

# Cross-Strait Logistics Dependencies: A Quantitative Assessment of Taiwan, Hong Kong, and Mainland China Terminal Interconnection

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## Abstract

*The terminal networks of Taiwan, Hong Kong, and mainland China collectively handle over 35% of global containerized trade volume, yet the structural interconnections among these nodes — and the systemic exposure those interconnections create — have received limited analytical attention in the Western policy literature. This paper presents a quantitative assessment of cross-strait terminal interdependence, drawing on AIS vessel routing data, port authority disclosures, and original field survey work conducted in Hong Kong and Shenzhen between March and May 2025. We identify three categories of interdependence — operational, financial, and informational — and assess each across a panel of seventeen major nodes. Findings suggest that disruption at any single node in the cross-strait system would propagate to adjacent nodes far more rapidly and severely than aggregate throughput statistics would predict. Policy implications for allied continuity planning are discussed.*

**Keywords:** cross-strait logistics, terminal interdependence, Taiwan, Hong Kong, China, supply chain resilience, Asia-Pacific

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## 1. Introduction

The cross-strait logistics system — encompassing the terminal networks of Taiwan, Hong Kong, and mainland China — represents one of the most consequential concentrations of global throughput capacity in the contemporary economy. Kaohsiung, Hong Kong, Shenzhen, Shanghai, and Ningbo-Zhoushan collectively rank among the world's busiest container ports, and the routing patterns that connect them shape the operational tempo of global trade in ways that are not fully captured by node-level throughput statistics.

Despite the strategic significance of this system, structural analyses of cross-strait interdependence remain limited in the open Western literature. Existing assessments tend to treat individual nodes in isolation or to aggregate the system at a level of abstraction that obscures operationally significant detail. The literature that does engage with cross-strait dynamics is overwhelmingly focused on geopolitical and military considerations rather than on the logistics infrastructure characteristics that determine disruption propagation.

This paper addresses that gap with a node-level, quantitatively grounded assessment of the operational, financial, and informational ties that bind these terminals together. The empirical work underlying this paper was conducted during a research visit to Hong Kong and Shenzhen in spring 2025, supplemented by AIS data analysis and structured interviews with terminal operations personnel.<sup>1</sup> The visit substantially augmented what is available through purely open-source channels.

The paper proceeds as follows. Section 2 develops the conceptual framework distinguishing three dimensions of interdependence. Section 3 describes the data and methodology underlying the empirical analysis. Section 4 presents node-level findings across the seventeen-terminal panel. Section 5 discusses policy implications for allied continuity planning. Section 6 addresses limitations and outlines directions for follow-up work.

## **2. Conceptual Framework**

We define cross-strait interdependence along three dimensions, each of which captures a distinct mechanism through which disruption at one node can propagate to others.

### ***2.1 Operational Interdependence***

Operational interdependence refers to the routing, scheduling, and capacity-sharing relationships among terminals that cause throughput shifts at one node to produce measurable effects at others. Feeder service patterns, transshipment arrangements, and shared shipping line schedules all contribute to operational interdependence and can be measured directly from AIS vessel tracking data over time. Operational interdependence is the most visible form of cross-strait connection and the most amenable to quantitative analysis.

### ***2.2 Financial Interdependence***

Financial interdependence refers to the ownership, investment, and revenue-sharing structures that link terminal operators across jurisdictions. Cross-shareholdings among regional terminal operating companies — particularly those involving Hutchison Ports, COSCO, and the major Taiwanese carriers — create financial exposures that propagate operational disruption into financial markets and corporate strategy. Financial interdependence is less visible than operational interdependence but in some respects more consequential, as financial exposure persists even when operational connections are temporarily disrupted.

### ***2.3 Informational Interdependence***

Informational interdependence refers to the shared management systems, data exchange protocols, and operational intelligence flows that connect cross-strait terminals. Many terminals in this system rely on shared terminal operating system vendors and shared port community systems, creating informational dependencies that extend the reach of any single cyber incident across multiple jurisdictions. Informational interdependence is the least studied of the three dimensions and the most difficult to assess from purely open-source channels.

## **3. Data and Methodology**

The analysis covers seventeen major terminals across Taiwan (Kaohsiung, Taipei, Taichung), Hong Kong (Kwai Tsing, eight terminals), and mainland China (Shenzhen Yantian and Shekou, Shanghai Yangshan, Ningbo-Zhoushan, Xiamen, and Guangzhou Nansha). Terminal selection was based on annual throughput exceeding 5 million TEU and active participation in the cross-strait trading system.

AIS data was obtained from a commercial provider and aggregated to the port-pair level over the 2020–2024 observation period. Vessel calls were filtered to retain only commercial container traffic, with bulk carriers, tankers, and specialized vessels excluded from the analysis. Financial interdependence was coded from corporate disclosures, regulatory filings, and industry association reports, with ownership relationships traced through publicly available shareholding records.

Informational interdependence was assessed through a combination of public information about terminal operating system architectures and structured interviews conducted during the spring 2025 field visit. Interview protocols emphasized open-ended discussion of operational practices rather than direct questions about

cybersecurity posture, in recognition of the sensitivity of the latter. Interview respondents are not identified and quotations from interviews are paraphrased rather than reproduced verbatim, in accordance with the informed consent procedures applicable to the field research.

### ***3.1 Limitations of Cross-Strait Data Access***

Data access varies substantially across the cross-strait system. Hong Kong terminals operate under disclosure norms broadly consistent with OECD jurisdictions, and the field visit produced rich operational detail for these facilities. Mainland Chinese terminals operate under more restrictive disclosure norms, and the empirical base for these nodes is correspondingly thinner. The author's assessment of mainland Chinese terminals in this paper relies more heavily on AIS data and inference from operational patterns than on the direct site engagement that informed the Hong Kong analysis.

## **4. Findings**

Operational interdependence within the cross-strait system is substantially higher than aggregate throughput statistics suggest. Direct feeder relationships connect Hong Kong's Kwai Tsing terminals to Shenzhen Yantian and Shekou at volumes that effectively integrate the three locations into a single operational system. Daily feeder vessel calls between Kwai Tsing and the Pearl River Delta terminals average 47 movements per day during the observation period, with peak volumes during seasonal demand surges exceeding 80 movements per day.

Transshipment patterns between Kaohsiung and the Pearl River Delta terminals create a similar integration at the system's southern edge. Approximately 31% of Kaohsiung's container throughput involves cargo destined for or originating in Pearl River Delta terminals, a level of operational integration that would not be evident from throughput statistics alone.

### ***4.1 Financial Concentration***

Financial interdependence is concentrated among a small number of terminal operating groups. Hutchison Ports operates or holds substantial stakes in terminals at Hong Kong, Shenzhen, and Ningbo. COSCO operates terminals at Shanghai, Ningbo, Xiamen, and Guangzhou Nansha. These concentrations mean that operational disruption affecting one terminal frequently produces immediate financial pressure on related terminals — including those in different political jurisdictions.

The financial concentration finding has implications beyond immediate disruption propagation. Cross-shareholding structures create governance interdependencies that influence operational decision-making during normal operations as well as during disruption events. The consequences of these interdependencies for system-level resilience are not well captured in existing analytical frameworks and warrant further research attention.

### ***4.2 Informational Concentration***

Informational interdependence is more difficult to assess from purely open sources but field interviews suggested that a small number of terminal operating system vendors serve the majority of terminals in the dataset. This concentration creates the potential for cyber incidents at one node to propagate to others through shared software dependencies, vendor remote access channels, or common configuration vulnerabilities.

The author was not able to verify TOS vendor concentration through purely open-source channels — vendor relationships are routinely treated as commercially sensitive — but multiple field interview respondents independently identified the concentration pattern, lending support to the finding despite the limitations of purely open verification.

## 5. Policy Implications

The cross-strait logistics system is more tightly coupled than it appears at first inspection. Continuity planning that treats Taiwan, Hong Kong, and mainland China as independent logistics jurisdictions will systematically underestimate the speed and severity with which disruption at any single node propagates across the system. Allied logistics planning should treat the cross-strait system as a unified operational environment for purposes of disruption modeling, while preserving the political distinctions among jurisdictions for other policy purposes.

The informational dependencies identified here warrant particular attention from cybersecurity planners. The concentration of terminal operating system vendors creates the conditions for a single compromised vendor relationship to produce cascading effects across politically separate jurisdictions. This is precisely the kind of structural vulnerability that conventional threat assessment frameworks tend to overlook because it cuts across the jurisdictional categories those frameworks typically employ.

## 6. Limitations and Future Work

This paper's findings rest on a combination of quantitative analysis and qualitative fieldwork conducted during a single research visit. Extending the empirical base will require additional fieldwork — including, ideally, extended visits to mainland Chinese ports that were not accessible during the spring 2025 trip. The author intends to conduct follow-up fieldwork in 2026, contingent on funding and institutional support.

Several specific research priorities flow from this paper. First, the TOS vendor concentration finding warrants more rigorous empirical verification through channels that this paper's open-source methodology could not access. Second, the financial interdependence analysis should be extended to incorporate the evolving ownership structures emerging from recent regulatory changes in mainland China. Third, the analytical framework developed here should be extended to other strategically significant logistics systems — Indian Ocean corridors, Mediterranean transshipment networks, and trans-Atlantic feeder systems — to assess its generalizability.

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<sup>1</sup> Field visit conducted March–May 2025. Institutional access in Hong Kong was facilitated through an affiliation with the Centre for Maritime Studies, National University of Singapore. The author thanks regional academic colleagues who arranged terminal site visits and operational discussions on a confidential basis. The author confirms that no classified or export-controlled information was shared during the field visit.

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