International Journal of Marine Engineering Innovation and Research, Vol. 9(3), Sept. 2024. 612-623
(pISSN: 2541-5972, eISSN: 2548-1479)

Conceptual Framework for Risk Management in the Container Shipping Operations to Support Maritime Logistics in Indonesia

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(Received: 01 August 2024 / Revised: 11 August 2024 /Accepted: 2 September 2024)

***Abstract*— Risk management is an important thing to do in every business activity and by business operator to ensure business continuity. The trend of increasing container shipping volumes in Indonesia shows the increasing need for a low-cost logistics distribution with large volumes. This condition will also be balanced by an increase in potential risks in container shipping operations. Previous research generally focuses on certain activities or locations, and there has not been much research on risk management in container shipping operations in a sequence activities of supply chain. The various risk management methods that exist today provide many options for implementation. This condition also provides an opportunity and is important to do further research in this area. This research is devoted to risk management of container shipping operations activities, and is intended to determine risk management research trends, existing risk management methods, potential or research gaps for further research as well as risk management framework concepts that can be proposed. The research was carried out using bibliometric analysis and systematic literature review of previous research, interpreting the results in the form of qualitative descriptions to answer existing problems. Research results show an increasing research trend for the last 5 years, with 18 method of risk management applied. This research provides a concept of how to assess container shipping operation risk management related to logistic supply chain. The option of integrating 3 risk management approach methods, namely SCOR, CSORA and HOR, is proposed in this research, as a conceptual framework for risk management in container shipping operations to support maritime logistics in Indonesia, including propose location or object and aspects for further research, and 3 key success factors to implement the conceptual framework as a reference.**

Keywords—risk management, container shipping, container operation, bibliometric, literature review, maritime logistics, SCOR, CSORA, container logistics, house of risk.

I. Introduction

Indonesia is the world's largest archipelagic country, consisting of 17,001 islands (BPS 2022) interconnected by water (seas, rivers, lakes). In fact, approximately two-thirds of Indonesia's area is water. Geographically, Indonesia's government has promoted continually of Indonesia's population distribution, infrastructure, and economy to achieve more equitable development. The logistics sector, a crucial contributor to Indonesia's economy, is consistently being enhanced. The demand for reliable logistics distribution encompasses equitable distribution, diverse types of logistics, support from various transportation modes, timely deliveries, and cost-effective distribution. [1] illustrated the logistics challenges in Indonesia (specifically on Java Island) in Figure 1. Approximately 90% of cargo transportation occurs via land/road, 7% via sea, and 3% through other means. This stark contrast exists when compared to Indonesia's vast maritime territory and the number of islands. Containerized cargo transport, especially for the three main ports in Java – Tanjung Priok (Jakarta), Tanjung Emas (Semarang), and Tanjung Perak (Surabaya) – is predicted to experience an average growth of 53,5% by 2025 compared to the volume in 2017 [1].

The Indonesian government, through the "Tol Laut" program, has initiated the transportation of logistics via sea vessels (maritime logistics) to support cost-effective national logistics distribution. This collaboration involves container shipping companies. However, there are still various risks and challenges in managing and operating containers as a means of cargo transportation. For container shipping companies, ensuring a reliable supply of containers throughout the supply chain for maritime logistics is essential. Proper management is crucial, especially considering potential risks that could disturb the company during each well-managed process and activities.

The identification of risks arising from business and the operation of container assets is an ongoing process. Assessment and mitigation of these risks occur during the management and operation of containers. Maritime logistics practitioners increasingly favor sea transportation using containers over break bulk systems for specific commodities. This choice considers factors such as security, ease of handling, speed and cost-effectiveness compared to a break-bulk or dry-bulk cargo system.

Several studies related to container management, including risk assessments, have been carried out previously. [2] emphasized the importance of identifying risk factors in container control and operations, as well as integrating them deeply at the risk analysis stage and decision-making process, one of which is by quantitatively modeling the container shipping context

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and its operational risks. Their quantitative model integrates uncertainty as a central component of risk, allowing for a deeper understanding of knowledge base weaknesses. Meanwhile, [3] focused on the importance of conducting risk investigations and risk ranking of reefer container operations during shipping or shipping through risk evaluation modeling. They propose an evaluation model using risk analysis. Traffic accidents emerge as the most significant potential risk, accounting for 41.8% compared to other accidents Prioritization during container operation, related to intermodal transportation through a container control mechanism using sensors, was proposed by [4] to reduce the risk of container loss. According to [5], every container shipping company is required to carry out a Risk Analysis and Assessment and is focused on container management policies. Other researchers, risk assessments for containers must also be carried out at container terminal locations, especially to avoid work accidents [6][7]. There are at least 28 root causes of risks related to containers that have been identified using the PESTLE framework and then analyzed using the Bayesian method and provides insights for risk management and mitigation [8]. Meanwhile, [9] focuses and considers on risks within the Container Supply Chain and propose two modeling solutions to address these risks.

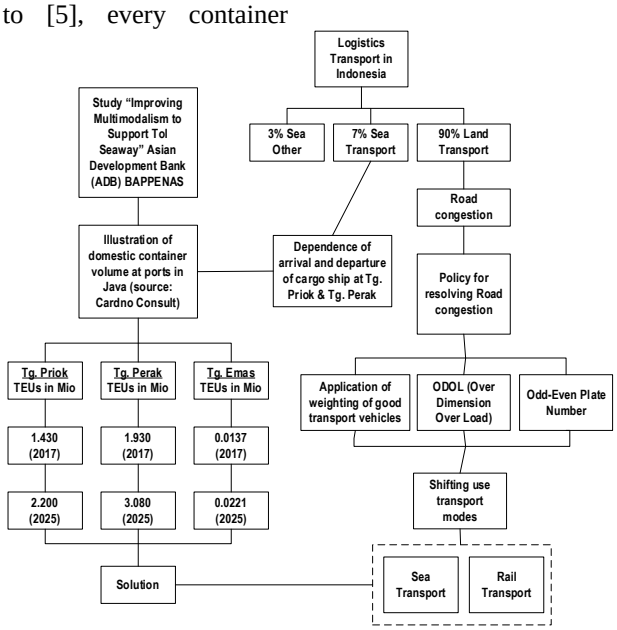

Figure 1. Challenges in Cargo Transportation in Indonesia (in Java) [1]

The focus of previous research has generally been on one object or activity related to containers, including research on container operational risk management. Not many studies have examined the risk management of container logistics activities in a sequent of processes involving various objects or locations of activities, both at shipping company container depots, shippers' warehouses, container stacking yards, ports or container terminals, on board ships and during the shipping process. goods, activities at the port of discharging, including at the location of the consignee warehouse. It is important to carry out further research in this area. Various risk management methods in container operations, including risk assessment process, provide many options for implementation. However, choosing the right method, including the possibility of integrating several existing risk management methods, is also an option and at the same time provides the opportunity to propose new methods or a conceptual framework for risk management that can be used in container shipping operations.

Hopefully that the results of this research can provide information on answers to several problems that arise regarding risk management in the container shipping operation, including: (1) what are the trends in risk management research related to container shipping operations, (2) what methods can be used to assess related risks of container shipping operations, (3) what is the potential for developing risk management research in container shipping operations (4) what is the concept of risk management methods for container shipping operations to support maritime logistics in Indonesia. Apart from answering these four questions, it is hoped that this research can provide information on solutions to overcome the risks and challenges in managing and shipping containers, so that it can support the effectiveness and efficiency of maritime logistics distribution in Indonesia.

In general, from this research information was obtained in increasing container risk management research for the period 2019 – 2024, which is possible related to the increase in demand for logistics distribution using container media globally, the potential for further research on risk management related to operational activities and container shipping, especially to support maritime logistics in Indonesia, especially when viewed from the perspective of the container supply chain activities. A framework concept integrating 3 risk management methods is proposed in this research, which combines the SCOR, CSORA and HOR methods so that further research can be carried out and implemented in actual activities.

II. METHOD

Research was carried out by studying and analyzing previous research, with bibliometric analysis of bibliographic data and continued with a systematic literature review. A descriptive and qualitative explanation of the results of bibliometric and SLR is an interpretation of the results of previous research.

As illustrated in Figure 2, to answer the four research questions related with container shipping operational risks as presented in introduction, the research was carried out in the sequence of steps as follows:

1. Retrieve data or data mining (including bibliographic information) from the Scopus website for previous research with certain keywords and period (first publication till 2024) for each stage in Figure 3. PRISMA flow diagram.
2. Literature review of relevant articles obtained according to previous search and screening results.
3. A bibliometric analysis to find existing research gaps related to container shipping operations risks.
4. Formulate and propose the next research based on the research gaps obtained.

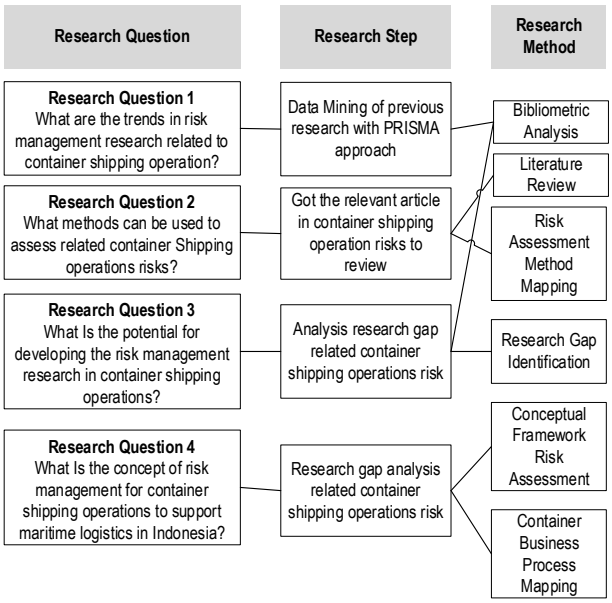

Figure 2. Research Method

Data Identification

Through the literature review carried out, data collection was completely limited to research documents that have been published and indexed by Scopus, related to risk management in container shipping operations since they were first published and included in journals or other publications indexed in Scopus. Previous research on research documents and bibliographies, which is only limited to published documents indexed by Scopus, was mostly carried out by previous researchers, even though the research topics were different from those carried out by current researchers, including those carried out by [10][11].

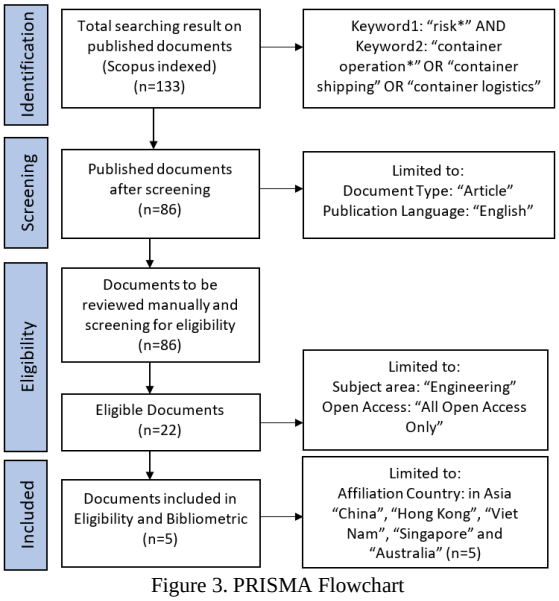

Figure 3. PRISMA Flowchart

Data Collection

Data collection was gathered directly on the Scopus website (www.scopus.com) with certain keywords and continued with the screening process using the PRISMA method. All data saved in CSV and RIS format for further bibliometric analysis with VOSViewer software and literature review to get research gaps related container shipping operational risks.

The script or search language for data retrieval is as follows:

(TITLE-ABS-KEY ("risk*") AND TITLE-ABS-KEY ("container shipping" OR "container operation*" OR "container logistic")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "ENGI")) AND (LIMIT-TO (OA , "all"))

Data Analysis

Bibliographic data collection was carried out last after all the search processes using the PRISMA approach, as illustrated in the flow in Figure 3. The bibliographic data obtained is a detailed explanation of information from the first research publication documents, containing author information, affiliation name, citations number, references, keywords (based on the author and publisher), publication journal name, research country, publication language, research area, document access category, and publication number. Statistical analysis and further bibliometric analysis were carried out using a bibliometric analysis software, VOSViewer [12][13].

III. Results and Discussion

What are the trends in risk management research related to container shipping operations?

Research trends are taken based on data of research article that have been published and indexed by Scopus as of July 17, 2024, using the PRISMA concept approach as shown in Figure 3, and data is taken from the official Scopus website with a registered account.

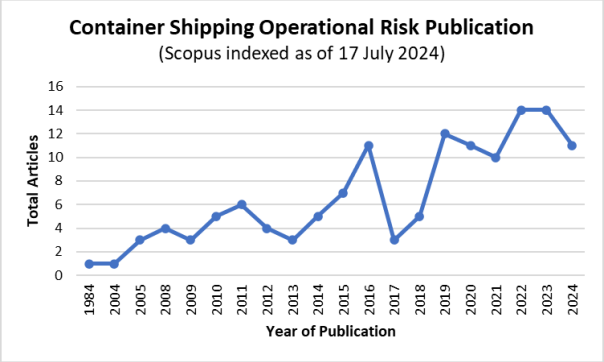

Figure 4. Container Shipping Operational Risk research trends (processed)

From the Scopus data mining, around 133 studies were obtained regarding container shipping operations risk, where there is a positive trend in the form of an increasing trend in research regarding operational risk and container shipping in the last 4 years (2021 - 2024) as shown in Figure 4.

An interesting thing is that the first research was conducted by [14] regarding the operation of container tanks and emphasized the importance of mitigating risks in the operation of container tanks to increase shipping safety

Furthermore, for research in Asia, there are only 5 (five) countries that conduct direct research related to operational risks and container shipping, namely China, Hong Kong, Vietnam, Singapore, and Australia with a total of 8 studies or around 6% of the total research in the world. This research is limited to Scopus indexed publications, and is not included in other publications, for example, in Web of Science, Crossref, Google Scholar and other types of publication indexes, so that the research results cannot be concluded that they represent the general picture of research.

What methods can be used to assess related container shipping operations risks?

Every risk assessment requires a certain method to be focused and obtain valid results and resolve the problems raised and achieve the goals you want to achieve, including risk management problems in container shipping operations. Previous research that has been published can be a reference for obtaining a map of assessment methods in container risk management.

TABLE 1.
MAPPING OF RISK ASSESMENT METHODS TO RESEARCH OBJECTS

Method	Research Object				
	Port Terminal	Human (Ship Crew)	Container Operation/Shipping	Maritime Transport	Supply Chain
Bayesian Network	V		V	V	
Delphi			V		
DEMATEL	V				
Fuzzy		V	V	V	
CSORA			V		
CSOR			V		
Fault Tree Analysis		V	V		
Evidential Reasoning			V		
Literature Review			V		V
Risk Assessment and Analysis			V		
Interpretive Structural Modeling	V				
Analytical Hierarchy Process			V		
FMEA				V	
Formal Safety Assessment		V			
ESG (Economic, Social, Government)			V		
SWOT				V	
Success Likelihood Index Method		V			
House of Risk (HOR)	V				

There are 18 risk assessment methods used in research conducted based on the objects studied from 22 research articles, as shown in table 1, with 5 categories of research objects related to container shipping operations, namely port terminals, human (ship crew), container operations/shipping, maritime transport, and supply chain. In table 1 it is shown that the risks of container shipping operations related to the supply chain are the results of a literacy study. The newest method specifically related to container shipping operation risk was developed by [16] and is known as CSORA. Meanwhile, table 2 shows the SLR (systematic literature review) results for 22 articles, including research objects, risk assessment methods, and research results or findings. There are 18 methods, and 5 main research objects can be identified from 22 articles as SLR result.

From tables 1 and 2, information is obtained on various risk management methods and different points of view for research objects that are closely related to container operations. This shows that every point where the container moves will have operational risks attached, so that choosing the right an assessment method becomes a challenge as well as a choice and opportunity to be able to identify risks (risk event and risk agent), assess critical risks, determine preventive action needed, or mitigate existing risks.

TABLE 2.
RESULTS OF SLR OF CONTAINER SHIPPING OPERATIONAL RISK

Author	Method	Research Finding / Results
[15]	▪ Bayesian Network ▪ Fuzzy ▪ CSORA	Risk control is an important issue in container shipping and logistics management due to inconsistencies in risk definitions and the existence of uncertainty. The proposed risk evaluation mechanism and the list of identified CSORs can be useful in system management, decision making, and reliability performance
[6]	Fault Tree Analysis (FTA)	The results of the risk assessment show that containers that fall onto the berth during loading and unloading have the highest risk value. Meanwhile, the results of the Fault Tree Analysis show that traffic accidents are the biggest potential risk, namely 41.8% compared to other accidents. Apart from that, human factors, especially due to negligence in operating vehicles or equipment and equipment damage, are highest causes of accidents at container terminals.
[2]	▪ Evidential Reasoning ▪ Fuzzy ▪ Bayesian Network	Development of a new method by integrating Fuzzy and BN methods into FRBN (Fuzzy Rule Bayesian Network) to anticipate negative impacts on container shipping and logistics risks. This paper proposes an advanced QRA model considering the gaps in addressing uncertainty in the current CSOR literature. The proposed model tries to capture risk comprehensively with initial and epistemic uncertainty as its core characteristics through the synthesis of FMEA, ER, FBRN and risk mapping.
[5]	▪ SLR (CSO) "Container Shipping	The research results show that there is attention to port and container shipping companies as the main subject of research; and Asia-Pacific and Europe as fruitful areas of empirical study. Thirty-five (35) common information, physical and financial risks were identified across CSOs. Regarding the RAA aspect,

Author	Method	Research Finding / Results
	Operations" ▪ Risk Assessment and Analysis (RAA)	an establishment of a joint framework that recognizes uncertainty as a core component of risk is needed to support the CSO aspect in dealing with emerging issues.
[16]	CSORA (Container Shipping Operations Risk Analysis)	This paper fills the gaps in the updated CSORA framework by considering recent advances in container shipping operations and risk management. This framework can be used by practitioners as a tool for CSORA and academics as a testing tool to facilitate comparison and development of QRA models.
[17]	▪ Bayesian Network ▪ DEMATEL ▪ ISM (Interpretive Structural Modeling)	Research shows that risks related to technology, facilities, and equipment are the most significant and pressing risks in the system; human risk affects all system components by influencing other factors; organizational risk management has a fundamental impact on system stability; Apart from that, the uncertainty of external risks has increased the variability of each logistics route.
[18]	▪ Bayesian Network ▪ Fuzzy	The new framework proposed in this research supports risk-based dynamic resilience analysis of maritime container transportation networks. This provides a paradigm shift in resilience analysis by integrating component risk analysis at the local level and component risk impacts at the global level into a complex network.
[19]	▪ Fuzzy ▪ AHP – Analytical Hierarchy Process	This paper evaluates risk mitigation strategies against three risk consequences. Managers can benefit from the systematic identification of mitigation strategies, which shipping companies can consider adopting to reduce the impact of operational risks. 18 mitigation strategies were identified.
[20]	Systematic Literature Review	Nearly 90% of logistics providers have implemented or will implement IoT solutions to improve customer needs. The aim of this research is to demonstrate the real need to integrate real-time data in supply chain risk management to be more reactive and proactive in decision making. In fact, predictive risk management will help supply chain stakeholders be more reactive to disruptions and make proactive mitigation decisions by considering the likelihood of risks occurring
[21]	FSA – Formal Safety Assessment	Based on the risk factor ranking analysis made, it was found that seafarers looked at human factors, and considered systemic aspects and work-related aspects as the most influential factors impacting container shipping safety
[22]	▪ Bayesian Network ▪ Fuzzy ▪ Delphi	Uncertainty is a fundamental obstacle in the evaluation and management of container shipping operational risk (CSOR). This research presents a quantitative CSOR analysis model with comprehensive uncertainty handling. This research shows several important points from modern QRA studies in the field of container shipping including (1) a transparent and reasonable risk foundation (e.g., risk concept, set of risk parameters, risk approach), (2) current understanding of risk from risk theory studies, (3) examination of existing risk approaches, and (4) more comprehensive model testing with pragmatic, calculative, and comparative validation.
[23]	▪ Bayesian Network ▪ Evidential Reasoning	Design of the Uncertainty Quantification Module (UQM) model, where the BN method is used for model testing. Obtained 32 HEs (Hazardous Events) related to container operations, which were grouped into 3 things: (1) information, (2) physical and (3) payment. This study shows that there is still room for improvement of risk analysis tools and the art of their application with the latest theoretical risk knowledge, especially in dealing with uncertainty.
[24]	▪ Fuzzy ▪ Bayesian Network ▪ FMEA (Failure Mode Effect Analysis)	This paper aims to develop a new model for assessing maritime supply chain risk factors by combining a fuzzy belief rule approach with Bayesian networks. This new model, compared with traditional risk analysis methods, could increase the accuracy of results in conditions of high-risk data uncertainty
[25]	Systematic Literature Review	The vulnerability of the container shipping industry requires LSOs (Liner Shipping Operators) to assess risks based on the business environment, reliability, and capabilities of their organizations, as well as the punctuality of their vessels using appropriate mathematical models. Developing a framework to analyze, assess and evaluate the above problems is needed. First, a mathematical model to assess risk based on the business environment in a country from a CLSI (Container Liner Shipping Industry) perspective needs to be developed. Second, a mathematical framework for evaluating the reliability and organizational capabilities of LSOs needs to be established. Third, it is necessary to determine the right approach to analyze the punctuality of ships to/from certain ports in an uncertain environment.
[26]	▪ Bayesian Network ▪ ESG approach (Economic, Social, Governance)	This research identifies 45 sustainability risks faced by container shipping companies covering economic, social, and environmental perspectives. Theoretically, this research establishes a customized evaluation and mitigation framework for the sustainability risks of container shipping companies by considering the risk appetite of decision makers.
[27]	▪ SWOT ▪ Delphi	The overall conclusion drawn is that security risk assessments are important considering recent technological changes, such as the increasing risk of cyber-attacks on electronic navigational aids, and geopolitics, such as tensions in the Middle East and the South China Sea.
[28]	▪ FTA – Fault Tree	Humans are a key element of life safety on board ships and are an important factor contributing to most accidents and incidents in the maritime industry. This paper intends to increase the level of safety control

Author	Method	Research Finding / Results
	Analysis ▪ Fuzzy ▪ SLIM – Success Likelihood Index Method	and reduce the losses of maritime container transportation in the future, in addition to highlighting the potential consequences of failures and crucial human errors in operational processes. At this point, identifying the causes of container loss during the shipping process of container ships can provide actionable solutions to reduce future losses.
[29]	▪ House of Risk ▪ Business Continuity Plan Approach	This research tries to answer the question regarding what events risk disrupting business processes at the Container Terminal. Based on research and analysis of possible disruptions using the House of Risk model at the Teluk Lamong Container Terminal, of the 12 risk agents that have been determined, there are 6 risk agents that are prioritized to be prevented/mitigated to reduce major impacts on business. The highest ARP contributions are as follows: (1) BMKG disaster warnings; (2) External theft; (3) Failure of management policies; (4) IT sabotage; (5) Mass employee demonstrations; (6) Pandemic.
[30]	Systematic Literature Review	This paper has identified a total of 35 risk factors and classified them into different categories. This paper also reveals that risks associated with physical flows have more serious risk impacts than other types of risks; however, one risk factor related to information flow (shipper withholding cargo information) is the most significant among all factors.
[31]	▪ Bayesian Network ▪ FMEA – Fault Mode Effect Analysis	Risk analysis in ports plays an increasingly important role in ensuring the reliability of port operations, the safety of maritime transportation and the resilience of supply chain distribution. The research provides a powerful risk evaluation tool for port safety management. The proposed new method highlights its potential in facilitating risk analysis of system design and operations in a broad context when appropriately adapted to study other container ports.
[32]	▪ Systematic Literature Review ▪ Delphi Survey	Identification of risk factors provides a foundation for supply chain risk analysis and accident prevention. As a result of the research, 83 risks were obtained related to the maritime container supply chain, and were classified into external risk factors (society and environment/nature) and internal risks (management, infrastructure, and technology, operational/physical)
[33]	Container Shipping Operational Risk Analysis CSORA	28 potential risks and 47 connections were identified in three groups of initiative, transition, and sequel. This paper shows the changes in operational risks of container shipping in the process of blockchain integration using recent data. This creates awareness of the emerging risks, provides insight into those risks, and sets the basis for further research

What is the potential for developing risk management research in container shipping operations?

The potential for developing further research on risk management in container operations and shipping can be obtained through a literature review process (using a bibliometric or SLR approach) or by making direct observations of research objects to be taken.

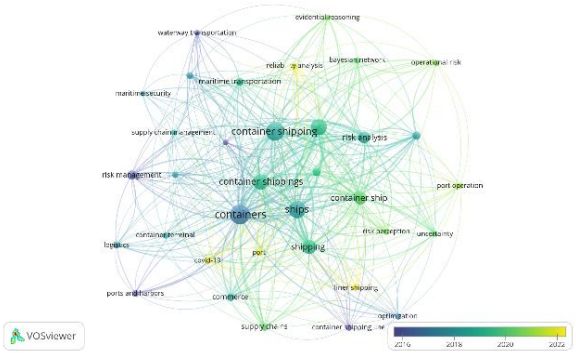

Figure 5. Research relationships related to container operation risk (All keywords – 5 occurrences)

Figure 5 shows trends in research topics based on keywords provided by the author or those determined by the publisher. Each keyword provided will form a network or connection with other research as in the bibliometric output for all keywords obtained by running VOSViewer software.

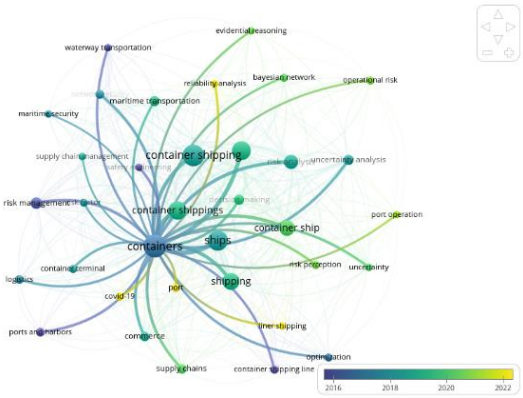

Figure 6. Container-specific research relationship map (All keywords – 5 occurrences)

Meanwhile, Figure 6 shows the relationship between containers and other keywords. As seen in the relationship picture, several keywords do not have a sign of research relationship or correlation, for example, supply chain and container logistics (SCM) with risk management, so this is one of the gaps in future research.

From Tables 1 and 2 regarding the results of the SLR risk assessment method, it can also be seen that there is a new method introduced by and designed specifically for container operational risk management, namely CSOR (Container Shipping Operations Risk) Analysis and abbreviated as CSORA which was introduced by [16]. Meanwhile, from the aspect of the research object, the discussion regarding the supply chain in new container logistics is limited to a literature review, while the scope or limitations of research are generally for one research location, for example port terminals, aspects of human error, security, transportation media. There has not been any research that discusses risk management of operations and shipping containers by sea (maritime logistics) as a discussion of a series of container logistics activities in supporting maritime logistics.

TABLE 3.
TOP 5 STRONGEST KEYWORD AND LINK STRENGTH (ALL KEYWORD – 5 OCCURENCES)

keyword	occurrences	total link strength
container	55	261
ships	42	253
container shipping	34	218
risk assessment	35	207
container shipping	49	180

Table 3 shows the top 5 research keywords that are widely carried out and have strong research relationships, while table 4 shows the opposite condition, research keywords with the weakest research relationships. From these two tables it can be concluded that research related to containers, risk assessment is still the main research topic, while related to supply chain management there is not much interest. This is also an opportunity for further research to be carried out with the topic of container operations connected to risk assessment and supply chain management.

TABLE 4.
TOP 5 WEAKEST KEYWORD AND LINK STRENGTH (ALL KEYWORD – 5 OCCURENCES)

keyword	occurrences	total link strength
maritime security	5	14
supply chain management	5	14
container shipping line	6	21
container terminal	6	21
port and harbor	7	24

The sequence processes of container logistics in question starts from the activity of handing over empty containers to the shipper, the process of loading goods, handing over to the container depot/container yard, handling activities at the terminal, loading onto the ship, shipping by sea using container ships, unloading to land, as well as delivery to the owner of the goods or consignee, as well as returning the empty container to the home base. This is also a research gap, and it would be very interesting to carry out research on operational risk management and container shipping in supporting maritime logistics in Indonesia in all supply chains.

What is the concept of risk management methods for managing container shipping operations to support maritime logistics in Indonesia?

From the discussion of risk management for operations and shipping or container logistics, both using a bibliometric analysis and Systematic Literature Review, there are research gaps that can be addressed for

further study and research, as stated in the research gap discussion, namely how to managing operational risks and container shipping when connected to the logistics supply chain concept, with research objects covering several locations which of course have their own characteristics. Determining the right research approach method is needed to get accurate results and can be used as a reference for creating a modeling or container risk management framework in general.

From Tables 1 and 2, there are at least 2 (two) risk management approach methods that can be used, namely the HOR (House of Risk) and CSORA (Container Shipping Operations Risk Analysis) methods for container operations. For an approach from the supply chain business process side, the SCOR (Supply Chain Operations Reference) framework is the main choice considering that SCOR is designed to model logistics business processes from a supply chain perspective. The modeling or preparation of this framework is aimed at identifying and analyzing risks in container management, so that the option to integrate the three methods can be made, with a focus and function according to each method. CSORA is used to identify operational risks in the management and delivery of containers in maritime logistics activities related to physical flow, information flow and financial flow (module 1). Meanwhile, for CSORA module 2, it is not used in preparing operational risk management and container shipping framework modeling. SCOR 12.0 with its 6 elements (Plan, Source, Make, Deliver, Return, Enable) as a reference for mapping container operation and delivery business processes at each container activity location and existing business processes, to optimize the logistics distribution process. HOR as the final method is used to identify risk events and triggers obtained from CSORA and SCOR, measure and manage risks in various contexts, including logistics (risk level assessment, determining critical risks, and determining preventive actions that need to mitigate the risks, and prioritization for implementation) (carried out at each stage of analysis refer to HOR Phase 1 and HOR Phase 2 perspective).

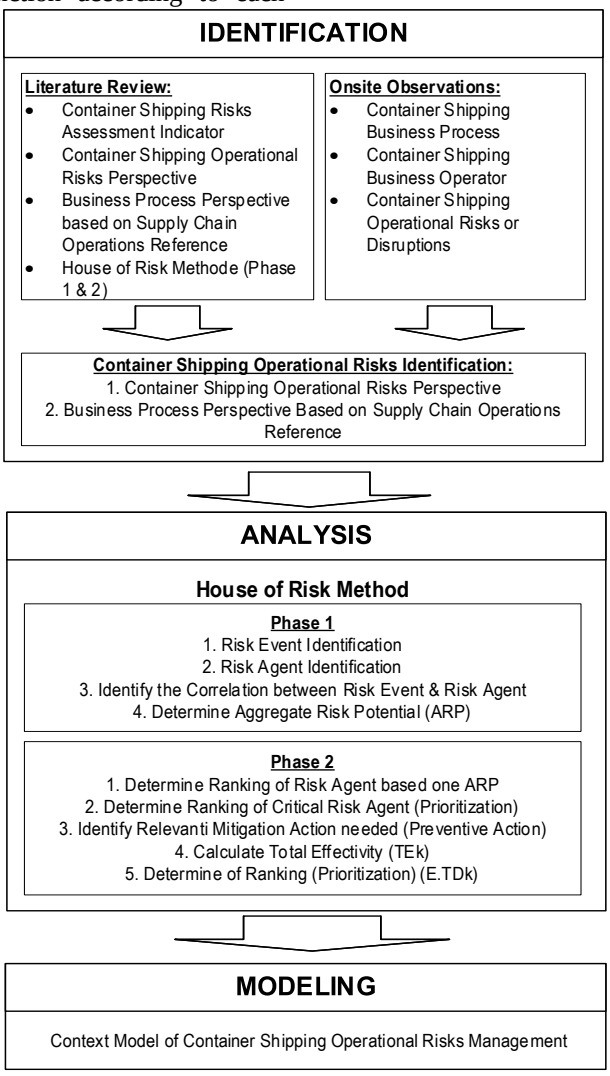

Figure 7. Hybrid Concept for Container Shipping Operations Risk Assessment

From the approach concept presented above, a risk management framework can be modeled in the form of a proposed hybrid framework as shown in Figure 6 below.

a. Identification Stage
   Explain the process of the results of literacy studies and field observations, to identify operational risks for shipping containers, using the perspective of the SCOR, CSORA and HOR approaches.
b. Analysis Stage
   Explains the analysis process of risk identification results obtained from the perspective of the phase 1 and phase 2 HOR method approaches.
c. Modeling Stage
   It is the result of analysis at the process stage, which can be in the form of a context diagram or a systematic (framework) concept for operational risk management for shipping containers.

Implementation of the opinion concept is carried out in the following process sequence:

1. Identify container operational risks using a SCOR perspective approach (mapping risky container logistics business processes).
2. Identify container shipping operational risks using the CSORA module 1 perspective approach (related to physical, information flow and financial flow).
3. Carry out data processing using Phase 1 HOR perspective approach:
   a. Identification of risk events (Risk Events) based on the SCOR and CSORA approaches (for Phase 1) that have been carried out previously.
   b. Identify risk triggers (Risk Agents) for each identified risk event.
   c. Assess the relationship between Risk Events and Risk Agents.
   d. Determine Aggregate Potential Risk
4. Carry out data processing and analysis using the Phase 2 HOR method, namely:
   a. Determine risk trigger ranking based on ARP.
   b. Determine critical risk triggers (Risk Agent).
   c. Identify necessary mitigation or preventive actions.
   d. Calculate the total effectiveness of prevention or mitigation actions taken.
   e. Determine the ranking of the total effectiveness calculated previously.

Figure 8 illustrates the business process of container movement, as well as showing possible container movements that can be proposed for further research (scope for research). In detail the possibility movements and activities carried out can be summarized in Table 5.

TABLE 5.
CONTAINER MOVEMENT STATUS

No	Location	Activities
	Port of Loading (POL)	
1	Container Depot	▪ Release empty container ▪ Stuffing IN ▪ Stacking container ▪ Receiving full container ▪ Container relocation into CY/Port ▪ Container repair
2	Shipper	▪ Stuffing OUT ▪ Relocation to depo/CY
3	Container Yard	▪ Release empty container. ▪ Receiving container (full/ empty) ▪ Stacking full container ▪ Haulage/cargo-dooring ▪ Plugging (for reefer) ▪ Transshipment container
4	Port/ Terminal	▪ Stevedoring (loading) ▪ Haulage
5	Vessel	▪ Stowage container ▪ Keep secure container onboard
	Port of Discharging (POD)	
6	Port/ Terminal	▪ Stevedoring (discharging) ▪ Haulage
7	Container Yard	▪ Delivery container (full/ empty) ▪ Stacking container ex discharging ▪ Relocation to depo
8	Consignee	▪ Stripping OUT ▪ Relocation empty container (ex-stripping OUT)
9	Container Depot	▪ Stripping IN ▪ Stacking container ▪ Reposition of empty container ▪ Container repair

Each container movement and status change illustrated in Table 5 and Figure 8, refer to common activities on the container supply chain approach to support maritime logistics distribution. Further analysis needs to be carried out using the SCOR perspective, while the arrow illustration in Figure 8, showing the possibility of container movement, that mean there is a physical flow of containers, information flow, and for certain activities there is also a financial flow. These three flows are the factors that must be identified at the beginning when implementing the CSORA perspective.

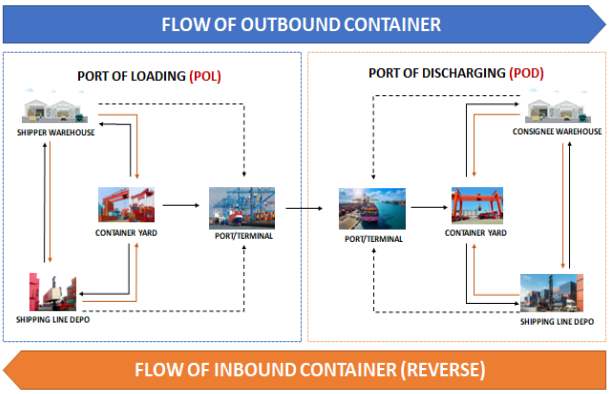

Figure 8. Container logistic movement business process

Key success factors for implementation of the conceptual framework of SCOR, CSORA and HOR integration for container shipping operational risk management include:

1. Identify risk event and risk agent based on the sequence processes of container movement using the SCOR, CSORA and HOR perspective approaches.
   a. Mapping the container movement process using the SCOR approach, especially for the plan and make element.
   b. Identify risk event and risk agent in each container shipping operational process refer to the SCOR approach.
   c. Linking each risk event and risk agents related to the physical flow of containers, the information flow during shipping process, and identify the financial transactions flow include related parties, refer to the CSORA perspective.
   d. Analyze risk event and risk agent using House of Risk perspective, especially determining critical risks and preventive (mitigation) actions that need to be taken.
2. Commitment to manage risks, especially critical risks that exist and can disrupt the distribution of container shipping operation or organizational objectives and determine the preventive action needed to mitigate the risk.
3. Disclosure of information regarding potential risk events and risk agents, including risk barriers or obstacles faced by each department or process related to container shipping operations.

IV. Conclusion

The use of containers for shipping and distributing the goods through the seawater (maritime logistics) is predicted will continuously increase linearly with the increasing demand and the need for low-cost logistic distribution with large volumes. It will increase potential risks for container shipping operations in supporting maritime logistics, include in Indonesia. In conditions of lack of control or inability to proper of risk management, it has the potential to become a risk that could result in losses for the risk owner. It is mandatory and important for a container operator, especially shipping company to manage risks in container shipping operations, considering that apart from ships, containers are the company's main asset in providing logistics distribution services, to maintain business continuity. Previous research generally focuses on certain activities or locations, and there has not been much research on risk management in container shipping operations in a sequence activities of supply chain. The various risk management methods that exist today provide many options for implementation. This condition also provides an opportunity and is important to do further research in this area. In this research, information was obtained that there is an increasing trend in container risk management research in the last 5 years (2019 - 2024), which means that container shipping operational risk management has become an interesting topic for research, especially from SLR, there are at least 18 approach methods used for 5 research objects, including port/terminal, ship crew (human), and Supply Chain. The option of integrating 3 risk management approach methods, namely SCOR, CSORA and HOR, is proposed in this research, as a conceptual framework for risk management in container shipping operations to support maritime logistics in Indonesia, including propose location or object and aspects for further research, and 3 key success factors to implement the conceptual framework as a reference. The selection of this method is based on the characteristics of each method in assessing container shipping operational risk.

Several follow-up actions need to be taken, including conducting research or studies directly within a container shipping company on the proposed concept. This needs to be done to find out and test whether the proposed conceptual framework can be implemented fully, effectively and with optimal results. Further research related to risk management for logistics distribution activities other than containers, can be carried out considering that previous trends and research have not been able to examine all aspects that may need to be assessed, and risk managed as desired by the company.

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