MINISTRY OF HIGHER EDUCATION AND SCIENTIFIC RESEARCH

NATIONAL HIGHER SCHOOL OF MANAGEMENT

ENSM. KOLÉA University Pole

GRADUATION DISSERTATION

To obtain an Academic Master degree in Supply Chain Management

Mitigating Operational Risks in Maritime Goods Transportation Company

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Academic year 2023/2024

ABSTRACT

Tis research examines the operational risks encountered by ARKAS Algérie Spa, a leading maritime transport company. Through a qualitative approach utilizing semi-structured interviews and documentary analysis, the study identifies key risks within the Exploitation and Operations departments. By employing tools such as process maps and Bowtie diagrams, the research highlights risks associated with documentation errors, container handling, and information transfer. The findings suggest that proactive risk management strategies and enhanced training programs can significantly improve operational efficiency and safety at ARKAS Algérie Spa. The study offers actionable recommendations for mitigating these risks, contributing to the development of more resilient risk management practices in the maritime sector.

Keywords: maritime transport, risk management, operational risks, bowtie diagram, maritime resilience.

RESUME

Cette recherche examine les risques opérationnels rencontrés par ARKAS Algérie Spa, une entreprise de transport maritime de premier plan. Grâce à une approche qualitative utilisant des entretiens semi-structurés et une analyse documentaire, l'étude identifie les principaux risques au sein des départements Exploitation et Opérations. En utilisant des outils tels que les cartes des processus et les diagrammes Bowtie, la recherche met en évidence les risques liés aux erreurs de documentation, à la manutention des conteneurs et au transfert d'informations. Les résultats suggèrent que des stratégies de gestion des risques proactives et des programmes de formation améliorés peuvent considérablement améliorer l'efficacité opérationnelle et la sécurité chez ARKAS Algérie Spa. L'étude propose des recommandations concrètes pour atténuer ces risques, contribuant au développement de pratiques de gestion des risques plus résilientes dans le secteur maritime.

Mots-clés: transport maritime, gestion des risques, risques opérationnels, diagramme en nœud papillon, résilience maritime.

ملخص

تبحث هذه الدراسة في المخاطر التشغيلية التي تواجهها شركةARKAS Algérie Spa ، وهي شركة رائدة في النقل البحري. من خلال منهجية نوعية تعتمد على المقابلات شبه المنظمة وتحليل الوثائق، تحدد الدراسة المخاطر الرئيسية في أقسام الاستغلال والعمليات. باستخدام أدوات مثل خرائط العمليات ومخططات عقد العنق تسلط الدراسة الضوء على المخاطر المرتبطة بأخطاء الوثائق، والتعامل مع الحاويات، ونقل المعلومات. شير النتائج إلى أن استراتيجيات إدارة المخاطر الاستباقية وبرامج التدريب المحسنة يمكن أن تحسن بشكل كبير من الكفاءة التشغيلية والسلامة .تقدم الدراسة

توصيات عملية للتخفيف من هذه المخاطر، مما يساهم في تطوير ممارسات إدارة المخاطر الأكثر مرونة في قطاع النقل البحري.

الكلمات المفتاحية: النقل البحري، إدارة المخاطر، المخاطر التشغيلية، مخطط عقد العنق ، مرونة النقل البحري.

ACKNOWLEDGEMENT

I am profoundly thankful for the blessings that Allah have accompanied me throughout my life, from the south areas of Algeria to its north beginning with my nurturing family and extending to my cherished friends I am deeply appreciative of the supportive network that surrounds me.

I am deeply grateful and will always remain thankful to every god fearing teacher who has imparted wisdom and values to me. From my earliest years and first teacher in primary school my mother to my current academic journey professors

And I am also thankful for this establishment and every element of it for always being kind

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LIST OF ABRIVIATIONS

BIA : Business Impact Analysis

BWM : Ballast Water Management

CSOR : Container Shipping Operational Risks

ECS : Exploitation and Operations Departments

ERM : Enterprise Risk Management

FTA : Fault Tree Analysis

FMEA : Failure Modes and Effects Analysis

HACCP : Hazard Analysis Critical Control Point

HSE : Health, Safety, and Environment

ISPS : International Ship and Port Facility Security

QRA : Quantitative Risk Assessment

RAA : Risk Assessment and Analysis

SMS : Safety Management System

QMS : Quality Management System

SOLAS : Safety of Life at Sea

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INTRODUCTION

Context and Thematic Interest

Maritime transport is the backbone of global trade, enabling the seamless movement of goods across continents and serving as the lifeblood of the world economy. Sir Walter Raleigh's timeless assertion encapsulates the essence of maritime trade, emphasizing its pivotal role in global prosperity. Approximately 90% of world trade relies on maritime transport (Shuo Ma, 2021), underscoring its indispensable role in sustaining international commerce.

In the aftermath of the 2007-2008 global financial crisis, there has been a notable increase in board-level engagement with Enterprise Risk Management (ERM). Various surveys reveal that risk management has surpassed accounting as the primary concern for corporate boards, with around 80% of boards regularly reviewing risk policies and assessing risk appetite statements. The financial crisis exposed vulnerabilities across many organizations, even those with established ERM frameworks. Deloitte's 2013 survey highlighted the widespread acknowledgment of the need for change, with 94% of organizations revamping their approach to strategic risk management in the three years prior. However, cultural impediments and challenges in integrating data across organizational silos remain significant obstacles (James Lam, 2017).

Despite its critical importance, the maritime transport sector is not immune to operational risks. From terminal congestion and adverse weather conditions to cybersecurity threats, the sector faces numerous challenges that can result in significant disruptions, financial losses, and safety hazards. Effective risk management in this domain is not just a matter of regulatory compliance; it is a strategic imperative for companies seeking to strengthen their competitive edge and operational resilience.

Against this backdrop, this dissertation explores the operational risks faced by ARKAS Algérie Spa, a prominent maritime transport company in Algeria. By focusing on the specific challenges within this context, the study aims to illuminate the intricacies of risk management in maritime transport. Through a meticulous evaluation of operational risks and their mitigation, ARKAS Algérie Spa and similar companies can enhance their efficiency, safety, and sustainability in the dynamic landscape of global trade.

As we move through the chapters, we will delve into the complexities of operational risks in maritime transport, uncover strategic insights, and propose actionable recommendations to bolster resilience and ensure the seamless flow of goods across the seas.

Objectives

The primary objective of this study is to explore and understand the specific operational risks faced by ARKAS Algérie Spa, particularly within its Exploitation and Operations departments. By adopting a qualitative approach, this study aims to provide an in-depth understanding of these risks and propose effective strategies for their management.

Problem Statement and Research Question

This dissertation addresses the inherent risks in maritime transport operations, which can lead to significant disruptions and financial losses. The research question guiding this study is:

How can operational risks in maritime transport be effectively identified, analyzed, and mitigated to enhance overall safety and efficiency?

This question seeks to explore the complexities of risk management in maritime logistics

Reason for Choice

The growing complexity of global supply chains underscores the critical role of maritime transport. Effective management of operational risks in container shipping is essential for maintaining supply chain integrity, especially in a rapidly changing global environment. This research contributes to existing knowledge by exploring risk management practices specific to the maritime sector.

ARKAS Spa was chosen due to its significant role in the industry and its extensive experience since 2004. The study focuses on the Exploitation and Operations departments to identify key operational risks and develop targeted strategies for managing them.

Plan Announcement

The structure of this dissertation is organized into three main chapters, each addressing a distinct aspect of the study:

Chapter 1: Theoretical Framework

This chapter examines the evolution of maritime trade, the role of maritime transport in global trade, the Algerian context, and key concepts related to operational risks and risk management.

Chapter 2: Methodology Framework and Study Field

This chapter outlines the qualitative approach adopted, focusing on interviews and documentary analysis. It also details the data collection and analysis techniques used, such as process maps and bowtie diagrams.

Chapter 3: Results and Discussion

This chapter presents a case study of ARKAS Algérie Spa, analyzing its operational structure, identifying risks, and evaluating current risk management practices through the use of process maps and bowtie diagrams.

CHAPTER 1 : THEORITICAL FRAMEWORK

This chapter delves into the theoretical underpinnings of maritime transport and risk management. It covers the evolution and importance of maritime trade, the specific context in Algeria, and key concepts related to operational risks. It also discusses various risk management processes and tools, highlighting their relevance to maritime operations.

Section 1 : Literature Review and applications

In our literature review section, we explore operational risks within maritime transport companies, with a specific focus on three pivotal dimensions: resilience, container shipping, and the utilization of the bowtie method. Our examination draws from an array of research conducted in the last three years (2021-2024).

1.1. Resilience in Maritime Transport and Supply Chains

The first study by (Yui-yip Lau et al., 2024) conducts a bibliometric analysis of maritime transport resilience, focusing on research trends and thematic patterns from 1997 to 2023. Meanwhile, the second study by (Jiaguo Liu et al., 2023) systematically assesses resilience in maritime supply chains, particularly amidst post-COVID-19 challenges.

In comparing the two studies on maritime resilience, both works aim to enhance understanding and management of resilience within the maritime domain.

Despite their differing aims and methodologies, both studies share commonalities in their findings and limitations:

- Findings:
  - Both studies stress the importance of risk assessment and resilience in maritime transport.
  - They highlight the significance of managing systemic risks and fostering collaboration within maritime operations.
- Limitations:
  - Neither study provides detailed strategies for resilience development, limiting actionable insights.
  - Both acknowledge potential biases from expert opinions, urging cautious interpretation of results.
  - Methodological limitations include oversights in framework construction and potential lack of diverse expert perspectives.

The subsequent table delineates the aims, methods, findings, and limitations of each study as outlined in their respective papers:

Table 1 : Pertinent Research Related to Resilience in Maritime Transport and S.C

Title and reference	The aim of the study	Methods and materials	Findings	Limitations
Maritime transport resilience (Yui-yip Lau et al., 2024)	Conducting a bibliometric analysis of the maritime transport resilience, focusing on research trends and thematic patterns from 1997 to 2023.	- 735 valid research papers analyzed. - Analysis tools: VOSviewer, Python, and CiteSpace. - Data sourced from Web of Science Core Collection. - Academic institutions examined using Python.	- Maritime transport relies on risk assessment and resilience. - Stakeholder engagement is key for port resilience. - Inclusive planning is crucial for climate change impacts. - Data analysis improves port understanding. - Managing systemic risks is critical for resilience.	- Abstaining from a detailed exploration of specific strategies for the development of resilience; - Experts' opinions may introduce bias.
Maritime supply chain resilience (Jiaguo Liu et al., 2023)	systematically assess resilience in maritime supply chains.supply chain resilience in the maritime industry amid post-COVID-19 challenges.	- Approach Integrates - AHP for goal prioritization - QFD for linking goals, strategies, and practices, and - DEMATEL for identifying interdependencies among strategies	- Resilience goals underscored adaptability and robustness. - Resilience strategies prioritized collaboration, flexibility, and integration. - Resilience practices included information sharing, coordination, risk management, and infrastructure improvement..	- Potential lack of practical strategies; - Limited Diversity in Experts perspectives; - Oversight in framework construction ; - Experts' opinions may introduce bias.

Source : Self Developed

1.2.Operational Risks in Container Shipping

The first study by Son & Peggy (2021) aims to provide a comprehensive overview of risk analysis and assessment in container shipping operations, while the second study by Son Nguyen et al. (2021) focuses on proposing a risk analysis model that quantifies uncertainty in risk assessments.

Despite their differing aims and methodologies, both studies share commonalities in their findings and limitations:

- Findings:

Both studies identify various approaches and methodologies for risk analysis and assessment within container shipping operations.

They highlight challenges in quantitative risk analysis, such as the lack of a dominant theoretical framework.

- Limitations:

- Neither study delves deeply into specific operational risk implications, potentially limiting the applicability of their findings.
- Advanced tools and methods are not employed in either study, suggesting potential areas for improvement in future research.
- Both studies acknowledge uncertainties in their approaches and advocate for further exploration of diverse perspectives.

The subsequent table delineates the aims, methods, findings, and limitations of each study as outlined in their respective papers:

Table 2 : Pertinent Research Related to Operational Risks in Container Shipping

Title and reference	The aim of the study	Methods and materials	Findings	Limitations
Container shipping operational risks: an overview of assessment and analysis(Son & Peggy, 2021)	To provide a comprehensive overview of risk analysis and assessment in container shipping operations.	- Conducted four key steps: material collection, categorization, content analysis, and synthesis. - Retrieved 598 papers from Web of Science and 1512 from Scopus. - Utilized NVivo 12 for content analysis. - Established a categorization framework based on existing literature.	- Reviewed 96 papers on CSOR assessment. - Identified RAA approaches and methodologies. - Established classification framework for CSOR studies. - Recognized challenges in quantitative risk analysis.	- Not delving into specific operational risk implications.
An Operational Risk Analysis Model for Container Shipping Systems considering Uncertainty Quantification (Son Nguyen et al., 2021)	To propose a risk analysis model for container shipping systems that quantifies uncertainty in risk assessments.	- Applied Bayesian probability for risk quantification. - Used Evidential Reasoning with three uncertainty indicators. - Conducted risk ranking and mapping with Risk Magnitude and Uncertainty Indexes.	- Demonstrated model functionality. - Confirmed criticality of physical flow risks. - Identified uncertain information inaccuracies. - Highlighted significance of financial risks. - Suggested applicability beyond CSOR. - Proposed potential for computer-based risk monitoring..	-Limited to organizational scale, impacting generalizability. - Advanced tools/methods not used. - Specific operational risks not fully explored.

Source : Self Developed

1.3. Application of the Bowtie Method in Maritime Operational Risk Management

The study by (M. H. Alencar, 2023) focuses on formulating a risk identification methodology using Bowtie analysis specifically for subsea pipeline systems, with a focus on transportation of hazardous materials during field operations.

On the other hand, the study by (Kun et al., 2021) aims to develop an operational risk model specifically for blowout scenarios in offshore drilling operations.

In comparing the two studies on risk analysis within hazardous industries, both works share a common objective of developing methodologies to enhance risk management practices.

- Findings :

- Identification of Major Failure Modes: Both studies prioritize major failure modes within their industries.
- Implementation of Barriers: They emphasize implementing barriers to prevent incidents or mitigate consequences.
- Utilization of Risk Assessment Framework: Both studies utilize Bowtie analysis for risk assessment.

- Limitations:

- Generalizability: Both acknowledge limitations in generalizing findings.
- Data Reliability: They rely on operational field data, which may be biased.
- Complexity of Operational Realities: Simplifications in analysis may not fully capture operational complexities, potentially leading to oversights.

The subsequent table delineates the aims, methods, findings, and limitations of each study as outlined in their respective papers:

Table 3: Pertinent Researches Related to Bowtie Method in Maritime Operational Risk Management

	The aim of the study	Methods and materials	Findings	Limitations
Risk identification and Bowtie analysis for risk management of subsea pipelines (M. H. Alencar, 2023)	- Formulate a risk identification methodology using Bowtie analysis for subsea pipeline systems.	- Employed Bowtie analysis framework. - Utilized data from the PHMSA database.	- Identified major pipeline causes during field operations. - main failure modes. - Implemented barriers to prevent incidents or limit consequences. - Used Bowtie method to structure the problem and monitor effectiveness of measures	- Generalizability of findings to other contexts may be limited.
Operational risk analysis of blowout scenario in offshore drilling operation (Kun et al., 2021)	- Develop an operational risk model for blowout scenarios in offshore drilling.	- Construct Bowtie Model. - Transform to Bayesian Network Model. - Estimate Probability of Blowout Accident.	- Developed operational risk model addressing evolving hazards and uncertainties. - Conducted sensitivity analysis to identify system weaknesses.	- Relied on operational field data with potential limitations. - Simplifications may not fully capture operational complexities.

Source : Self Developed

This section delineates the conceptual framework and definitions essential for comprehending operational risks within the maritime industry. Establishing a clear theoretical foundation is crucial for analyzing the multifaceted nature of these risks and formulating effective management strategies.

Section 2 : Conceptual framework and definitions

The conceptual framework section of this dissertation provides a comprehensive overview of maritime trade dynamics and risk management practices within the industry.

It comprises three key components:

- Role and Evolution of Maritime Trade: Examines the historical development and current significance of maritime trade, with a focus on regional context.
- Advanced Risk Management Practices: Explores the evolution of risk management from basic strategies to sophisticated frameworks, emphasizing their importance in addressing uncertainties.
- Operational Risks in Maritime Transport: Analyzes internal and external factors affecting operational risk management, introducing tools like the Bowtie Diagram for effective risk analysis.

2.1. Maritime Trade

Maritime trade stands as a cornerstone of global commerce, embodying Sir Walter Raleigh's timeless assertion that "Whosoever commands the trade of the world commands the riches of the world, and consequently the world itself" (1552-1618).

In this part we delve into the intricate dynamics of maritime trade, elucidating its pivotal role in shaping the modern economic landscape.

2.1.1. Maritime Transport's Role in Global Trade

In his seminal work, "The Economics of Maritime Business," Professor Shuo Ma explicates the inherent symbiosis between maritime transport and international trade, emphasizing trade as the paramount force shaping shipping operations across diverse transportation modes.

Maritime transport efficiently handles both low-value and high-value cargoes, optimizing inventory costs by expediting the transit of goods. Vital commodities such as minerals, cereals, and energy resources, including oil and gas, benefit from maritime transport's cost-efficiency and scale economies. Ships, renowned for their unparalleled capacity, routinely carry immense cargo volumes, often exceeding half a million tons per voyage. Consequently, natural resources, typically traded in substantial quantities, heavily rely on maritime transportation.

Statistical evidence underscores maritime transport's preeminence in facilitating global trade. Approximately 90% of international trade, by weight or volume, occurs via ships, excluding intra-European Union transactions. However, in terms of the value of traded goods, maritime transport accounts for around 60% of global trade. This disparity arises from Europe's significant intra-regional trade, predominantly facilitated by land-based transportation modes.(Shuo Ma, 2021)

2.1.2. History of maritime trade

Global seaborne trade has experienced significant expansion over the past seven decades, marked by distinct "golden" periods of growth. This paper examines the trajectory of maritime traffic from 1950 to 2019, identifying key drivers and periods of acceleration.

(1950-1970) - First Golden Period

During this era, maritime trade witnessed remarkable expansion, increasing more than fivefold from 500 to 2,605 million tons. This surge was propelled by industrial expansion and post-war reconstruction efforts in Europe and Japan, resulting in an average annual growth rate of 8.6%.

(1970-2000)- Deceleration Phase

The subsequent decades saw a slowdown in growth, attributed to factors such as completed construction projects, infrastructure development slowdowns, and two oil shocks. Seaborne trade experienced relatively modest growth, with an average annual rate of only 2.2%.

(2000-Present)- Second Golden Period

The emergence of the second golden period, particularly between 2002 and 2008, witnessed another significant surge in global seaborne trade. This was driven by rapid economic growth and industrial development in China, fueled by investments in construction and infrastructure projects.

Impact of COVID-19 Pandemic:

The onset of the COVID-19 pandemic exposed vulnerabilities within global supply chains, highlighting the critical need for adaptability and resilience. Port congestion, shipment delays, labor shortages, and soaring freight rates emerged as challenges, surpassing initial expectations. (Shuo Ma, 2021, p. 116)

Industry Adaptability:

Despite disruptions, the maritime industry demonstrated adaptability and efficiency, with global shipping lines achieving significant operating profits exceeding US$110 billion in 2021. (UNCTAD, 2022).

These challenges underscore the need for a robust and resilient maritime supply chain to withstand future disruptions and ensure the uninterrupted flow of goods worldwide(Xiong Li et al., 2022).

Future Outlook:

Looking ahead, the UNCTAD projects moderate growth in global maritime trade, with forecasted annual growth rates of 1.4% for 2022 and 2.1% for the period 2023-2027. This slower pace reflects evolving dynamics in global trade patterns and economic conditions. (REVIEW OF MARITIME TRANSPORT 2023)

2.1.3. Maritime supply chain

In contemporary trade dynamics, a novel paradigm has emerged wherein nations exchange semi-finished and intermediate goods rather than finalized products. Termed the global value chain or global supply chain, this phenomenon heavily relies on the maritime supply chain for the global movement of commodities.

The maritime supply chain plays a pivotal role in ensuring the seamless and efficient transportation of goods across the globe. From ferrying raw materials to manufacturers to delivering finished products to end consumers, the maritime supply chain serves as the lifeblood of the global economy. Its smooth functioning is indispensable, as any disruption could potentially jeopardize the entire economic system. (Jasmine Siu Lee Lam & Xiwen Bai, 2016)

The core pillars of the maritime logistics chain encompass goods transportation, port and terminal management, and transit services, each playing a complementary and essential role in sustaining the efficiency and effectiveness of maritime transport operations. (Dong-Wook Song & M. Panayides, 2012)

2.1.4. Maritime logistics

Sun Tzu's enduring assertion, "The line between disorder and order lies in logistics," underscores the perpetual importance of effective logistics management in maintaining order within complex systems. This principle remains relevant in contemporary maritime logistics, where the smooth flow of goods is paramount for global trade.

Historical Context and Industry Transformation:

Throughout history, the intrinsic link between maritime logistics and global trade has been pivotal, driving continuous advancements in ships and ports. The advent of 'integrators' in the 1990s marked a pivotal shift in the industry, as companies began offering comprehensive logistics solutions to ensure seamless goods movement.

Academic Inquiry and Field Expansion:

In academic circles, maritime logistics has emerged as a dynamic area of scholarly exploration, spurred by evolving roles of seaports and evolving demands of shippers and customers within the broader supply chain and logistics framework. (Jiaguo Liu a, , Bingmei Gu a, and , Jihong Chen, 2023)

Conceptual Evolution and Contemporary Challenges:

Originally grounded in traditional shipping and port operations, maritime logistics has undergone significant transformation, incorporating aspects of integration, environmental sustainability, and resilience. This conceptual broadening reflects the evolving complexities of contemporary global trade.

Challenges and Perspectives:

Despite its evolution, the assessment of maritime logistics performance often remains narrowly focused on metrics related to shipping connectivity and terminal efficiency. There is a growing acknowledgment of the necessity for a more comprehensive evaluation, recognizing its broader implications within the logistics ecosystem.

The Strategic Imperative of Maritime Logistics

General Antoine Henri Jomini's timeless assertion in 1838, "Logistics comprises the means and arrangements which work out the plans of strategy and tactics," underscores the pivotal role of logistics in executing strategic plans effectively.

In the context of maritime operations, this principle holds true, as emphasized by by (Dong-Wook Song & Eon-Seong Lee, 2014)who define maritime logistics as the comprehensive process of planning, implementing, and managing the movements of goods and information involved in ocean carriage.

Building upon this definition, , (Photis M. Panayides & Dong-Wook Song, 2013) further elucidate the central position of maritime logistics in global trade, highlighting its evolution, challenges, and academic perspectives. Together, these insights form a cohesive narrative that underscores the integral nature of maritime logistics in shaping global trade operations and logistics strategies.

Table 4 : Comparison of Maritime Logistics and Maritime Transportation

	Maritime Transportation	Maritime Logistics
Concept	The process of carrying and handling cargoes across the ocean.	The process of planning, implementing and managing the movement of goods and information involved in ocean carriage
Focusing point	Maritime transportation emphasizes individual functions relating to sea transportation. Each function pursues its own aims or competitiveness.	Maritime logistics is concerned with not only individual functions relating to sea transportation, but also an effective logistics flow as a systematic entity of the logistics integration system.
Managerial function	Sea transportation activities: contracting, shipping, sea voyage, moving cargo, and loading/unloading	**Sea transportation activities**: Contracting, shipping, sea voyage, moving cargo, and loading/unloading. Additional **logistics services:** Stripping/stuffing, storage, warehousing, offering a distribution center, quality control, testing, assembly, packaging, repacking, repairing, inland connection, and re-use

Source : (Aylin Caliskan & Yucel Ozturkoglu, 2016, p. 364)

Differentiating Shipping from Freight Forwarding

Shipping encompasses the global movement of cargo via maritime vessels, managed by shipping lines either through ownership or charter agreements. It involves various types of vessels such as oil tankers, container carriers, and passenger ships.

Shipping operations include cargo booking, vessel loading planning, secure transportation, and documentation issuance, coordinated across departments within shipping lines.

The complexity of shipping lies in strategic route planning, cargo volume forecasting, vessel allocation, port selection, cost analysis, and manpower coordination.

Freight, on the other hand, specifically refers to the goods transported by carriers in exchange for financial gain, with a focus on maritime operations conducted by shipping lines. Freight encompasses diverse cargo types including dry bulk commodities like iron ore and coal, containerized cargo, general cargo/break bulk, and wet bulk such as tanker cargo.

The varying sizes and characteristics of freight necessitate specialized handling expertise to ensure safe transportation**.**(haiersh manaadiar, 2020)

Table 5 : Key and supportive activities of maritime logistics

	Shipping lines	Port / terminal operations	Fright forwarders
Main function	Moving cargo between ports	1. Shipping reception 2. loading/ unloeading cargos 3. stevedoring 4. connecting to inland transportation	Booking vessels ; preparing for requisite documents for ocean carriage and trade , on be half of shippers
Supportive logistics services	5. Documentation relating to sea trade ; 6. Container tracking and information ; 7. Intermodalserive	8. Weaarhousing ; 9. Offering a distribution center 10. testing 11. assembly 12. repairing 13. inland connection	14. Inventory managelent 15. packaging 16. wearhousing

Source : (Lee and all 2012)

2.1.5. Maritime trade in Algeria

Maritime transport is vital for Algeria's economy, handling 97% of its trade. Research by Haddoum Kamel underscores its crucial role. Algeria's strategic location, with 1200 km of coastline near Southern Europe, offers potential for a transshipment hub. Slimani (2018) suggests this hub could improve regional trade using Algeria's maritime borders and the Trans-Saharan Highway..(MERZOUG, 2023).

Decline in National Maritime Trade Participation

Algeria's historical prominence as a maritime trading nation has witnessed a notable decline over recent decades, as evidenced by dwindling national maritime trade participation rates. Kamel Khelifa's research highlights the concerning trend wherein Algeria's share of maritime trade has diminished, underscoring the urgent need for strategic interventions to reverse this decline and revitalize the nation's maritime commerce activities.

Impact of Limited Vessel Capacity on Economies of Scale

The limited capacity of Algeria's ports to accommodate larger vessels has profound implications for the realization of economies of scale in maritime transport operations. As indicated by data from the Doing Business Report (2014), the inability to handle larger container vessels significantly curtails cost efficiencies and compromises Algeria's competitiveness in global trade.

This underscores the imperative for infrastructure investments aimed at enhancing port capacities to unlock potential cost-saving benefits.

Importance of Efficient Port Operations for Trade Promotion

Academic insights from the University of Béjaïa emphasize the critical role of streamlined port operations in reducing transit times, lowering import costs, and fostering a conducive environment for trade growth. Optimizing port efficiencies is essential for bolstering Algeria's trade performance and positioning the nation as a key player in the maritime domain. .(MERZOUG, 2023)

Implications of Low Traffic Density on Transport Costs

Algeria's maritime transport sector contends with the adverse effects of low traffic density, leading to inflated transport costs that undermine the competitiveness of its economy. Slimane Merzoug's observations underscore the need for initiatives aimed at increasing traffic density through strategic interventions that promote trade growth and attract more shipping activity to Algerian ports. Addressing this challenge is pivotal for enhancing cost efficiencies and fostering sustainable economic development.

Logistic Performance Ranking and Connectivity Index

Algeria's logistic performance ranking places it at 107th among 189 economies, according to the World Bank's "Connecting to Compete 2018" report. This ranking reflects the nation's challenges in logistics and underscores the importance of improving connectivity and logistical efficiency to enhance its trade competitiveness. Addressing these issues is crucial for Algeria to optimize its maritime transport sector and strengthen its position in the global market.

2.2. Risk Management

This part will discuss the risk management evolution and main aspects

2.2.1. Evolution and Contemporary Perspectives on Risk Management

The following part will tdiscuss the history of risk management

The history of risk management *In examining the evolution and contemporary viewpoints of risk management, we embark on a journey from ancient maritime roots to modern enterprise practices. This exploration unveils pivotal historical developments and diverse perspectives, shedding light on the dynamic landscape of risk assessment and management.*

Ancient Roots of Risk

The concept of "risk" traces back to ancient times, although its precise etymology remains debated. Some scholars propose its derivation from the Spanish "arriesgar," meaning "to collide with a rock," while others suggest a more ancient Latin origin ("resecare"), implying a "reef" or "obstacle." This term is closely tied to maritime endeavors, particularly the explorations of Portuguese and Spanish navigators from the 15th century onwards. The maritime context aligns with the early development of insurance, as seen in the earliest insurance codes rooted in maritime law. (Coleman, 2011, p. 9)

Formalization of Risk Assessment:

Despite its ancient roots, the formal mathematical assessment of risk based on probability emerged much later in Europe, particularly from the 17th century onwards. Peter Bernstein attributes this delay to historical reliance on intuition for decision-making, prevalent until the Renaissance. The formalization of risk assessment marked a significant shift towards proactive risk management practices.

Development in Banking and Insurance (17th century to early 1940s):

From the 17th century to the early 1940s, risk management primarily developed within the domains of banking and insurance. Techniques such as actuarial science, relying on probabilistic and statistical concepts, emerged during this period. However, despite advancements, instances of inadequate risk management were evident, as indicated by the high rate of insurance company failures during the mid-19th century in England.

Quantitative Advances and Industry Expansion (1940s onwards):

Starting from the 1940s, increasingly sophisticated quantitative methods for risk evaluation were adopted across various sectors, including petroleum and nuclear industries. Concurrently, the concept of risk in finance underwent significant evolution with the development of theories by scholars like Markowitz and Merton. This period witnessed the expansion of risk management beyond traditional domains, reflecting a broader recognition of risk in diverse industries.

Modern Enterprise Risk Management (Early 2000s onwards):

Since the early 2000s, enterprise risk management has experienced substantial growth, driven by international consulting firms disseminating frameworks such as COSO II (2004). This era witnesses a shift towards comprehensive risk management practices, although there are occasional oversights of fundamental principles developed by early pioneers in banking and insurance. (Frédéric Cordel, 2019)

The Human and Organizational Factors (HOF)

The Human and Organizational Factors (HOF) approach has become crucial in risk industries, integrating technical and human aspects to prevent accidents effectively. Its key features include:

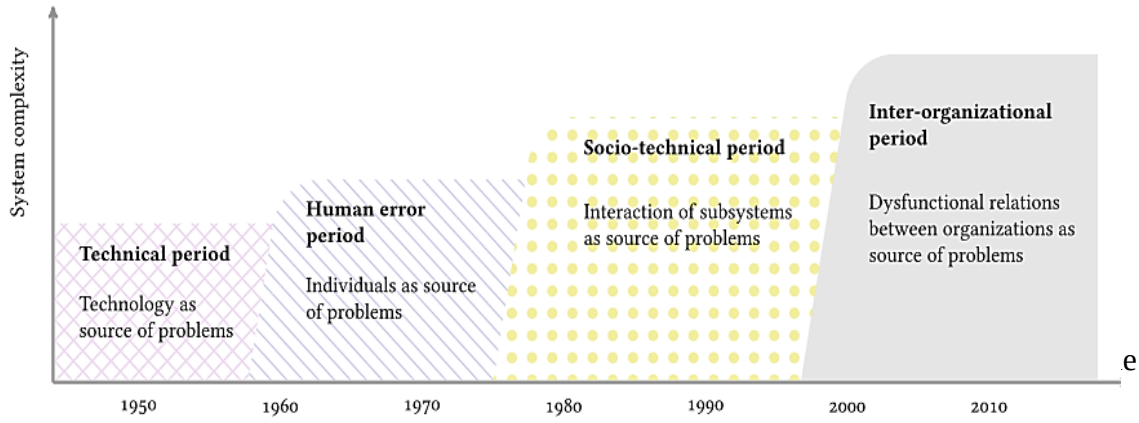
- Integrated Perspective: Recognizes the interdependence of human operators and technical systems, promoting collaboration instead of a "man versus machine" mindset.

- Realistic Understanding: Acknowledges human limitations and aims to minimize errors while enhancing adaptability to diverse operational scenarios.
- Field-Oriented Methodology: Focuses on real-world interactions between technical systems, humans, and organizations to develop targeted interventions.

Benefits of the HOF approach include enhanced safety, improved reliability, effective risk mitigation, and enhanced organizational resilience.

By integrating human and organizational factors, it ensures safer and more reliable operations in risk industries.

Figure 1 : Evolution of risk management approaches



Source : (Benoît Journé et al., 2020, p. 26)

James Lam's definion of risk

president and founder of a leading risk management consulting firm, defines risk as a variable capable of deviating from expected outcomes. He emphasizes the potential impact of risk on organizational objectives and overall performance, highlighting its significance in decision-making processes. (james lam, 2017)

ISO's Definition of Risk:

In contrast, the International Organization for Standardization (ISO) provides a broader definition of risk, integrating both probability and consequence dimensions. According to ISO, risk is defined as the combination of the likelihood of an event occurring and its potential impact. This definition underscores the inherent uncertainty surrounding objectives and acknowledges the dynamic nature of risk within organizational contexts.

Incorporating Positive and Negative Risks:

Both Lam and ISO recognize that risks can yield both positive and negative outcomes. ISO specifically acknowledges the existence of opportunities within the risk landscape, emphasizing the potential for events to produce favorable results. Similarly, the COSO II framework acknowledges the potential for positive impacts to counterbalance negative risk effects or present opportunities for value creation.

Role of Opportunities in Risk Management:

While opportunities are integral to the risk management process, they are not explicitly included within the definition of risk itself. Instead, opportunities are considered within the broader context of risk management practices, emphasizing the importance of addressing both positive and negative dimensions of uncertainty to effectively manage risk.

2.2.2. Risk management process and tools

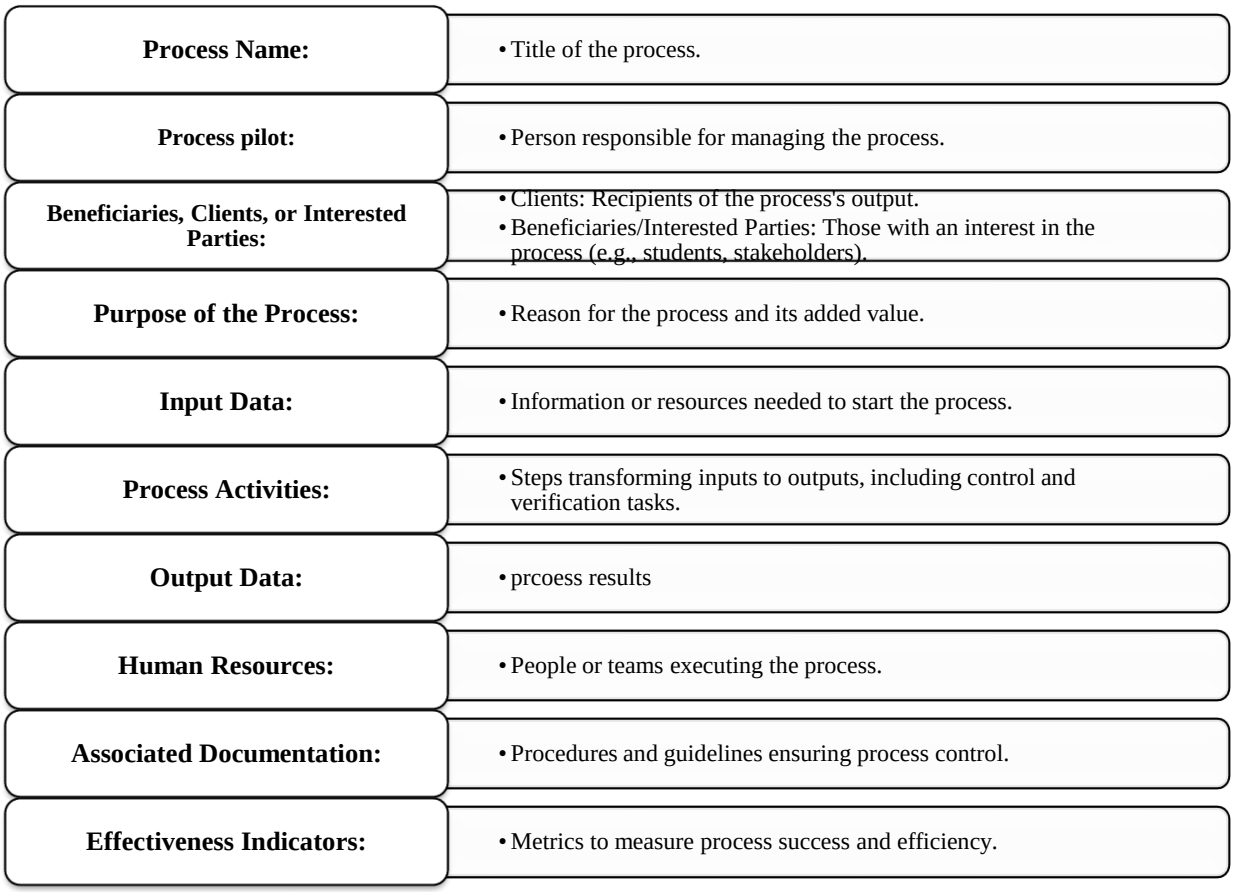
"In risk management, the process matters more than the outcome. Careful attention to the process ensures desired results." This fundamental principle encapsulates the essence of effective risk management. In the proposed ISO 31000 standard, the emphasis is on meticulously identifying, assessing, and addressing risks.

Process map

The process approach allows for significant gains in terms of performance, compliance, and the quality of products and services, as well as in timelines, cost control, risk management, and the identification of opportunities because it is based on:

- Prioritizing added value;
- Detecting, correcting, and preventing dysfunctions;
- Optimal use of resources;
- Taking into account legal and regulatory requirements and social and societal expectations.(FD X50-176, 2017)

Figure 2 : The Elements of the Process Map



Source : Self Developed based on (FD X50-176, 2017)

Risk management process

The risk management process outlined in the proposed ISO standard consists of five stages.

- Communication and Consultation:

This initial step aims to establish a shared vision of the risk management framework with stakeholders by exchanging common working assumptions.

- Establishing the Context:

By considering all constraints and opportunities presented by regulatory, competitive, monetary, demographic, and other developments, organizations adapt their internal structures to anticipate environmental risks.

- Risk Assessment:

- Risk Identification: The objective is to map risks based on events that may facilitate, hinder, or delay goal achievement. The ISO 31000 standard covers both corporate and business risk management dimensions, including risks associated with missed opportunities.

- Risk Analysis: The standard requires describing the causes and positive or negative impacts of risks on processes, probabilizing the triggering events. The methodology aligns with classical approaches in internal control and risk management.

➢ Risk Evaluation:

This step involves comparing estimated risk levels from risk scenario simulations with established risk criteria. If the risk level does not meet acceptability criteria, indicating a threat to the company's sustainability, the risk requires treatment (duplication, separation, elimination, etc.).

➢ Risk Treatment:

- The objective is to eliminate or reduce the vulnerability of the enterprise.
- Strategies may include avoiding risk by deciding not to start or terminate an activity, removing the risk source through protective investments, changing the probability of occurrence through duplication investments, or sharing the risk with stakeholders through insurance transfer.

➢ Surveillance and Review:

This phase involves constructing a risk management information system for monitoring risks. This methodology closely resembles the ARM approach, which includes risk identification and analysis, control tool examination, optimal tool combination selection, decision implementation (including budgeting), and reporting and monitoring risk management (Pascal, 2009)

Risk assessment tools

Risk assessment is crucial for organizations, aiding in identifying and managing potential risks to enhance decision-making, resilience, compliance, resource allocation, and stakeholder confidence.

➢ **Fault Trees: Principles and Methodology**

Fault trees are pivotal tools in risk assessment, offering a structured and graphical representation of causal factors contributing to risk emergence. This method enables analysts to visually map out various events and their dependencies, facilitating a comprehensive understanding of potential failure pathways within a system. Key principles underpinning fault trees include:

- Integration of Probabilities: Calculations must integrate probabilities across all relevant branches when multiple causes converge to the same event to accurately determine its frequency.

- Probability Propagation: Downstream event frequencies along a branch depend on the upstream cause's frequency and the probability of the separating branch, determined by the conditional probabilities of its components.
- Complexity Considerations: The complexity and detail of fault trees necessitate precise data on each event for accurate probabilistic treatment, emphasizing comprehensive analysis.
- System Reliability: System failure occurs when all components fail, emphasizing the criticality of component reliability. Conversely, proper functioning of all components ensures system integrity.
- System Behavior: Understanding system behavior is essential. A new failure during system downtime does not restore functionality, and removing a failure during proper system operation does not induce failure.

Fault tree analysis facilitates the calculation of the probability of the final event or risk, known as the "Event of Interest Frequency" (EIF). This structured methodology provides organizations with a systematic approach to identifying, assessing, and mitigating potential risks effectively, thereby enhancing overall system reliability and safety.

- **The Bowtie Concept: A Visual Approach to Risk Management**

The Bowtie concept offers a graphical representation of risk information, enhancing comprehension and facilitating targeted risk management strategies. Bowtie diagrams depict a single Hazard & Top Event combination, illustrating Threats leading to the Top Event and the ensuing Consequences. Key components of the Bowtie concept include:

- Application Across Industries: Bowtie diagrams find application in diverse sectors, including Oil and Gas Exploration and Production, Chemical Processing, Defence and Security, Shipping, Packaging and Logistics, Medical, Aviation, Mining, and Emergency Response.
- Integration with Safety Engineering Techniques: Bowtie diagrams can integrate various safety engineering techniques, enhancing analysis and quantification.

The Bowtie concept provides a structured and visually intuitive approach to risk management, offering a comprehensive representation of risk elements and their relationships across industries. Bowtie analyses focus on activities or operations with recognized potential for harm, producing diagrams encapsulating several key elements. Each diagram is linked to a specific hazard, representing a source of energy or activity capable of causing harm, and illustrates a single 'top event'—a potential manifestation of the hazard.

Threats denote events likely to trigger the top event, while Barriers act as defenses against these threats.

By systematically analyzing and visualizing these elements, Bowtie diagrams provide valuable insights into risk management and mitigation strategies, enhancing operational safety and resilience.

- **Failure Mode and Effects Analysis (FMEA)**

FMEA is a comprehensive risk analysis technique aiming to identify potential failure modes, assess their effects' severity, and evaluate their likelihood of occurrence and detection. This method helps prioritize improvement actions, allocate resources efficiently, and document risks systematically. Key components of FMEA include:

- Purpose and Methodology: FMEA evaluates potential failure modes based on their occurrence, severity, and probability of detection, enabling effective risk prioritization and mitigation.
- Key Evaluation Criteria: FMEA assesses failure modes based on occurrence, probability of non-detection, and severity, facilitating prioritization of potential failures.
- Adherence to the 20/80 Rule: FMEA aligns with the 20/80 rule, where a minority of identified risks often accounts for the majority of observed failures, emphasizing comprehensive analysis.

2.2.3. Enterprise risks

Enterprise Risk Management (ERM) is crucial for navigating uncertainties and ensuring resilience. By establishing clear risk appetite and integrating oversight functions like risk, audit, and compliance, companies optimize risk assessment and mitigation efforts, considering external economic factors to manage their risk and return profile effectively..

Risk Appetite in Enterprise Management

To establish a robust Enterprise Risk Management (ERM) policy, companies must clearly define their risk appetite, a fundamental aspect of risk governance. This entails determining the level of risk considered acceptable in pursuit of strategic and business goals, covering both risk appetite and tolerance. This process is essential for effective governance, enabling employees at all levels to make informed decisions aligned with the company's risk posture.

Risk Categories for Organizational Governance

The Risk Apetite Statement addresses key risk categories such as strategic/business risk, market risk, credit risk, operational risk, and reputational risk. To establish clear metrics to guide operational risk management .

- Strategic Risks arise from an organization's business strategy and objectives, such as entering new markets or introducing new products.
- Operational Risks stem from day-to-day activities and processes, including technological glitches, human errors, and supply chain disruptions.
- Financial Risks originate from financial operations and management, including credit, market, and liquidity risks.
- Legal/Compliance Risks result from non-compliance with laws, regulations, or industry standards, covering issues such as contract disputes and regulatory violations.
- Reputational Risks stem from events that damage the organization's reputation, such as product recalls, legal disputes, or negative media coverage.(james lam, 2017)

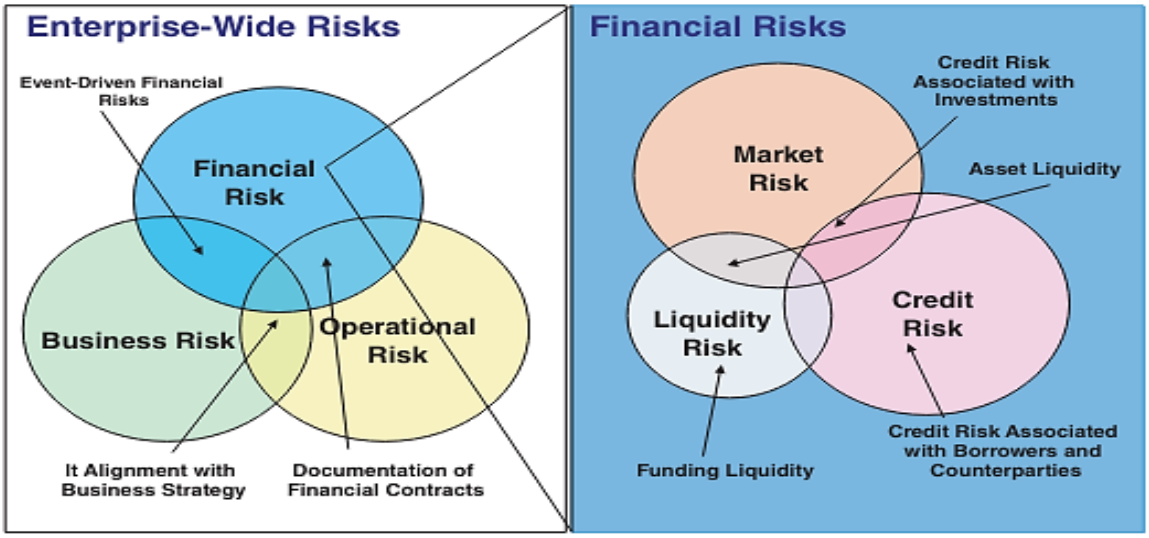
Risk interdependencies

During periods of economic uncertainty, successful companies prioritize robust risk management processes across all decision-making levels. According to James Lam's "Implementing Enterprise Risk Management,"

An integrated ERM framework aligns oversight functions like risk, audit, and compliance, optimizing risk assessment, mitigation, and reporting efforts.

It also considers external economic factors, such as interest rates and inflation, and their potential impact on the organization's risk and return profile.

Figure 3 : Risk Interdependencies



(Source james lam, 2017, p. 16)

Maritime risks

Risk classification in maritime supply chains categorizes risks based on their relevance .

Risk Classification in Maritime Supply Chains

Risk classification is fundamental for effectively managing risks within maritime supply chains. It involves categorizing risks based on their relevance to specific facets of the supply chain, such as supply and organizational management. Various methodologies, including Failure Modes and Effects Analysis (FMEA), statistical accident reviews, and consultations with industry experts, are employed to assess and mitigate these risks (Cheik Aboubakar Ouedraogo et al., 2020)

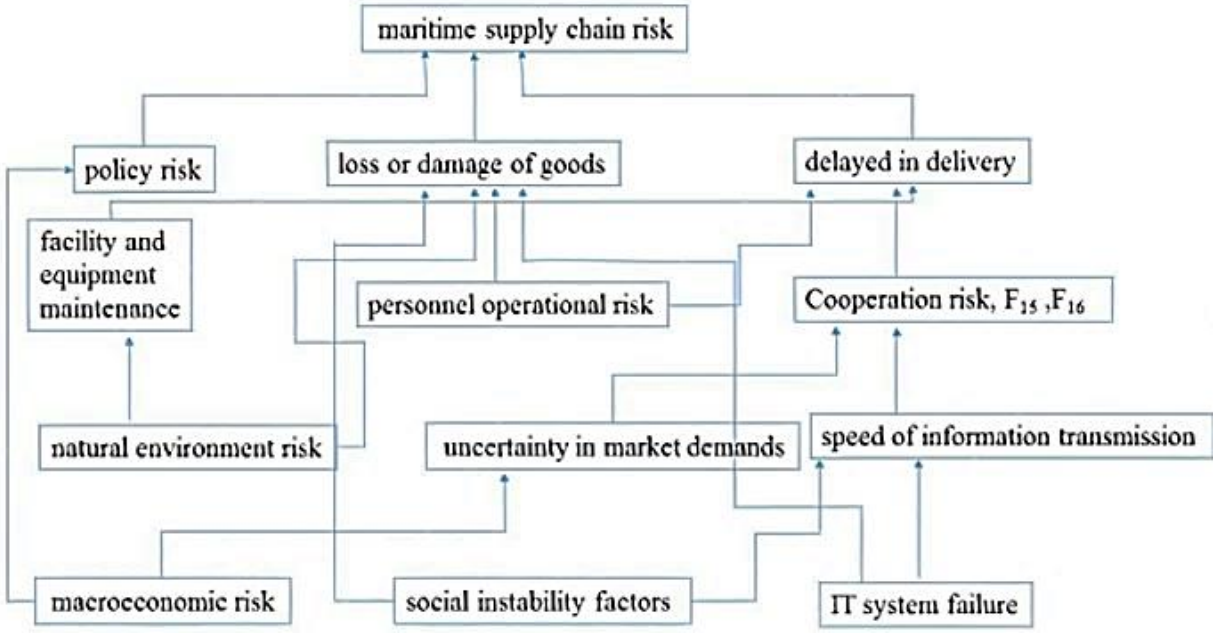
Risk Classes in Maritime Operations

A comprehensive review of existing literature reveals several distinctive risk classes pertinent to maritime operations. These include Supply Risk, Demand Risk, Business Risk, Operational Risk, Environmental Risk, Organizational Risk, and Infrastructural Risk (Jyri Vilko et al., 2019)Each risk class addresses specific challenges encountered within the maritime supply chain, ranging from disruptions in product flow to logistical bottlenecks and environmental hazards.

Maritime Risks in Scholarly Studies

Numerous scholarly studies have explored various risks within the maritime supply chain. These investigations have identified significant concerns, such as operational, physical, and financial risks stemming from container security initiatives. Furthermore, they have shed light on the impact of geographical factors and shifts in stakeholder composition on the dynamics of maritime supply chains, particularly those operating through ports.

Figure 4: Hierarchical structure of risk system of maritime supply chain



Source : (He Jiang et al., 2017, p. 31)

2.3.1. Definition of Operational Risk:

Operational risk, distinct from financial risk, encompasses various sources such as internal (fraud), external (geopolitical events), and strategic (competitive price wars) risks. Unlike market and credit risk, operational risk poses a multifaceted challenge due to its diverse nature and the complexity in defining it succinctly. Originating in enterprise risk management (ERM) during the 1990s, operational risk was initially framed to include risks beyond credit and market risks. Definitions provided by entities like the Basel Committee and Solvency 2 offer comprehensive coverage, addressing deficiencies or failures in internal procedures, personnel, systems, and external events while excluding strategic and reputational risks. Nevertheless, the definition of operational risk varies within the supply chain and container shipping literature. For instance, Talley (2012) emphasizes operational risks in liner shipping, highlighting potential asset devaluation due to physical damage from technical failures or human errors, alongside legal liabilities arising from corporate actions.

2.3.2. Classification of Operational Risks

Operational risks are commonly organized into distinct categories to aid comprehension and mitigation strategy development. Such categorization assists organizations in identifying and prioritizing areas for risk management, enhancing resilience and readiness amid uncertainty

Categories of operational Risks

In the realm of risk management, risks are commonly organized into distinct categories to facilitate comprehension and the development of mitigation strategies. The following delineates prevalent risk categories alongside indicative instances:

- Human-Induced Risks: This classification encompasses intentional, purposeful actions such as fraud or acts of malicious destruction, as well as inadvertent errors resulting from factors like fatigue, incompetence, deficient supervision, or inadequate staffing levels.
- Cumulative Interactive Risks: Risks in this category arise from the gradual accumulation of minor errors over time, culminating in substantial losses as they propagate throughout an organization. This phenomenon, exemplified by the Swiss cheese model, occurs when multiple layers of control fail concurrently, leading to catastrophic incidents.
- Systems and Process Risks: This category encompasses risks stemming from technological malfunctions, programming inaccuracies, deficiencies in data management, inadequate processing capacity, misplaced or erroneous documentation, and insufficient segregation of duties.
- Exogenous Factors: Risks associated with external occurrences, such as the sinking of a cruise liner, can precipitate far-reaching consequences beyond the immediate incident. For instance, such an event might significantly impact the entire cruise industry and prompt immediate alterations in shipping insurance premiums.
- Random Occurrences: This category pertains to events with a low probability of occurrence but significant potential impacts, often attributable to chance circumstances. Examples include winning a lottery jackpot, where the likelihood of success is minimal yet the ramifications are substantial.

The categorization of risks serves to assist organizations in identifying and prioritizing areas for mitigation and risk management endeavors, thereby fortifying resilience and readiness in the face of uncertainty. (RODNEY, 2009, p. 113 to 234)

Classification of operational risks by Causes

Operational risk classification, rooted in an analysis of its underlying causes, offers a structured framework essential for comprehensively managing risks within organizations. Originally proposed by Mestchaian (2003) and subsequently elaborated upon in scholarly works, this classification system extends beyond conventional definitions stipulated by regulatory bodies like the Basel Committee on Banking Supervision (BCBS).

Table 6 : Operational risks categories and their examples

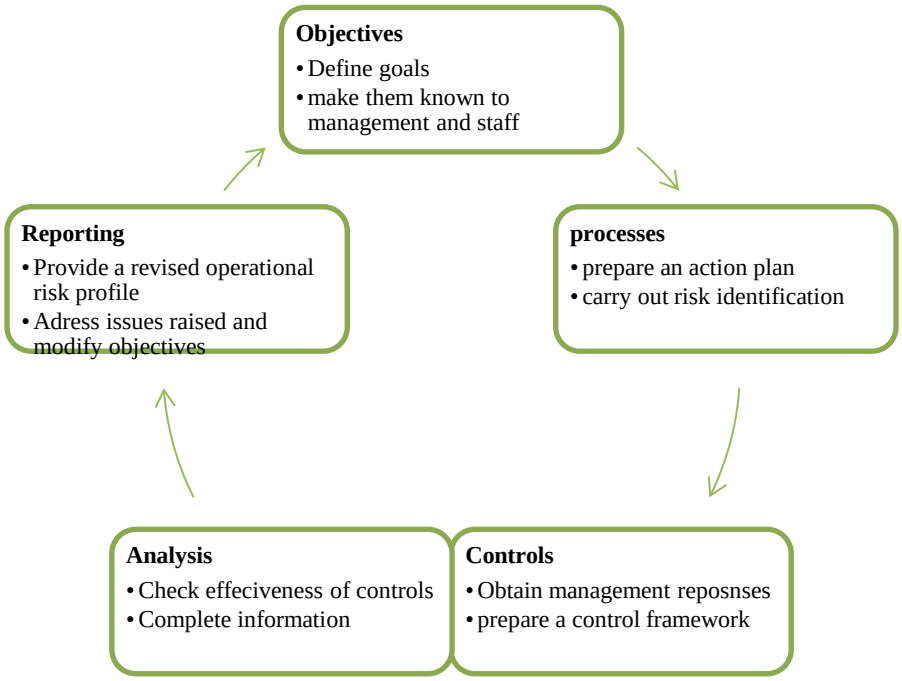
Risk	Category	Examples
People Risk	Errors and omissions	- Concealing losses - Misuse of important information - Non-disclosure of sensitive issues
	Employment, health and safety	- Employee actions - Employee defection - Strikes - Employee injury - Discrimination and harassment issues - Infliction of distress - Compensation disputes - Labor disputes - Employee illness - Forced retirement
	Internal fraud	- Embezzlement - Money laundering - Unauthorized fund transfers - Accounting fraud - Credit card fraud - Tax fraud
People Risk	Trading misdeeds	- Insider trading - Market manipulation - Improper pricing - • Unauthorized trading
Process Risk	Errors and omissions	- Employee error - Inadequate quality control - Inadequate security - Inadequate supervision - Failure to file a proper report
Process Risk	Transaction and business process risk	- Inadequate account reconciliation - Inadequate transaction completion - Inadequate transaction execution - Loss of critical information
Technology Risk	General technology problems	- New technology failure - Technology-related operational errors
	Hardware	- System failure - Outdated hardware
	Security	- Computer virus - Data security - Hacking
	Systems	- Inadequate systems - System maintenance
	Telecommunications	- Fax • Internet - E-mail - Telephone
External Risk	External fraud	- Burglary - External misrepresentation - External money laundering - Robbery
	Natural disasters	- Flooding - Hurricane - Blizzard - Earthquake
	Non-natural disasters	- Arson - Bomb threat - Explosion - Plane crash

Source : (Imad A.Moosa, 2007, p. 100-101)

2.3.3. The operational management risk cycle

The operational risk management cycle is a structured process involving several key steps to identify, assess, and mitigate risks within an organization. It begins with establishing clear goals and communicating them throughout the organization. Action plans and risk identification procedures are then developed. Controls are implemented based on management responses, forming a comprehensive risk management framework. Analysis evaluates control effectiveness to inform decision-making. Reporting provides an updated operational risk profile, guiding adjustments to objectives. This cyclical approach enables proactive risk management, bolstering resilience and minimizing potential disruptions(Paola Luraschi & Joshua Corrigan, 2013)

Figure 5: Operational Management Risk Cycle



Source:(Coleman, 2011, p. 9)

2.3.4. Operational risks and the bowtie diagrame

A brief theoretical background for bowtie analysis for risk management

The Bowtie concept originated within the Shell Group in the late 1970s (Ualison Rébula et al., 2021)and underwent subsequent refinement by The Royal Dutch/Shell Group and ABS Consulting in 2012. It has emerged as a significant tool for risk identification and prevention concerning major incidents and accidents (Nima & Faisal, 2012)

This conceptual framework offers a graphical representation of risk data typically found in risk registers. Its adoption is widespread across various industries, including Oil and Gas Exploration and Production, Chemical Processing, Defence and Security, Shipping, Packaging and Logistics, Medical, Aviation, Mining, and Emergency Response.

Bowtie concept and elements :

Each Bowtie diagram serves as a distinct visual representation, capturing a specific combination of Hazard and Top Event. These diagrams vividly portray the Threats that could trigger the Top Event—essentially the release of the Hazard—and outline the potential Consequences that may ensue. Moreover, they showcase the Controls implemented to thwart each Threat and to minimize the severity and probability of each Consequence.

In Bowtie terminology, the term "Top Event" is employed akin to how "Hazard" is used in certain industries. Here, "Hazard" refers to the activity itself, such as "driving," with "inability to decelerate" exemplifying a Top Event. This nuanced framework allows for the possibility of multiple Top Event Bowties associated with a specific hazardous activity.

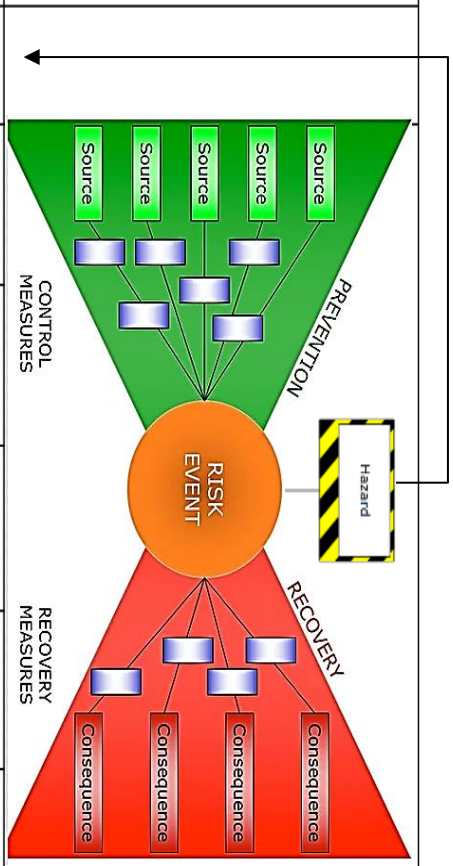
Threats can originate from both internal and external sources, while Consequences represent the outcomes of events impacting objectives, occurring at the system boundary. Maintaining disciplined terminology and conceptual consistency is crucial when working with Bowtie diagrams.

The versatility of the Bowtie concept extends to its applicability across various entities, including Systems, Services, Processes, and Organizations. To comprehensively map an organization's Operational Risk Baseline, Bowtie diagrams must meticulously capture all Hazards and Top Events related to service provision, addressing both system and organizational failures within the operational context.

Once Hazards and Top Events are identified and recorded, their associated risk level can be assessed. This assessment involves determining the likelihood of the worst credible Consequence, either qualitatively or quantitatively, considering the likelihoods of occurrence of each Threat and the effectiveness of each Control. This likelihood is then combined with the severity of the Consequence to derive a risk level for the Top Event.

(Dr. Rober & Mr. Anthony P, 2012) propose that the Bowtie concept is a useful tool for documenting Operational Risk Assessments and integrating key safety processes. Bowtie analysis provides a visual representation of operational risks, facilitating comprehensive risk assessment and management.

Figure 6 : The Elements of the Bowtie Diagram

The Elements	Their significance	The bowtie diagrame
The hazard	The hazard serves as the foundational element of the bowtie diagram, marking the outset of potential harm. It embodies an operation, activity, or material posing a risk, necessitating containment or careful handling to prevent a loss of control.	
Source (threats)	Threats are the sources of harm that have the potential to trigger the top event. They may arise from various sources such as failures, external influences, or operational challenges. Each threat must possess the capability to independently cause the top event.	
Prevention (preventive barriers)	Preventative barriers are safeguards implemented to avert the occurrence of the top event, positioned on the left side of the diagram. When preventative barriers function effectively, the activation of mitigative barriers becomes unnecessary, thereby enabling the avoidance of all potential consequences.	
Risk event (top event)	the top event marks the moment when control over a hazard slips away, but harmful outcomes haven't happened yet. It's like the central knot that ties everything together in the diagram. All efforts are directed towards either preventing this event from happening or lessening its impact if it does occur.	
Recovery (corrective / mitigating barriers)	Mitigative barriers consist of controls and strategies geared towards diminishing the impacts of consequences once the top event has transpired. Situated on the right side of the diagram, While it may not always be possible to prevent an incident, diligent efforts to mitigate its consequences are paramount.	
Consequences	Consequences refer to the negative outcomes that may arise from the top event, Identifying and understanding these potential consequences is essential for effective risk management.	

Source : Self-elaborated based on : (A. de Ruijter & F. Guldenmund, 2014)

Bowtie and operational risks:

Operational Safety Cases shift focus from achieving operational acceptance to managing risks, including assessing the risk baseline, determining acceptability, and monitoring risk levels. At this stage, effective risk management takes precedence over constructing explicit safety arguments. The goal is to validate existing risk assessments based on in-service experiences and adapt to changes in the environment and system.

During operations, maintaining a complex Safety Case becomes impractical. Instead, standardized risk principles outlined in ISO 31000 are more relevant. Operational risk management should be prioritized over elaborate safety arguments, Terms like Threats, Controls, Likelihood, and Consequence are more applicable in operational contexts compared to abstract argumentation concepts. With terms like "Operational Risk Assessment" considered more suitable.

The theoretical framework outlined in this chapter lays the foundation for understanding the complexities of operational risks in maritime transport. It highlights the necessity of adopting comprehensive risk management strategies to address these challenges effectively.
This background sets the stage for the empirical investigation presented in the subsequent chapters

CHAPTER 2 : METHODOLOGY FRAMEWORK AND STUDY FIELD

This chapter details the research design and methodological approach adopted in this study. It explains the qualitative approach, including the use of semi-structured interviews, and documentary analysis. The chapter also outlines the data collection and analysis techniques used to address the research questions Finally, organizational definitions are presented.

Section 1: Methodology Framework

This section discusses the methodology framework of this study, including its research design and methodological approach, as well as the data collection methods and instruments used.

1.1. Research Approach

This part discusses the methodological approach for data collection, emphasizing the use of qualitative research.

Definition and rationale behind the qualitative method choice

The following table show the definition of the qualitative method and the reason for choice for this specific study and objective :

Table 7 : Definition and reason of choice of Qualittative method

Definition	Qualitative research design adopts a constructivist perspective, viewing knowledge as being constructed through individual experiences and interactions. This methodological approach encompasses various methodologies such as narratives, phenomenology, ethnography, grounded theory, and case studies. The primary objective is to delve deeply into participants' perspectives and lived experiences, thereby obtaining rich and contextual insights into the phenomena under investigation (Enas A. et al., 2021).
Reason of choice	ISO stipulates that "qualitative assessment defines the consequences, probability, and level of risk using terms such as 'high,' 'medium,' and 'low' and may combine consequence and probability to assess the resulting risk level based on qualitative criteria." (Frédéric Cordel, 2019)

Source : Self Developed

1.1.1. Problem-Based Approach

This approach entails categorizing risks based on their nature and impact, such as economic, commercial, technical, social, and safety risks. (Pascal, 2009)

For Arkas SPA, this could involve scrutinizing factors like productivity, profitability, service quality, operational methods, and safety protocols.

1.1.2. Top-Down and Bottom-Up Approaches

- Top-Down Approach: Involves gathering insights from leadership and governance bodies first and disseminating them throughout the organization.

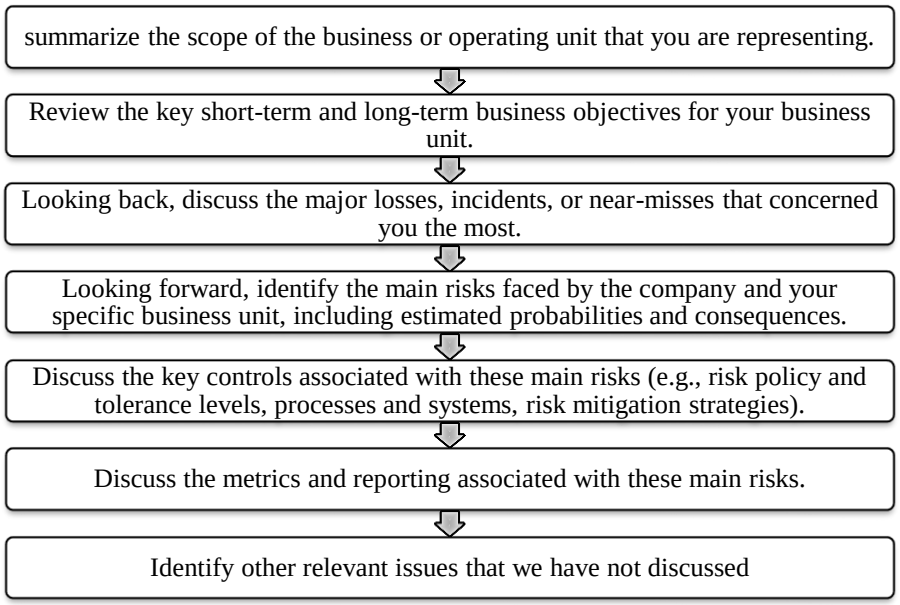
  While providing a macro view of risks, it runs the risk of potential biases and disconnect from ground realities.

1.2. Data collection techniques

To identify and mitigate operational risks within Arkas Spa, the study followed the guidelines of James Lam, a renowned expert in enterprise risk management.

- Lam's guidelines were chosen for their wide recognition and respect in the field, ensuring a systematic and comprehensive approach to risk identification and analysis.
- This method enhances the reliability and validity of the findings by providing a structured framework that addresses the qualitative aspect of operational risks.
- Utilizing the appropriate instruments for data collection according to Lam's guidelines is crucial for ensuring accurate and reliable results.

Figure 7 : Essential Steps in Identifying and Analyzing Enterprise Risks



Source : (james lam, 2017, p. 261)

1.2.1. Semi Directive Interviews

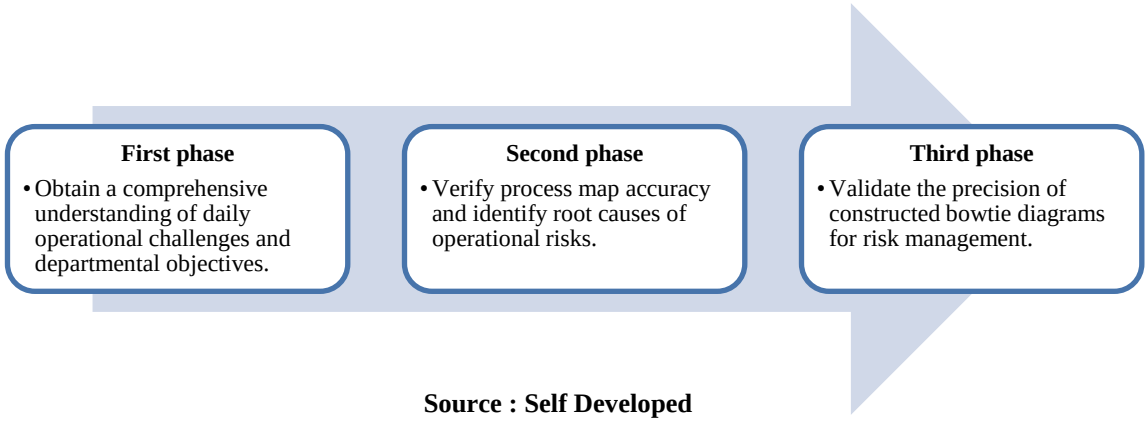
Semi-structured interviews are a flexible yet guided research method commonly used in social sciences.

They involve exploratory discussions based on thematic guides, allowing for deep exploration and discovery while maintaining flexibility. Unlike structured interviews, semi-structured interviews enable the emergence of new questions based on interviewee responses.

They emphasize contextualized knowledge construction rather than simple fact reporting and are chosen based on researchers' ontological and epistemological perspectives.(Ruslin et al., 2022)

There were three main phases of conducting the semi directive interviews for this specific study with each its objective .

Figure 8 : The Interviews Phases and Objectives



Source : Self Developed

the reason of choice of the interviewees:

- Position: Heads of departments selected for their role in the departments that may provide valuable insights.
- Experience: Experience is a key characteristic for the interviewees, as it indicates their knowledge of their activities and their experience in dealing with risks as they occur.
- Availability: The port operations team conducts their work on-site and therefore were not available for the semi-structured interviews.
- Cost Control Manager: The main objective of the cost control manager is to minimize the overall costs of the enterprise by reducing each department's expenses. This role provides an overview of departmental workflows and identifies the most costly issues.
- IT Department : The IT department handles technology risks, which are one of the main categories of operational risks.
- Sales and Key Accounts Manager : The sales and key accounts manager’s perspective on the commercial department was crucial for obtaining an overview of the company's global operations.

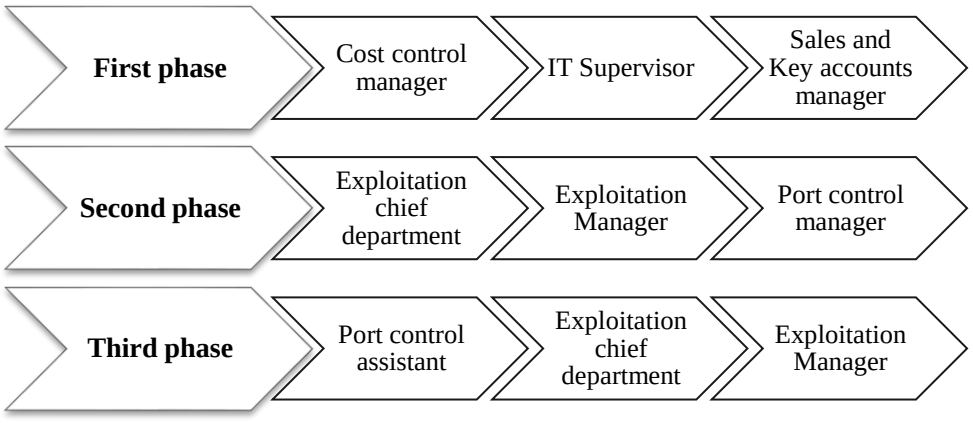
Table 8 : Interviewee's Characteristics

N	Initials of the interviwee	Position	Experience	duration	N° of interviews
01	S.D	Exploitation chief department	17 years	1h30min	2
02	S.T	Exploitation Manager (CMC and documentation)	18 years	1 hour	3
03	N.H	Port control manager	11years	1 hour	1
04	F.	Port control assistant	8years	1 hour	2
05	W.B	Sales and Key accounts manager	10 years	45 min	1
06	Y.O	Cost control manager	10 years	45 min	1
07	A.D	IT supervisor	11 years	45 min	1

Source : Self-Developed

The semi directive interviews were conducted with the managers , supervisors and assistants according to the objective of each phase as the following figure shows :

Figure 9 : The Quality of interviewees based on the objective of each phase



Source : Self Developed

1.2.2. Academic Documentary analysis

Document analysis is a qualitative research method used to examine and interpret documents such as reports, internal correspondence, publications, and other written materials.

This method involves systematically reviewing and analyzing textual, visual, or audio materials to extract relevant information and insights related to the research topic or question. Document analysis can be used as a standalone method or in combination with other qualitative research techniques to triangulate data and provide a comprehensive understanding of the phenomenon under investigation.(Glenn A. Bowen, 2016)

The inclusion of this aspect in the study was considered indispensable due to its capacity to provide a comprehensive perspective on the potential risks that the company might encounter, drawing upon insights gleaned from analogous studies within the same domain. Moreover, this approach facilitates an examination of strategies for risk mitigation, thereby enriching the understanding of proactive measures that can be implemented to safeguard against potential adversities.

- Three articles were analyzed and their reference is the following : (Son & Peggy, 2021) (Yusheng Zhou & Kum Fai Yuen, 2024) (Son Nguyen et al., 2021)
- Five main books were consulted for this study :

- Risk-Conscious Operations Management (Prabhakar V.Varde, 2023)
- Economics of maritime business (Shuo Ma, 2021)
- Gestion des risques et contrôle interne (Frédéric Cordel, 2019)
- Implementing entreprise risk management (james lam, 2017)
- Management des risques (Pascal, 2009)

1.3. Data analyses tools

In this study, two primary data analysis tools were utilized to enhance the understanding and management of operational risks: process maps and bow-tie diagrams .

These tools were illustrated in the first chapter and were selected for their ability to provide detailed insights into process objectives and risk factors, thereby improving the efficiency and accuracy of risk identification and analysis.

1.3.1. Process maps

The process map was deemed essential for this study as it facilitates a comprehensive understanding of the process's ultimate objectives and specific characteristics.

This understanding, in turn, enhances the efficiency of risk identification, allowing for a more precise and effective analysis of potential operational risks.

1.3.2. Bow-tie Diagram

The bowtie diagram was selected for this study due to its effectiveness in identifying and analyzing operational risks. This choice is justified by the complex nature of operational risks, which often have numerous potential causes and a wide range of possible consequences.

The bowtie diagram's structured approach allows for a comprehensive visualization of these relationships, facilitating a more thorough risk assessment and management process

Unknown unknowns risk management framework

The known unknown framework categorizes risks based on our knowledge of them into four types: (TRESHANI & DAVID, 2017)

Known Knowns: Fully understood risks that can be managed. Approaches include top-down and bottom-up methods, with data collected through site visits, interviews, and questionnaires, and tools like process maps.

Known Unknowns : Risks we are aware of but whose impact is uncertain. Managed with problem-based approaches, using tools like the Bowtie diagram, and data from process maps, interviews, and documents.

Unknown Knowns : Risks understood internally but not communicated. Managed using various approaches (top-down, bottom-up, problem-based), with data from documentary analysis and tools like finalized Bowtie diagrams.

Unknown Unknowns: Unforeseen risks that are difficult to manage until identified, and thus not included in the study.

Section 2 : Presentation of the Study Field

This section provides an overview of the company Arkas Algiers SPA, detailing its evolution, activities, and organizational structure. It sets the context for understanding the operational environment in which the study is conducted, highlighting the company's significance in the maritime transport sector.

2.1. The Evolution of Arkas Algiers SPA

Arkas Holding, founded in 1902 as an import agency in Izmir, shifted to international transportation in 1944 under Lucien Gabriel Arcas.

It expanded with Lucien Arkas Shipping Agency in 1964 and introduced container transportation to Turkey in 1978. Renamed Arkas Shipping and Transport S.A. in 1979, it diversified with Emes Shipping & Transport in 1996 and Arkas Container Transport S.A. (Arkas Line) in 2009.

Today, Arkas operates 49 vessels, ranking 30th globally. This journey culminated in the formation of Arkas Holding, overseeing 66 firms in international transportation, symbolizing Turkey's maritime transport excellence.

Arkas SPA is a joint-stock entity established in Algiers in 2004, emerged to provide agency services for Arkas Line. Subsequent to its foundation, Arkas Algerie augmented its scope beyond the Mediterranean and Black Sea regions by commencing representation of Hapag-Lloyd in 2005. Presently, Arkas Algerie operates across four offices situated in Algiers, Annaba, Bejaia, and Oran, with a workforce ranging between 100 and 249 employees.

2.2. The Organisation of Arkas Algiers SPA

This part illustrates the services and departments, as well as the selected departments for the study.

2.2.1. ARKAS Algiers SPA Services

ARKAS Algiers SPA offers a comprehensive range of services in the maritime transport sector, catering to diverse needs. These services include:

- Maritime transport services encompass a diverse range of offerings to meet shipping needs. These include passenger and freight maritime transport, freight maritime transport, on-demand maritime transport (tramping), container maritime transport, cargo transport for construction and timber, coastal shipping (cabotage), ship chartering, and services for shipowners and maritime navigation companies.
- maritime support and handling services, include ship agents (consignatories), maritime brokers, ship loading and unloading (stowage and stevedoring), handling services for

luggage and freight, container handling services, container depots, boat inspection services, and expertise from maritime experts.

- Port and shipping management services encompass the management of ports, dry cargo ports, shipping and transport agents, freight forwarding agents with warehouses, maritime freight brokers, freight consolidators, customs clearance agents for maritime freight, bunker fuel brokers, freight handling agents, integrated freight services with forecasting studies, and partial load coordination and assortment.
- Specialized storage and management services cater to various industries, offering services such as specialized storage services for stores and warehouses, industrial equipment warehousing, enterprise and equipment management, and merchant ship management.
- services that provide expertise in areas such as engineering consultancy for transport infrastructure and traffic, maritime transport engineering consultancy, port activities consultancy, and maritime freight handling consultancy.

Through its diverse portfolio, ARKAS Algiers SPA facilitates efficient maritime transport operations and ensures customer satisfaction.

2.1.2. ARKAS Algiers SPA Departments

ARKAS Algiers SPA operates through various departments, each playing a crucial role in facilitating the company's operations and achieving its objectives , the following figures shows the business structures of the company as well as the support structures :

Figure 10: the departments of Arkas SPA and their objectives

Business Structures:	Operations : Manages day-to-day activities and logistics.
	Logistics : Optimizes transportation and distribution processes.
	Container Management & Control : Oversees the tracking and maintenance of shipping containers.
	Exploitation : Maximizes resource utilization and operational efficiency.
Support Structures:	Management : Sets strategic direction and coordinates overall operations.
	Sales and marketing : Promotes services and secures contracts
	Customer Service : Ensures customer satisfaction and resolves inquiries.
	Demurrage : Manages fees for cargo delays.
	Disbursement Accounts : Handles payments and financial transactions
	General Means Service : Maintains company assets and infrastructure.
	HR & Payroll : Manages human resources functions and payroll processing.
	IT : Maintains information technology systems and provides technical support
	Accounting & Finance : Manages financial transactions and reportin
	Cost Control : Monitors and minimizes expenses.
	Delivery Order Service : Facilitates the issuance of delivery orders for shipments.

Source : Self-Devoleped

2.1.3. ARKAS Algiers SPA selected Departments

ARKAS Algiers SPA operates through a range of departments, each pivotal in facilitating the company's operations and attainment of its objectives.

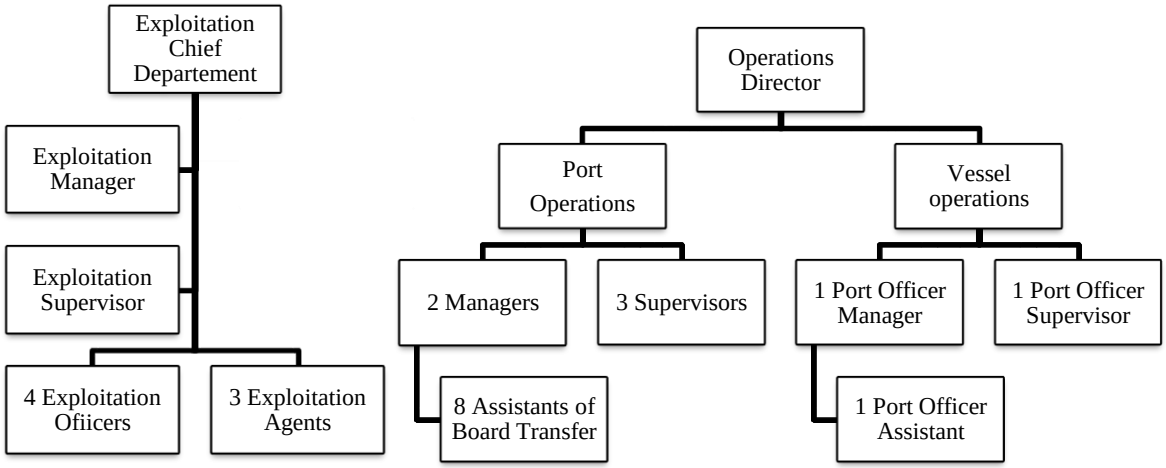
This study focuses on these two departments :

- Operations Department: This department is responsible for the seamless execution of logistics operations. Its duties encompass coordinating vessel schedules, managing cargo handling, ensuring compliance with customs regulations, overseeing docking and unloading operations, maintaining the integrity of work documents, and procuring necessary equipment.
- The Exploitation Department manages shipping and logistics documentation, ensuring compliance with regulations. It offers specialized services:

- Logistics Service: Focuses on inventory management, transportation planning, and warehousing, aiming for process optimization and cost reduction.
- Container Management and Control (CMC) Service: Specializes in efficient container handling, ensuring integrity and availability, and managing administrative tasks.

In collaboration, these departments ensure the efficiency and effectiveness of ARKAS Algiers SPA's transportation and logistics activities, significantly contributing to the company's success.

Figure 11 : Organizational chart of Exploitation and Operations Departments



Source : Self Developed

The methodological approach employed in this study ensures a robust analysis of operational risks in maritime transport.

CHAPTER 3 : RESULTS AND DISCUSSION

This chapter presents and discusses the results of the data collection process. It includes the findings from the questionnaires and semi-structured interviews, as well as an analysis of process maps and bowtie diagrams. The chapter also addresses the study's limitations and areas for improvement.

Section 1 : Results

The first section of this chapter demonstrates the results of the methodology applied for the study from the questionnaires and interviews to the bowtie diagrams and process maps as well as discussing them .

1.1. Results of data collection

This part illustrated the findings of the main findings of the interviews

According to the respondents' answers, the exploitation officers collectively strive to enhance efficiency in completing the specified tasks in the below figure , while they also specified that collaboratively ensuring task completion is an additional responsibility. And the same applies to exploitation agents

1.1.1. Results of the semi-directive interviews

- In the first phase of the semi-structured interviews aimed at gaining a thorough understanding of daily operational challenges and departmental objectives, the following managers were interviewed: Cost Control Manager, IT Supervisor, and Sales and Key Accounts Manager. And one of the objectives of the second phase were to identify the operational objectives of the targeted departments . The main results obtained were as follows :

Figure 12: Semi-directive interviews first and second phase main results

the Entreprise's strategic objective	Diversify service offerings
	Enhance partner and client satisfaction
	Reduce operational costs
	To expand its global port network.
	Augmenting the fleet capacity.
the most internal common challenges	Documentation errors
	Legal compliance issues, including taxes and fines
	Operational delays
	Internal system disruptions (referred to as "YNA")
	Documentation delays
	Internet irruptions
Operational objectives of exploitation and operations deparments	Precise data transmission
	Regulatory adherence
	Streamlined processes
	Timely execution of operations

Source : Self-Devoleped

- The remaining results of the semi structured interviews and Questionnaires were illustrated in the second part of this section in the process maps and the bowtie diagrams .

1.2. The Process Maps

This part presents the process maps of the focus departments—exploitation, shipping, and operations—and delineates the interactions between them.

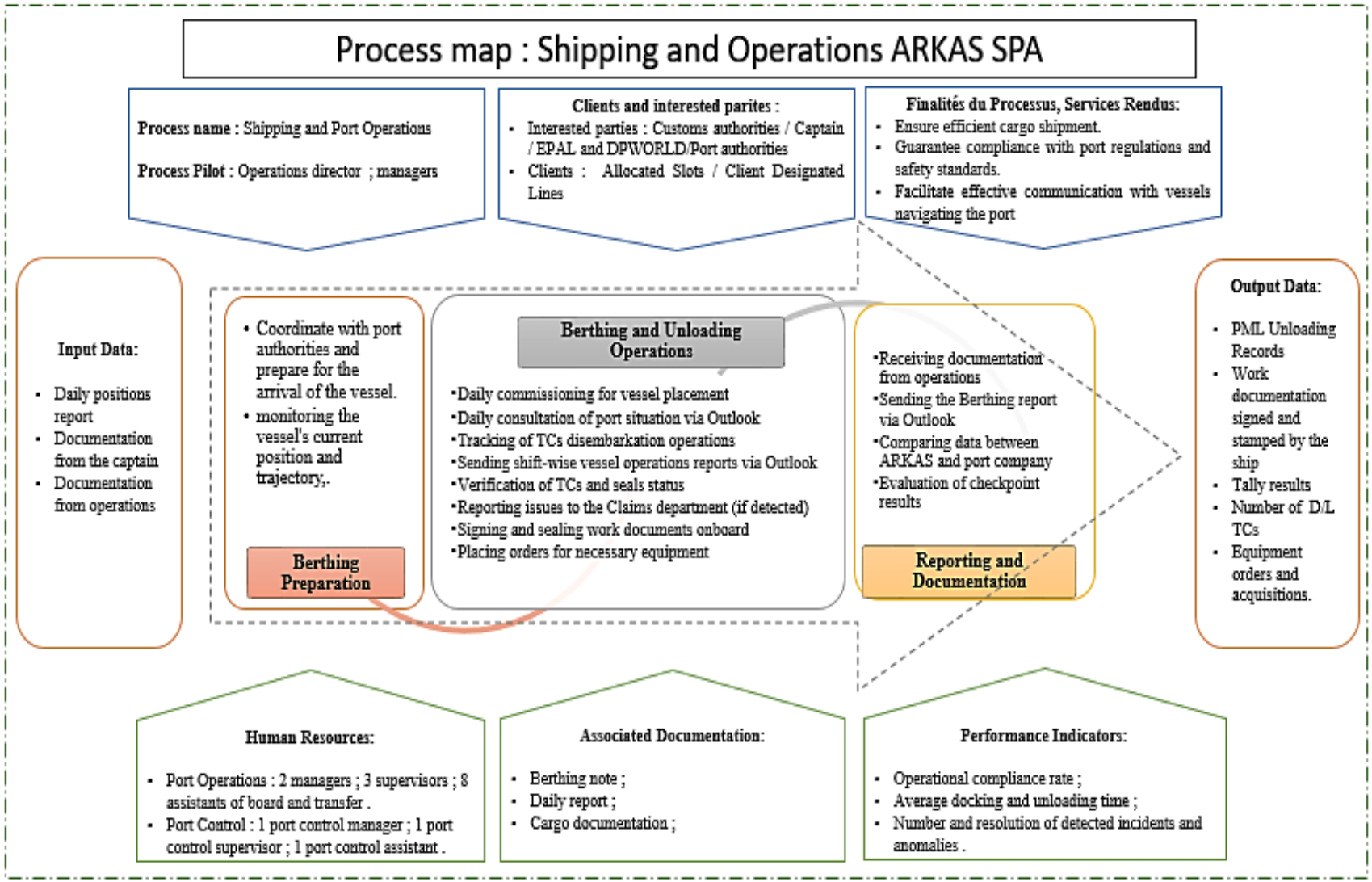
1.2.1. Shipping and operations process map

The Shipping and Port Operations process at ARKAS SPA ensures the efficient management of cargo shipments and vessel berthing. This begins with the collection of critical input data, such as daily vessel position reports and documentation from the ship captain and operations team. Coordination with port authorities during berthing preparation involves monitoring the vessel's position and trajectory, assigning berths, and updating port conditions.

During berthing and unloading, the process includes daily commissioning for vessel placement, tracking transport container (TC) disembarkation, and sending shift-wise reports. Verification of TCs and seals ensures the integrity of goods, with any anomalies reported to the Claims department. Work documents are signed onboard, and equipment orders are coordinated to facilitate operations. Reporting tasks involve receiving operational documents, sending detailed berthing reports via Outlook, comparing data with port company records, and evaluating checkpoint results for compliance.

Output data includes PML unloading records, signed work documentation, tally results, disembarkation/loading TC records, and equipment orders. Human resources involved are managers, supervisors, and assistants overseeing boarding and transfer operations, supported by a port control team. Key performance indicators include the operational compliance rate, average docking and unloading time, and the number and resolution of detected incidents. Essential documents are the berthing note, yard report, and cargo documents.

Figure 13 : Shipping and Operations Process map



Source : Self-Devoleped

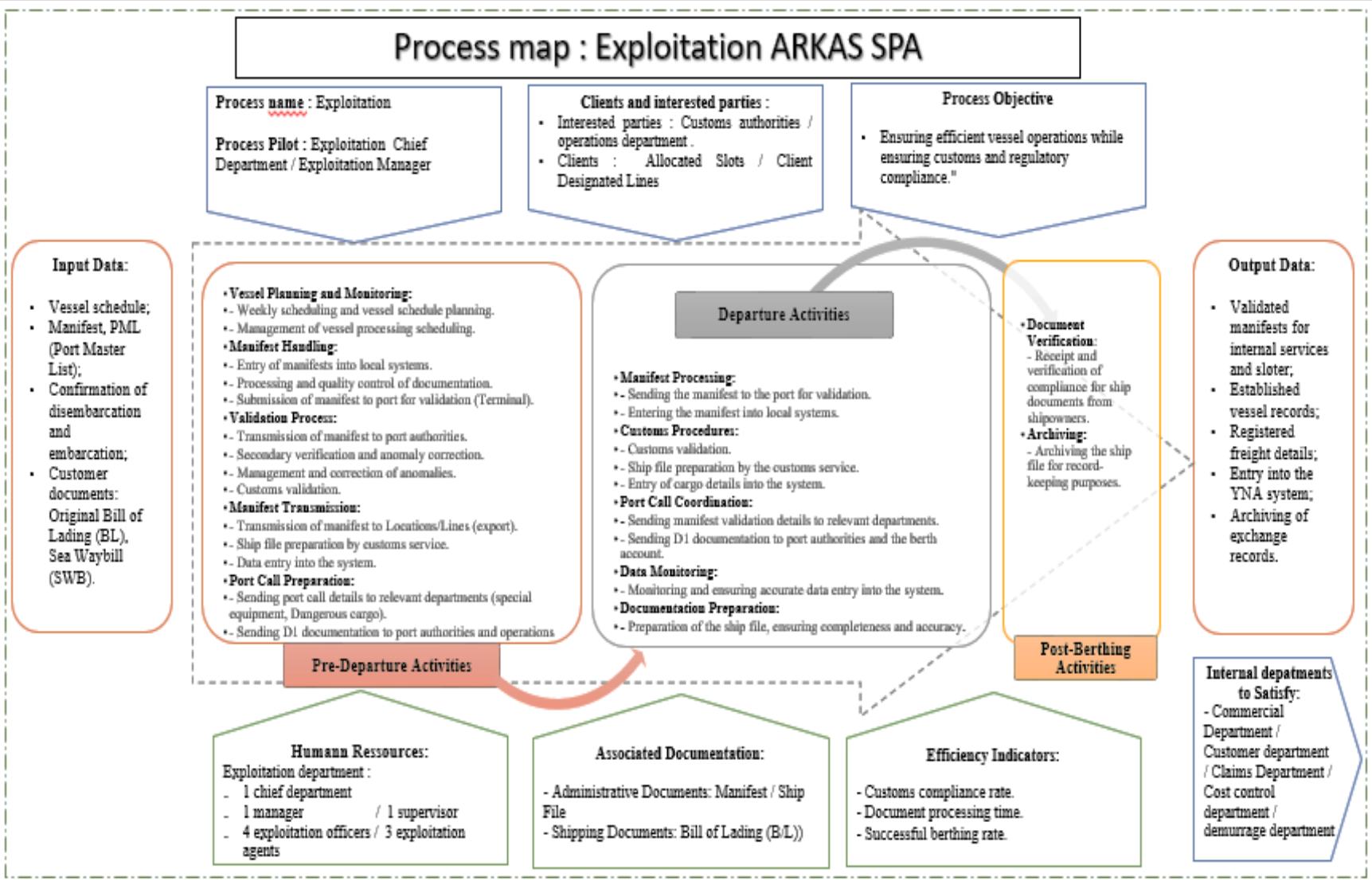
Source : Self-Devoleped

1.2.2. Exploitation process map

The Exploitation process at ARKAS SPA focuses on the efficient and compliant execution of vessel operations, particularly loading and berthing. It begins with collecting input data such as the vessel schedule, manifest, Port Master List (PML), and customer documents like the Original Bill of Lading (BL) and Sea Waybill (SWB). Pre-departure activities involve vessel planning and monitoring, including weekly scheduling and manifest quality control, followed by transmission to port authorities. Anomalies are corrected, customs validation is secured, and port call details are coordinated.

During departure, the manifest undergoes port validation and customs procedures to ensure compliance. Pre-departure documentation is prepared and sent to port authorities and the operations team. Post-berthing activities include verifying received documents, archiving ship files, and monitoring efficiency indicators such as customs compliance rate, document processing time, and successful berthing rate. Human resources involved include a chief department, supervisor, exploitation officers, and agents. Key documents include administrative records like manifests and ship files, as well as shipping documents such as the Bill of Lading (B/L).

Figure 14 : Exploitation Process map



Source : Self-Devoleped

1.2.3. The interaction between the processes :

The interaction between the exploitation and operations/shipping processes plays a crucial role in ensuring the efficient management of vessel operations while adhering to regulatory standards. This interaction involves several key aspects:

- **Input Data Coordination:**

- Shipping and Port Operations receive daily position reports and documentation from the captain, coordinating with port authorities for vessel arrivals.
- Exploitation receives vessel schedules, manifests, and confirmation of embarkation/disembarkation, ensuring the collection of necessary customer documents.
- Interaction: Shipping and Port Operations provide daily reports and operational documents to the Exploitation team for vessel status updates and preparation purposes.

- **Vessel Planning and Coordination:**

- Shipping and Port Operations coordinate vessel placement and track container disembarkation, reporting any issues with container seals.
- Exploitation manages weekly vessel scheduling, transmits manifests to port authorities, and prepares necessary documentation.
- Interaction: Information on vessel placement and tracking from Shipping and Port Operations assists the Exploitation team in managing scheduling and customs/port documentation.

- **Departure and Berthing Activities:**

- Shipping and Port Operations conduct daily commissioning for vessel placement, process operational documentation, and provide berthing reports.
- Exploitation processes manifests, coordinates customs procedures, and maintains efficiency indicators.
- Interaction: Departure and berthing reports from Shipping and Port Operations facilitate manifest processing, customs coordination, and record-keeping by the Exploitation team.

- **Post-Berthing and Documentation:**

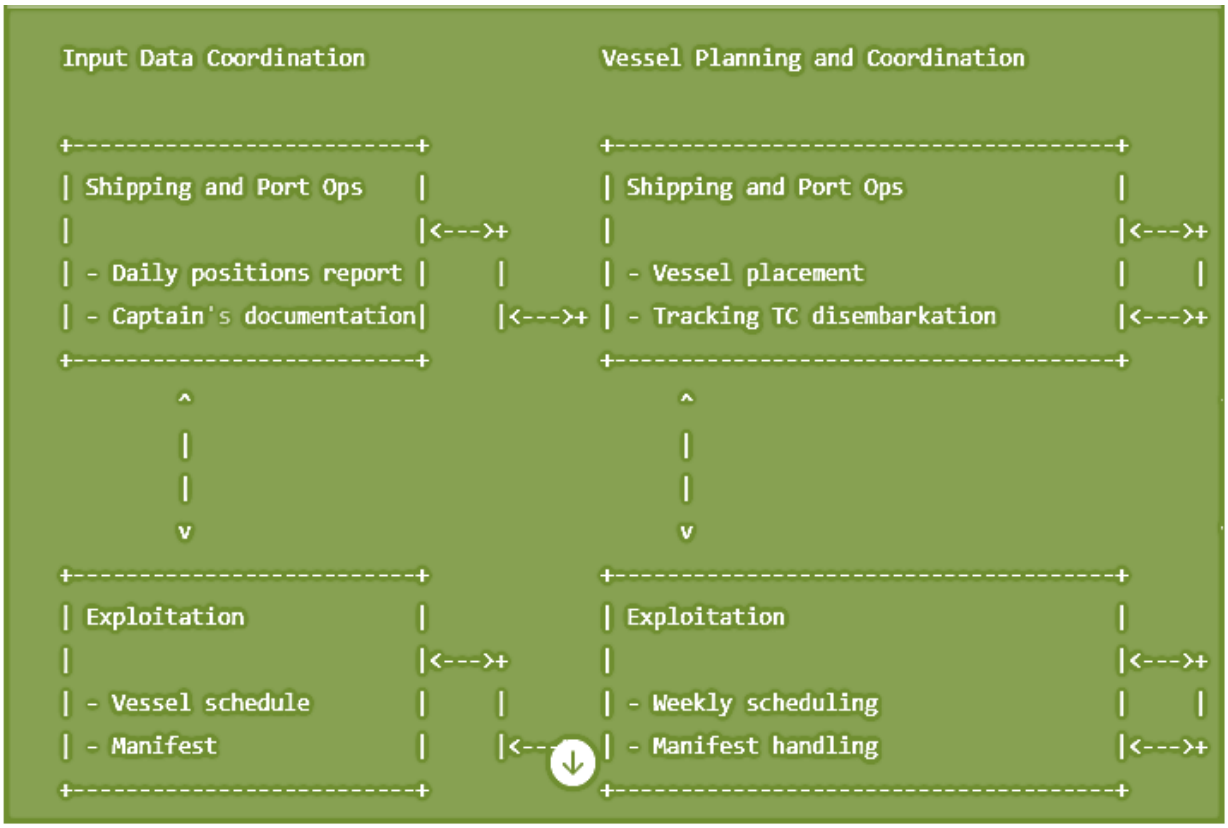
- Shipping and Port Operations sign and seal work documents, verify operational documentation, and send final reports.
- Exploitation verifies received documents, archives ship files, and monitors efficiency indicators.
- Interaction: Final documentation and reports from Shipping and Port Operations support the Exploitation team in verification, archiving, and regulatory compliance.

In summary, these interactions between exploitation and operations/shipping processes ensure seamless coordination, data exchange, and compliance throughout vessel operations. This structured approach enhances efficiency, regulatory compliance, and documentation accuracy within maritime operations.

This interaction diagram highlights the seamless flow of information and coordination between the Shipping and Port Operations and Exploitation processes at ARKAS SPA.

Each step involves a reciprocal exchange of data and documentation, ensuring efficient and compliant maritime operations.

Figure 15 : Interaction diagram of the two processes



Source : Self-Devoleped

- **Input Data Coordination:**

- Shipping and Port Ops receive daily position reports and captain's documentation.
- Exploitation receives vessel schedules and manifests.

- **Vessel Planning and Coordination:**

- Shipping and Port Ops coordinate vessel placement and track container (TC) disembarkation.
- Exploitation manages weekly scheduling and manifest handling.

- **In this diagram:**

- Arrows represent the flow of information between departments.
- Inputs from Shipping and Port Ops (daily position reports, captain's documentation) go to Exploitation.
- Outputs from Exploitation (vessel schedules, manifests) go to Shipping and Port Ops.
- There's an interaction (represented by the double-headed arrow) between the departments, indicating collaboration or exchange of information.

The structured workflows and dedicated team enable ARKAS SPA to maintain high standards of efficiency, compliance, and communication within the maritime industry.

1.3. The Bowtie Diagrams

Drawing from interviews, questionnaires, and academic document analysis, an exhaustive exploration of operational risks within ARKAS SPA was conducted, focusing particularly on exploitation, shipping, and operations processes. Bow tie Diagrams, a systematic approach was employed to visually depict the intricate relationships among operational risks, their causes, preventive measures, and potential outcomes.

The risks identifies were :

- Errors in documentaiton During documentation governance ;
- Container Damage Risk During Handling and Transport ;
- Information Delay Risk in Information Transfer ;
- Transportation Delay Risk during Maritime Transport ;
- Cargo Rerouting Risk during Cargo Shippin .

1.3.1. Errros in documentation During documentaiton governance

In the dynamic realm of documentation and port operations, numerous threats can hinder efficiency and safety. These encompass miscommunication, human error, technological challenges, and time constraints. However, proactive measures are pivotal in mitigating these risks effectively.

Threats:

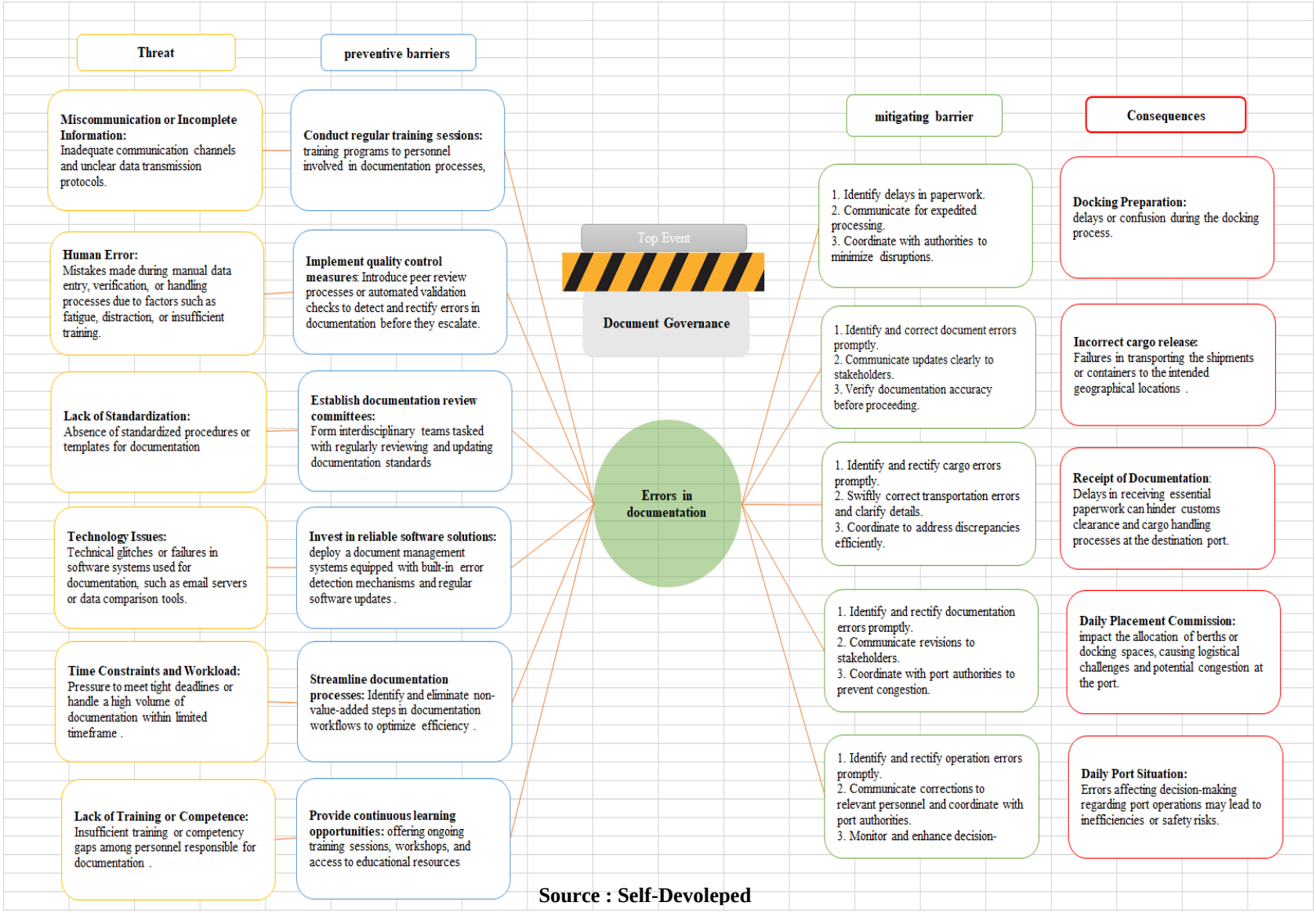
- Miscommunication or Incomplete Information : Inadequate communication channels and unclear data transmission can lead to delays and errors.
- Docking Preparation Delays or Confusion : Issues in preparing for docking processes can cause logistical challenges and potential congestion.
- Lack of Standardization in Documentation : Absence of standardized procedures or templates may result in errors and inconsistencies.
- Incorrect Cargo Release : Mistakes in cargo release can disrupt transportation processes and lead to financial losses.
- Receipt of Documentation Delays : Delays in receiving essential paperwork can hinder customs clearance and cargo handling.
- Technology Issues : Technical glitches or failures in software systems can disrupt documentation processes.
- Time Constraints and Workload : Pressure to meet deadlines or handle high volumes of documentation may compromise accuracy and efficiency.
- Lack of Training or Competence : Insufficient training or competency gaps among personnel can lead to operational errors.
- Daily Port Situation Errors : Mistakes in decision-making regarding port operations can result in inefficiencies or safety risks.

Preventive Barriers and Mitigating Measures:

- Regular Training Sessions : Enhance communication skills and ensure staff competence.
- Quality Control Measures : Implement peer review processes, automated validation checks, and documentation review committees.
- Investment in Technology : Deploy reliable software solutions with error detection mechanisms and regular updates.
- Standardization and Streamlining : Establish standardized procedures, streamline documentation processes, and eliminate non-value-added steps.
- Continuous Learning Opportunities : Offer ongoing training sessions, workshops, and educational resources.

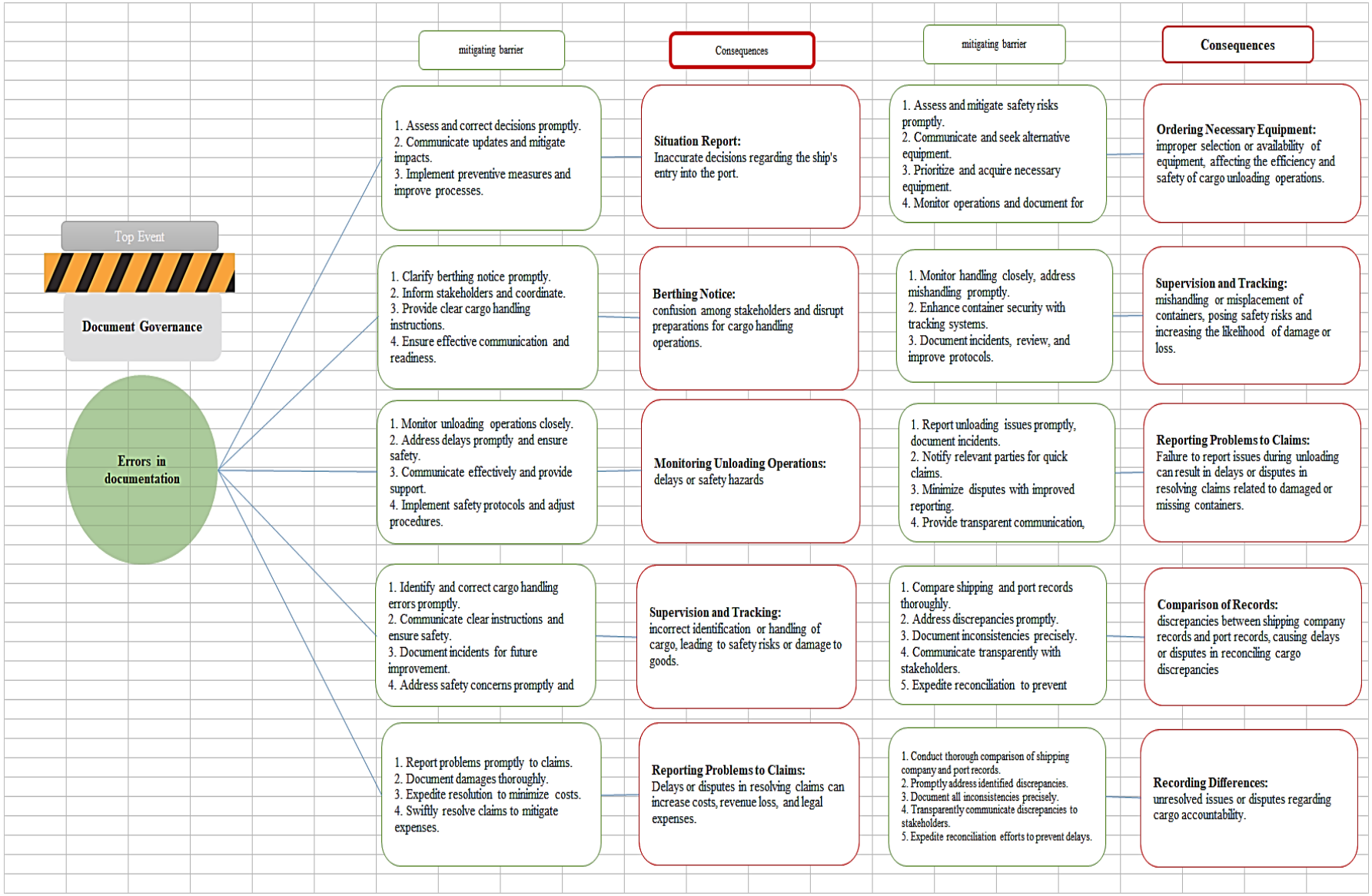
- Timely Coordination and Communication : Identify and rectify errors promptly, communicate updates clearly, and coordinate with relevant authorities.
- Regular Monitoring and Enhancement : Continuously monitor and enhance decision-making processes

Figure 16 : Bowtie diagram (errors in documentation 1)



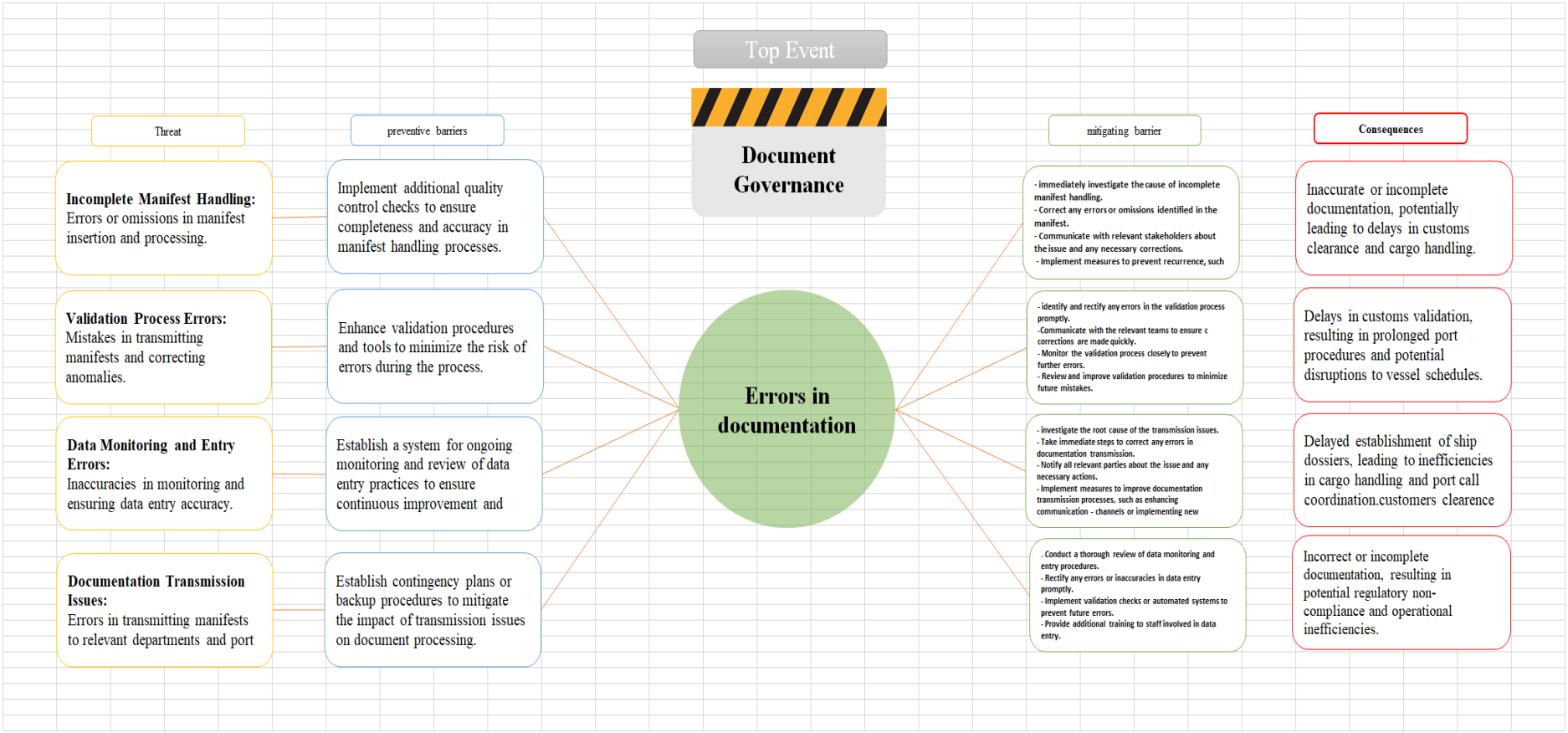
Source : Self-Devoleped

Figure 17 : Bowtie diagram (erros in documtation 2)



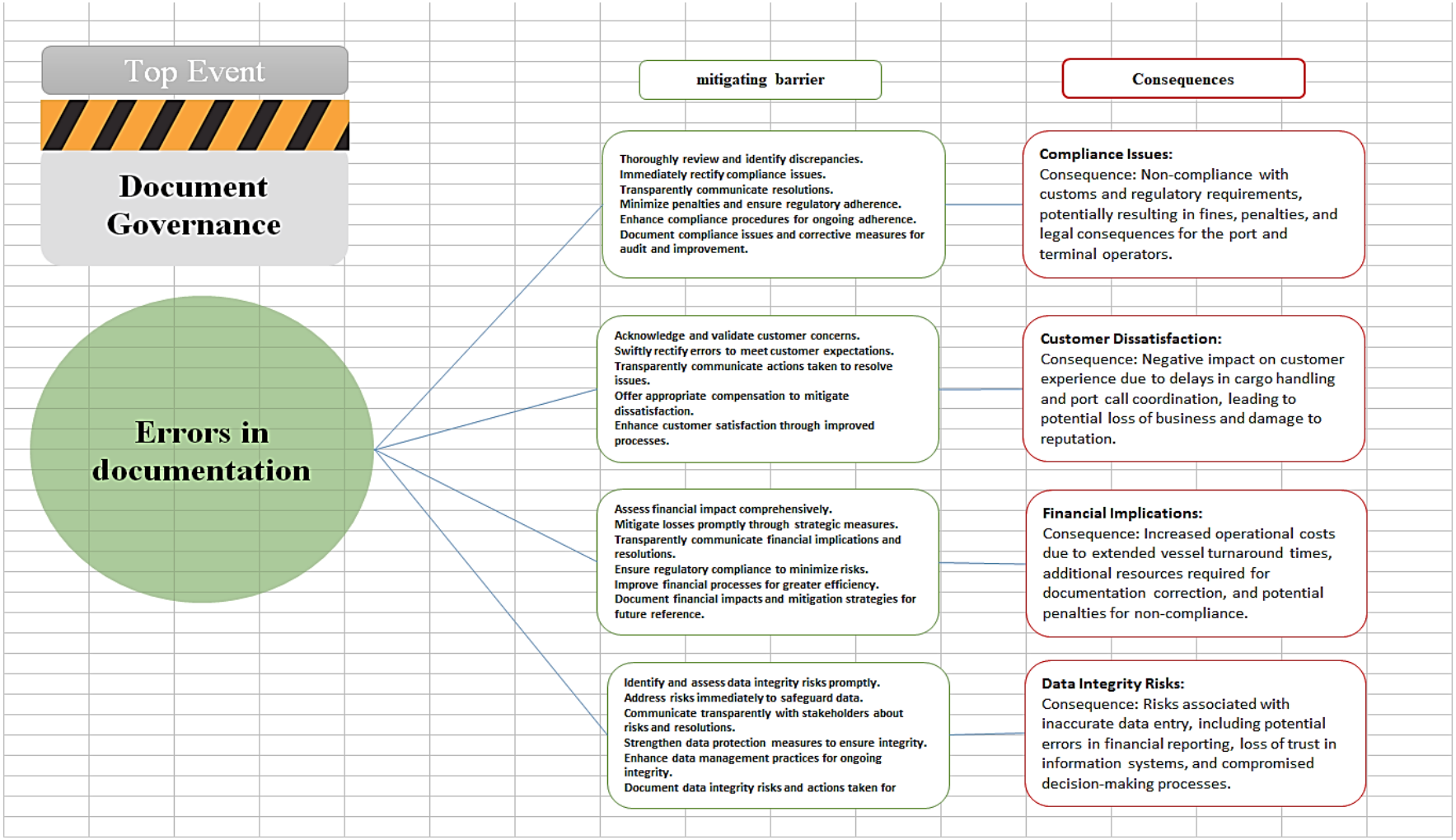
Source : Self Developed

Figure 18 : Bowtie diagram (erros in documtation 3)



Source : Self Developed

Figure 19 : Bowtie diagram (errors in documentation 4)



Source : Self Developed

Interactions and Importance:

These preventive barriers and mitigating measures are interlinked and paramount for effective risk management. For example, regular training enhances staff competence, reducing human errors. Quality control measures and standardized procedures ensure accuracy and consistency, mitigating risks of miscommunication and incomplete information. Investment in technology facilitates efficient data transmission and error detection, enhancing operational efficiency.

Moreover, timely coordination, communication, and continuous learning foster a proactive organizational culture, enabling swift issue resolution. Regular monitoring and enhancement ensure adaptability, minimizing the impact of unforeseen challenges.

In summary, this integrated approach emphasizes proactive identification and mitigation of threats, enhancing operational efficiency, reducing financial risks, and fostering a culture of continuous improvement within the organization.

1.3.2. Container Damage Risk During Handling and Transport

Container damage during handling and transport poses significant risks, including mishandling during crane and forklift operations, environmental exposure in container yards, and overloading/improper stowage. However, preventive measures and mitigating barriers can effectively address these risks.

- **Threats:**

- Mishandling during Crane and Forklift Operations : Inexperienced operators or rushed operations can lead to improper lifting, collisions, and dropping of containers.
- Environmental Exposure in Container Yards : Prolonged exposure to sunlight, rain, and salty air can cause rust, corrosion, and material degradation.
- Overloading and Improper Stowage : Cargo overloading, improper stowage, and inadequate securing can cause internal damage during transport.

- **Preventive Measures:**

- Operator Training : Implement comprehensive training programs for crane and forklift operators to ensure proper handling techniques.
- Environmental Protection : Implement protective measures in container yards to shield containers from environmental exposure.
- Cargo Inspection : Conduct rigorous cargo inspections to prevent overloading, ensure proper stowage, and adequate securing.

- **Top Event: Handling and Transport**

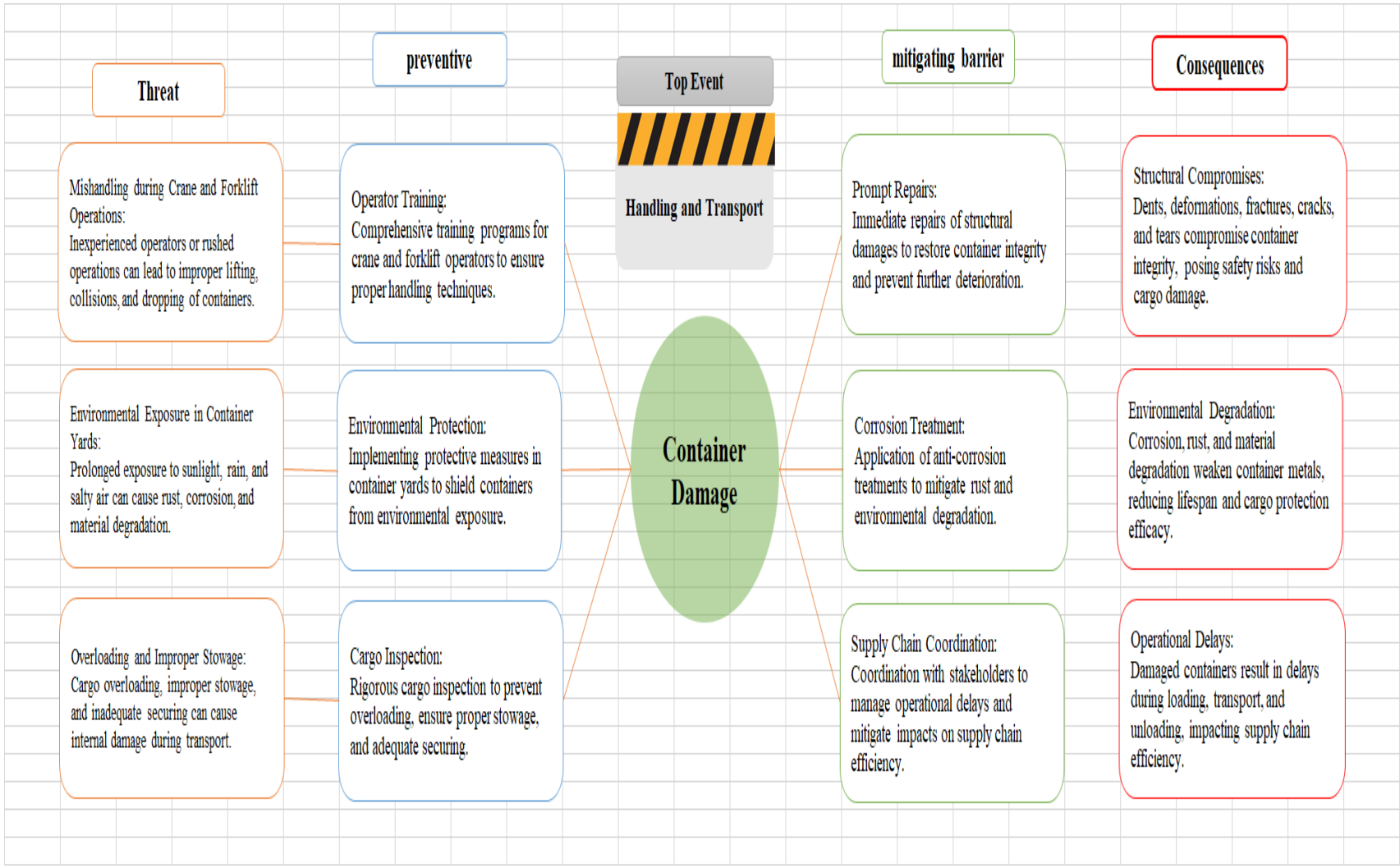
Mitigating Barrier : Prompt repairs of structural damages, application of anti-corrosion treatments, and coordination with stakeholders to manage operational delays.

- **Consequences:**

- Structural Compromises : Dents, deformations, fractures, cracks, and tears compromise container integrity, posing safety risks and cargo damage.
- Environmental Degradation : Corrosion, rust, and material degradation weaken container metals, reducing lifespan and cargo protection efficacy.
- Operational Delays : Damaged containers result in delays during loading, transport, and unloading, impacting supply chain efficiency.

These preventive measures and mitigating barriers are crucial for minimizing cargo damage risks, ensuring operational efficiency, and safeguarding supply chain integrity.

Figure 20 : Bowtie diagram (container dammage)



Source : Self Developed

1.3.3. Information Delay Risk during Information Transfer

The risk of insformation delay during the transfer of information within supply chains poses significant challenges, including delays in critical information transmission and disrupted supply chain operations. However, preventive measures and mitigating barriers can effectively address these risks.

- **Threats:**

- Various Information Channels : Delays in transmitting information across different channels in the supply chain lead to inefficiencies and disruptions.
- Timeliness of Information Dissemination : Supply chain partners failing to disseminate critical information in a timely manner, resulting in delays in decision-making and operations.

- **Preventive Measures:**

- Information Sharing Protocols : Implementation of standardized protocols for information sharing among supply chain partners to ensure timely and transparent communication.
- Automation of Documentation Processes : Adoption of digital platforms and automated systems for document processing to streamline procedures and minimize delays.

- **Top Event: Information Transfer**

-Mitigating Barrier: Prioritization of critical information transmission and expedited processing to mitigate the impact of delays on supply chain operations.

- **Consequences:**

- Disrupted Supply Chain Operations : Delayed transmission of critical information disrupts supply chain operations, leading to inefficiencies, missed deadlines, and customer dissatisfaction.
- Reduced Decision-Making Efficiency : Lack of timely information hampers decision-making processes, resulting in suboptimal choices and potential financial losses.
- Carrier Communication : Untimely transmission of important information by carriers regarding shipment status, schedules, or changes impacts supply chain visibility and planning.

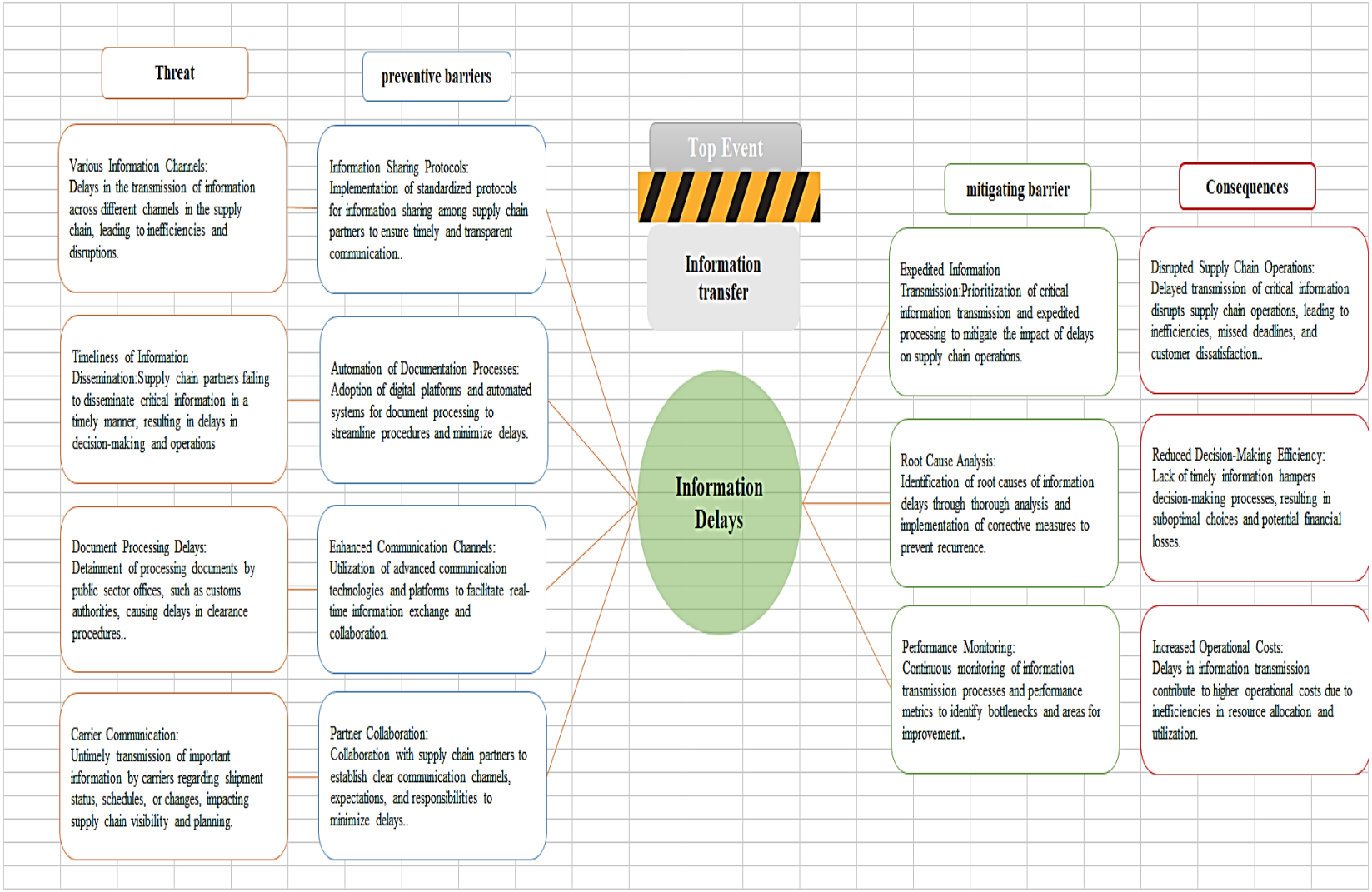
- **Additional Mitigating Measures:**

- Enhanced Communication Channels: Utilization of advanced communication technologies and platforms to facilitate real-time information exchange and collaboration.
- Root Cause Analysis: Identification of root causes of information delays through thorough analysis and implementation of corrective measures to prevent recurrence.

- Partner Collaboration : Collaboration with supply chain partners to establish clear communication channels, expectations, and responsibilities to minimize delays.
- Performance Monitoring : Continuous monitoring of information transmission processes and performance metrics to identify bottlenecks and areas for improvement.

These preventive measures and mitigating barriers are crucial for minimizing transformation delay risks, ensuring operational efficiency, and reducing costs within supply chain operations.

Figure 21 : Bowtie diagram (Information delays)



Source : Self Developed

1.3.4. Transportation Delay Risk during Maritime Transport

The risk of transportation delays during maritime transport presents various challenges, including terminal congestion, adverse weather conditions, and customs delays. However, preventive measures and mitigating barriers can effectively address these risks.

- **Threats:**

- Terminal Congestion Obstructing Vessel Access : Terminal congestion obstructs vessel access, leading to delays in cargo handling.
- Adverse Weather Conditions Impacting Vessel Navigation : Adverse weather conditions can hinder vessel navigation and cause delays in maritime transport.
- Customs Delays in Cargo Clearance : Customs delays in cargo clearance prolong the transportation process and cause operational disruptions.

- **Preventive Measures:**

- Enhanced Validation Procedures : Implement additional quality control checks and validation procedures to ensure completeness and accuracy in manifest handling processes.
- Continuous Improvement in Data Entry Practices : Establish a system for ongoing monitoring and review of data entry practices to ensure continuous improvement and error reduction.

- **Top Event: Maritime Transport**

Mitigating Barrier: Prompt investigation of incomplete manifest, correction of errors, communication with stakeholders, and implementation of preventive measures.

- **Consequences:**

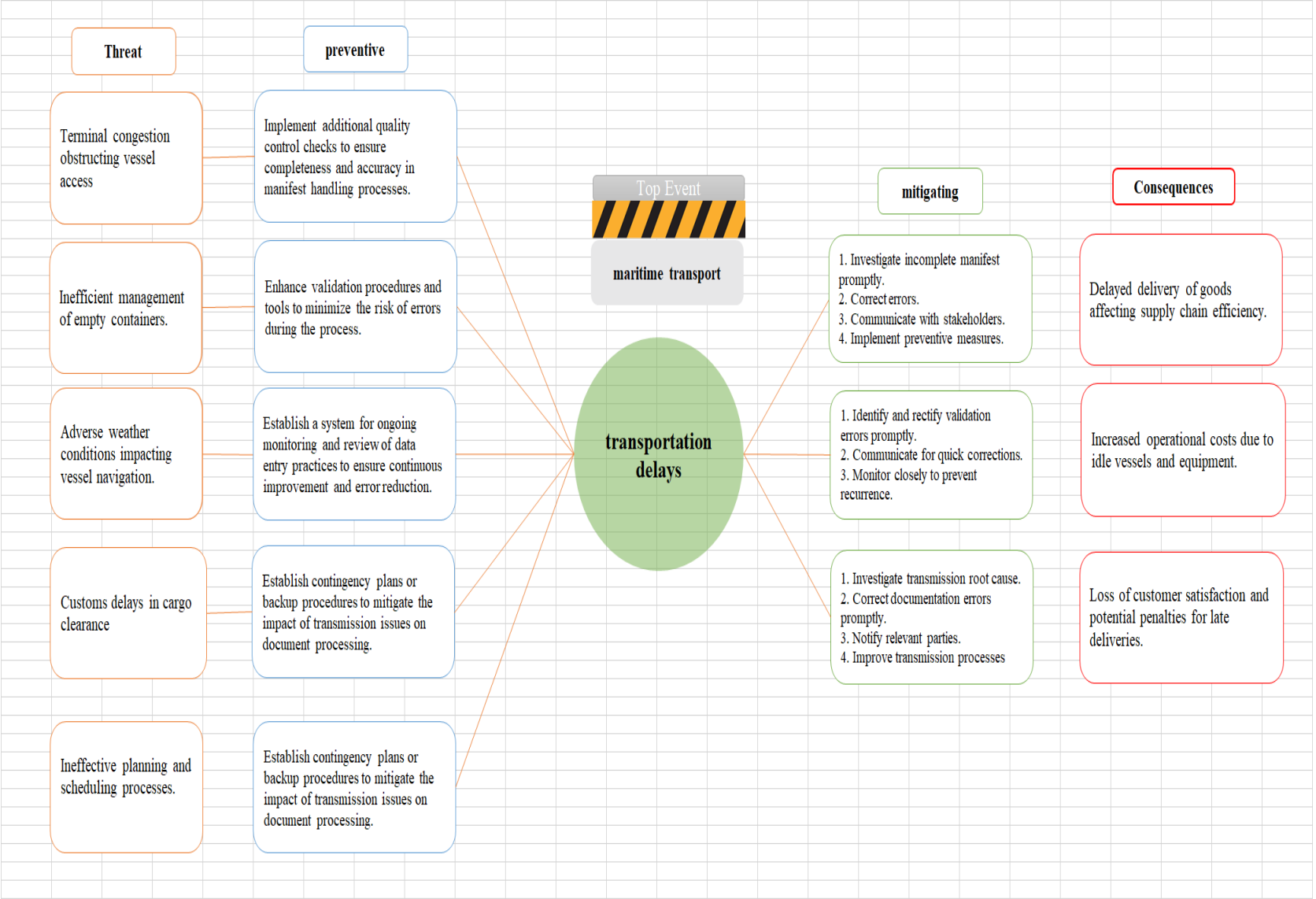
- Delayed Delivery of Goods : Delays in transportation lead to delayed delivery of goods, affecting supply chain efficiency.
- Increased Operational Costs : Idle vessels and equipment incur increased operational costs, necessitating contingency plans or backup procedures to mitigate the impact.
- Loss of Customer Satisfaction and Potential Penalties : Late deliveries result in loss of customer satisfaction and potential penalties, emphasizing the importance of effective planning and scheduling processes.

- **Additional Mitigating Measures:**

- Prompt Identification and Rectification of Validation Errors : Identify and rectify validation errors promptly, communicate for quick corrections, and monitor closely to prevent recurrence.

- Improvement in Transmission Processes : Investigate transmission root causes, correct documentation errors promptly, notify relevant parties, and improve transmission processes.

By implementing these preventive measures and mitigating barriers, maritime transport stakeholders can minimize transportation delays, enhance operational efficiency, and maintain customer satisfaction, ultimately ensuring smooth supply chain operations.



Source : Self-Devoleped

1.3.5. Entreprise system interruptions during the utilization of YNA

- **Threat :**

- System Failures: Internal system failures within the YNA platform due to software bugs, glitches, or technical issues.
- Inadequate Infrastructure: Insufficient resources allocated to maintain and support the YNA platform, leading to performance degradation or system crashes.
- Cyberattacks: Breaches or attacks targeting the YNA system, including hacking, malware infections, or denial-of-service (DoS) attacks.

- **Preventive Measures:**

- Thorough testing before deploying updates or new features to identify and resolve potential issues.
- Investing in scalable infrastructure to support increasing data loads and user demands.
- Conducting regular security audits and penetration testing to identify vulnerabilities and address them proactively.

- **Mitigating Barrier:**

- Activating contingency plans, communicating with stakeholders, and prioritizing critical tasks.
- Restoring from backups, investigating root causes, and notifying relevant parties.
- Assessing financial impact, implementing cost-saving measures, and reviewing insurance coverage.

- **Consequences:**

- Disruption of Operations: Interruptions in critical port operations leading to delays in vessel handling, cargo processing, and documentation.
- Loss of Data: Potential loss or corruption of important data impacting decision-making and regulatory compliance.
- Financial Losses: Decreased productivity, missed deadlines, and potential financial losses due to downtime.
- Reputational Damage: Eroding trust with clients, partners, and regulatory authorities due to persistent system interruptions.
- Legal Consequences: Data breaches or failures to comply with data protection regulations resulting from system interruptions leading to legal implications.

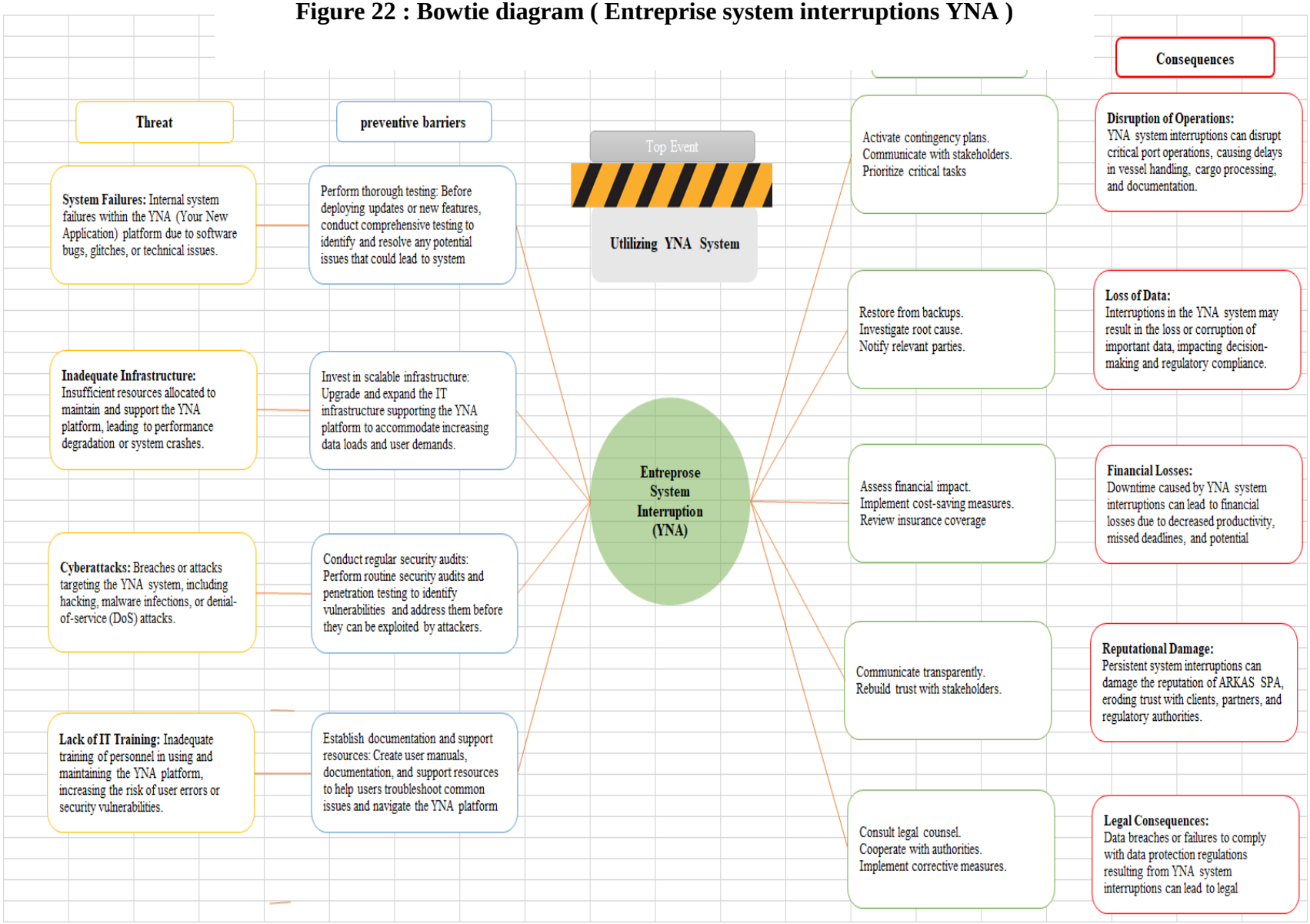
- **Additional Mitigating Measures:**

- Establishing documentation and support resources to assist users in troubleshooting common issues.

- Consulting legal counsel, cooperating with authorities, and implementing corrective measures to address legal consequences.

By implementing these preventive measures and mitigating barriers, ARKAS Algérie Spa can minimize interruptions in the utilization of the YNA system, enhance operational efficiency, and maintain s stultimately ensuring smooth maritime trans port operations.

Figure 22 : Bowtie diagram (Entreprise system interruptions YNA)



Source : Self-Devoleped

1.3.6. Cargo Rerouting Risk during Cargo Shipping

The risk of cargo rerouting during cargo shipping poses significant challenges, including regulatory changes, geopolitical instability, security threats, capacity constraints, and documentation errors. However, proactive preventive measures and mitigating barriers can effectively address these risks.

- **Threats:**

- Regulatory Changes : New import/export regulations or trade agreements necessitate compliance adjustments.
- Geopolitical Instability : Political conflicts or trade disputes may require avoiding certain regions or ports.
- Security Threats : Increased piracy activities or security risks along planned routes pose security threats.
- Capacity Constraints : Congestion at ports or limited terminal capacity affects planned cargo movements.
- Documentation Errors : Incorrect or incomplete paperwork causes delays in customs clearance.

- **Preventive Measures:**

- Stay Updated on Regulations : Continuously monitor regulatory changes and adjust compliance practices accordingly.
- Diversify Shipping Routes : Explore alternative routes to mitigate geopolitical risks.
- Implement Advanced Security Measures : Collaborate with authorities and employ advanced security measures to address security threats.
- Invest in Infrastructure : Address capacity constraints by investing in infrastructure and implementing dynamic scheduling.
- Use Automated Systems and Provide Comprehensive Training : Utilize automated systems for documentation and provide comprehensive training to mitigate documentation errors.

- **Top Event: Cargo Shipping**

Mitigating Barrier: Conduct risk assessments, develop contingency plans, and implement corrective actions to address political conflicts or trade disputes.

Consequences:

- Legal Compliance Risks : Risks of non-compliance with regulations or contractual obligations may lead to legal consequences.
- Reputation Damage : Delayed or disrupted deliveries can negatively impact company reputation.

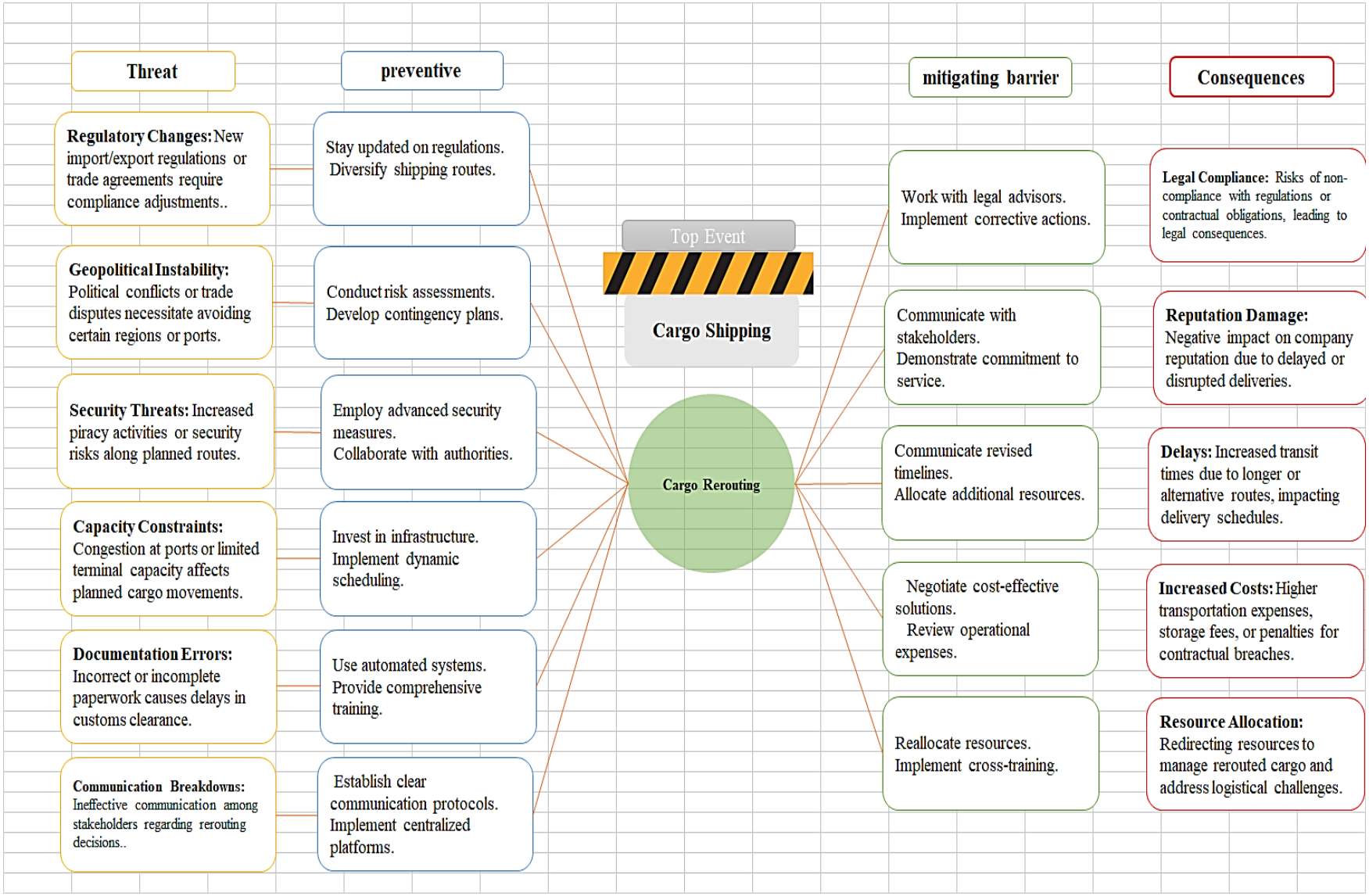
- Delays : Increased transit times due to rerouting impact delivery schedules and increase operational costs.
- Increased Costs : Higher transportation expenses, storage fees, or penalties for contractual breaches result in increased costs.
- Communication Breakdowns : Ineffective communication among stakeholders regarding rerouting decisions leads to resource allocation challenges.

➢ **Additional Mitigating Measures:**

- Demonstrate Commitment to Service : Communicate revised timelines, allocate additional resources, and negotiate cost-effective solutions to address delays.
- Establish Clear Communication Protocols : Implement centralized platforms and cross-training to improve communication and resource allocation.

By implementing these preventive measures and mitigating barriers, cargo shipping companies can navigate the challenges of rerouting effectively, minimize delays, reduce costs, and uphold their reputation for efficient service delivery.

Figure 23 : Bowtie diagram (Cargo rerouting)



Source : Self-Devoleped

Section 2 : Discussion

This study has provided a comprehensive analysis of the operational risks faced by ARKAS Algérie Spa, with a focus on qualitative data gathered through semi-structured interviews and documentary analysis. The research identified critical risks across the company's Exploitation and Operations departments, revealing areas of concern that need to be addressed to enhance the company’s risk management practices.

One of the key findings is the presence of inefficiencies in documentation processes. These inefficiencies stem from miscommunication, incomplete information, and the lack of standardized procedures across various departments. Errors in documentation can lead to delays, operational disruptions, and financial losses. This highlights the need for ARKAS Algérie Spa to establish more stringent quality control measures and standardized documentation processes to minimize errors.

Additionally, the study identified significant risks related to container handling and transport. These include mishandling during crane and forklift operations, exposure to environmental conditions in container yards, and issues with overloading and improper stowage. Preventive measures such as comprehensive operator training, environmental protection protocols, and rigorous cargo inspections are essential to mitigating these risks. Implementing these measures can enhance the safety and integrity of cargo, reducing the likelihood of damage and ensuring smoother operations.

Information delays during supply chain operations also emerged as a critical risk. Delays in transmitting vital information can disrupt the entire logistics process, leading to inefficiencies and potential financial losses. To address this, ARKAS Algérie Spa should focus on improving its information-sharing protocols and automating documentation processes. By utilizing digital platforms and establishing standardized procedures for timely communication, the company can minimize information-related disruptions and enhance decision-making efficiency.

Furthermore, the application of the Bowtie diagram as a risk assessment tool proved to be highly effective in visualizing and analyzing risks. This tool helped identify gaps in current controls and highlighted areas where preventive measures are lacking. The structured approach of the Bowtie diagram facilitates a clearer understanding of causal relationships between risks, controls, and outcomes, thereby enabling more informed decision-making in risk management.

Overall, this study underscores the importance of moving from a reactive to a proactive approach in managing operational risks at ARKAS Algérie Spa. The findings suggest that adopting advanced risk management tools, enhancing staff training, and improving

communication protocols are crucial steps in mitigating risks and improving overall operational efficiency. These strategies not only ensure the resilience of ARKAS Algérie Spa but also contribute to the broader goal of maintaining a competitive edge in the dynamic maritime transport industry.

Conclusion

The findings from this chapter provide a comprehensive understanding of the operational risks at ARKAS Algérie Spa and the effectiveness of current risk management practices. The discussion highlights the need for proactive risk management, continuous professional development, and the adoption of advanced logistics and risk management tools.

By addressing these areas, ARKAS Algérie Spa can enhance its operational efficiency, safety, and resilience, contributing to its long-term success in the competitive maritime transport industry.

CONCLUSION

This dissertation has examined the critical role of risk management in maritime transport, with a particular focus on ARKAS Algérie Spa. The research emphasized the importance of this sector in global trade, where approximately 90% of the world's goods are transported by sea. However, the maritime industry faces significant operational risks, ranging from logistical challenges to cybersecurity threats, which can lead to disruptions, financial losses, and safety concerns.

In exploring the specific risks faced by ARKAS Algérie Spa, this study adopted a qualitative approach to gain an in-depth understanding of the company's risk management practices. By conducting semi-structured interviews and analyzing relevant documents, the research identified key operational risks within the company's Exploitation and Operations departments. These risks included inefficiencies in documentation, container damage, and information delays, all of which have the potential to impact the company's operational efficiency and safety.

The analysis highlighted the need for a more proactive and systematic approach to managing these risks. Tools such as process maps and the Bowtie diagram were effectively used to visualize and assess the identified risks, offering a clearer understanding of the potential threats and preventative measures. The study emphasized that effective risk management in the maritime industry must go beyond compliance with regulations; it requires strategic foresight to anticipate and mitigate future risks.

Despite the strengths of ARKAS Algérie Spa's existing risk management practices, the research identified several areas for improvement. These include enhancing access to internal data, establishing a formal quality management system, and integrating more comprehensive risk assessment tools. Addressing these areas can significantly improve the company's ability to manage operational risks effectively.

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- **Study Limitations:**

Several limitations were encountered during the study:

- Lack of access to the company's documentation impeded the ability to obtain critical information.
- The absence of a quality management system limited the use of management tools, complicating risk identification.
- There was a dearth of academic literature on operational risks in maritime transport, especially within the Algerian context.
- Restricted availability of port operations employees hindered access to information.

- Certain data requirements, such as human errors and process risk causes, did not align with the company's management practices, and the company did not approve the use of prepared questionnaires.

➢ **Areas for Improvement:**

To enhance future research efforts:

- Improved time management could lead to better outcomes.
- Including additional risk management specialists for consultation could provide valuable insights.
- A more comprehensive examination of various departments might yield deeper insights into the interconnected nature of risks within maritime operat

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APPENDEX

INTERVIEW GUIDE

Greetings and introduction to the interview:

Good morning [Madame/Sir],

I am mechedal meriem a graduate student currently pursuing my Master's degree in Supply Chain Management. At the national higher school of management – Kolea .

As part of my final year project, I am conducting an in-depth analysis of operational workflows, challenges, and risk management strategies across various departments.

Your insights and experiences are invaluable to my research, particularly in understanding the intricacies of your department's operations and the effectiveness of risk mitigation strategies.

Phase 1: Understanding Daily Operations and Challenges

Objective: To gain a comprehensive understanding of the workflows, processes, and challenges encountered by managers and their departments.

1. Exploitation Chief Department (S.D.)

- Could you delineate the primary stages involved in the exploitation process within your department?
- What are the predominant challenges you encounter in maintaining seamless exploitation operations?
- How do you monitor and assess the performance metrics of your team?
- What risk management strategies do you employ to mitigate operational risks in your department?

2. Exploitation Manager (S.T.)

- Could you elucidate the documentation process for Container Management and Control (CMC) in detail?
- At which stages in the documentation process are errors most likely to occur, and why?
- What methodologies do you implement to ensure the accuracy and timeliness of documentation?
- What are the critical risks associated with the documentation process, and how are they managed?

3. Port Control Manager (N.H.)

- Can you outline the essential steps involved in port control operations?
- What are the most recurrent risks associated with managing port operations?

- How do you ensure the efficacy of port operations in the face of these risks?
- Which performance indicators are utilized to evaluate the success of port operations?

4. Port Control Assistant (F.)

- What are the core responsibilities entailed in your role as a port control assistant?
- How do you engage with other teams to address the risks inherent in port control operations?
- What are the primary challenges in ensuring the precision and timeliness of port operations, and how do you tackle them?
- How do you evaluate the effectiveness of your contributions to the team?

5. Sales and Key Accounts Manager (W.B.)

- Can you describe the sales process within your department and its influence on overall operations?
- What are the main commercial risks associated with managing key accounts?
- How do you collaborate with other departments to mitigate these commercial risks?

6. Cost Control Manager (Y.O.)

- What are the fundamental responsibilities of your role in cost control within the organization?
- How do you ensure that departmental expenditures are aligned with budgetary constraints while optimizing operational efficiency?
- What are the principal risks related to cost overruns, and what strategies are employed to mitigate them?
- How do you evaluate the financial performance of various departments?

7. IT Supervisor (A.D.)

- Could you describe the role of the IT department in enhancing operational efficiency within the organization?
- What are the primary technology-related risks managed in your role?
- How do you ensure the reliability and security of the company's IT infrastructure?
- What strategies are implemented to minimize disruptions caused by technological failures?

Phase 2: Identifying and Analyzing Risks

Objective: To assess the frequency and severity of identified risks and understand departmental responses to them.

Common Questions for All Managers:

- On a scale from 1 to 4, how frequently do the identified risks manifest within your department?

- On a scale from 1 to 4, how severe are these risks when they occur?
- Can you provide instances of recent incidents where these risks have impacted departmental operations?
- How did your department respond to these incidents, and what preventive measures have been adopted to avert future occurrences?

Phase 3: Evaluating Risk Mitigation Strategies

Objective: To appraise the efficacy of current risk mitigation strategies and explore avenues for enhancement.

Common Questions for All Managers:

- How would you evaluate the effectiveness of your department's current risk mitigation strategies?
- Can you describe a scenario where your risk management strategies successfully averted a significant disruption?
- What improvements would you propose to bolster the effectiveness of risk mitigation within your department?
- How do you ensure that your team remains vigilant and proactive in identifying and addressing emerging risks?

Thank you for taking the time to answer my questions and for allowing me to conduct this interview. Your expertise will greatly contribute to the success of my project.