Unmasking Opportunities and Challenges in the Colombo Port Mega Hub Transformation

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Abstract

Colombo Port is a key transshipment hub in its region due to its strategic location, which connects feeder connections in the Indian sub-continent and main sea routes. Despite its historical significance, the port faces challenges due to evolving ship design and industry growth, leading to the emergence of competitors in nearby countries. Despite only having one of the three terminals initially planned, the Port of Colombo is transforming into a 'mega hub'. Delays in adapting to industry shifts have cost the port its potential market share, allowing newer ports in neighboring countries to compete for transshipment traffic. The transformation journey is hindered by various internal and external factors, including socioeconomic, political, environmental, and technological impacts. This paper aims to uncover the Port of Colombo's challenges in its transformation, exploring potential opportunities through qualitative analysis based on secondary data and existing literature. The study reveals that while the Colombo Port has promising opportunities, such as its strategic location, historical significance, enhanced maritime trade capabilities, regional connectivity, and potential economic growth, challenges like delayed adaptation to evolving trade dynamics impede its progress. Despite these obstacles, the port's aspirations to become a Mega Hub remain promising yet challenging.

Keywords: Port of Colombo, Port development, ‘Mega Hub’ Port, Transshipment Hub

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1. Introduction

1.1. Background and Problem Identification

In the ever-evolving global commerce landscape, ports serve as vital conduits for exchanging goods, acting as catalysts for economic growth. At the center of this dynamic environment stands the Colombo Port, poised for a transformative journey into a Mega Hub - a strategic vision aiming to elevate its prominence in themaritime domain. The maritime industry, characterized by shifting trade patterns and technological advancements, demands a nuanced understanding of factors influencing port development. Colombo, strategically positioned at the crossroads of major shipping routes, has emerged as a focal point for significant investments in port infrastructure.

The Colombo Port Mega Hub Vision is rooted in the strategic response of the Government of Sri Lanka (GOSL) to the escalating demands of the international shipping industry in the late 1990s (MoFP, 2010). This visionary move was driven by the surge in global containerized cargo volumes and the commendable annual throughputs of the Port of Colombo during that period. The subsequent comprehensive study led to the inception of the Colombo Port Expansion Project (CPEP) in 2008, situated west of the existing port, covering approximately 600 hectares, (Lakmali, 2015). The Mega Hub Vision not only aspires to meet the demands of contemporary global trade but also envisions positioning Colombo as a premier maritime hub in the Indian Ocean region (Smith et al., 2021; Jones et al., 2020).

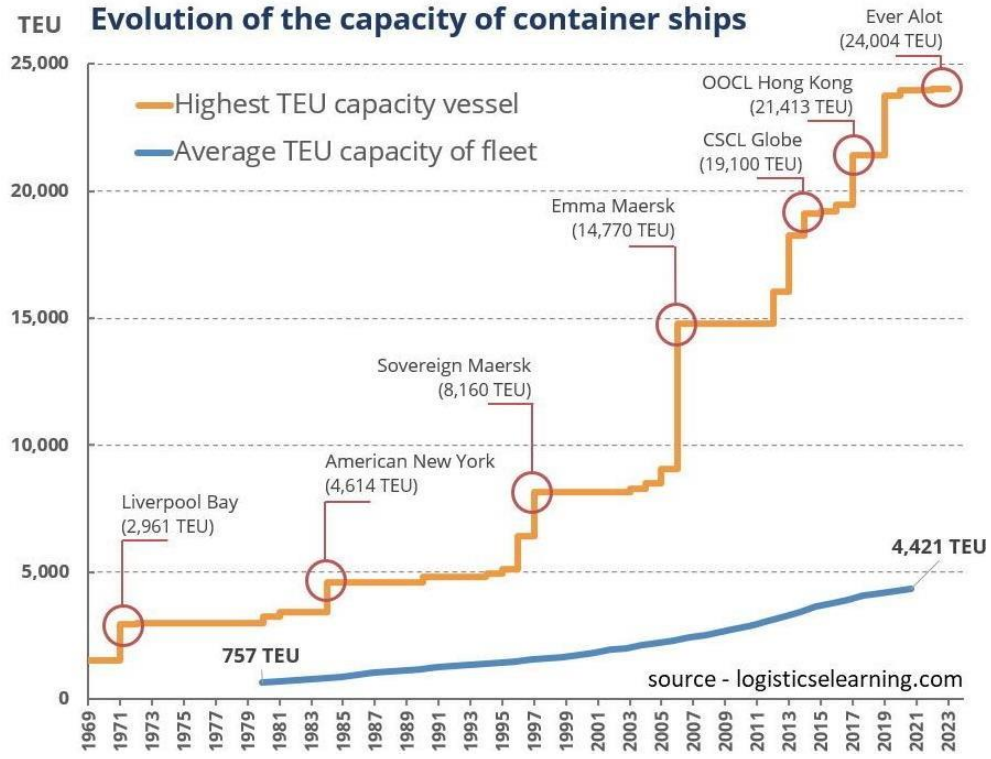
Envisioned under the CPEP were three container terminals, South, East, and West, each with a length of 1,200 meters, and facilities for three alongside berths. The expansion aimed to elevate the Port of Colombo's annual throughput capacity from 4.5 million twenty-foot equivalent units (TEUs) to an anticipated 11.7 million TEUs across three phases (CPEP Report, 2008). Financed primarily through a US$300 million loan from the Asian Development Bank (ADB), supplemented by GOSL funding, the CPEP involved extensive dredging of the approaching channel, inner harbor basin, and the construction of a breakwater to accommodate the phased development of three new container terminals (ADB, 2008).

The foresight behind the expansion was underscored by the evolving landscape of container shipping, marked by the emergence of mega-size container carriers with capacities exceeding 20,000 TEUs. This strategic positioning aligns with the national policy framework outlined in 2010 by the Ministry of Finance and Planning (MoFP, 2010). With a focus on transforming Sri Lanka into a strategically significant economic center by 2020, the policy emphasized the Port of Colombo's role as a Modern Technological Transshipment Hub in Asia, projecting a substantial increase

in net assets and envisioning private sector participation in port-related industrial activities as a dominant feature.

In the maritime landscape dominated by the Port of Colombo, which serves as the nucleus of Sri Lanka's ports and logistics activities, the imperative question arises regarding its potential to transform into a Mega Hub. The current combined annual capacity of 7.5 million TEUs across three container terminals, with an anticipated increase to 10 million TEUs upon completion of the new East Terminal as per the Colombo Port Expansion Project (CPEP) projections, underscores the port's strategic significance (CPEP Report, 2008). The escalating demand in global shipping, marked by repeated orders for ultra-large container carriers by Main Line Operators (MLOs) (Figure 1), necessitates a critical examination of the Colombo Port's adaptability to contemporary trade patterns and capacity to evolve into aMega Hub.

Figure 01: Evolution of the capacity of container ships



Source: www.logisticselearning.com, (2023)

The advent of mega-size container carriers, exemplified by vessels exceeding 24,000 TEUs, introduces significant economies of scale, enhancing cost- effectiveness, fuel efficiency, speed, and environmental sustainability from the perspective of shipping

lines (Merk & Busquet, 2015). However, the rapid proliferation of these mega carriers exerts substantial pressure on existing container terminals, demanding infrastructure adjustments that many ports had not anticipated. Quay walls must be heightened, strengthened, and lengthened to accommodate these colossal ships and harbor basins often require expansion, while channels need deepening to facilitate safe navigation (Merk & Busquet, 2015).

This juncture of increased shipping volumes and the emergence of mega-size container carriers poses a twofold challenge for the Colombo Port: first, to assess its latent potential to accommodate and thrive in this evolving maritime environment, and second, to identify the obstacles and constraints that may impede its journey towards realizing the Mega Hub Vision (Kawasaki et al., 2022). With their substantial demands and challenges, the modern-day mega carriers underscore the urgency for comprehensive research on the infrastructure and superstructure requirements of seaports and container terminals, examining the Colombo Port's trajectory as a timely and crucial endeavor in the global maritime discourse (MOFP, 2010).

In the dynamic realm of global commerce and evolving maritime industry landscapes, the Colombo Port faces a fundamental query: 'Does the Colombo Port still possess the untapped potential and opportunities to realize its envisioned status as a Mega Hub? Moreover, what formidable obstacles act as constraints to this transformative journey?' Therefore, the primary inquiry of the current study centersaround assessing whether the Colombo Port retains the potential to transform into a mega-hub port while concurrently examining the obstacles that may impede this journey.

1.2. Research Questions and Objectives

1. What latent opportunities could contribute to realizing the Mega Hub Vision for the Colombo Port and enhancing its strategic positioning for the future?
2. What challenges/obstacles hinder this transformation process?

In addressing the above-identified research questions, this paper carries the following objectives.

- To uncover opportunities for the advancements of port technology and its strategic positioning, considering its geographical positioning, existing infrastructure, and adaptability to contemporary industry changes.
- To identify obstacles hindering the expected transformation, considering the aspects of operational and infrastructural challenges.

1.3. Significance of the Study

The significance of the current study lies in its potential contributions to both local and international stakeholders involved in the movement of global goods and freight transportation systems. Corbett and Winebrake (2008) emphasize the critical role of such movements in various transportation modes. The research provides valuable information for stakeholders to comprehend the importance of national policies in developing infrastructure, establishing multi-modal transportation connections, improving business processes, and enhancing efficiency and productivity. Mainly, in the aspect of local policymakers, this study serves as a guide for understanding the Port of Colombo's potential as a Mega Hub. By exploring the implications of development initiatives, the research aids in attracting transshipment container volumes that are not currently routed through the port. It also highlights the strategic geographic position of the island, presenting an opportunity to position the Port of Colombo as a crucial economic center for Sri Lanka. Moreover, considering its academic contribution, the study contributes to the existing body of knowledge, providing a foundation for future maritime and port development scholars. By addressing the evolving dynamics of container trade and mega hub concepts, the research adds to the expanding literature on global port development.

2. Literature Review

The literature review provides a comprehensive overview of the key themes related to the research on the Colombo Port Mega Hub Vision. A thorough examination of economic, environmental, and geopolitical dimensions is imperative to comprehend the multifaceted nature of port development (Jones & Wang, 2020; Brown et al., 2019). The review focuses on the keywords identified as central to the study: The concept of Mega Hub, Port Development, Port Infrastructure, Trade Routes, and Opportunities and Challenges associated with the overall mega hub transition process.

2.1. The Concept of ‘Mega Hub’

The concept of a Mega Hub in the maritime industry denotes a strategic vision for ports to elevate their prominence and play a pivotal role in global trade-Mega Hubs, characterized by significant throughput capacities, act as crucial nodes connecting various trade routes. The development of ports into Mega Hubs involves substantial infrastructure enhancements, aligning with the changing dynamics of container shipping and the emergence of mega-size container carriers (Smith et al., 2021). The literature underscores the importance of proactive measures by ports to adapt to evolving trade patterns and shipping industry fundamentals.

Research by GOSL (1990s) highlights the government's strategic response to the surge in global containerized cargo volumes, leading to the Colombo Port Expansion Project (CPEP) initiation in 2008. The expansion aimed to position the Port of Colombo as a Modern Technological Transshipment Hub, responding to the national policy framework outlined in 2010 (MoFP, 2010). Mega Hub development involves addressing current demands and anticipating and preparing for future changes in container shipping dynamics.

The Colombo Port Expansion Project provides dredging and breakwater construction sufficient to accommodate three terminals, which will be constructed sequentially. The project includes establishing a new marine operations center, relocation of a submarine oil pipeline, provision of navigational aids, and construction of shore utilities. The Project will be developed on a public-private partnership basis. The harbor infrastructure works, i.e., dredging, breakwater construction, and other works, will be implemented by the Sri Lanka Ports Authority (SLPA). The first two terminals were operationalized in 2010 and 2015, respectively, and were constructed by operators selected through open competitive bidding under a build-operate-transfer concession agreement. The initial concession bid was for one terminal.

2.2. The Port Development

The port of Colombo is strategically located on the East-West main sea route as a central transshipment hub in South Asia (Kawasaki et al., 2022). However, in recent years, Colombo Port lost its market share in the regional transshipment market because its fundamentals changed and did not adapt (ADB, 2013). Colombo Port cannot offer the additional operating capacity required to compete with the Indian subcontinent transshipment market or the depth required to berth the latest generation container ships. To remain as a transshipment hub port, Colombo Port must develop additional container berths with the required depth to address these capacity and depth infrastructure constraints.

2.3. Port Infrastructure

According to Notteboom et al. (2022) good infrastructure and high accessibility or connectivity are increasingly becoming basic competitive requirements (Notteboom et al., 2022). Port infrastructure has long been recognized as a critical determinant of a nation's competitiveness in international trade (Notteboom & Rodrigue, 2005). Efficient port facilities, including terminals, berths, and intermodal connections, are vital for reducing cargo handling times and transportation costs (Brooks & Pallis, 2014). Ports with robust infrastructure are better positioned to attract shipping lines, leading to increased trade volumes (Tongzon & Heng, 2005).

2.4. Trade Routes and Patterns

Moreover, the literature stresses the significance of understanding trade routes and patterns in the context of port development. Colombo's emergence as a hub port is attributed to its access to the Indian Ocean and its ability to link feeder connections, reflecting the importance of trade route dynamics in port development (Corbett & Winebrake, 2008).

3. Methodology

This study employs a qualitative research design, utilizing a document review method to delve into the opportunities and challenges intertwined with the Colombo Port Mega Hub Transformation. Hence, the primary data source for this research consists of scholarly literature about port development, Mega Hub concepts, and maritime infrastructure. The document review entails meticulously examining key sources, including peer-reviewed articles, government reports, policy documents, and industry publications. The inclusion criteria for document selection emphasized relevance to the Mega Hub concept, port development, maritime infrastructure, and associated challenges and opportunities. Additionally, official reports such as the Colombo Port Expansion Project (CPEP) Report (2008) government responses to international shipping demands, and the national policy framework for port development (MoFP, 2010) contribute crucial insights. Rigor and validity are ensured through systematic document selection and analysis. The inclusion criteria enhance the reliability of the study by focusing on reputable and relevant sources. Priority is given to scholarly articles with empirical evidence, reports from reputable organizations, and official government publications. Only documents published in the last two decades were considered to maintain the timeliness of information.

Qualitative analysis through the document review method is conducted descriptively. The document review method is well-suited for this study, given its reliance on secondary data sources such as published documents. This approach is justified by its ability to provide a comprehensive and nuanced exploration ofexisting knowledge on the subject matter (Hart, 1998). Given the reliance on a document review method, ethical considerations are primarily evaluated through proper citations and referencing. Hence, this study adheres to the ethical standardsof academic integrity, providing due credit to selected document authors.

4. Analysis and Discussion

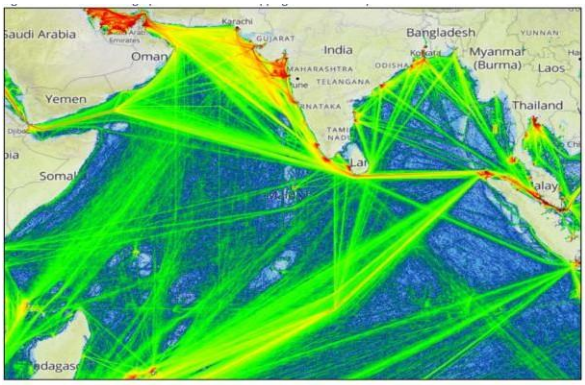
4.1. Opportunities and Potentials of the Port of Colombo

4.1.1. The Strategic Geographical Positioning

The Colombo Port's strategic geographical location, highlighted by Smith et al. (2021) positions it as a critical element in its potential evolution into a Mega Hub. As explained by the author, this positioning, at the intersection of major shipping routes, establishes the port as a vital link connecting feeder connections in Indian sub-continent trade with the main sea routes, as illustrated in Figure 2. As ADB (2007) and Finnigan (2019) noted, the port's natural advantages include a well- protected deepwater harbor and proximity to the crucial east–west trunk routes connecting the Asia-Pacific, Europe, and the United States East Coast regions. Colombo Port is the closest transshipment port to vast and rapidly expanding markets. ADB further points out that, for Europe-bound cargo in the east and south segments of the ISC, utilizing Colombo Port as a hub offers advantages overSoutheast Asian ports due to the shorter distance.

This point in literature can be justified by comparing the alternative ports in Sri Lanka, including Hambantota and Trincomalee, and proximate international ports like Chennai, Karachi, and Male. The port of Colombo has been the most critical in creating container traffic flow in the region (Park, 2020). Despite the unique advantages of Hambantota's deep-sea capabilities and Trincomalee's natural harbor, Colombo maintains preeminence due to its robust logistics, infrastructure, and the pivotal role it plays as a central transshipment hub. These combined attributes underscore the strategic significance of the Colombo Port in facilitating global maritime trade compared to the other ports in Sri Lanka (Samaranayake & Smith, 2019).

Figure 02: Colombo Port's strategic positioning



Source: National Port Directions, (2019)

4.1.2. The Expected Economic Benefits

Ensuring the continued transshipment port status of the Colombo Port is not only projected to contribute additional foreign exchange to the country, as highlighted by ADB (2016), but it is also expected to stimulate the growth of ancillary industries such as ship chandlery and bunkering due to a larger influx of ships. This, in turn, will spur economic activities and create employment opportunities that would not have otherwise existed. The maintenance of Colombo Port's transshipment hub status is positioned to transform Sri Lanka into a distribution and logistics hub for the South Asian region, fostering additional economic activities and employment prospects, as noted by the ADB (2007). They further explained that their strategy also involves promoting public-private partnerships (PPPs) in the ports sector, aligning with implementing the landlord port model to enhance efficiency. In 2017, India owned 53% of the regional market in container throughput, followed by Sri Lanka, 24%, and Pakistan and Bangladesh held 12% and 10%, respectively (Finnigan, 2019).

According to ADB (2016), the expansion project is anticipated to boost economic growth by improving national competitiveness in international trade through reduced costs and faster delivery times. They elaborate that the export container traffic handled by the Colombo Port is expected to experience an annual increase of 9.5% from 2011 onwards. The expanded capacity will not only allow the Colombo Port to elevate its market share in ISC transshipment but is also projected to lead to an 8% annual growth in transshipment volumes from 2011. This, in turn, is poisedto generate additional income for Sri Lanka through transshipment. If the project progresses smoothly, ADB anticipates that direct payments from transshipment traffic alone could augment the contribution of the ports sector to GDP by an additional 0.1% by 2015 and attract foreign direct investment of approximately. $800 million to the ports sector by 2024.

4.1.3. The Expected Social Benefits

As highlighted by ADB (2007), anticipated significant positive social impacts of the project, center around the creation of direct and indirect employment opportunities during project construction and operation phases. Asian Development Bank reports 1,950 jobs during construction, with specific allocations for tasks such as constructing the breakwater and staging each of the three terminals. Moving into the operation phase, completing the breakwater, and commissioning the three terminals is estimated to generate 3,870 permanent jobs. Proximity to the project is identified as a critical factor influencing the beneficiaries, particularly those residing near quarry sites, land-based transport routes, and barge load-out points. ADB emphasizes that income impacts from quarrying activities are expected to benefit contractors, service

providers (such as transport), and workers, often drawn from unskilled and economically disadvantaged sectors. The projected estimates for quarrying activities indicate varying employment opportunities, ranging from 4,000 to 12,000 per year, depending on the production method employed. ADB also underscores additional social benefits from increased vessel traffic and initiatives beyond the immediate project scope, such as developing a free trade zone. As per ADB's assessments and records, the overall impact suggests that the project will generate numerous social benefits, particularly in new employment opportunities across a spectrum of job categories, encompassing both skilled and unskilled labor and benefiting low-income earners.

4.2. Challenges Faced by the Colombo Port in its Transformation Process

4.2.1. Environmental Challenges

The environmental ramifications of port development, especially within the ambit of Mega Hub aspirations, stand out as a pivotal consideration, as highlighted by ADB (2007). Kumara (2022) underscores that port operations intricately link to various emission-producing sources, encompassing port administration vehicles,power plants supplying electricity to tenant buildings, electrified and fuel-powered cargo-handling machinery, ships, harbor crafts, trucks, and rail locomotives. ADB (2007) notes that while mega-size container carriers bring significant economies of scale, they simultaneously introduce environmental challenges. Merk and Busquet's study (2015) delves into potential environmental barriers rising from the adjustments required in port infrastructure, such as heightened quay walls andexpanded harbor basins, necessitated by mega carriers. This, in turn, underscoresthe need for ports, as emphasized in the literature, to strike a balance between the economic benefits of Mega Hub development and environmentally conscious practices. ADB (2007) stresses explicitly the importance of Colombo Port harmonizing economic benefits with sustainable practices. Additionally, ADB (2007) underscores the project's adherence to various regulatory frameworks, including ADB’s Environmental Assessment Guidelines (2003), Sri Lanka's National Environmental Act No. 47 (1980), the Coast Conservation Department's (CCD) jurisdiction, and compliance with Sri Lanka’s Coast Conservation Act 57 (1981). Negotiating the Environmental Impact Assessment (EIA) of the overall project through these regulatory frameworks poses a considerable and challenging task, as highlighted by ADB (2007). Among all these, adhering to sustainability principles has been a challenge.

4.2.2. Policy-level Issues are Derived from Political Instability in theCountry

MoFP's (2010) evaluation delves into the synchronization between Colombo Port's Mega Hub Vision and the national policy framework delineated in 2010. This scrutiny aims to determine if the policy objectives and strategies articulated in 2010 foster an environment conducive to realizing the Mega Hub Vision, considering contemporary economic and geopolitical realities. Notably, the political landscape witnessed a series of upheavals after the project's initiation. Although instigated under the 'Mahinda Chinthana' policy framework in 2005, subsequent changes in government in 2015 and 2019 led to the introduction of different national policy frameworks. Consequently, the original policy framework faced challenges aligning seamlessly with the evolving national policies of newly appointed governments. This discrepancy stands out as a notable challenge encountered by the ColomboPort Mega Hub conversion project, reflecting challenges shared by various ongoing development projects in the country.

4.2.3. The Inadequate Infrastructure and Operational Capacity

As highlighted by ADB (2007) Colombo Port, with its current depth of 15 meters, faces limitations in accommodating the latest generation of containerships, such as the 9,000 TEU vessels, a capacity handled by its competitors in Dubai, Singapore, Salalah, and Tanjung Pelepas. ADB underscores the prevailing trend in shipping economics favoring larger container vessels, with major shipping lines already introducing 11,000 TEU vessels for the Asia-Europe route. As many experts envisioned at that time, the following generation of mega-size container carriers with carrying capacity above 20,000+ TEUs have now become a reality and are already on the waters in the present day. Each subsequent generation of container ships that evolved has challenged and limited the number of ports of call. Maersk Line South Asia has further raised the issue of insufficient operational capacity in the Colombo port to handle considerable cargo and transshipment volumes by 2019,as cited in Finnigan (2019). Consequently, the existing infrastructure andoperational capacity emerge as significant challenges for Colombo Port in its journey towards becoming a mega hub port. As indicated by empirical evidence from the CPEP Report (2008), a necessary step is the immediate upgrading of infrastructure to handle these larger vessels. This strategic move is deemed essential not only to adapt to the evolving landscape of larger vessels but also to embrace technological advancements and maintain competitiveness among globaltransshipment hub ports.

4.2.4. Increased Competition

The competitive landscape for Colombo Port has intensified, as pointed out by ADB (2007). The utilization of larger containerships necessitates Colombo Port to vie for the ISC (Indian Sub-Continent) transshipment market with well-established ports like Singapore alongside emerging contenders such as Dubai, Port Klang, Salalah, and Tanjung Pelepas. ADB highlights that these ports, wholly or partially owned by established port operators and shipping lines, can offer superior productivity and expedited ship turnaround times, providing an inherent advantage. As Finnigan (2019) noted, the Sri Lankan port infrastructure and maritime trade face competition from regional ports such as Dubai, Singapore, and the recently developed Sagarmala Port in India. The expanding Indian port capacities under Sagarmala will make Sri Lanka no longer a significant partner in the transshipment of goods, as per the author. Consequently, Colombo Port's once efficient and strategically located position in the ISC transshipment market has seen erosion due to the entry of new players in Southeast Asia and the Gulf region. These entrants leverage modern institutional structures and advanced equipment, reducing ship waiting and turnaround times, as outlined in ADB's observations (2007).

4.2.5. Lack of Strategic Investments to Address Emerging IndustryTrends

As noted by Notteboom (2022) ports should do their investments strategically. The absence of straightforward strategic investments prevents the port from developing dynamic strategies for the changing environmental contexts. As per the author, port investments should be directed strategically to reallocate existing port resources, reorganize the port management, create new and existing physical (e.g. terminal) or non-physical (e.g. education) assets, implement efficiency-oriented measures, and improve the sustainability of the port and the supply chains.

However, some literature highlights that Colombo port lacks strategic investments (Finnigan, 2019). Notably, the evolving landscape of ship design specialization and the increasing size of vessels are integral to the mega hub development project. Colombo Port's delayed response and limited proactive adjustment to these dynamics have, in turn, hindered its capacity to capture potential market share. Scholars in the field identify this limited sensitivity to emerging industry trends as a pressing challenge that requires attention from the port of Colombo. Both Smith et al. (2021) and the CPEP Report (2008) underline the imperative for Colombo Portto confront these challenges, emphasizing enhanced adaptability to contemporary trade patterns, especially considering the emergence of mega-size container carriers.

5. Conclusion

The Colombo Port's aspiration to become a Mega Hub presents a promising yet challenging path. Its strategic location and historical significance offer a foundation for growth. Additionally, enhanced maritime trade capabilities, potential economic growth through increased shipping activities, job creation, infrastructure development, and strengthened regional connectivity can be identified as favorable opportunities. However, the delayed adaptation to evolving trade dynamics and other challenges have hindered its potential. These hurdles encompass logistical complexities, environmental considerations, financial and investment obstacles, regulatory complexities, and the need for effective stakeholder management. Successfully navigating these challenges while capitalizing on emerging trends is imperative for the port's smooth transformation as a mega hub port.

6. Recommendations

Hence, this research is conducted based on secondary data; this paper does not provide specific and ground-level recommendations regarding the Mega hub transformation journey of Colombo Port, which requires thorough policy-level investigation and a deep understanding of the overall process. However, based on the limited literature, this article can provide general recommendations for successfully expanding and altering any port development project. Those include '*strategic investments*' in infrastructure enhancement and operational efficiency of existing port, '*technological advancements'* by embracing collaborations and partnerships to adopt cutting-edge technologies that will bolster the port's competitiveness, '*proper alignment with the national policy'* to ensure the sustainedprogress even admits the dynamic economic and political contexts and '*focus on sustainability'* as a key priority area of port's development to balance both economic growth with environmental good health.

7. Limitations and Further Research

7.1. Limitations

This study is primarily associated with the inherent limitations of the document review method since it excludes recent developments not yet documented in scholarly sources. Another limitation is the inherent biases or limitations within the existing literature that might influence the analysis of the current study. Though there are many other essential aspects in this mega-hub transformation process, the limited scope of the current paper cannot cover every aspect, and this focuses only on possible opportunities and challenges faced by the port of Colombo. Despite

these limitations, based on the available literature, the study aims to provide a comprehensive understanding of the opportunities and challenges the Port of Colombo faces in its expansion life.

7.2. Further Research Areas

Future studies could delve deeper into specific aspects, such as the environmental impact of Mega Hub development, geopolitical influences on port operations, or a comparative analysis of other successful Mega Hub ports. Primary research involving stakeholders' perspectives could provide richer insights into challenges and opportunities.

References

Asian Development Bank (ADB). (2007). Colombo Port Expansion Project Report. Retrieved from https://www.adb.org/sites/default/files/project-documents/39431-01-sri-emr-03.pdf.

Asian Development Bank. (2013). Sri Lanka: Colombo Port Expansion Project (formerly Colombo Port South Harbor Development) Sovereign Project | 39431-013 Retrieved from https://www.adb.org/projects/39431-013/main

Asian Development Bank. (2016). Democratic Socialist Republic of Sri Lanka: National Port Master Plan. Asian Development Bank. Retrieved from https://www.adb.org/sites/default/files/project-documents/50184/50184-001-tacr-en.pdf.

Brooks, M. R., & Pallis, A. A. (2016). The nature of port infrastructure governance. Research in Transportation Business & Management, pp. 20, 26–33.

Brown, et al. (2019). Challenges and Opportunities in Port Development: A Global Perspective. Transport Reviews, 39(6), 765-787.

Corbett, J. J., & Winebrake, J. J. (2008). Global Goods Movement and the Environment: The Role of Maritime Shipping. *Environmental Science & Technology*, 42(12), 4232-4238.

CPEP Report. (2008). Colombo Port Expansion Project Report. Government of Sri Lanka.

Finnigan, C. (2019). South Asia’s logistical hub: Challenges and opportunities for Sri Lanka’s transshipment future. LSE South Asian Center. Available at https://blogs.lse.ac.uk/southasia/2019/06/21/south-asias-logistics-hub-challenges-and-opportunities-for-sri-lankas-transshipment-future/

Jones, M., & Wang, L. (2020). Port Development in the 21st Century: A Comprehensive Analysis. *Journal of Transportation Geography*, 82, 102603.

Hart, C. (2019, November 28). *Doing a Literature Review*. SAGE Publications Inc. https://us.sagepub.com/en-us/nam/doing-a-literature-review/book257278

Kawasaki, T., Tagawa, H. & Kavirathna, C. A. (2022). Vessel Deployment and De-Hubbing in Maritime Networks: A Case Study on Colombo Port and Its Feeder Market. *Journal of Marine Science and Engineering*, 10(3), p.304. doi: https://doi.org/10.3390/jmse10030304.

Kumara, D. S. (2022). Energy Efficient Smart Port Development, Implementing Renewable Energy in A Port. A case study in the Port of Colombo, Sri Lanka. World Maritime University, Malmö, Sweden. Available at https://commons.wmu.se/cgi/viewcontent.cgi?article=3109&context=all_dissertations

Lakmali, I. (2015, May 10). Colombo Port Expansion Project. Academia.edu. https://www.academia.edu/12317779/Colombo_port_expansion_project

Merk, O., & Busquet, S. (2015). A New Competitiveness Index for Countries: The World Liner Supply 2015. *Maritime Policy & Economics: Sri Lanka*.

Ministry of Finance and Planning. (MoFP) (2010). The development of policy framework. Sri Lanka. Retrieved from https://www.npd.gov.lk/images/files/2023/A_Robust_National_Planning_Framework_for_Sri_Lanka_Main_8Jun.pdf.

National Port Directions Sri Lanka. (2019). https://www.bing.com/images/search?q=national+port+directions+sri+lanka+2019&qpvt=national+port+directions+sri+lanka+2019&form=IQFRML&first=1

Notteboom, T., & Rodrigue, J. P. (2005). Port regionalization: Towards a new phasein port development. *Maritime Policy & Management*, *32*(3),

Notteboom, T., Pallis, A., & Rodrigue, J. P. (2022). *Port Economics, Management and Policy*. Routledge. https://doi.org/10.4324/9780429318184

Park, Y. (2020). Port infrastructure and supply chain integration under the Belt and Road Initiative: Role of Colombo Port in the apparel industry in South Asia. *Transportation Research Procedia*, *48*, https://doi.org/10.1016/j.trpro.2020.08.025

Samaranayake, S., & Smith, S. (2019). The Port of Colombo: Challenges and Opportunities for Regional Hub Development. In Proceedings of the International Association of Maritime Economists Conference, 345-358.

Smith, A., Johnson, B., & Williams, C. (2021). Maritime Industry Trends. *Journal of Maritime Studies*, *15*(2), 45-62.

Sri Lanka Ports Authority (SLPA). (2019). *National Port Directions*. Retrieved from https://www.adb.org/sites/default/files/project-documents/50184/50184-001-tacr-en.pdf

Tongzon, J., & Heng, W. (2005). Port privatization, efficiency, andcompetitiveness: Some empirical evidence from container ports (No. 2005-01). Institute of Transport and Logistics Studies, The University of Sydney.

www.logisticselearning.com, (2023). Evolution of the capacity of container ships. Retrieved from https://logisticselearning.com/ .