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Investigating the Challenges, Implications, and Strategies of Port City Development in the East Coast Region of Peninsular Malaysia: An Exploratory Factor Analysis (EFA) Approach

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ABSTRACT

Seaports play critical roles in both national economic development and international trade since the majority of goods in transit between countries are transported via ocean vessels. The formation and development of seaports have resulted from economic development at the city, regional and global levels. Many cities exist due to their historical function as ports. Owing to the importance of interdependence between seaports and cities, this paper aims to explore the potential challenges of, implications of, and strategies for developing a port city in the East Coast Region (ECR) of Peninsular Malaysia. An empirical study was conducted in Malaysia using 101 online surveys of key stakeholders with experience in developing port cities, including representatives from shipping lines, freight forwarders, seaport operators, shipping lines, land or state authorities, and seaport authorities. The data collected were analysed using exploratory factor analysis (EFA). The EFA results showed that the development of a port city has implications and creates challenges for both the port and the city. This paper further indicates strategies for addressing these challenges and the implications for the future development of the port city in the ECR of Peninsular Malaysia.

1. Introduction.

1.1. Background of Seaport and Port City Development.

Seaport development is a complex process influenced by various factors, including economic conditions and social environment (Jugović et al., 2023). It is crucial to regional and national economic growth, with ports serving as major nodes for trade and maritime activities (Somu et al., 2022). The development of seaports encompasses operational, spatial, institutional, and socioeconomic advancements (Odiegwu & Enyioko, 2022). Seaports play a crucial role in national economic development and international trade (Hu & Zhu, 2009) as the majority of goods transported between countries rely on ocean vessels (Dang & Yeo, 2017). As key nodes in global supply chains, seaports function as industrial and logistics hubs, facilitating the transformation, transportation, and exchange of information within these networks (Notteboom et al., 2022). Their maritime character, combined with the spatial and functional clustering of activities, further strengthens their role in global trade. Competition within the seaport industry has been significantly shaped by the rapid growth of global trade and evolving logistics trends (Arbak, 2014). Song and Panayides (2012) highlighted how the port industry is undergoing substantial transformation, driven by globalisation, shifts in market dynamics, advancements in transportation, logistics integration, and the expansion of the maritime sector. Additionally, the continued growth in container traffic and vessel sizes has placed further

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demands on port operations and infrastructure.

A seaport typically serves as a transit hub, facilitating the movement of people and goods between land and sea. It acts as a gateway, linking oceanic and inland transportation systems while integrating multiple modes of transport (Notteboom et al., 2022). Beyond logistics, seaports are vital economic catalysts for adjacent cities, fostering socioeconomic development through service clusters and market integration (Funke & Yu, 2011; Shan & Lee, 2014). Furthermore, Abdullah et al. (2012) asserted that maritime activities serve as direct drivers of urban growth. They shape both land and maritime environments, impacting cities and rural areas, especially when shipping and maritime headquarters are nearby (Hein, 2016). Effective port development demands collaboration among public and private stakeholders, balancing logistics, transportation efficiency, and environmental considerations. Finally, seaport evolution is intrinsically linked to regional and global economic development (Liu & Ping, 2020). Scholars have extensively examined the growing contribution of port logistics services to hinterland economies (Cong et al., 2020). Figure 1 summarises the role of seaports.

Figure 1: The role of seaports.

Source: Notteboom et al., (2022); Hein (2016); Merk and Dang (2013).

Sakalayen et al., (2017) summarised how seaports initially functioned primarily as passenger gateways and transfer points for goods between ships and the shore. They have since evolved into critical components of global supply chains, significantly contributing to regional development and employment generation. Seaports serve as key network hubs, facilitating social capital development, community engagement, environmental protection, innovation, and industrial clustering. The interconnection between seaports and their surrounding regions is crucial to regional economic development. Regional development decisions are shaped by collaborations between port authorities, regional stakeholders, and government ministries (Zain et al., 2024). In this context, regional development is a broad and multifaceted concept, encompassing initiatives aimed at reducing regional disparities, supporting economic activity, and promoting employment and wealth creation.

1.2. Overview of Port City Development.

Port cities are complex urban environments that integrate maritime activities with land-based economic development (Selvaduray et al., 2022). The relationship between ports and cities has become strained due to environmental concerns, with water pollution being the primary issue for port authorities worldwide (Roberts et al., 2023). Sustainable development of port cities requires careful consideration of economic, social, and environmental criteria (Jugović et al., 2021). Port regions often consist of multiple cities evolving in different directions, creating a mosaic of specialised waterfront areas, maritime hubs, and service centres (Krośnicka et al., 2021). To address these challenges, transition management has been proposed as a mechanism for renewing and monitoring port-city relationships (Jugović et al., 2021). Additionally, implementing renewable energy, electric port equipment, and shore-to-ship power can help mitigate environmental impacts, although financial barriers remain significant obstacles (Roberts et al., 2023). Cooperation between port city stakeholders is crucial for overcoming these challenges and fostering sustainable development.

The sustainability of port activities, in both historical and contemporary settings, has often required collaboration among multiple stakeholders, including corporate and governmental entities at the domestic, municipal, federal, and international levels (Hein & Schubert, 2021). Port cities serve as critical economic hubs with extensive maritime operations, acting as bridges between domestic and international markets, where trade, culture, and environmental systems intersect at the land-sea interface (Xiao & Lam, 2017). Additionally, coastal cities are pivotal in linking major commercial zones, such as Europe and Asia, into a global trade environment where shipping accounts for over 90% of total commerce (Rodrigue et al., 2006).

The role of ports has evolved beyond their traditional function as sea-to-shore transfer points such that they have become integrated logistics hubs (Cheung & Yip, 2011). Ports have transitioned from standalone infrastructure to dynamic assets embedded within urban economies. The mutual interdependence between ports and cities fosters urban expansion, while economic and technological advancements within cities simultaneously drive port innovation and growth. The shift from port-to-port cargo movement to door-to-door logistics has reshaped port-city interactions, necessitating the development of integrated transport networks and logistics zones to optimise trade efficiency and urban mobility (López-Bermúdez et al., 2020).

A port city serves as both a commercial epicentre and a key mobility hub, facilitating import/export activities, industrial operations, and tourism (Zheng et al., 2020). Many of these cities originated from ports, with port expansion directly influencing regional development. Historically, scholars such as Hoyle (1989) and Hayuth (1982) were among the first to examine the port-city dynamic, a topic that has remained central to contemporary research (Browne et al., 2017). However, modern urban planning trends have increasingly led to ports being decoupled from city spaces, particularly in rapidly industrialising nations such as Singapore and South Korea where ports have moved away from urban centres due to spatial constraints and logistical requirements (Hoyle, 1997–1998).

Ultimately, a port-city relationship is influenced by multiple factors, including maritime trade, economic institutions, land resources, traffic volumes, tourism, logistics, mobility, demographics, and technological innovation. Chen (2015) highlighted the synergistic interdependence between ports and metropolitan areas, emphasising the necessity for closer collaboration in modern urban development. Cities provide essential services for port operations such as telecommunications, transport infrastructure, water supply, and housing, while ports contribute to economic growth, employment, and technological advancements. To ensure the continued efficiency of maritime trade, cities must allocate space for port expansion, enhance rail and road networks, and invest in smart logistics and digital connectivity.

2. Literature Review.

2.1. Background of Seaports in Malaysia.

Since gaining independence in 1957, Malaysian ports have been pivotal to the nation's economic development. The maritime industry saw significant growth in the 1970s following the government's declaration in the Third Malaysia Plan to establish Malaysia as a maritime nation. Before then, the country was primarily served by two major ports, Penang Port and Port Klang, which were the key hubs for both incoming and outgoing trade. However, during the period of the Second Malaysia Plan (1971-1975), the government planned the development of two additional ports, Johor Port (opened in 1977) and Kuantan Port (operational by 1984). The 1980s also saw the completion of Bintulu Port in East Malaysia (1982) and Kemaman Port in Peninsular Malaysia (1983). The most recent federal port, the Port of Tanjung Pelepas (PTP), was completed in 2000 (Ng & Lee, 2007).

In 1980, the concept of Malaysia as a maritime nation emerged as part of the country's Third Development Plan, establishing the foundation for significant infrastructural development in the maritime sector and the introduction of new shipping lines to support international trade. Since then, the maritime sector has become a dynamic and rapidly developing industry, particularly significant for a nation where 80% of its territory is maritime and its maritime area exceeds its landmass. The government's growing recognition of the need to focus on the maritime sector, especially given the increasing outflow of freight revenue, led to dedicated efforts to develop it (Karuppiah, 1985). Malaysia's territory is divided into three main regions: Peninsular Malaysia and the two states of Sabah and Sarawak on Borneo. Peninsular Malaysia is strategically located between the South China Sea and the Strait of Malacca, two key bodies of water that play crucial roles in global shipping (Tavakoly Sany, 2019). The country is governed by both state and federal authorities, with federal ports being regulated by the Ministry of Transport (MOT) and state ports coming under the jurisdiction of state ministries. Port authorities function as regulators, supervisors, and facilitators of the activities of port operators (Jeevan et al., 2019). Currently, Malaysia has 18 major seaports, with Port Klang, PTP, Penang Port, Johor Port, Kuantan Port, Kemaman Port, and Bintulu Port being the most prominent (Soon & Lam, 2013; Jeevan et al., 2021). These ports are classified into several regions (Anang & Jeevan, 2018):

- Southern Region: Johor Port, PTP, and Malacca Port, with Johor Port and PTP located close to each other.
- Eastern Region: includes Kemaman Port, Kuantan Port, and Tok Bali Port.
- Northern Region: Penang Port and Lumut Port.
- Central Region: Port Klang and Port Dickson.
- East Malaysia: includes Labuan Port in Sabah and Bintulu Port in Sarawak.

Private ports and jetties, such as those in Port Dickson and Lumut, benefit from industries like mining, oil, and gas (Van der Heide, 2020). In conclusion, Malaysia's ports are crucial in meeting national needs, especially as the country progresses during the 21st century (Idris, 1998). Ports are vital to the economic development of coastal cities, supporting international trade and serving as key hubs for transportation networks that connect land and sea. Historically, Malaysia's main ports, such as Port Klang and PTP, have leveraged their strategic locations along the Strait of Malacca to become major players in the global shipping industry. The Malaysian government continues to focus on initiatives aimed at improving port efficiency, enhancing performance, and attracting more shipping lines, particularly at Port Klang and PTP, as outlined in the Ninth Malaysia Plan (2006-2010) (Ng & Lee, 2007).

2.2. Overview of Container Throughput in Malaysia (2014 - 2023).

Ports in Malaysia have significantly contributed to the country's economy, with container throughput seeing substantial expansion in recent years. The total cargo capacity handled by Malaysian ports increased from 152.3 million tons in 1995 to 254.5 million tons in 2000, while container throughput has experienced a dramatic 400% growth since 2000, accounting for a quarter of all containers handled in the region (Malaysia) (Ahmad, 2023). This growth underscores the expanding role of Malaysia's maritime sector, which has also provided substantial economic opportunities for coastal communities (Menhat et al., 2021).

Table 1 presents the container port throughput in Malaysia (in twenty-foot equivalent units, TEUs) from 2014 to 2023, highlighting a general upward trajectory with some fluctuations. From 2014, when throughput was 22,373,309 TEUs, to 2023, when it reached 28,243,627 TEUs, the growth rate was approximately 26.2%, representing an increase of 5,870,318 TEUs.

Table 1: Container port throughput in Malaysia from 2014-2023.

Year	Container Throughput (TEUs)
2014	22,373,309
2015	23,876,312
2016	24,847,833
2017	23,783,893
2018	24,941,402
2019	26,419,903
2020	26,677,778
2021	28,418,874
2022	27,318,733
2023	28,243,627

Source: MOT - Malaysia Transportation Statistics (2023).

2.2.1. 2014-2016 Growth.

Container throughput in Malaysia grew consistently from 22,373,309 TEUs in 2014 to 24,847,833 TEUs in 2016. This period saw an annual average growth rate of 5.4%, driven by favourable global trade conditions and Malaysia's growing role as a regional logistics hub.

2.2.2. 2017 Dip.

In 2017, throughput decreased to 23,783,893 TEUs, a 4.3% reduction compared to 2016. This decline can be attributed to various global trade challenges, including shifts in trade patterns and increased competition from other regional ports.

2.2.3. 2018-2019 Recovery.

Throughput rebounded in 2018 and 2019, reaching 24,941, 402 TEUs and 26,419,903 TEUs, respectively. This growth reflected Malaysia's continued investment in port efficiency, infrastructure, and strategic initiatives to handle higher trade volumes.

2.2.4. 2020 Resilience Amid Pandemic.

Despite the disruption of the COVID-19 pandemic, Malaysia's throughput grew slightly to 26,677,778 TEUs in 2020. This showcased the resilience of Malaysia's ports in supporting global trade even amid global economic challenges.

2.2.5. 2021 Peak.

In 2021, throughput peaked at 28,418,874 TEUs, the highest in the decade covered in the data, marking a 6.5% growth from 2020. This surge aligned with the global trade recovery and increased shipping demand.

2.2.6. 2022 Decline.

In 2022, throughput fell to 27,318,733 TEUs, reflecting a 3.9% decline compared to 2021. This dip can be attributed to global supply chain challenges and falling growth in global trade.

2.2.7. 2023 Slight Recovery.

In 2023, throughput rose slightly to 28,243,627 TEUs, reflecting Malaysia's continued efforts to enhance its port efficiency and maintain its competitiveness in the global maritime industry.

This rise in container throughput reflects Malaysia's strategic positioning as a regional logistics hub. Ports such as Kuantan Port on the east coast handle essential cargoes including iron, bauxite, and chemicals, supporting the growth of various industries. Malaysia's port cities also benefit from the country's proximity to key international shipping routes, which link these cities to Southeast Asia and the Indochina region, thus enhancing trade and fostering economic connectivity. These developments have bolstered the economic prospects of Malaysia's port cities, helping them maintain their competitive edge in global trade (MIDA, 2021).

In conclusion, the relationship between port cities and economic growth has been evident in Malaysia's development over the past decade. The expansion of container throughput highlights the importance of strategic port development in driving national economic success. As Malaysia's ports continue to grow, their impact on the surrounding cities and industries remains significant, demonstrating that ports are vital engines of economic development. Continued investment in port infrastructure and innovation will be essential for sustaining economic growth in Malaysia's port cities and strengthening the country's position in global trade.

2.3. Current Challenges, Implications, and Strategies for Sustainable Port City Development.

Port city development faces numerous challenges, including environmental concerns, economic pressures, and the need for sustainable growth. Water pollution is a primary issue for port authorities worldwide, along with air, noise, and waste pollution (Roberts et al., 2023). Balancing port activities with urban development and tourism is crucial, as exemplified by Malaga's efforts to maintain port operations while accommodating additional cruise tourism (Zarei et al., 2024). To address these challenges, port cities must focus on sustainable practices, such as renewable energy adoption and electric port equipment, although financial barriers often hinder their implementation (Roberts et al., 2023). Measuring port city development is complex, with the related factors including port characteristics, maritime stakeholder awareness, and government involvement (Selvaduray et al., 2022). A bibliometric approach was used to identify challenges and propose frameworks for sustainable port city development, particularly in relation to cruise tourism (Selvaduray et al., 2023). Collaboration between port and city authorities is essential for overcoming obstacles and achieving balanced, sustainable port-city relationships.

Moreover, port city development involves complex interactions between economic growth and environmental sustainability. Studies have highlighted the need to measure port city criteria (Selvaduray et al., 2022) and address environmental challenges (Roberts et al., 2023). Research on Chinese ports revealed varying levels of sustainable development, emphasising the importance of balancing economic strength with ecological services (Qu et al., 2023). Port-city relationships evolve in stages, influenced by multi-scale factors at national, provincial, and individual levels (Wu et al., 2022). To achieve high-quality port city development, recommended strategies include improving industry proportions, managing population density, and enhancing innovation. Overall, successful port city development requires coordinated efforts to balance economic growth, environmental protection, and stakeholder interests.

Recent research has highlighted strategies for sustainable port city development, emphasising the need to balance economic growth against environmental, social, and cultural sustainability. Andrade et al. (2021) proposed five strategies for sustainable coexistence between cruise tourism and port cities, addressing the challenges of touristification. De Martino (2021) advocated a relational perspective in sustainable port development, emphasising stakeholder collaboration and value creation. Jugović et al. (2021) suggested using transition management to renew port-city relationships, considering economic, social, and environmental criteria. Beškovnik and Bajec (2021) presented 19 strategies for smart city-port ecosystem development, leveraging the Internet of Things for synchronised growth. These studies collectively emphasise the importance of holistic planning, stakeholder engagement, and technological innovation in achieving sustainable port city development. They also highlight the need for adaptive strategies to address the complex and dynamic nature of port-city interfaces, given the patterns of urbanisation and evolving mobility.

Most studies related to the development of port cities in Malaysia have been limited in scope, particularly regarding the challenges of, strategies for, and implications of this development. For instance, Jeevan et al. (2015) focused exclusively on the challenges and development strategies in the context of Malaysia's dry ports. However, their study did not address the challenges faced by port cities with a substantial port infrastructure, industrial zones, and warehouses, and which serve as key centres of economic activity. Similarly, Selvaduray et al. (2023) reviewed the existing literature on port cities and identified challenges related to attracting cruise visitors. However, this study did not empirically discuss the factors influencing port city development in the context of the East Coast Region (ECR) of Peninsular Malaysia. Therefore, the current study aims to form the second phase of research on port cities in the ECR of Peninsular Malaysia, focusing on quantitative analysis (through surveys) to empirically confirm the challenges of, strategies for, and implications of port city development in this region. Also discussed are various strategies proposed by the interviewees for addressing the challenges encountered in developing a seaport city.

3. Methodology.

3.1. Exploratory Factor Analysis (EFA).

Exploratory factor analysis (EFA) is a statistical technique used to identify and examine the underlying factors that influence or do not influence a variable in a study (Masduki & Zakaria, 2022). This method is essential for reducing a large number of variables into a more manageable set of factors, thereby simplifying complex data (Singh & Kumar, 2014; Rahlin et al., 2019). The key advantage of factor analysis is its ability to extract maximum common variance from all the variables and consolidate them into a common score (De Silva et al., 2019). EFA is particularly useful when there is no clear expectation about the number or nature of the variables because its exploratory nature allows researchers to explore the main dimensions underlying a large set of latent constructs, often represented by a series of items (Williams et al., 2010). This characteristic of EFA makes it a widely used technique in various fields, including economics, social science, marketing, sociology, and education (Singh & Kumar, 2014; Costello & Osborne, 2005). Alongside this broad application, EFA has been utilised in several studies of the maritime sector, such as those by Pantouvakis (2006), Jeevan et al. (2018), Somu et al. (2022), and Bandara et al. (2016).

In this study, EFA was conducted using the principal component analysis (PCA) method with varimax rotation, facilitated by IBM SPSS 30 software. The objective was to identify the key elements influencing port city development. Following a similar approach to that used by other researchers (Bandara et al., 2016; Somu et al., 2022), the analysis involved conducting EFA, after which the items were regrouped based on the factors identified through the analysis. The flexibility of EFA when exploring latent constructs and identifying underlying relationships makes it an invaluable tool for uncovering the complex dimensions that contribute to various phenomena, including the development of port cities.

The purpose of conducting exploratory factor analysis (EFA) is to describe and summarise data by identifying and grouping together correlated variables (Zikmund & Babin, 2010). In this study, EFA was applied to analyse and explore the four categories of port city development in the East Coast Region (ECR) of Peninsular Malaysia, using SPSS version 30 as the software.

In EFA, factor extraction is performed using principal component analysis (PCA) to determine the number of factors to be retained, while varimax rotation is applied to optimise the factor clarity. Varimax rotation is the most widely used orthogonal rotation method as it enhances interpretability by maximising the variance of factor loadings (Hair et al., 2014). According to Hair et al. (2014), factor loadings with absolute values below ±0.5 are discarded, while those exceeding ±0.55 are considered essential for measurement. Additionally, factor loadings below 0.40 are considered weak, whereas loadings of 0.60 or higher are deemed strong. Table 2 shows the measures of the appropriateness of factor analysis.

Several conditions must be met to ensure the appropriateness of conducting factor analysis. First, the Kaiser-Meyer-Olkin (KMO), also called the Measure of Sampling Adequacy (MSA), should exceed 0.50 (Hair et al., 2010). Second, Bartlett's test of sphericity should be statistically significant at $p < 0.001$, indicating that the correlation matrix is suitable for factor analysis (Hair et al., 2014), as shown in Table 2.

Table 2: Measures of Appropriateness of Factor Analysis.

Item	Range
Kaiser-Meyer-Olkin (KMO)	> 0.50
Bartletts's Test of Sphericity	< 0.001 (p-value)
Total Variance Explained	> 60%
Eigenvalues	> 1.0
Factor Loadings	> 0.5

Source: Authors.

3.2. Research Design.

To explore the potential challenges of, implications of, and strategies for the development of port cities, this study employed an online questionnaire survey targeting 200 Malaysian seaport operators and key industry stakeholders. The survey was designed to capture quantitative data concerning perceptions of port city development in the East Coast Region (ECR) of Peninsular Malaysia. Structured around a Likert scale (ranging from 1 – strongly disagree to 5 – strongly agree), the survey focused on three core areas related to port city development: challenges, impacts, and strategies. Open-ended questions were excluded in order to streamline responses and ensure ease of data processing during exploratory factor analysis (EFA). The questionnaire design was informed by an extensive review of the existing literature on port city development, as well as the findings from semi-structured interviews conducted during the first phase of the study (Zain et al., 2024).

Table 3: Measures of Appropriateness of Factor Analysis.

	Sections / Components	No. of Items
A.	Challenges to the development of the port city concept	30
B.	Implications of port city development for the city	15
C.	Implications of port city development for seaport	14
D.	Strategies for port city development	20
	Total	79

Source: Authors.

Using Google Forms, the questionnaire was distributed online to 200 key players in Malaysia who had an extensive knowledge of port city development. They were randomly selected from contact information or links provided on the official websites of regional port associations, freight forwarders, seaport operators, shippers, shipping lines, seaport authorities, state authorities, seaport authorities, and regional planning divisions. Between August 2024 and January 2025, an online survey was conducted of key players involved in top-, middle-, and low-level management.

4. Results and Discussion.

Of the 200 survey questionnaires distributed, 101 responses were received, giving a response rate of 51%. This exceeded the minimum acceptance rate of 33%, which is generally considered acceptable for online surveys (Nulty, 2008). According to Awang (2015), Bahkia et al. (2019), and Rahlin et al. (2019), 100 responses are typically sufficient for conducting exploratory factor analysis (EFA) and obtaining reliable estimates of parameters. Hair et al. (2010) also supported this, noting that a sample size exceeding 100 is ideal for producing significant results.

Regarding sample size, there is no fixed ratio of the number of subjects to the number of variables as this depends on various factors, including the communalities of the variables (i.e., the proportion of variance explained by the common factors), the correlation level among the factors, and the number of variables that define each factor. In general, 100 to 200 subjects are typically sufficient when communalities exceed 0.5, and each factor is defined by at least seven variables (MacCallum et al., 1999; Mundfrom et al., 2005). However, if commonalities are low, larger sample sizes may still yield inaccurate estimations of factor loadings, rendering the results less reliable (Izquierdo et al., 2014). Before conducting EFA, the appropriate sample size must be determined based on various guidelines (Sakaluk & Short, 2017).

4.1. Section A: Challenges to the Development of the Port City Concept.

Using the principal component analysis (PCA) extraction method with varimax rotation, the EFA procedure was conducted on 30 items measuring the Section A construct (challenges to the development of the port city concept in the East Coast region of Peninsular Malaysia). Table 4 shows that the KMO value was 0.773, which exceeds the minimum requirement of 0.5, while Bartlett's test of sphericity was significant at $p = 0.000$ ($p < 0.001$). These results (KMO > 0.5 and the significant Bartlett's test) confirmed that the data were suitable for further analysis using EFA (Hoque et al., 2017).

Table 4: The KMO and Bartlett's Test Score.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.773
Bartlett's Test of Sphericity	Approx. Chi-Squared	2079.530
	df.	435
	Sig.	0.000

Source: Authors.

The results listed in Table 5 indicate that eight components emerged from the EFA procedure, based on the eigenvalues greater than 1.0. The eigenvalues ranged from 1.991 to 4.659. The percentage of variance explained by each component is as follows: Component 1: 15.529%, Component 2: 10.988%, Component 3: 9.821%, Component 4: 8.969%, Component 5: 8.499%, Component 6: 7.481%, Component 7: 6.648%, and Component 8: 6.636%. The total variance explained for Section A is 74.571%, an acceptable value as this exceeds the minimum requirement of 60%.

Table 5: Total Variance Explained.

Total Variance Explained			
	Rotation Sum of Squared Loadings		
Component	Total	% of Variance	Cumulative %
1	4.659	15.529	15.529
2	3.296	10.988	26.516
3	2.946	9.821	36.337
4	2.691	8.969	45.306
5	2.550	8.499	53.806
6	2.244	7.481	61.287
7	1.994	6.648	67.935
8	1.991	6.636	**74.571**

Source: Authors.

Table 6 presents the eight components that emerged from the EFA procedure, along with their respective items. The factor loading for each item indicates its importance in measuring the corresponding construct. The minimum acceptable factor loading is 0.5, so items with factor loadings below this threshold were removed. Consequently, one item (A4) was deleted as it failed to meet the minimum factor loading requirement. Additionally, four items (A7, A18, A22, and A28) were removed due to cross-loading as they exhibited more than one significant loading and needed to be excluded from further analysis (Hair et al., 2014).

Table 6: Outcomes from EFA, Rotated Component Values, Reliability Test for EFA Results (Challenges to the Development of the Port City Concept in the ECR of Peninsular Malaysia.

Outcomes from EFA	Challenges to the Development of Port City Concept in ECR of Peninsular Malaysia)	Values	No. of Items and Cronbach's Alpha
1. Stability	A_{20} Difficult to maintain relationship between port and city	0.871	7(0.875)
	A_{26} No port-centric logistics activities	0.712	
	A_{21} Lack of investment	0.647	
	A_{13} Political instability	0.618	
	A_{19} Environmental problems created by port activities	0.607	
	A_{14} Low-socioeconomic status (e.g., poverty, poor education, high unemployment rate)	0.601	
	A_{17} Lack of new technology adaptation (e.g., artificial intelligence, robotic process automation, autonomous systems)	0.542	
2. Community perceptions	A_6 Negative perceptions of or thinking about port city development among community (e.g., benefits or advantages of port city)	0.809	5(0.784)
	A_5 Lack of knowledge and collaboration between businesses and stakeholders	0.631	
	A_8 Poor return on investment (e.g., dredging, equipment, machinery)	0.552	
	A_{15} Low migration rate to East Coast of Peninsular Malaysia	0.528	
	A_{10} Imbalance in economic development between port and city	0.523	
3. Operational	A_{30} Lack of data and research on port cities in the East Coast region of Peninsular Malaysia	0.854	3(0.766)
	A_{29} Lack of policy support	0.781	
	A_{23} Seaport operational inefficiency	0.557	
4. Population growth	A_{25} Lack of production volume (goods/products)	0.810	3(0.830)
	A_{24} Congestion (e.g., trucks and ship/vessels)	0.727	
	A_{12} Slow population growth	0.548	
5. Scarcity of resources	A_3 Limited number of industrial developments to support seaport	0.812	3(0.702)
	A_2 High investment costs (e.g., land, dredging, production)	0.586	
	A_1 Scarcity of space for development of ports	0.567	
6. Efficiency	A_{16} Port competition (e.g., services, efficiency of port activities, handling costs)	0.744	1(0.737)
7. Capacity	A_9 Insufficient capacity (e.g., number of vessels, truck weight limits, bridge weight limits)	0.849	2(0.706)
	A_{11} Problem of removing sediment deposits, thus reducing the available depth of water	0.583	
8. Connectivity	A_{27} Issues with connectivity and accessibility (e.g., road, rail, gateway)	0.817	1(0.869)

Source: Authors.

The last column of Table 6 includes the Cronbach's alpha coefficient, which measures reliability. As recommended by Pallant (2011), Cronbach's alpha values above 0.6 indicate high reliability, an index considered acceptable by Nunnally and Bernstein (1994). The Cronbach's alpha coefficients for the eight factors concerning the challenges to the development of the port city concept are 0.875, 0.784, 0.766, 0.830, 0.702, 0.737, 0.706, and 0.869, respectively. These values indicate a relatively high level of reliability, suggesting that the identified variables effectively measure the same construct. For example, the first factor, stability, is associated with the difficulty of maintaining a relationship between a port and the city (0.875); a lack of port-centric logistics activities (0.712); lack of investment (0.647); political instability (0.618); environmental problems created by port activities (0.607); low-socioeconomic status (e.g., poverty, poor education, and a high unemployment rate) (0.601); and a lack of new technology adaptation (e.g., artificial intelligence, robotic process automation, and autonomous systems) (0.542). The higher loadings of the variables suggest that the challenges to port city development are influenced by the difficulty of maintaining a relationship between a port and the city, as well as a lack of port-centric logistics activities.

4.2. *Section B: Implications of Port City Development for the City.*

Using the principal component analysis (PCA) extraction method with varimax rotation, the EFA procedure was conducted on 15 items measuring the Section B construct (impact of the port city concept on the city). Table 7 shows that the KMO value was 0.768, exceeding the minimum requirement of 0.5, while the Bartlett's test result was significant at 0.000 (p-value < 0.001). These results (KMO > 0.5 and the significant Bartlett's test) confirmed that the data were suitable for further analysis using the EFA data-reduction procedure (Hoque et al., 2017).

Table 7: The KMO and Bartlett's Test Score.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.768
Bartlett's Test of Sphericity	Approx. Chi-Squared	714.977
	df.	105
	Sig.	0.000

Source: Authors.

The results in Table 8 show that five components emerged from the EFA procedure, based on the computed eigenvalues greater than 1.0. The eigenvalues range from 1.549 to 2.897. The percentages of variance explained by components 1 to 5 are 19.315%, 18.282%, 15.607%, 10.763%, and 10.327%, respectively. The total variance explained for measuring Section B is 74.294%, which is acceptable as it exceeds the minimum requirement of 60%.

Table 8: Total Variance Explained.

Total Variance Explained			
	Rotation Sum of Squared Loadings		
Component	Total	% of Variance	Cumulative %
1	2.897	19.315	19.315
2	2.742	18.282	37.597
3	2.341	15.607	53.204
4	1.614	10.63	63.967
5	1.549	10.327	**74.294**

Source: Authors.

Table 9 presents the five components that emerged, as well as their respective items resulting from the EFA procedure. The factor loading for each item indicates its importance in measuring the construct. The minimum acceptable factor loading value is 0.5, so items with factor loadings below this threshold were removed. Thus, one item (B5) needed to be deleted as it failed to meet the minimum requirement.

Table 9: Outcomes from EFA (Implications of Port City Development for the City).

Factors	Items	Loading Factors	Cronbach's Alpha
1. Enhancing economic growth through port and industry	B_3 Encourage the development of domestic industries	0.813	4(0.784)
	B_2 Promote economic activity	0.787	
	B_1 Excellent port accessibility (e.g., raw materials, finished products)	0.785	
	B_4 Encourage port education (e.g., training and education programmes)	0.749	
2. Sustainable urban development for community empowerment	B_8 Promoting community-level job creation	0.895	3(0.896)
	B_6 Meet the target/ideal population in the city	0.894	
	B_7 Adequate facilities and infrastructure in the city	0.882	
3. Environmental sustainability	B_{10} Road damage (port-connecting road)	0.856	3(0.790)
	B_{12} Competition over land use	0.792	
	B_{14} Pollution (eg., air, water, odour, carbon emissions)	0.708	
4. Managing the dual impact of tourism growth	B_9 Encourage tourism activity	0.882	2(0.595)
	B_{11} Crime and other social problems	0.656	
5. Economic transformation and liveability	B_{15} Job losses (destruction of traditional jobs)	0.854	2(0.425)
	B_{13} High cost of living	0.571	

Source: Authors.

The Cronbach's alpha coefficients for the factors concerning the implications of the development of the port city concept for the city are 0.784, 0.896, 0.790, 0.595, and 0.425, respectively. These values indicate a relatively high level of reliability, suggesting that the identified variables effectively measure the same construct (except factors 4 and 5, which show poor reliability, being less than 0.6). Encouraging tourism activity is crucial, especially in areas like the East Coast of Peninsular Malaysia, where tourism and port activities are significant economic drivers. Therefore, this aspect remains important for the development of port cities. Increased tourism can lead to greater community-level job creation. According to Selvaduray et al. (2023), the development of port cities would generate job opportunities, infrastructural investment, and overall economic growth since these cities would serve as transportation hubs, industrial centres, and trade gateways.

4.3. Section C: Implications of Port City Development for Seaport.

Using the principal component analysis (PCA) extraction method with varimax rotation, the EFA procedure was conducted on 14 items measuring the Section C construct (impact of the port city concept on the seaport). Table 10 shows that the KMO value was 0.827, which exceeds the minimum requirement of 0.5, and Bartlett's test was significant at 0.000 (p-value < 0.001). Based on Table 10, these results (KMO > 0.5 and the significant Bartlett's test) indicate that the data were suitable for further data reduction in the EFA procedure (Hoque et al., 2017).

The results listed in Table 11 show that four components emerged from the EFA procedure, based on the computed eigenvalues greater than 1.0. The eigenvalues ranged between 1.384 and 3.471. The percentages of variance explained by components 1 to 4 are 24.793%, 23.163%, 14.717%, and 9.889%, respectively. The total variance explained for measuring Section

Table 10: The KMO and Bartlett's Test Score.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.827
Bartlett's Test of Sphericity	Approx. Chi-Squared	799.596
	df.	91
	Sig.	0.000

Source: Authors.

C is 72.562%, which is acceptable since this exceeds the minimum requirement of 60%.

Table 11: Total Variance Explained.

Total Variance Explained			
	Rotation Sum of Squared Loadings		
Component	Total	% of Variance	Cumulative %
1	3.471	24.793	24.793
2	3.243	23.163	47.955
3	2.060	14.717	62.673
4	1.384	9.889	**72.562**

Source: Authors.

Table 12 presents the four components that emerged, along with their respective items resulting from the EFA procedure. The factor loading for each item indicates its importance in measuring the construct. The minimum acceptable value for factor loading is 0.5, so items with factor loadings below 0.5 were removed. Thus, one item (C_4) needed to be deleted because it failed to meet the minimum factor loading requirement. Additionally, two items (C_{10} and C_{14}) were deleted due to cross-loading as they had more than one significant loading. They were excluded from further analysis (Hair et al., 2014).

Table 12: Outcomes from EFA (Implications of Port City Development for Seaport).

Factors	Items	Loading Factors	Cronbach's Alpha
1.Evolving Seaport Dynamics	C_{11} Port congestion	0.822	4(0.849)
	C_{12} Competition over land use	0.761	
	C_8 Inspire variations in port business	0.732	
	C_9 Innovation in new technology	0.641	
2.Sustainable growth	C_5 Variations in human resources	0.815	4(0.843)
	C_1 High transport network integration	0.789	
	C_6 Income generation to port	0.760	
	C_3 Flexible commercial activity	0.725	
3.Tourism	C_2 Encourage tourism activity	0.886	2(0.662)
	C_7 Demand increase (port services - e.g., handling, loading, storage)	0.643	
4.Hijacking	C_{13} Hijacking of cargo	0.857	1(0.785)

Source: Authors.

The Cronbach's alpha coefficients for the factors concerning the implications of port city development for seaport operations are 0.849, 0.843, 0.662, and 0.785, respectively. The higher loadings of the variables suggest that the implications of port city development for the seaport can be influenced by encouraging tourism activity. Lousada and Castanho (2022) stated that tourism is considered one of the most important pillars for the social and economic sustainability of many regions and localities. Ports have played important roles throughout the centuries in connecting land and sea. Such connections enhanced global trade, economic growth, and, ultimately, cultural exchanges between different societies from around the globe. More recently, the importance of ports has increased due to their particularly important role in fostering sustainable tourism and coastal development (Lousada & Castanho et al., 2023). According to Jeevan et al. (2019), Kuantan Port and PTP in the East Coast Region are close to wonderful beaches that have continual sunshine. In addition, the existence of several islands, such as Redang and the Perhentian Islands, increases the demand for cruise activities from these seaports. Therefore, seaports and harbours can be used as marketing or promoting tools to boost regional economic development. This strategy would provide tourists, passengers, or vessel crews with access to seaports, especially to enjoy waterfront views. With rapid tourist development, crime-related problems such as hijacking might occur (with a loading factor of 0.857), but every problem must have strategies and solutions.

4.4. Section D: Strategies for Port City Development.

Using the principal component analysis (PCA) extraction method with varimax rotation, the EFA procedure was carried out on 20 items measuring the Section D (strategies for port city development) construct. Table 13 shows that the KMO value was 0.897, which is higher than the minimum requirement of 0.5, and the Bartlett's test result is significant, with a p-value of 0.000 (p-value < 0.001). These two results (KMO > 0.5 and the significant Bartlett's test) indicate that the data were adequate to proceed with the data reduction procedure in EFA (Hoque et al., 2017).

Table 13: The KMO and Bartlett's Test Score.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.897
Bartlett's Test of Sphericity	Approx. Chi-Squared	1867.504
	df.	190
	Sig.	0.000

Source: Authors.

The results listed in Table 14 show that three components emerged from the EFA procedure, based on the computed eigenvalues greater than 1.0. The eigenvalues ranged between 3.317 and 6.107. The percentages of variance explained for components 1 to 3 are 30.537%, 25.489%, and 16.584%, respectively. The total variance explained for measuring Section D is 72.610%, which is acceptable since this exceeds the minimum requirement of 60%.

Table 14: Total Variance Explained.

Total Variance Explained			
	Rotation Sum of Squared Loadings		
Component	Total	% of Variance	Cumulative %
1	6.107	30.537	30.537
2	5.098	25.489	56.025
3	3.317	16584	**72.610**

Source: Authors.

Table 14 presents the three components that emerged, along with their respective items resulting from the EFA procedure. The factor loading for each item indicates the importance of the respective item in measuring its construct. The minimum acceptable value for factor loading is 0.5, so items with a factor loading below 0.5 were removed from the analysis. No items were deleted since they all met the minimum requirement to have a factor loading of at least 0.5. However, four items (D_6, D_7, D_8, and D_9) were deleted due to cross-loading as they had more than one significant loading. They were excluded from further analysis (Hair et al., 2014).

Table 15: Outcomes from EFA (Strategies for Port City Development).

Factors	Items	Loading Factors	Cronbach's Alpha
1.Port and Urban Development Strategy	D_{11} Adapt to new technology	0.834	7(0.933)
	D_{12} Overall development (comprehensive strategy to develop port and city)	0.831	
	D_{10} Development of free industrial zones	0.790	
	D_{18} Implement survey / research on port and city integration/development	0.738	
	D_{19} Promoting transhipment services in East Coast region of Peninsular Malaysia	0.700	
	D_{13} Long-term investment in port city	0.687	
	D_{14} Plan and conduct effective meetings with stakeholders	0.629	
2.Integrated Port City Development	D_4 Development of industrial parks	0.858	5(0.918)
	D_5 Designing and operating dry ports within the port city concept	0.830	
	D_2 Strengthening collaboration among stakeholders and community	0.807	
	D_3 Developing port city planning	0.784	
	D_1 Equal development of community, land, and seaport	0.734	
3.Community Engagement and Sustainable Development	D_{17}Strengthening relationship with stakeholders and community	0.807	4(0.870)
	D_{20} Promoting port education and training programmes for community	0.770	
	D_{16} Developing port marketing strategies	0.745	
	D_{15} Mixed-use industrial development	0.698	

Source: Authors.

The last column of Table 15 includes the Cronbach's alpha coefficient, which measures reliability. The Cronbach's alpha coefficients for the factors concerning the implications of port city development on seaport operations were 0.933, 0.918, and 0.870, respectively. The higher loadings of the variables suggest that the strategies for port city development in terms of seaport operations could be encouraged by the development of industrial parks as part of an integrated port city development. The creation of industrial parks attached to seaports has become widespread. This improves not only socioeconomic development but also port logistics services, enhancing the development of the logistics industry. For example, in Vietnam, the trend of attaching industrial parks to seaports is growing and being effectively promoted (Nandimvu, 2021).

Jointly developed by Malaysia and China, the Malaysia-China Kuantan Industrial Park (MCKIP) is the first industrial park in Malaysia and the first to be accorded National Park status. Its sister park in Guangxi, China is the Malaysia Qinzhou Industrial Park (CMQIP). The two parks have been identified by both governments as 'Iconic Projects for Bilateral Investment Co?operation', which will drive the development of industrial clusters in both countries. Kuantan Port will be an important gateway for logistics services for the MCKIP, which is just 10 kilometres away. At present, Kuantan Port mainly handles bulk cargoes for nearby industrial areas. To meet the anticipated increase in demand, Kuantan Port is expanding its bulk cargo terminal by developing a new deep?water terminal (NDWT), which is intended to become a container port for trans?shipment cargoes (Tsang, 2017) as a form of industrial cooperation under the Belt and Road Initiative. Sun et al. (2022) supported this concept, stating that a port and port-oriented industries are the original development foci driving the economic development of a port city; subsequently, the port city becomes the focus, with the transformation of its urban industrial structure driving the port's economic transformation. In the context of community engagement and sustainable development, an important strategy is to strengthen relationships between stakeholders and the community (there was a higher loading under this category, 0.807). In the context of sustainability, ports often emerge as points of contention involving stakeholders from the maritime industry, local government, and communities. A well-established communication channel is crucial for sharing knowledge, actions, experiences, and cultural values, thus contributing to the successful development of a port (Valionienė & Župerkienė, 2024).

Conclusion and Recommendations.

This study focuses on four key components to identify the main categories or factors related to the development of port cities in the Eastern Corridor Economic Region (ECER), using exploratory factor analysis (EFA). The components include challenges in developing the port city concept; the implications of port city development for the city; the implications of port city development for seaport operations; and strategies for port city development. This study identified eight challenges to the development of a port city in the ECER. Despite these challenges, particularly that of maintaining a stable relationship between the port and the city, they can be addressed through various strategies identified in this study. For instance, strengthening relationships between stakeholders and the community is crucial. Historically, cities and ports have had strong relationships, and these can continue to be strengthened through increased port activities stimulating urban activities and vice versa (Hall & Jacobs, 2012; Veenboer, 2014; Jugović et al., 2021). In each port city, the port and the local citizens have a unique relationship. Ports have the capacity to generate significant influences on the region, city, and often the entire country (D'agostini & Jo, 2019).

Next, this study found that the implications of port city development are both positive and negative (see Tables 9 and 12). In terms of the positive implications, for example, the development of domestic industries, tourism activities, and the promotion of economic activities could create direct output, national income, employment, and tax revenues for the city. According to Cong et al. (2020), the development of modern industry and transportation has contributed to the prosperity of original port cities and the growth of new port cities, such as Shanghai, Qingdao, and Dalian in China. Currently, 55% of the world's population, approximately 4.2 billion people, reside in cities. This trend is expected to continue, with the urban population projected to double by 2050 and seven out of 10 individuals expected to live in cities (World Bank, 2021). As a result, city regions are becoming increasingly important, especially since half of the global urban population lives within approximately 100 km of a coastline. Cities worldwide have established complex relationships with their ports, with the origin of many cities being based on the port location. Thus, ports are advantageous for the development of port cities.

While there are potential negative consequences, such as criminal activity and social problems, these can be mitigated through sustainable strategies such as promoting educational and training programmes for the community related to the port (see Table 15). By promoting these forms of education and training, such as skills development in logistics, shipping operations, or maritime safety, residents can acquire valuable skills that open doors to better-paying jobs. Increased trade activity fosters indirect employment opportunities in related industries such as transportation, warehousing, and manufacturing (Ayesu & Boateng, 2024). This study recommends that national and local governments, port businesses, and port authorities support the growth of ports because of their positive impact on local economic development. Future research will be conducted to monitor the development of port cities in the ECER by referring to the factors and subfactors highlighted in this study.

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