ISBN: 978-628-96613-3-0. ISSN: 2414-6390. Digital Object Identifier: https://dx.doi.org/10.18687/LACCEI2026.1.1.314

Intermodality and Port-Hinterland Connectivity: Chancay Port and the Central Highway vs. Sydney's Port Botany Rail Link

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Abstract*– Global trade in the Pacific basin increasingly depends on how efficiently ports connect with their hinterlands through rail and road-based logistics networks. This article compares the emerging Chancay–Central Highway system in Peru with the mature rail and intermodal network serving Sydney's Port Botany. A mixed case study design combines recent literature on port governance, smart ports and risk management with official statistics, the Container Port Performance Index and operational indicators from port authorities and terminal operators. The analysis focuses on four dimensions: maritime capacity and performance, hinterland infrastructure and intermodality, governance and risk, and strategic positioning in global trade corridors. Results show a marked asymmetry between maritime capacity and inland connectivity in both cases. Chancay is being developed as an integrated deep-water logistics platform linked to trans-Pacific routes, but its performance will depend on overcoming bottlenecks along the Central Highway, Andean connections and Lima's metropolitan freight network, and on managing geopolitical and governance risks associated with a single foreign-controlled operator. Port Botany already handles high container volumes and has substantial unused terminal capacity, yet remains constrained by limited rail share, urban congestion and fragmented institutional responsibilities. The article concludes that intermodality is shaped less by engineering decisions than by the alignment of governance, risk management frameworks such as ISO 31000, regulation and long-term public investment, and argues that Chancay offers Peru an opportunity to embed rail, dry ports, digital port community systems and risk governance from the outset.

Keywords- Intermodality, Logistics Efficiency, Port Botany, Intermodal Infrastructure.

I. INTRODUCTION

How well seaports are connected to their hinterlands via rail and road-based logistics networks significantly influences global trade patterns, particularly in the Pacific region. Container ports located in very large metropolitan areas or in export-oriented corridors are facing increasing congestion not at the port but throughout their inland transportation networks. Studies of Port Governance, Port Community Systems, and their impact on hinterland connection performance as well as on progress toward increasing the level of rail use and sustainability indicate that the success of these networks relies heavily on the ability of the authorities managing the ports to manage multiple stakeholders and establish digital communications between these parties [1].

At the same time, cases at Port Botany demonstrate that improvements in terminal operations through privatization and improved efficiency on the terminals do not necessarily imply that the landside transport system is resilient when there is still fragmentation in rail capacity, regulatory systems and institutional co-ordination among the key stakeholders involved in those landside operations [2].

The recent progress in building the deep-water port of Chancay, located north of Lima, illustrates both the possibility for increased trade routes through the Belt and Road Initiative as well as the dangers that can come from them. One aspect of this project is that it presents an opportunity for Peru to create new trade lanes to Asia, as it will allow for faster travel times through ocean shipping than current methods. However, without a sufficient investment in developing greater capacity for the region's land-based transportation infrastructure and the establishment of appropriate governance measures, these advantages will likely be short-lived [3].

Similar discussions have occurred in Australia where Port Botany has been a key container hub for a long time but still experiences limitations in terms of increasing the proportion of freight transported via rail.

Port-hinterland connections are becoming more important than ever for the overall competitiveness of countries, distribution of wealth among regions, and how environmentally friendly global trade is. If inland corridors are either unreliable or congested, then, while ports may show high productivity levels (high efficiency) at the coast, that productivity may be offset by increased costs associated with backside land transport (street level), longer times waiting to pick up products from the port warehouse and an increased chance of disruption on the road to their destination. This is especially important for economies that rely to a large degree on perishable goods (time-sensitive), such as refrigerated agrifood products and the minerals needed to complete supply chains that need predictability in their logistics windows. In this regard, intermodal transport is more than just a "modality" or method of transportation; it is system capability, which means how all aspects of moving goods by truck, rail, ocean and air are integrated, i.e. how available the physical infrastructure (the transport system) is, how coordinated the existing institutions and decision-making processes are and how easy it is to get

information regarding where a product is located and what it will take to transport it to the final destination. By comparing emerging corridors such as Chancay-Central Highway with established corridors such as Port Botany you will have a much better understanding of which constraints are inherent to geography and urbanization, and which can be attributed to governance, planning, and investment.

To assess how maritime capacity and inland transport are balanced; and the exchange of lessons between Peru and New South Wales on designing resilient and sustainable logistics corridors, the article uses port governance and smart port literature as well as risk management literature as the basis of comparison between the emerging Chancay-Central Highway System (CCS) and the more developed Port Botany Rail and Intermodal Network (PBN). The article's findings suggest that both CCS and PBN can be considered for further investments in infrastructure to improve their respective port-hinterland connectivity as well as the overall efficiency of the logistics systems in which they operate. By exploring these connections, the research aims to generate recommendations for policy makers, port authorities, shippers and logistics providers who are seeking to improve their respective logistics networks' efficiency through increased investment in intermodal systems.

II. Literature Review

Research surrounding ports and hinterland connectivity has evolved from narrowly focusing on maritime throughput to adopting a wider systemic view of the Port (Port System). Ports seen through the Port System perspective are thought to serve as nodes within complex logistics systems, where port governance, digitalization, and intermodality are key components of successful Port Systems. The relationship between port governance and investments in rail and inland terminals and the position of ports within regional logistics corridors is one area that has been explored in depth. Tijan et al., discuss the evolution of the port authority into a co-ordinator of the various Port Community Systems and a facilitator for digital platforms that can reduce transaction costs associated with the use of rail and barge services in particular, and the use of rail and barge services in European landlord ports in general [1]. Lin et al., provides evidence that governance strategies and Smart Port strategies have an interdependent relationship and that ports that have clearer mandates and collaborative governance frameworks are more likely to implement fully integrated digital systems that allow for the efficient management of hinterland transportation flows in real time [4].

Black and Roso examined how Port Botany has progressed post-privatization, concluding that although the privatization of Port Botany has given private operators an opportunity to improve terminal level efficiency, the landside distribution system remains hindered by a significant number of rail bottlenecks and an endless amount of institutional fragmentation among state agencies, rail infrastructure managers, and local governments. Industry and policy documents indicate that the terminals at Port Botany can handle much more than what they currently do, with the major limitation of the port being due to the landside distribution system, where approximately 20% of the total number of containers are moved by rail and continue to suffer from congestion on the most critical truck routes [2].

As the rapid growth of Chancay Port leads to the formation of a strand of literature on Chinese investment and the area of logistics and geopolitics in general, so has Barboza Sanchez's analysis on the opportunities and obstacles that arise from the Port of Chancay. He highlights opportunities such as reduced shipping times from South America to Asia; the possibility of attracting new services to Peru; and reconfiguring trade routes through the Pacific Ocean. He also discusses some of the risks it may pose to other ports in Peru if it is not designed as part of an integrated national network of inland transportation. Along with Barboza Sanchez, Apostolopoulou and Pizarro explore Chancay through the lens of critical urban geography, describing the way in which the combination of the port and associated logistics park and real estate development can be viewed as a form of "infrastructural urbanization." The authors also highlight the way in which local community members can negotiate with central authorities about the effects of large-scale maritime Silk Road infrastructure development on their communities [5].

As is common among defense think tanks and policy institutes, the emphasis placed on Chancay by these entities is that Chancay serves as a strategic node in China-Peru relations and as a potential power shift in the natural order of influence on the Pacific coastline. [6] for example, the depth and exclusive use provisions of the deep-water port together with the governance systems associated with it will have long-term importance regarding the manner in which the United States and its allies will react to the growing Chinese presence and control of infrastructure in this hemisphere. Additionally, research on the increasingly robust economic ties between China and Peru via Belt and Road Initiative, demonstrates from an economic standpoint, the benefits that the Chancay port offers in terms of reducing trade costs for mining exports and refrigerated products, provided that there are sufficiently developed hinterland transportation networks supporting the port.

An additional body of literature that supports the literature on port performances is that of Port Performance Indicators and Global Benchmarking. Container Port Performance Index created in conjunction with the World Bank and S& P Global uses vessel time in Port as an indicator of port efficiency alongside showing the significant differences in performance levels between Latin American ports. Most recently, Callao has been recognized as one of the better-performing ports in Latin America, even though it is still behind many of the Asian and Middle Eastern Top-performing Terminals. This suggests that there is significant scope for improvement in both Seaside and Landside operations. The World Bank's World Development

Indicators on Container Port Traffic demonstrates that Containerized Trade experienced tremendous Growth over the Past Decade in both Peru and Australia, reinforcing the need to ensure that a Port's Capacity corresponds with its Hinterland Infrastructure [7].

Integrated risk management and governance frameworks are highly applicable when studying the evolution of an industry from an emerging to a mature port system, as illustrated by the experience of Latin America with integrated compliance and risk management systems based on ISO 31000 and ISO 37001. The authors, Lizarzaburu et al. also show that implementation of ISO 31000 in the region has shifted from a traditional regulatory compliance approach towards a more strategic viewpoint where governance, risk and performance are connected. Furthermore, their studies demonstrate the importance of transparent governance, defining roles and having written controls when managing large capital projects and public-private partnerships; which has direct relevance to port/corridor investment [8].

Regionalization of ports and the inland node concept can further clarify some of the confusion surrounding these cases. In regionalized port systems, the performance of the port is dependent on an interconnected system of inland consolidation, customs facilitation, and intermodal transfer points, which all help to alleviate the demand peaks on the port and decrease urban trucking intensity while at the same time providing a level of continuity from sea to land transport. The regionalization view also highlights that capacity is not merely a characteristic of terminals but rather an attribute of the entire corridor, shaped by network effects, reliability of service, coordination of functions between multiple actors, and other related factors. In the case of historically developed metropolitan ports, the regionalization strategy is frequently adopted as a retrofitting approach to compensate for insufficient available land and conflicts with other competing urban land uses. Newer gateways provide a unique opportunity to implement an integration into the operations of the port and inland terminals from the outset by establishing standardized operating procedures and an electronic exchange of data (for example, for scheduling purposes, managing slots, and improving the overall use of resources on both road and any future rail lines).

The literature indicates that four elements define successful intermodal port hinterland systems. To begin with, port authorities and regulators must bring together disparate actors and align incentives across various freight transport modalities, including maritime terminals, railways, trucking companies, and inland terminals. Streamlined coordination of these disparate actors is accomplished, in part, via the use of port community systems and other formalized systems of governance [1],[4]. Secondly, the planning and financing of hinterland transport corridors over the long-term favor the continued development of rail-based transport corridors and other high-capacity corridors; when ports are situated in densely populated metropolitan areas such as Port Botany, this becomes even more imperative. Thirdly, regarding the establishment of new nodes such as Chancay, the successful creation of new infrastructure to integrate with an existing national transport network and the identification and control of strategic risk in regard to large foreign investors is critical to the ongoing success of these nodes. Lastly, adopting a structured risk management framework similar to those outlined by Lizarzaburu and others can be useful in providing a disciplined approach to identifying and mitigating operational, financial, governance, and geopolitical risks that may disrupt intermodality over the medium term [8].

III. Methodology

This study employs a detailed comparative case study design supported by mixed qualitative and quantitative data. The case studies selected to compare, and contrast are Chancay Port with its proposed hinterland connections using the Central Highway and associated corridors in Peru; and Sydney's Port Botany with its rail-based intermodal transport linkages – in New South Wales. There are three key reasons for selecting these two cases for comparison. Firstly, both ports either currently have (or will have) an essential role connecting mineral-rich regions in the hinterland of Latin America and Asia. Secondly, they demonstrate differences in their respective development patterns regarding infrastructure – Chancay is a newly initiated deep-water gateway, while Port Botany is a fully-fledged container hub that is trying to grow the number of containers shipped via rail (i.e., increase rail volume). Finally, both ports are involved in a broader context of governance reform, the management of risk and the strategic repositioning/realignment of both regions via cooperative initiatives under the Belt and Road Initiative in Peru or through privatization initiatives and policy Directional development of rail in New South Wales.

There are three primary means of gathering evidence in the study. The initial source is through a structured review of academic literature and governmental policies concerning Port Governance, Intermodality, Smart Ports, Belt and Road Investment and Risk Management. This consists of reviewing all peer-reviewed journals indexed in Scopus and Web of Science that focus on Port Governance, Intermodal Transportation, Smart Ports, Belt and Road Investments, Risk Management, with an emphasis on articles that have been published post-2018 to be consistent with current discussions about: Digitalization of Ports, Port Community Systems (PCSs), Governance of Infrastructure [1], [3], [4], [5].

The second source of information is from official government sources; specifically, statistics and operational indicators from databases owned by multiple international organizations as well as from organizations involved with shipping ports. Examples of data found in the World Bank World Development Indicators on shipping containers being shipped via sea routes may provide a better understanding of the national level shipping (port) statistics of Peru and

Australia. Additionally, The World Bank Container Port Performance Index provides comparative information regarding the efficiency of various shipping ports, and provided the author with a direct comparison between Callao and Chancay [7]. Information from international media sources indicate both the current state of the port development project in Chancay, Peru as well as what is expected to be its future development project to handle containers for incoming containerized cargo through the port. All relevant containers shipped through the port are sent to DP World's Callao facility where they are held until the containers reach their final destination. The data are provided to give readers an idea of how the capacity of different shipping ports is expected to change over time based upon what has been published on those shipping ports [9], [10], [11].

The analysis of documents about the third type of source comes from the review of strategic planning documents, policy documents and other similar sources of information that have been created by government departments and/ or representatives of the freight and transport industry in New South Wales (e.g. The New South Wales Freight and Ports Strategy which defines specific percentage targets for rail's market share of container movement within the Port of Botany), industry associations who have put together submissions that document their views on current supply chain bottlenecks and that contain proposals for changes in mode, and the Government of Peru and its regulatory agencies who are providing information describing the legal status of the Chancay as a private sector port intended for public use, and the anticipated impact of Chancay on enhancing the overall economic development and creating employment in Peru.

The data was placed in a straightforward comparison system, consisting of four areas of interest: maritime capacity/performance; hinterland infrastructure/intermodality; governance/risk management; and strategic positioning in global trade corridors. In each area of interest, qualitative information from literature and policy papers was verified by quantitative data. From this process, we created an example indicator table which compared throughput capacity for Chancay, Callao and Botany Ports (using both the actual container volumes processed at each port) with the rail share of each port for that time period; and processed through the container port ranking system of Port Authority Melbourne (PAM) to obtain the relative real-world performance of each port against PAM's performance rankings. The same indicators used in the example table were the basis of the Simple Bar Chart which can be created in either a spreadsheet application, or a statistic application's package, allowing other researchers to duplicate and expand on this research.

For improving the consistency and fidelity of comparisons, we consider our selected indicators as representative of broader patterns of performance of systems and we explicitly define two different perspectives, capacity and effective capacity. The operational limitations that influence the ability of terminals to deliver on their designed capacities (i.e., modal distribution, reliability of corridors, and urban access conditions) have also been incorporated into our assessments of terminal capacity. Our analysis examined the individual institutional agency's documents, which highlighted how we utilize this documentation as a reference to understand their institutional mandates, accountability measures, and identified targets (such as rail share goals and corridor improvement priorities), to better align the respective performance objectives of agencies and operators. In cases where there was conflicting data from multiple documents, the latest recorded official report will be taken as the preferred option, along with any value that can be confirmed by other independent publications. Therefore, while this approach cannot eliminate uncertainty associated with data due to varying reporting across different agencies and operators, it will mitigate the risk of placing an unduly large emphasis on a singular data point. This approach will also offer greater clarity into how infrastructure, governance, and risk management functions intermingle within two port-hinterland systems.

The analysis has been constructed through an interpretive-explanatory method, not an econometric method. The purpose of the analysis is not to provide an estimate of how much each of the various interventions causes a certain outcome, but rather to identify and explain the relationships between governance, risk management and infrastructure investment that produce specific characteristics in terms of intermodal patterns and connections between ports and hinterlands. In their formulation of risk governance, Lizarzaburu et al. identified and examined questions regarding how actors assess and respond to the risks associated with the development of intermodal transportation systems and corridors including: congestion risk, demand risk, governance and corruption risk, and geopolitical risk [8].

IV. Results and Discussion

There are two port systems in the region that are very similar to their goals of being a Pacific Gateway for the mineral export and containerized trade industries. Still, these two systems have different capacity levels, intermodal options and risk associated with the respective ports. The Chancay Port project has been designed specifically as a deep-water container terminal and multi-purpose terminal with expected throughput capacity of approximately 1 million containers per year during the first phase of construction. As additional phases are constructed, the projected capacity for the Chancay Port project is expected to increase from 1.5 million to 5 million containers. Port Botany, on the other hand, currently has an annual throughput of approximately 2.6 million containers. Additionally, the terminal handle capacity of Port Botany significantly exceeds the current volume of cargo being processed at this facility. Therefore, Port Botany can grow its volume substantially but is limited in its capacity to grow due to the infrastructure limitations surrounding the distribution of the goods from the terminal.

To ground this comparison, Table 1 summarizes selected indicators for Chancay, Callao and Port Botany.

TABLE I
SELECTED INDICATORS FOR CHANCAY, CALLAO AND PORT BOTANY (LATEST AVAILABLE DATA)

Port and indicator	Year of reference	Value
Chancay: designed annual container capacity, first phase	2024	One million containers
Chancay: projected annual capacity at full development	2024	One point five to five million containers
Callao: actual container throughput	2024	One point nine six million containers
Callao: estimated annual capacity after expansion	2024	Around three million containers
Port Botany: actual container throughput	2019–2020	Around two point six to three point one million containers
Port Botany: assessed terminal handling capacity	2020	Around seven point two million containers
Port Botany: share of containers moved by rail	2016–2021	Around seventeen to twenty per cent
Callao: position in Container Port Performance Index	2023	Twenty sixth globally

Values are drawn from DP World and NSW Ports press releases and technical reports, from Shipping Australia trade statistics and from the World Bank Container Port Performance Index[9], [11], [12]. Because the available indicators come from different reporting cycles, the comparison should be interpreted as an indicative system-level comparison rather than a strict same-year performance benchmark. Where possible, the most recent official or verifiable data were used, but differences in reference years limit direct comparability across capacity, throughput, and modal-share indicators.

The first outcome is regarding an imbalance between maritime capabilities and hinterland/regional infrastructure capabilities. Port Botany has an estimated capacity of more than 7 million containers; however, its actual volume handled falls well short of this due primarily to the fact that less than 20% of container movements are via rail and that congestion on the roads limits the ability of trucks to operate efficiently. The NSW government has continuously set targets of approximately 28% for increasing the share of rail freight; however, evidence indicates that these targets have not been achieved and therefore there is a need for additional investment in freight-only rail corridors and intermodal terminals.

The variance between logistics costs and Variability can also be viewed as a function of generalized logistics costs and Variability. In the Port of Botany, the "last-mile" issue is exacerbated by urban congestion, competing passenger rail priorities and the operational complexity of managing a diverse number of public and private stakeholders in a very dense urban area. In addition, while terminals may have some available capacity, the system may have extreme peak-period Variability causing increased buffer times, higher levels of inventory costs and emissions as a result of long periods of idling and frequent stop-start truck movements. A similar risk associated with Chancay is that of corridor fragility - the impact of mountainous geography, seasonal surges in demand, and interruptions caused by social or climatic events on the ability of the corridor to effectively move the volume of goods (within the context of being able to take advantage of the efficiency of terminal operations). Additionally, these types of dynamics indicate that improving performance will require not only increasing physical capacity but also improving the reliability of service through traffic management, enforcement of freight windows, sequencing of capital investments, and the institutional capacity of stakeholders to coordinate their decision-making across multiple jurisdictions and operators.

By contrast to the Chancay project, which is being planned as an integrated complex of port logistics linked via tunnels to the main coastal highway and connected to Central Highway rail and road links to the Andes, the Chancay Port will have to cope initially with an underdeveloped rail freight transport system, limited existing road corridors because of mountains and congestion, and an evolving framework for institutional coordination among port operators, central government agencies, regional authorities, and the municipalities surrounding the port. Thus, it is likely that the Chancay port will face a high risk from bottlenecks caused by poor connectivity between the Chancay Port's terminal and surrounding regions, especially during peak harvesting times or periods of social or climatic interruption, rather than from underutilization of its berths.

Another finding concerns the governance and regulation of Chancay port, which is owned by a company whose parent company is a shipping corporation that has connections to the State-Owned Enterprises (SOE) of China. The port is classified as a private port for the purpose of public use under Peruvian law and therefore has been granted exclusive operational rights. The governance model at Chancay is very different from those adopted at the majority of European ports, which typically employ landlord port governance structures. It is also markedly different from other Australian ports such as Port Botany, which have been developed using a mixed-ownership model, whereby terminal operators are granted a concession to operate

a terminal at the port (and therefore share the revenue of the port) with the port authority and operate under a strong regulatory oversight regime. While the concentration of governance and control at Chancay may provide improved speed of decision-making and coordinated planning within the port perimeter, it also represents an increase in the strategic and governance risk associated with the development of Chancay. These risks include the reliance on one operator for critical infrastructure, the risk of competing national development objectives against national business strategy, and the increased geopolitical scrutiny associated with the Belt and Road Initiative. [6] analysts have stated that these elements elevate Chancay beyond a simple asset of logistics, placing it in a broader discussion regarding critical infrastructure and national security.

The governance structure for Port Botany in Sydney is complicated because research concerning post privatization postulate that divisions exist amongst the responsibilities of private terminal operators, the port authority and numerous levels of government, creating challenges for co-ordination, however, allows for the establishment of systematic/transparent regulatory frameworks with respect to rail access pricing and investment as well as incorporating "the public interest" in terms of decarbonization and quality of local environments within organizational planning. Monthly discussions regarding the transfer of freight away from trucks towards rail located at the Port Botany are now seen by many from an "emission reduction" and "congestion" reduction viewpoint and that rail transportation and logistics will be viewed as a means to improve port governance in regard to sustainability.

Another dimension that relates to these changes is the concept of trade and the strategic positioning of a country. In particular, World Bank data has shown that Peru and Australia both have had a large increase in their container port volumes over the past ten years, which is related to an increase in their respective mineral export volumes along with trade diversification within their respective economies [7]. The introduction of the Chancay terminal will change the geography of trade flows between Peru, South America, and Asia because it will provide a direct corridor to connect all these locations. Current models estimate that the corridor will reduce total shipping times to Asia by approximately 10 days and will provide a 20 percent reduction in the total cost for logistics in comparison to the current models being used to ship to Asia from South America using Port Botany. Port Botany is still a significant port for manufactured goods entering the country and is an important hub for Peruvian and Australian agricultural exports as well as the mineral economy, but Port Botany is facing a number of challenges from other Australian ports including the expansion of their hinterlands and the subsequent increase in competition from these other Australian ports.

Risk management views can provide a framework for addressing these issues. Lizarzaburu et al. state that organizations in Latin America can use ISO 31000 based frameworks not only to determine operational and financial risks, but also to align infrastructure projects with their existing governance structure and compliance requirements. In Chancay's case this is further emphasized by needing to have an explicit risk register for the access tunnel and highways regarding congestion; community and environmental risk if there are surrounding districts; regulatory risk due to being the only port with exclusive rights; and geopolitical risk due to being a strategic point for China and Peru. Port Botany has similar requirements, as the risk assessments associated with it need to consider climate related events; failure of rail infrastructure; industrial disputes; and risk to reputation as a result of emissions and urban impacts [8].

The last component of the literature review focused on how a digital integrated logistics network is required for intramodal transportation to occur successfully and efficiently. As presented in [1] and [4], when port authorities are an active participant in establishing community systems, they; increase the visibility of cargo flows across all modes of freight transportation (i.e., truck, rail, barge) and allow for better coordination of freight movement between those different transport modes. Although the port system in Port Botany has established a fairly advanced IT infrastructure and developed a number of strategies for future enhancements on the landside, there are still substantial barriers to creating greater value because of fragmentation among operators of different transport modes and legacy information systems. In Chancay, there is an opportunity for the development of a "digital platform" that will allow for the seamless integration of port operation, customs, trucking, and, in all likelihood, future rail operator functions. This digital platform should incorporate lessons learned and best practices from other parts of the world, as well as taking into account any elements unique to the local risk and governance environment.

Based on the comparative indicators and qualitative evidence, Figure 1 summarizes the main analytical finding of the study: maritime capacity does not automatically translate into intermodal performance. Instead, effective port-hinterland connectivity depends on the interaction between maritime capacity, hinterland infrastructure, and governance-risk management.

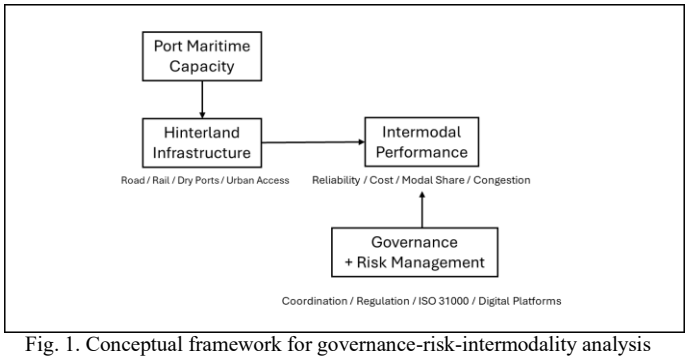

Fig. 1. Conceptual framework for governance-risk-intermodality analysis

V. CONCLUSIONS

Both Chancay and Sydney Ports Botany are located On the Pacific Ocean. They have invested heavily infrastructure including cargo management terminals along the foreshores of these ports, and the construction of deepwater ports that allow ships to load and unload containers quickly and efficiently, as well as having various forms of road and rail transport available for deliveries. However, beyond just the physical aspects of infrastructure and engineering capabilities, these two ports will face numerous governance challenges through developing policies to connect rail and road corridors, achieving consensus among the different users of these corridors, and managing the impact of increased traffic congestion on their operations.

Peru is developing a major public infrastructure project in Chancay that will revolutionize both trade in the Pacific basin and Peru's status as a major maritime hub. The port will initially be designed with a capacity of approximately 1 million TEU per year and may be expanded up to 1.5 million TEU or more; a significant increase in Peru's overall container-handling capacity. The port's depth, geographic position, and dedicated logistics infrastructure give Chancay a substantial competitive advantage over many other major ports in Asia when serving long-distance shipping routes. However, in order for Chancay to sustain its potential for economic development, several factors must occur: The Central Road & associated transportation infrastructure must be upgraded; Urban access must be managed to eliminate chronic congestion; and Governance arrangements must be established that align the interests of the foreign port operator, the Peruvian government, and the communities in which the port is located. The lessons learned from Callao, a port that has improved its operational performance but continues to be challenged by increased volumes and a complex institutional environment, will be invaluable in understanding the fiscal and operational issues associated with integrating maritime modernization with regional transportation networks.

Port Botany has a completely different set of opportunities and constraints compared to other ports because it currently handles so many container volumes, its terminals can also absorb additional capacity in terms of future growth, but it continues to have relatively low rail modal shares, high numbers of containers moving by truck, or through urban areas marked with traffic congestion. Although long-term strategies for increasing rail modal share, creating inland intermodal terminals, and decarbonizing freight transport have been articulated, the wider implementation of these strategies would require coordinated investment, regulatory stability, and sustained political support. Hence, this case demonstrates that delaying the Hinterland's adaptation to accommodate a large metropolitan port incurs significant costs and that it becomes increasingly difficult to reclaim the modal share of freight transport once road-based systems dominate.

These findings suggest that the main policy implication is to manage port-hinterland connectivity as an integrated corridor system, rather than expanding port infrastructure as it is. For Chancay, this means treating the port, access tunnel, Central Highway, potential rail links, dry ports, logistics platforms, customs processes and surrounding communities as part of a single intermodal system rather than as separate projects. For Port Botany, it means continuing to align rail investment, pricing rules, intermodal terminal capacity and environmental objectives so that unused maritime capacity can be converted into effective landside performance. In both cases, digital port community systems and risk management frameworks such as ISO 31000 can support coordination among public authorities, private operators and logistics users by making risks, responsibilities and performance indicators more visible. Therefore, the broader lesson is that intermodality should be governed as an ongoing system capability, measured through indicators such as rail share, truck turnaround times, corridor reliability and congestion exposure, rather than treated as a one-time infrastructure investment. The broader comparisons show how important port connections are as part of a global value chain. With an increasing amount of Pacific Trade and the influence of strategic tensions on maritime trade routes, there will be more focus placed on ports like Chancay and Botany. Success for these ports will not only rely upon how many containers they are moving but also on the level of sustainable, resilient, and stable connectivity for the people and places touching them.

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