

EXECUTIVE SUMMARY

Developing Response Measures for Port Dangerous Goods Container Logistics Supply Chains in Disaster and Emergency Situations

Na-Young-Hwan Choi · Dae-Hyeon Kim · Ah-Rom Kim ·
Jeong-Jun Bae

1. Background and Purpose

1) Background and Necessity

- The importance of dangerous goods management in port and land transport stages is growing in accordance with the government's strengthened disaster and safety management framework.
- Increase the need to refine disaster response systems and advance dangerous goods management standards
- The advancement of industrial structure has resulted in an increase in dangerous goods throughput and an intensified operational burden at major ports
- Diversify the types of dangerous goods and expand the potential

for handling risks

- Accidents occurring throughout the port-inland transport process raise the possibility of critical consequences including disruption of logistics functions, environmental pollution, and human casualties.
- Strengthen the imperatives for preemptive management in response to escalating multifaceted risk factors
- Domestic and international accident cases identified structural vulnerabilities including information deficiencies, procedural inadequacies, and storage-handling management limitations.
- Raise the need for improving dangerous goods management systems
- Whereas major foreign ports have established integrated management systems encompassing facilities, workforce, information, and institutions, domestic response systems remain insufficient across all supply chain stages.
- Identify the need to strengthen core elements including training, dedicated facilities, alternative port procedures, and information integration
- Existing research concentrates on single-facility or partial regulatory approaches and lacks supply chain resilience-based studies.
- Increase the need for developing comprehensive supply chain

management frameworks for disaster and emergency preparedness

2) Purpose

- This study reviews disaster and emergency cases involving port dangerous goods containers and develops response measures to ensure logistics supply chain continuity in disaster situations involving land transport.
- Analyze the impacts on dangerous goods logistics supply chains based on disaster and emergency cases occurring in port and land transport processes
- Assess the current status of dangerous goods management and response system conditions in port-linked land transport stages
- Examine dangerous goods container management and supply chain response systems at major foreign ports
- Comprehensively analyze specific risk levels and accident impacts degrees by dangerous goods types at major ports in Korea
- Formulate response measures for port dangerous goods containers against disasters and emergencies based on the above findings

2. Content and Methodology

1) Research Scope

- The research scope covers the entire supply chain involving the movement and handling of dangerous goods containers across port and land transport stages.
- Incorporate multidimensional factors including facilities, information systems, human elements, and legal-institutional frameworks throughout port-road-rail transport operations into the analysis
- The spatial scope encompasses the full range of port loading-unloading, transfer, and storage processes as well as road and rail transport stages connected to inland regions.
- Establish the continuous supply chain flow between port and land transport stages as the analysis target
- The scope of disaster includes major disaster categories including natural disasters, dangerous goods-induced fires and explosions, facility malfunctions and accidents, and terrorist attacks.
- Categorize impact factors on the dangerous goods supply chain according to disaster type
- The scope of principal agents encompasses all entities with direct and indirect participation in the dangerous goods supply chain.

- Incorporate terminal operators, transport and cargo handling companies, government ministries, local governments, and disaster response organizations such as fire response and environmental agencies
- The content scope covers an analysis of management system conditions and vulnerabilities centered on human factors, facility infrastructure, legal-institutional frameworks, and information systems.
- Examine standards, operational practices, and problems for each element to derive structural factors

2) Research Content

- Through an analysis of domestic and international disaster and emergency cases, this study examines the characteristics and influencing factors that have emerged in dangerous goods logistics supply chains.
- Review domestic cases such as Ulsan Port and Pyeongtaek Port and international cases including Tianjin Port and Beirut Port
- This study identifies the dangerous goods management processes and operational status within the port-land transport linkage structure.
- Document the phase-specific procedures across loading-unloading, storage, transfer, and dispatch operations, and the operational realities of legal-institutional frameworks, facilities, and information

management systems

- A comparative analysis is conducted on dangerous goods container management approaches and supply chain response systems at major international ports.
- Identify structural attributes of management procedures, institutional arrangements, and information connectivity systems
- Risk factors and impact ranges are assessed based on risk analysis data categorized by dangerous goods types and accident impact information from key ports.
- Compile key elements regarding risk ranges by cargo type, handling conditions, and impact scope in accident scenarios
- This study consolidates improvement strategies for dangerous goods logistics supply chain preparedness against disasters and emergencies.
- Derive implications identified in facilities, workforce, legal-institutional frameworks, and information systems

3. Result

1) Summary

- Based on domestic and international dangerous goods accident cases, this research extracts key vulnerability factors that affect the entire supply chain.

- Identify critical factors in damage escalation, including dangerous goods information omissions, lack of inter-agency coordination, and delayed initial response
- Identify common vulnerability factors through comparison of international cases such as Tianjin Port and Beirut Port with domestic cases including Ulsan Port and Pyeongtaek Port
- Structural limitations in domestic port dangerous goods management systems are confirmed.
- Uncover management gaps such as lacking inter-agency cooperation structures, missing port-tailored response protocols, and deficient integrated information platforms
- Extract improvement requirements for institutional and operational aspects through comparison of domestic and international management systems
- Based on dangerous goods risk analysis categorized by cargo types at major ports, this research identifies factors determining risk level variations.
- Find elevated risk levels for particular commodities including HS 382499 and HS 271019
- Confirm cargo volume and handling frequency as significant contributors to risk assessment, with variations occurring according to port-specific cargo throughput structures
- Spillover effects on port operations and supply chains are derived from dangerous goods accident impact analysis.
- Confirm potential damage to infrastructure such as cargo handling

-
- equipment, berths, and yards along with operational disruptions
- Raise possibilities of secondary damages including domestic and international logistics delays, environmental damages, and increased social costs
 - This study applies Fuzzy AHP to prioritize response measures and present sequential priorities for policy implementation.
 - Revise dangerous goods-related laws, strengthen dedicated equipment systems, and develop disaster and emergency response manuals
 - Reinforce infrastructure management, enhance inter-ministerial cooperation, and establish an integrated information platform
 - Improve handler training, upgrade safety manager education, and strengthen disaster and emergency preparedness training
 - This research identifies the needs and directions for legal and institutional improvements.
 - Requiring supplementation of provisions related to dangerous goods storage, education, and transfer within the Act on the Arrival and Departure of Ships
 - Propose long-term necessity for enacting the Regulations on Safety Management of Dangerous Goods at Ports (tentative title)
 - Improvement directions for follow-up tasks and industry issues are presented.
 - Extract requirements for estimating dangerous goods storage volume, sophisticating impact evaluation, and studying modal shift-oriented supply chains
 - Identify industry issues including storage yard space shortages,

excessive workload for safety managers, and inadequate inter-port consultation body operations

2) Policy Suggestions

- It is necessary to establish a phased implementation roadmap for port dangerous goods logistics supply chains in preparation for disasters and emergencies.
- Determine legal-institutional enhancements, dedicated handling system reinforcement, and response manual formulation as primary priorities through Fuzzy AHP analysis
- Fuzzy AHP analysis findings designating legal-institutional enhancements, dedicated handling system reinforcement, and response protocol formulation as primary priorities
- Identify infrastructure management enhancement, inter-ministerial cooperation, and integrated information platform development as secondary priorities
- Designate handler training improvement, safety manager education, and disaster and emergency drill enhancement as tertiary priorities
- Confirm the need for developing year-by-year implementation schedules aligned with priorities and establishing long-term deployment phases
- Enhancement of legal-institutional structures for port dangerous goods safety governance is necessary.
- Require reinforcement of provisions concerning dangerous goods

storage, handler education, and transfer safety protocols under the Act on the Arrival and Departure of Ships

- Call for standardization of self-safety management plans and clarification of disaster preparedness procedures
- Propose establishment of port-specific regulatory systems through long-term enactment of the Regulations on Safety Management of Dangerous Goods at Ports (tentative title)
- The research identifies the necessity of developing dedicated dangerous goods storage yard design and storage capacity calculation standards reflecting terminal conditions.
- Raise necessity for calculating dangerous goods storage volumes considering environmental and facility characteristics near terminals as well as properties of dangerous goods
- Call for establishment of storage capacity standards based on precise analysis of explosion and fire impact radius and cascading damage potential
- It is necessary to develop a survey framework for evaluating dangerous goods accident consequences.
- Underscore the need for building an integrated impact assessment framework incorporating infrastructure, equipment, and human damage alongside environmental and societal costs
- Require precise assessment research considering terminal-specific facility and equipment status as well as surrounding area conditions

- Strategies for stabilizing supply chains through modal shift in dangerous goods transportation need to be formulated.
 - Require review of modal transition strategies toward rail and coastal maritime transport to reduce heavy reliance on roads
 - Require construction of incentive-oriented policy designs incorporating comprehensive logistics costs, environmental costs, and accident costs
- It is necessary to activate inter-port cooperative mechanisms and institutionalize policy dialogue forums.
 - Need to expand existing Busan Port-focused consultation body frameworks to other ports to ensure practical effectiveness
 - Propose reflecting field challenges and strengthening policy connectivity through policy forums based on an industry-academia-research-government collaboration framework