranging from 3.21 to 3.66 on a 5-point Likert scale. This suggests that the majority of strategies are perceived to be moderately to highly effective, although substantial variation exists among them.

4.6.2. Top-Perceived Effective Strategies

Supplier risk audits (Mean = 3.66, 65.17%) and supplier diversification (Mean = 3.65, 68.54%) emerged as the most effective strategies, with relatively low standard deviations (0.77 and 0.72 respectively), indicating broad agreement among respondents. Safety stock (3.62) and backup suppliers (3.57) were also rated highly in both mean score and % effectiveness (66.29%), reflecting the value placed on redundancy and proactive supplier evaluation. These strategies are generally proactive, reflecting a recognition that disruption mitigation is most successful when embedded into procurement and supplier management systems. These findings also underscore that firms value supplier-related assessments and redundancy mechanisms as effective shields against upstream and logistics disruptions.

4.6.3. Moderate PE and Mixed Consensus

The composite SCDRM System—comprising risk identification, assessment, treatment, and monitoring—ranked moderately with a mean score of 3.58 and 66.29% of respondents rating it as either ‘effective’ or ‘very effective.’ While this reflects a generally positive evaluation, it also suggests implementation inconsistencies or capacity gaps in some firms, particularly in institutionalizing regular monitoring and risk review practices. Notably, Internal Risk Review Mechanisms scored the lowest among system-level practices in earlier adoption analysis (Section 4.5), but in terms of effectiveness, they received an improved evaluation (mean = 3.53), reinforcing that when such practices are in place, they are valued. Strategies such as Supply Chain Collaboration (3.55, 57.30%), and BCP existence/execution (3.53 each) received slightly lower mean ratings but still had a mode of 4, implying many firms rated them as “effective.” However, the standard deviations around 0.81 suggest moderate variation in experiences, indicating that effectiveness may depend on firm size, implementation quality, or contextual adaptability.

4.6.4. Lowest-Rated Strategies

Lower-tier strategies, such as Emergency procurement or supplier credit (Mean = 3.21, 60.67%) showed the lowest effectiveness rating, coupled with a high standard deviation (1.11), implying inconsistent or unpredictable outcomes.

Global benchmarking (3.43, 53.93%) also exhibited weaker PE, possibly due to limited localization, contextual mismatches, or lack of implementation support.

These findings suggest that reactive strategies and externally derived best practices may be less adaptable or less embedded in local operational systems. Even strategies like Advanced Forecasting Tools (mean = 3.13), while intuitively valuable, may underperform due to data quality issues, or lack of digital infrastructure.

4.6.5. Variability in Perception (Standard Deviation Analysis)

The highest standard deviations were recorded for long-term contracts (1.13), emergency procurement (1.11), and global benchmarking (1.05)—signaling significant variation in perceived effectiveness. This variation indicates that while some firms benefit substantially, others may find these strategies impractical, costly, or poorly implemented. Conversely, strategies like supplier diversification (0.72) and supplier risk audits (0.77) had low standard deviations, reflecting consistent perceived effectiveness across firms.

4.6.6. Interpretation of Findings: Perceived Effectiveness of Strategies

Despite the low overall adoption of structured SCDRM practices, several underutilized strategies—most notably forecasting tools and BCPs—were perceived by respondents as moderately to highly effective. This finding mirrors the conclusions of Wagner and Bode (2008b) and Ganiyu et al. (2020), who argue that proactive and preemptive risk management systems not only help prevent supply chain disruptions but also enhance the overall resilience and responsiveness of firms in turbulent environments. The apparent disconnect between perceived value and actual implementation a missed opportunity for strategic risk reduction and highlights the impact of operational, financial, and institutional barriers that hinder implementation.

The high perceived effectiveness of supplier audits and supply base diversification is particularly notable. These strategies align well with the buffering logic of RDT, which emphasizes that firms reliant on volatile external resources must mitigate that dependence through multi-sourcing, supplier vetting, and contractual flexibility (Kalaitzi, 2016; Hillman et al., 2009).

Their favorable perception indicates a tacit recognition among Ethiopian pharmaceutical manufacturers that external resource shocks require internal strategic responses, and that such strategies can offer both flexibility and supply assurance.

A more nuanced insight from the data is the mismatch between perceived effectiveness and institutional commitment to many globally recommended SCDRM strategies. For instance, tools like emergency procurement frameworks, benchmarking practices, and scenario planning were inconsistently perceived and rarely adopted. The variability in responses suggests that awareness alone is insufficient to drive implementation; rather, factors such as institutional inertia, regulatory fragmentation, skill shortages, and infrastructure limitations likely mediate whether a strategy is viewed as implementable or simply aspirational. This supports Feitosa et al. (2021), who argue that the perceived strategic fit—not merely technical validity—often governs the practical utility of a risk management intervention. Conversely, strategies grounded in internal operational control—such as inventory buffers, supplier performance monitoring, and cross-functional coordination mechanisms—tended to show both higher levels of consensus on effectiveness and a clearer pathway to institutionalization. These findings emphasize that SCDRM strategies perceived as internally actionable and less institutionally encumbered are more likely to be valued and eventually adopted, especially in resource-constrained settings.

4.8. Challenges to SCDRM Implementation

4.8.1. Frequency of Implementation Challenges

This section aims to identify the institutional, operational, and contextual challenges that pharmaceutical firms have faced in implementing SCDRM strategies. Understanding these implementation challenge is essential for diagnosing the practical constraints that hinder the effectiveness of even well-designed risk mitigation plans. Respondents (n = 89) were presented with a list of potential challenges and asked to indicate whether each has been experienced by their firm.

Table 4.14. Frequency Distribution of Challenges to SCDRM Implementation (n=89)

Source: Survey Data (2025)

Implementation Challenge	Reported SCDRM Implementation Barriers (n=89)			% Total		
	Yes	No	Not Sure	% Yes	% No	% Not Sure
Forex constraints	86	0	3	96.6	0	3.4
Financial resource limitations	79	5	5	88.8	5.6	5.6
Lack of visibility technology	71	10	8	79.8	11.2	9
Lack of awareness/training	69	15	5	77.5	16.9	5.6
Regulatory/policy misalignment	69	10	10	77.5	11.2	11.2
Skill shortage	64	18	8	71.9	20.2	9
Supplier disengagement	61	15	13	68.5	16.9	14.6
Poor cross-functional collaboration	61	23	5	68.5	25.8	5.6
Low internal support	56	23	10	62.9	25.8	11.2
Resistance to change	53	23	13	59.6	25.8	14.6

As summarized in **Table 4.14**, the most frequently reported implementation barrier was foreign exchange (forex) constraints, flagged by 96.6% of respondents. This barrier has systemic roots in Ethiopia's macroeconomic environment and was further validated in the open-ended and interview findings as a bottleneck to procuring APIs, raw materials, and logistics services. Financial resource limitations (88.8%) were also widely cited, indicating structural liquidity and working capital challenges across firms.

The third most cited challenge was the lack of visibility or monitoring technology (79.8%), suggesting a significant digital capability gap in risk tracking and early warning systems. This has important implications for the design and effectiveness of any proactive SCDRM system.

Similarly, the lack of awareness or training (77.5%) and regulatory/policy misalignment (77.5%) ranked fourth and fifth, respectively, underscoring gaps in institutional readiness and alignment between the pharmaceutical sector and national policy frameworks.

Other notable challenges included skill shortages (71.9%), supplier disengagement (68.5%), and poor cross-functional collaboration (68.5%). These findings indicate that SCDRM failures are not simply external or technical in nature, but also stem from internal organizational limitations—such as inadequate cross-departmental planning or risk ownership.

4.8.2. Severity of Implementation Challenges

This subsection assesses the degree of impact that identified barriers have had on the firm's operations and its ability to implement SCDRM strategies effectively. While the previous subsection 4.8.1. (prevalence of barriers) established the presence of implementation barriers, this follow-up question explores the severity of their consequences on current performance and risk management execution. Respondents were asked to evaluate the extent of operational or strategic disruption caused by each barrier, using a five-point Likert scale: **1 = No Impact**; to **5 = Very Severe Impact**.

These responses provide insight into which barriers have the most weakening effects, allowing for more evidence-based prioritization of interventions at both firm and policy levels.

Table 4.15. below summarizes severity ratings and percentage of respondents indicating “High” (4) or “Very Severe” (5) operational impacts for each challenge.

Table 4.15. Challenges Ranking and Percentage as 4 or 5 (n=89)

Source: Survey Data (2025), Researcher's SPSS Analysis

Implementation Challenge	Total no. of responses under each Likert scale (1-5)					Mean Score	% High impact + Very Severe Impact
	1	2	3	4	5		
Budget constraints	3	0	0	28	58	4.63	96.6%
Difficulty securing foreign exchange	3	0	8	13	56	4.51	77.5%
Lack of technological systems	3	5	15	53	10	4.00	70.7%
Regulatory/policy misalignment	5	3	15	48	15	3.98	70.8%
Skilled personnel shortage	3	15	10	43	13	3.78	62.9%
Low awareness/training	3	13	46	15	10	3.73	62.9%
Poor cross-functional coordination	3	10	46	18	8	3.71	60.7%
Internal resistance to change	9	17	17	37	11	3.61	53.9%
Low internal prioritization	3	13	41	23	5	3.56	51.7%
Weak supplier engagement	3	15	36	20	8	3.41	49.4%

1. **Financial Constraints as the Most Severe Barrier**

   Budget constraints (mean = 4.63) and foreign exchange access (mean = 4.51) are overwhelmingly cited as the most weakening operational barriers. With 96.6% of respondents rating financial limitations as "high" or "very severe," this underscores a core structural vulnerability: the absence of financial resilience mechanisms. Despite awareness and intention, many firms are functionally unable to implement SCDRM strategies due to lack of liquidity and unpredictable forex regimes. These findings are consistent with earlier frequency results and align with Gereffi (2021) and UNCTAD (2022) on LMIC constraints in operationalizing resilient supply chains.

2. **Technological and Institutional Deficits**
   Lack of visibility tools (mean = 4.00) and policy misalignment (mean = 3.98) emerge as systemic enablers of disruption. More than 70% of respondents rated these as highly or very severely disruptive. Technological maturity — particularly real-time tracking, predictive analytics, and digital procurement — remains critically underdeveloped. Similarly, regulatory misalignment between agencies leads to conflicting rules and inertia. These system-level issues are disabling firm-level agility and response.

3. **Human Capital Gaps and Organizational Inertia**
   Respondents identified lack of trained personnel (62.9%), low awareness (62.9%), and internal resistance (53.9%) as severe barriers. This cluster points to a human resource deficit not only in numbers but in competencies, mindset, and institutional memory. These barriers suggest that even if SCDRM tools or plans are introduced, cultural inertia and insufficient capacity prevent meaningful execution.

4. **Fragmentation and Weak Supplier Engagement**
   Poor cross-functional coordination (60.7%) and weak supplier engagement (49.4%) reflect misalignment both within and outside the firm. Supply chain resilience requires integration — yet departmental silos and transactional supplier relationships are common. This suggests that relational risk management and systems thinking are underutilized despite their prominence in global best practice frameworks (Poberschnigg et al., 2020).

4.8.3. Severity of Implementation Challenges

The study reveals that Ethiopian pharmaceutical manufacturers face a constellation of systemic, institutional, and organizational barriers that inhibit the effective implementation of SCDRM strategies. Top among these are foreign exchange shortages, financial resource constraints, limited supply chain visibility, and regulatory misalignment—challenges widely recognized in the literature as critical impediments in LMICs (Pettit et al., 2010; Kamalahmadi & Parast, 2016; WHO, 2022). These findings also reaffirm local studies such as Tegegne (2022) and Neguse (2019), which identified similar challenges facing Ethiopian pharmaceutical importers and manufacturers, including bureaucratic bottlenecks and underdeveloped infrastructure.

From a Resource Dependence Theory (RDT) perspective, the financial and technological constraints reported by firms represent structural vulnerabilities embedded in external dependencies—namely, reliance on volatile foreign exchange markets, imported inputs, and weak institutional ecosystems. The inability of firms to buffer these dependencies—either through diversified financing, local sourcing, or strategic alliances—exposes a deeper systemic fragility that cannot be resolved by firm-level action alone (Guerra et al., 2024).

At the organizational level, the study found pervasive issues related to low internal prioritization, poor cross-functional coordination, and siloed decision-making structures. These are consistent with findings from Dellana et al. (2022) and other Risk Management Maturity Model (RMM) scholars, who view such traits as indicative of low maturity stages, where risk management is neither formally institutionalized nor embedded into strategic planning. Instead, responses tend to be reactive, fragmented, and dependent on the initiative of individual departments rather than a cohesive organizational risk governance culture. Furthermore, institutional misalignments and procedural inefficiencies at customs and regulatory bodies were frequently cited in qualitative interviews. These findings suggest a misfit between policy frameworks and operational realities, echoing warnings from UNCTAD (2022) and WHO (2021) that effective SCDRM in LMICs requires not only technical interventions but governance reform and multi-stakeholder coordination.

4.9. Theoretical and Practical Implications

The findings of this study offer strong empirical validation for the integrated theoretical framework that underpins this research—comprising Supply Chain Risk Management (SCRM) theory, Resource Dependence Theory (RDT), and Risk Management Maturity Models (RMMs). Each framework provides a distinct but complementary lens to interpret the dynamics observed in Ethiopia's pharmaceutical manufacturing sector. From an SCRM perspective, the limited adoption of structured risk practices—such as forecasting tools, supplier audits, emergency procurement protocols, and business continuity planning (BCP)—reveals a systemic lack of proactive preparedness.

This supports foundational propositions by Kleindorfer and Saad (2005) and Tang (2006), which stress that SCRM maturity hinges on the continuous application of risk identification, assessment, and mitigation mechanisms. The observed gaps reflect an environment where most firms still rely on reactive or ad hoc strategies, lacking formal risk governance structures and cross-functional coordination. As such, the thesis substantiates the criticism by Wieland and Wallenburg (2012) that without integrated risk visibility, supply chains remain vulnerable to cumulative disruption effects.

RDT, meanwhile, offers a powerful explanatory lens for understanding the chronic vulnerabilities of Ethiopia's pharmaceutical firms. The sector's heavy reliance on imported APIs, excipients, machinery, and foreign exchange represents structural dependencies that are largely outside the control of individual firms. These dependencies amplify exposure to disruption and limit firms' bargaining power with upstream actors. As RDT predicts, several firms have responded by adapting SCDRM strategies. These adaptations mirror theoretical assertions by Hillman et al. (2009) and Kalaitzi (2016), highlighting how organizations attempt to regain autonomy and reduce external uncertainty through strategic engagement and resource alignment.

The Risk Management Maturity Model (RMM) lens further enriches the theoretical contribution. The findings confirm that most Ethiopian pharmaceutical manufacturers operate at early stages of SCDRM maturity—characterized by limited formalization, poor integration, and weak alignment. This aligns with Dellana et al. (2022) and Guerra et al. (2024), who argue that firms at low maturity levels often lack risk governance protocols necessary for resilience. Furthermore, the observed disconnect between perceived effectiveness and actual adoption of best-practice strategies reveals both capability and institutional inertia, typical of low-maturity organizations.

From a practical standpoint, the study underscores that effective SCDRM in resource-constrained contexts such as Ethiopia cannot be achieved solely through firm-level interventions. The challenges revealed—such as foreign exchange scarcity, regulatory inefficiencies, and limited access to digital infrastructure—are systemic and require multi-level coordination. Thus, practical implications extend beyond individual firm capability building to include policy reforms, public-private collaboration, and donor-supported investment in risk governance infrastructure.

4.10. Alignment with Research Questions

This section synthesizes the major findings of the study in relation to each of the research questions, thereby validating the study's conceptual framework and affirming the relevance of the integrated theoretical lenses—namely, Supply Chain Risk Management (SCRM), Resource Dependence Theory (RDT), and Risk Management Maturity Models (RMM).

General Research Question: What is the current state of SCDRM maturity among pharmaceutical manufacturers in Ethiopia?

The study finds that the overall maturity level of SCDRM among Ethiopian pharmaceutical manufacturers is early-stage and fragmented. While awareness of key risks and strategies exists, most firms lack formal SCDRM systems, institutional integration, and cross-functional coordination. The findings reveal limited adoption of structured risk identification tools, scenario planning, and continuity frameworks. Digital visibility, supplier diversification, and benchmarking mechanisms are also underdeveloped. These characteristics are consistent with low to emerging levels of maturity as defined by international risk maturity models (Dellana et al., 2022; Guerra et al., 2024), confirming that most Ethiopian manufacturers operate reactively rather than proactively.

RQ1: What are the key sources of supply chain disruption risks encountered by pharmaceutical manufacturers in Ethiopia?

The study identified a multi-layered disruption risk landscape, dominated by external systemic risks. The top among these are foreign exchange shortages, regulatory and customs delays, and logistics breakdowns, all of which were reported as both frequent and highly disruptive. Upstream vulnerabilities—such as API shortages and unreliable suppliers—were also significant, particularly in their severity. Furthermore, qualitative findings introduced underreported yet critical risks including human capital instability, financial policy constraints, and shipping rigidities. These findings are consistent with RDT's assertion that external dependencies generate strategic vulnerabilities when not actively buffered (Pfeffer & Salancik, 1978; Kalaitzi, 2016).

RQ2: What SCDRM strategies have been adopted by these firms to manage disruption risks?

The adoption of SCDRM strategies is uneven and primarily reactive. While supplier audits and basic risk registers are present in some firms, core proactive strategies—such as backup sourcing, forecasting systems, and business continuity planning—are minimally adopted. Most firms lack formal risk protocols, integrated digital infrastructure, or real-time response systems. These gaps corroborate prior findings in LMICs (Hasan, 2021; Neguse, 2019), and indicate early maturity stages characterized by ad hoc decision-making and low institutionalization of risk governance (Dellana et al., 2022).

RQ3: How do pharmaceutical manufacturers in Ethiopia perceive the effectiveness of their SCDRM strategies?

Despite low adoption levels, manufacturers generally perceive SCDRM strategies—particularly supplier audits, diversification, and safety stock—as highly effective. However, their current use remains limited, signaling a clear disconnect between perceived value and implementation reality. This supports theoretical insights from Wagner & Bode (2008) and Feitosa et al. (2021), which show that strategic fit and institutional support are critical to operationalizing perceived best practices. The same match suggests that challenges are structural and systemic, rather than knowledge-based.

RQ4: What challenges hinder the effective implementation of SCDRM strategies among these manufacturers?

The study revealed a dual-layered challenge profile, comprising both internal (organizational) and external (systemic) challenges. Internally, firms struggle with limited technical capacity, cross-functional silos, poor prioritization, and inadequate human capital. Externally, challenges include forex scarcity, rigid regulatory regimes, customs inefficiencies, and lack of enabling policies. These constraints confirm the literature's view that SCDRM is not only a managerial issue but a structural governance challenge (Kamalahmadi & Parast, 2016; Guerra et al., 2024). From an RMM lens, these are symptoms of low maturity, where risk management lacks formalization, strategic integration, and institutional coherence.

CHAPTER FIVE:

SUMMARY OF KEY FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

5.1. Summary of Key Findings

This study systematically assessed SCDRM practices among pharmaceutical manufacturers in Ethiopia, adopting a mixed-methods research design. Primary data was gathered through structured surveys from 89 respondents across EFDA-licensed human medicine manufacturers, supplemented by expert interviews with six senior supply chain professionals. The findings were analyzed and thematically organized across six core dimensions aligned with the study's conceptual framework: (1) Disruption Risk Landscape, (2) SCDRM Strategies and Practices, (3) Perceived Effectiveness, (4) Implementation Challenges, (5) Contextual Innovations, and (6) International Alignment.

Key findings include:

1. **Disruption Risk Profile:** The study confirms that foreign exchange (forex) shortages represent the most frequent and most disruptive risk, with 100% of respondents reporting high severity. Other systemic risks—including regulatory and customs delays, transport breakdowns, and geopolitical instability—form a second tier of disruption, often affecting import reliability and lead times. Meanwhile, API shortages and forecasting failures, although less frequently reported, were identified as high-impact risks when triggered, revealing latent vulnerabilities.
2. **Adoption of SCDRM Practices:** The overall adoption of structured SCDRM strategies remains limited, signaling early-stage maturity in the sector. Only a few firms reported having formal supplier audit mechanisms and basic SCDRM systems in place. Critical strategies—such as BCP, emergency procurement protocols, and digital forecasting tools—were either absent or weakly institutionalized across the majority of firms.
3. **Perceived Effectiveness:** Despite low levels of formal adoption, most SCDRM strategies—particularly those involving supplier engagement (e.g., audits, diversification, buffer stocks)—were perceived as moderately to highly effective. This points to a capacity–awareness gap, in which firms understand the utility of SCDRM but lack the organizational structures or resources to implement them systematically.

4. **Implementation Challenges:** The most frequently cited challenges to effective SCDRM implementation include chronic forex constraints, limited financial capacity, absence of digital visibility tools, and poor regulatory coordination. These constraints reveal a deeper structural misalignment between risk exposure and organizational readiness, further highlighting the need for sector-wide investment in risk governance infrastructure.

Taken together, these findings demonstrate that while awareness of SCDRM is growing among Ethiopian pharmaceutical manufacturers, most operate at a low-to-intermediate level of risk management maturity. The sector's SCDRM landscape is marked by fragmented adoption, weak institutionalization, and limited alignment with global best practices. The presence of awareness without implementation, and strategy without integration, reflects a maturity profile that is nascent but potentially transformable with targeted policy, institutional, and capability-building interventions. Bridging this gap requires not only firm-level transformation but also supportive regulatory, financial, and infrastructural interventions to facilitate the transition toward systematic and strategic SCDRM maturity.

5.2. Conclusions

This study concludes that Ethiopia's pharmaceutical manufacturers operate in a highly vulnerable and structurally constrained environment—characterized by persistent exposure to macroeconomic instability, import dependency, and regulatory fragmentation. Firms contend with multi-layered SCDRs, ranging from forex shortages and supplier unreliability to infrastructural and geopolitical challenges. These conditions validate the assumptions of RDT: overreliance on foreign suppliers, limited local production, and rigid financial regulations intensify systemic exposure to exogenous shocks.

Through the lens of the SCRM Maturity Model, the findings confirm that most pharmaceutical manufacturers in Ethiopia remain at an early stage of SCDRM maturity. While there is moderate awareness of disruption risks and a generally high perception of the effectiveness of strategies such as supplier audits and buffer stock, their adoption remains limited and inconsistent.

Core indicators of maturity—such as formal risk identification processes, cross-functional integration, digital visibility tools, and scenario-based continuity planning—are largely absent or only informally practiced. This suggests a capability gap, where firms recognize the value of SCDRM but lack the systems, resources, or institutional support to internalize and operationalize those strategies effectively.

Furthermore, the study reveals limited strategic alignment between firm-level SCDRM practices and internationally recommended frameworks. This misalignment reflects not only internal capacity deficits but also external policy and infrastructure challenges that prevent progression to higher levels of maturity.

In conclusion, Ethiopia's pharmaceutical manufacturers remain trapped in a reactive and fragmented stage of SCDRM evolution. Advancing to a proactive, integrated, and resilient supply chain risk governance model will require coordinated action across multiple levels—firm, regulatory, and policy. Without systemic reforms and sustained capability development, the sector's vulnerability to disruption will persist, undermining national medicine security and industrial resilience. This study highlights the urgent need for a maturity-based approach to pharmaceutical SCDRM—one that is diagnostic, adaptive, and grounded in the realities of developing economies.

5.3. Recommendations

Drawing on the empirical insights and theoretical analyses presented in this study, this section outlines actionable policy recommendations aimed at strengthening SCDRM within Ethiopia's pharmaceutical manufacturing sector. Overall, a multi-level, cross-sectoral approach is required to transition Ethiopia's pharmaceutical industry from reactive disruption response toward institutionalized risk management maturity. These policy recommendations address the root constraints identified in this study and provide a practical roadmap for strengthening national medicine security. These recommendations are organized across three key stakeholder groups: (1) Pharmaceutical Manufacturers, (2) Policymakers and Regulators, (3) Development Partners and Donors.

5.3.1. For Pharmaceutical Manufacturers

Ethiopian manufacturers face multifaceted disruption risks stemming from external dependencies, institutional gaps, forex constraints, and limited SCDRM maturity. A holistic response must reinforce internal systems, formalize risk governance, and foster collaboration.

1. **Institutionalize SCDRM Systems**

   Integrate structured SCDRM tools—risk registers, scenario planning, supplier audits—into enterprise governance to enable proactive, risk-aware decision-making.

2. **Strengthen Human Capital Resilience**

   Workforce-related vulnerabilities require:

   - Retention incentives for critical staff.
   - Cross-functional SCDRM training (procurement, forecasting, regulatory).
   - Human resources continuity protocols, including succession and dual-role planning.

3. **Enhance Forecasting and Planning**

   Build supply chain planning functions and adopt digital tools (e.g., ERP, predictive analytics) to improve inventory visibility and responsiveness.

4. **Diversify Supplier Base and Sourcing**

   Reduce geographic concentration risks by qualifying regional/global suppliers and adopting dual- or multi-sourcing strategies.

5. **Improve Internal Coordination and Risk Governance**

   Form cross-functional risk committees (procurement, quality, regulatory, HR) to support integrated risk assessments and coordinated response.

6. **Foster Inter-Firm Collaboration**

   Share logistics, customs agents, and forecasting insights with peer firms to cut costs and improve readiness. Explore joint procurement and warehousing models.

7. **Contextualize Global Frameworks**

   Use international SCDRM frameworks as adaptable diagnostic tools tailored to Ethiopia's realities.

5.3.2. For Policymakers and Regulatory Institutions

Firm-level SCDRM efforts must be supported by systemic reforms. Structural barriers in trade, finance, regulation, and logistics undermine resilience across Ethiopia's pharmaceutical sector. The government and regulatory bodies must address these through coordinated policy action.

1. **Modernize Shipping and Logistics Policy**

   Monopolized freight systems and routing rigidity heighten disruption risks. Reforms should:

   - Liberalize freight by allowing private operators through competitive, risk-based tenders.
   - Allow multimodal routing via third-country ports based on cost and lead time.

2. **Improve Forex and Financial Access**

   Forex constraints severely restrict procurement. Policymakers should:

   - Designate pharma as a strategic sector and establish prioritized forex windows.
   - Digitize and fast-track franco valuta approvals for essential imports.
   - Enable credit-based procurement with public risk-sharing and credit insurance support.

3. **Streamline and Harmonize Regulation**

   Fragmented, slow regulatory processes reduce sourcing flexibility. Actions include:

   - Deploy e-dossier platforms to cut lead times and increase transparency.
   - Adopt risk-based release for low-risk products, aligned with WHO reliance models.
   - Advance regional regulatory harmonization and MRAs to diversify supplier access and speed import clearance.

4. **Institutionalize SCDRM Oversight**

   Lack of national coordination weakens risk response. Authorities should:

   - Establish a national pharmaceutical SCDRM taskforce under the Ministry of Health for cross-sectoral coordination.
   - Link licensing and public procurement eligibility to firm-level SCDRM maturity.

5. **Support Local Input Production**

   Reducing import dependency is key to long-term resilience. Government should:

   - Offer special incentives (e.g., tax breaks, land access) for local API, excipient, and packaging production.
   - Invest in input market development via R&D grants, incubators, and quality certification programs.

5.3.3. For Development Partners and Donors

Development partners—such as international donors, multilateral agencies, and NGOs—play a critical role in addressing structural bottlenecks, capacity deficits, and policy fragmentation that hinder supply chain resilience in low-resource settings.

1. **Build Human and Institutional Capacity**

   Support targeted training, curriculum integration, and risk literacy initiatives to embed SCDRM competencies across public and private actors.

   - Fund in-service and pre-service training in diagnostics, planning, and digital SCDRM tools.
   - Partner with academic institutions to institutionalize risk management skills.
   - Promote awareness through workshops, simulations, and toolkits.

2. **Support Infrastructure and Financial Innovation**

   Catalyze investment in logistics systems and enable financial flexibility to improve preparedness.

   - Co-finance logistics hubs and cold chain infrastructure via blended finance.
   - Pilot pooled procurement, buffer stocks, and joint purchasing hubs.
   - Back supplier credit through guarantees, credit insurance, or risk-sharing facilities.

3. **Promote Regulatory Modernization and Harmonization**

   Advance regulatory agility and alignment to facilitate diversification and regional integration.

   - Provide technical support for digital regulatory systems and e-platforms.
   - Facilitate MRAs and regional dialogue via AU, AMA, and COMESA platforms.
   - Adapt and localize global frameworks for implementation.

4. **Invest in Risk Intelligence and Knowledge Sharing**

   Strengthen evidence-based responses through improved data systems and peer learning.

   - Establish national/regional platforms for disruption monitoring and best practice sharing.

5.4. Study Limitations and Future Research Directions

This study offers a comprehensive descriptive assessment of SCDRM practices among large-scale pharmaceutical manufacturers in Ethiopia. However, several limitations must be recognized that may affect the scope and generalizability of the findings. First, the research is confined to large-scale producers of human medicines, excluding small-scale manufacturers, medical device producers, and other key supply chain actors such as importers, wholesalers, distributors, and retailers. As a result, the insights derived may not fully capture the dynamics and risks present across the broader pharmaceutical supply ecosystem. Second, the study employs a descriptive, cross-sectional design, which limits its ability to establish causal relationships or statistically link SCDRM maturity to outcomes like efficiency, resilience, or profitability. The primary focus remains on mapping current practices, stakeholder perceptions, and institutional barriers.

Third, data collection is based on self-reported inputs from key informants within the selected firms. While triangulation through interviews and document analysis enhances the credibility of findings, the potential for subjective bias and variation in interpreting SCDRM maturity cannot be fully eliminated. Furthermore, the study does not incorporate direct performance metrics, which restricts a more objective assessment of effectiveness.

Despite these limitations, the study contributes valuable insights into a strategically critical yet under-explored domain within Ethiopia's pharmaceutical sector. It is intended to inform evidence-based policymaking, foster institutional learning, and support capacity-building efforts aimed at strengthening pharmaceutical supply chain resilience.

To build on these findings and address the identified gaps, several directions for future research are proposed:

1. **Longitudinal Studies**

   Future research should explore the long-term impact of institutionalizing SCDRM on supply chain performance, continuity, and resilience. Such studies could help validate whether higher maturity levels translate into improved risk responsiveness and operational efficiency.

2. **Inclusion of Downstream Actors**

   Expanding the research scope to include importers, wholesalers, distributors, and retail pharmacies is essential for developing a comprehensive, end-to-end understanding of disruption risks and the coordination required for effective mitigation.

3. **Cross-Country Comparisons**

   Comparative studies involving low- and middle-income countries (LMICs) can help uncover common challenges, successful interventions, and locally adapted strategies, enhancing both theoretical understanding and policy relevance.

4. **Regional Integration Mechanisms**

   Research on regional regulatory harmonization, pooled procurement strategies, and cross-border supply chain cooperation could provide insights into reducing import dependency and addressing systemic vulnerabilities in the pharmaceutical sector.

Together, these avenues for future inquiry aim to foster a more robust, context-aware body of knowledge on pharmaceutical supply chain resilience—particularly in settings where resource constraints and external shocks pose persistent risks.

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Appendix-1: Survey Questionnaire

Title: Assessment of Supply Chain Disruption Risk Management Practices in the Ethiopian Pharmaceutical Manufacturing Sector

Instructions: Please rate the following items based on your firm's experience over the past 5 years.

Section 1: Frequency and Severity of Disruption Risks

Q1.1 – Frequency of Disruption Risks

Over the past five years, how frequently has your firm experienced the following types of supply chain disruptions? (Using Likert scale: 1 = Never, to 5 = Very Frequently; with below explanation)

1 = Never: The disruption has not occurred at all in the past 5 years.

2 = Rarely: The disruption occurred once or very infrequently.

3 = Occasionally: The disruption occurred a few times, but not regularly.

4 = Frequently: The disruption occurred multiple times & posed regular interruptions.

5 = Very Frequently: The disruption occurred repeatedly and was a persistent issue.

Question: How often have your firm experienced the following disruptions?	**Likert Scale (1-5) Rating**				
	1	**2**	**3**	**4**	**5**
• Inaccurate demand forecasting					
• Supplier unreliability or delivery failures					
• Delays in transport/logistics					
• Pandemic-related shocks (e.g., COVID-19)					
• Geopolitical or trade restrictions					
• Foreign exchange shortage					
• Regulatory or customs clearance delays					
• Shortages of APIs or excipients					

Q1.2 – Severity of Disruption Risks

For each disruption your firm has experienced, how severe was its impact on your operations? (Using Likert scale: 1 = No Effect, to 5 = Very Severe; with below explanation):

1 = No Effect: The disruption had no noticeable impact on operations.

2 = Minor Effect: The disruption caused slight inconvenience but did not disrupt core processes.

3 = Moderate Effect: The disruption led to some delays, rescheduling, or additional cost, but was manageable.

4 = Severe Effect: The disruption significantly affected production, procurement, or customer service.

5 = Very Severe Effect: The disruption caused major operational breakdowns, prolonged delays, or critical losses.

Question: How severe was the operational impact of the above disruptions?	**Likert Scale (1-5) Rating**				
	1	**2**	**3**	**4**	**5**
• Inaccurate demand forecasting					
• Supplier unreliability or delivery failures					
• Delays in transport/logistics					
• Pandemic-related shocks (e.g., COVID-19)					
• Geopolitical or trade restrictions					
• Foreign exchange shortage					
• Regulatory or customs clearance delays					
• Shortages of APIs or excipients					

Q1.3 – Additional Disruption Risks and Their Impact
(Open-ended response) (Optional)

Please describe any other types of supply chain disruption risks your firm has encountered over the past five years that were not listed above.

- How often did these disruptions occur?

- What specific impact did they have on your firm's operations, production, or procurement activities?

Section 2: SCDRM Strategies and Practices

This section evaluates **how frequently your firm applies** each of the listed risk management strategies.

Q2. *How frequently does your firm apply each of the following supply chain disruption risk management strategies?*

Please use the following scale:

1 = Never: The strategy is **not** used **at all** by your firm.

2 = Rarely: The strategy is applied only in exceptional or isolated cases.

3 = Occasionally: The strategy is applied sometimes, but not consistently.

4 = Frequently: The strategy is used regularly as part of normal operations.

5 = Very Frequently: The strategy is used to **a great extent** as a core and consistent part of the firm's risk management approach.

SCDRM Strategies	Likert Scale (1-5) Rating (Frequency of Adoption)				
	1	2	3	4	5
• Formal SCDRM system (risk identification, analysis, mitigation, and monitoring)					
• Diversification of suppliers/multi-sourcing					
• Supplier audits and performance reviews					
• Maintenance of safety stock or buffer inventory					
• Preference for local sourcing to reduce dependency					
• Use of digital forecasting tools or predictive analytics					
• Cross-functional collaboration on risk planning					
• Long-term contracting with critical suppliers					
• Benchmarking against international best practices					
• Documented business continuity plans (BCPs)					
• Simulation exercises/testing of BCPs					
• Emergency procurement protocols or flexible credit terms					
• Pre-arranged agreements with backup suppliers or transporters					
• Operational reallocation (rerouting, repurposing, etc.)					

Section 3: Perceived Effectiveness of SCDRM Strategies

(Q3.1 to Q3.2)

This section asks whether your firm uses a strategy, and if so, how effective it has been in reducing the associated disruption risk.

Q3.1 Indicate your perceived effectiveness, when your firm uses each of the following strategies, **how effective are the following strategies in minimizing disruption risks?**
(Using Likert scale: 1 = Not Effective, to 5 = Highly Effective; with the below explanation)

1 – Not Effective at All: The strategy did not improve supply chain outcomes or reduce disruptions in any observable way.
2 – Slightly Effective: The strategy led to minor or inconsistent improvements but did not meaningfully reduce risk.

3 – Moderately Effective: The strategy provided some benefits and mitigated disruption risk to a reasonable extent.
4 – Effective: The strategy consistently reduced disruption risks and improved supply chain resilience.
5 – Highly Effective: The strategy significantly and reliably prevented or mitigated disruptions with strong performance outcomes.

SCDRM Strategies	**Likert Scale (1-5) Rating** (Perceived Effectiveness)				
	1	**2**	**3**	**4**	**5**
• Formal SCDRM system (risk identification, analysis, mitigation, and monitoring)					
• Diversification of suppliers/multi-sourcing					
• Supplier audits and performance reviews					
• Maintenance of safety stock or buffer inventory					
• Preference for local sourcing to reduce dependency					
• Use of digital forecasting tools or predictive analytics					
• Cross-functional collaboration on risk planning					
• Long-term contracting with critical suppliers					
• Benchmarking against international best practices					
• Documented business continuity plans (BCPs)					
• Simulation exercises/testing of BCPs					
• Emergency procurement protocols or flexible credit terms					
• Pre-arranged agreements with backup suppliers or transporters					
• Operational reallocation (rerouting, repurposing, etc.)					

Q3.2 – Open-Ended Strategy Reflection (Optional)

Please describe any additional supply chain risk management strategies your firm has used over the past five years that were not listed above.

- What specific challenges did these strategies aim to address?

- How frequently were they used?

- How effective were they (as you perceive) in reducing disruption risks or improving supply chain resilience?

Section 4: Challenges to Implementation of SCDRM Strategies

Q4.1. Presence of Challenges

Scale: Yes = This challenge exists, No = Not a challenge, Not Sure

<u>Section 4:</u> Implementation Gaps and Challenges in SCDRM
(Q4.1. to Q4.3.)
This section explores the barriers your firm has faced in implementing SCDRM strategies.

Q4.1 – Experience of Implementation Challenges

Please indicate whether your firm has experienced any of the following challenges when implementing the SCDRM strategies.

Response Options (with explanation):

Yes, this is our challenge: *Your firm has directly encountered this barrier, and it has affected or delayed the implementation of SCDRM strategies.*

No, this is not our challenge: *This barrier has not been an issue for your firm in implementing SCDRM strategies.*

I am not sure: *You are unsure whether this barrier has affected your firm, or you do not have sufficient information to assess it.*

Implementing challenges	Yes	No	Not sure
• Insufficient budget or financial resources			
• Shortage of trained personnel or skills			
• Lack of executive or internal prioritization			
• Weak collaboration across departments			
• Unclear or misaligned government policies			
• Absence of digital risk management tools			
• Limited training and awareness programs			
• Resistance to organizational change			
• Weak partnerships with key suppliers			
• Difficulty in accessing foreign exchange			

Q4.2 – Impact of Implementation Challenges

If your firm has experienced any of the challenges (indicated in Q4.1), please rate the extent of impact (as you perceive) each has had on your firm's operations or ability to implement SCDRM strategies.

Response Options (with explanation):

1 = No Impact: *The challenge was present but had no noticeable effect on implementation or daily operations.*

2 = Minor Impact: *The challenge caused slight inconvenience or delays but did not seriously affect processes or timelines.*

3 = Moderate Impact: *The challenge affected specific activities or milestones but was manageable without significant disruption.*

4 = High Impact: *The challenge disrupted implementation efforts or performance considerably and required significant response.*

5 = Very Severe Impact: *The challenge critically impaired operations or prevented the successful implementation of key SCDRM strategies.*

Implementation challenges	Likert Scale (1-5) Rating (perceived impact)				
	1	2	3	4	5
• Insufficient budget or financial resources					
• Shortage of trained personnel or skills					
• Lack of executive or internal prioritization					
• Weak collaboration across departments					
• Unclear or misaligned government policies					
• Absence of digital risk management tools					
• Limited training and awareness programs					
• Resistance to organizational change					
• Weak partnerships with key suppliers					
• Difficulty in accessing foreign exchange					

Q4.3 – Additional Challenges and Their Impact
(Open-ended response) **(Optional)**

Please describe any other significant challenges your firm has encountered in implementing SCDRM strategies that were not listed above.

- What was the nature of the challenge?

- How did it affect your operations or strategy implementation?

- How would you rate the severity of its impact?

<u>Section 5:</u> Respondent and Firm Information**

(From *Q5.1 to Q5.3)* This section collects background information.

<u>Q5.1</u> Functional Role in the Company

Please select the *single most relevant* role that best describes your current position in the company. ***(Dropdown options in Google Form, or Tick in hard copy)***

- ☐ Chief Executive Officer / General Manager / Assistant or Deputy / Equivalent
- ☐ Supply Chain Manager
- ☐ Logistics Manager / Operations Manager / Equivalent
- ☐ Procurement Manager
- ☐ Technical Manager / Factory Manager / Plant Manager / Equivalent
- ☐ Production Manager
- ☐ Quality Assurance Manager
- ☐ Quality Control Manager
- ☐ Engineering Manager
- ☐ Warehouse Manager
- ☐ Finance Manager
- ☐ Marketing Manager

Q5.2 – Experience in the Pharmaceutical Industry

How many years have you worked in the pharmaceutical industry (in any functional area such as production, quality, procurement, or supply chain)?

Please select **one** option:

- ☐ Less than 5 years
- ☐ 5–10 years
- ☐ 10–15 years
- ☐ 15–20 years
- ☐ More than 20 years

Q5.3 – Source Countries for Inputs and Raw Materials

From which countries does your firm source its APIs, raw materials, excipients, packaging, spare parts, reagents, or other essential inputs?

✓ Tick all that apply.

If you select **"Other,"** please specify the country or region in the space provided.

- ☐ India
- ☐ China
- ☐ Europe (e.g., Germany, Italy, Switzerland, etc.)
- ☐ Local (Ethiopia)
- ☐ Other _____

Appendix-2: Expert Interview Guide

Title: Expert Interview Guide – Assessment of Supply Chain Disruption Risk Management (SCDRM) Practices Among Pharmaceutical Manufacturers in Ethiopia

Purpose: This guide supports the qualitative component of a postgraduate thesis aimed at assessing the status, barriers, and contextual adaptations of SCDRM strategies among Ethiopian pharmaceutical manufacturers. The interview aims to gather deep, experience-based insights from senior professionals involved in procurement, production, logistics, regulatory affairs, or strategic management.

Estimated Duration: 45–60 minutes

Confidentiality: All responses will be anonymized and used solely for academic purposes.

Section 1: Disruption Risks and Experiences

1. From your professional experience, what are the most frequent types of supply chain disruptions encountered in Ethiopia's pharmaceutical manufacturing sector?
    - Can you describe any specific examples or recurring patterns?
2. Which types of disruptions have had the most severe operational impacts in your organization or the sector overall?
    - How did these disruptions affect production, delivery, or market availability?
3. Are there any disruption risks that you feel are underreported or not well captured by standard survey tools?
    - (e.g., workforce issues, civil unrest, shipping monopolies, etc.)

Section 2: Risk Management Strategies

4. What risk management strategies have your organization (or others in the industry) adopted to mitigate these disruptions?
    - Which have been most effective, and why?

5. Are there any proactive tools or systems in place—such as forecasting models, risk registers, or supplier audits?
    - How institutionalized or consistent are these practices?
6. To what extent do firms in this sector engage in supplier diversification, use of local inputs, or regional sourcing?

Section 3: Effectiveness and Limitations

7. In your opinion, which SCDRM strategies have delivered the greatest resilience gains in practice?
    - Which ones are often overestimated or underutilized?
8. Are there differences in how strategies are perceived versus how they actually perform under disruption scenarios?

Section 4: Challenges to Implementation

9. What are the biggest challenges to implementing effective SCDRM strategies in Ethiopia's pharma sector?
    - (e.g., forex access, regulatory delays, internal coordination, technology gaps)
10. How do institutional and policy constraints—such as EFDA processes, customs, or financial rules—affect disruption response efforts?
11. What internal organizational challenges (e.g., budget, skills, leadership, collaboration) are most difficult to overcome?

Section 5: Contextual Practices and Local Innovations

12. Have you observed or adopted any informal or context-specific risk management approaches that are not part of global best practices?
13. Do these emerging strategies offer reliable solutions, or are they temporary fixes? What would it take to scale or institutionalize them?

Section 6: Strategic Reflections and Policy Implications

14. In your view, what needs to change—at the policy, regulatory, or sectoral level—to improve SCDRM practice in Ethiopia?
15. How can local manufacturers better align with global SCDRM standards and frameworks?
16. What role should development partners or donors play in improving SCDRM practices across the sector?

Closing Questions

17. Is there anything else you believe is important for understanding supply chain risks or improving resilience in Ethiopia's pharmaceutical manufacturing sector?