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Proposing An Optimal Administrative Model for Matarbari port: A RII-Based Weighted Scoring Approach

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Abstract - **Bangladesh's expanding international trade demands modern and efficient port infrastructure, with Matarbari Deep-Sea Port poised to become a key maritime hub. This study aims to identify the most suitable administrative model for Matarbari port by identifying the key factors influencing the selection of an optimal port governance structure, determining the relative importance (weights) of these factors and recommending the most appropriate administrative model. To achieve these objectives, a comprehensive literature review was conducted to identify eight critical evaluation criteria: operational efficiency, cost efficiency, financing and investment options, regional economic development, infrastructure and facilities, revenue generation potential, decision-making flexibility and user satisfaction. The Relative Importance Index (RII) method was applied to determine the relative weights of these factors based on expert input. These weighted factors were then used in a scoring matrix to evaluate four established port governance models: service port, tool port, landlord port and privatized port. The findings reveal that the landlord port model consistently scored highest across several key dimensions, particularly cost efficiency, financing capacity and infrastructure development. Based on these results, the study recommends a phased implementation of the landlord model, supported by long-term concession agreements and the integration of digital technologies and environmental standards. This approach is expected to ensure the sustainable, competitive and strategically aligned development of Matarbari Port.**

Keywords - **Landlord Port, Matarbari Port, Port Administration, Port Governance, Relative Importance Index (RII), Weighted Scoring Matrix.**

I. INTRODUCTION

Bangladesh gained large areas of the Bay of Bengal and important EEZ rights by settling maritime disputes with India and Myanmar more than ten years ago, making it a potential blue economy country [1]. Over the years, Bangladesh's economic advancement has become increasingly reliant on effective ocean trade, with almost 97% of all seaborne cargo and 92% of the country's container throughput by sea [2]. Therefore, the port of Chittagong has been instrumental in driving the Bangladeshi economy since the independence of the nation. During the fiscal year 2020–2021, the Chattogram Port Authority (CPA) handled approximately 3.2 million TEUs and 113.73 million metric tons of cargo, recording an annual growth rate of 11.98% [3]. The current port infrastructure, notably Chittagong, Mongla & Payra Ports, has underpinned the nation's international trade for decades [3]. Nevertheless, Bangladeshi ports are hindered by operational inefficiencies, weak infrastructure and a communication system that is often disruptive and leads to inefficiency [4]. In addition, Mahmud & Rossette (2007), recognize Chittagong as one of the most expensive and hazardous ports globally. Other ports lack robust connections to large cities. Nonetheless, where connections exist, the transportation infrastructure and related services are insufficient for efficient product delivery [4]. There is no direct rail connection to Mongla and Payra ports. 3.3% of the total containers from Chittagong Seaport are carried through rail, whereas road accounts for 96% and inland water for less than 1% [6]. The physical constraints pose significant inefficiencies to the maritime trade sector of Bangladesh. Existing port mechanisms in Bangladesh rely on transshipment hubs in Singapore, Colombo and Port Klang, resulting in an estimated 20-30% increase in logistical expenses and considerable delays in cargo delivery [7].

The Bangladeshi government has begun the Matarbari Deep-Sea Port development project in response to these difficulties. The project is expected to be fully operational by 2026 with the financial and technical help from the Japan International Cooperation Agency (JICA) [8]. In terms of regional connectivity, the Matarbari deep seaport, the Karnaphuli Tunnel and the related road and rail networks are expected to be a game-changer [9]. Post-Panamax ships with a draft of 18 meters and 8,000 TEUs will be able to pass through this port. Matarbari Deep Seaport has the prospect of serving as a regional center for nations in the Bay of Bengal with a motive to facilitate the trade of Bangladesh, northeast India, the eastern coast of India, landlocked Bhutan and Nepal, and other countries in the region [10]. Successful implementation of Matarbari Port could potentially contribute an additional 2% to 3% to Bangladesh's GDP growth [10]. The development of port operations and associated industries in the Matarbari region will enhance export competitiveness and reduce import costs, contributing to the region's overall economic potential. [11].

Choosing and executing the right administrative model is crucial for maximizing the capabilities of Matarbari Port. The massive port reforms that have occurred over the last several decades have raised questions about the conventional models of port organization [12]. The governance systems of ports profoundly affect operational efficiency, investment appeal and sustainability over the

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long run [13]. Therefore, port administration has changed throughout the years. Various models have emerged globally, each yielding varying performance outcomes [13].

As an emerging deep-sea port, Matarbari Port has the potential to become a regional maritime hub and significantly influence the economy of Bangladesh. Therefore, identifying the most effective administrative model for Matarbari Deep Sea Port is becoming increasingly important for the port's stakeholders as cargo volume continues to rise. In the marine transport sector, this issue has received very little attention. Previous research has acknowledged Matarbari Port's significance, yet there is an important knowledge gap on the best administrative model for this port. Therefore, this study aims to identify, evaluate, and recommend the most suitable administrative model for Matarbari Port by analyzing key influencing factors. The specific objectives of this research are:

1. To identify the key factors influencing the selection of an optimal administrative model for Matarbari Port.
2. To determine the relative importance (weights) of these factors.
3. To recommend the most suitable port administrative model based on the factor evaluation.

To achieve the first objective, this study reviewed past literature studies and the outcome is shown in Table 1. And to achieve the second objective, which is to determine the relative importance (weights) of these factors, the Relative Importance Index (RII) method is used. And based on factor evaluation, the third objective will be achieved, which is to recommend the most suitable port administrative model.

This study is followed by methodology, results and discussion in the next 3 sections. The study finishes with conclusions, with the goal of adding to the body of maritime logistics-related knowledge.

II. METHODOLOGY

A. Research design

In quantitative research, a combination of statistical, logical, and mathematical techniques is utilized to provide numerical data and concrete truths [14]. Collecting and analyzing structured data that can be represented numerically is typically considered as the backbone of quantitative research [15]. In that sense, this study adopts a quantitative research approach.

To address the first objective, which was to identify the key factors influencing the selection of an optimal administrative model for Matarbari Port, a comprehensive literature review was conducted to identify eight critical evaluation factors.

Then, to address the second objective, which was to determine the relative importance (weights) of these factors, the factors were then prioritized using the Relative Importance Index (RII) method, a widely used tool for quantifying expert judgments [16]. Then, to accurately use the Relative Importance Index (RII) scores as decision weights in evaluating administrative models, the RII values were normalized.

Finally, to complete the third objective, which was to recommend the most suitable port administrative model based on the factor evaluation, the weighted factors were applied in a scoring matrix to assess four established governance models: service port, tool port, landlord port, and privatized port. After that an optimal model was recommended.

B. Data collection

Because of restrictions in time and accessibility, this study used a convenience sampling method to gather expert opinions on the elements that were considered important when choosing an administrative model for Matarbari Port. Part one of the survey asked participants to rank the eight pre-determined selection criteria on a 5-point Likert scale, and part two asked them to provide feedback on their preferred methods of port governance against those criteria. Port officials, marine experts, policymakers and academics made up the fifteen-person sample (n = 15) that was ultimately selected (Table 1).

TABLE 1

RESPONDENT PROFILE

Category	Number of respondents
Port Officials	4
Maritime Professionals	5
Policymakers	2
Academicians	4
Total	15

The participants were chosen for this study because of their proximity to Matarbari Port policy and development, their competence and relevant field of expertise.

Despite the small sample size, the varied viewpoints provided valuable insights from those working in marine planning and governance, helping to validate the eight-factor approach.

C. Development of RII (Relative Importance Index)

To quantify the significance of factors influencing the selection of an optimal administrative model for Matarbari Port, this study employs the Relative Importance Index (RII) method. The Relative Importance Index (RII) method has been widely applied to prioritize and rank factors in various research contexts [17]. The RII approach involves collecting expert judgments through structured surveys and then quantifying these judgments to facilitate comparison and prioritization of factors [17].

This method is valued for its ability to systematically translate subjective expert opinions into a quantifiable index, making it a practical tool for ranking and decision-making [16].

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The RII was calculated using responses collected from the stakeholders. Each respondent rated the importance of eight predefined factors using a 5-point Likert scale (1 = Not Important to 5 = Extremely Important). The RII for each factor was computed using the following formula [18]:

$$\text{RII} = \frac{\sum w}{\text{A} \times \text{N}}$$

Where:

- w = the weight given to each factor by a respondent (1 to 5)
- A = the highest possible weight (5)
- N = the total number of respondents (15)

This structured approach allowed the study to rank and prioritize the eight key selection factors.

D. Normalization of RII Scores for Weight Determination

The RII values were normalized to accurately use the Relative Importance Index (RII) scores as decision weights in evaluating administrative models. This ensures that the weights sum to 1, making them suitable for weighted scoring and comparison.

Step 1: Compute the total RII

All RII scores obtained from expert responses were summed:

$$\text{Total RII} = \sum_{i=1}^{n} \text{RII}_i$$

Step 2: Normalize each RII score

Each individual RII score was divided by the total RII to obtain a normalized weight W_i:

$$W_i = \frac{\text{RII}_i}{\sum_{i=1}^{n} \text{RII}_i}$$

Where:

- W_i = Normalized weight of the i^{th} factor
- RII_i = Relative Importance Index of the i^{th} factor
- n = Total number of factors

E. Development of weighted scoring matrix

To recommend the most suitable port administrative model for Matarbari Port, the study developed and applied a weighted scoring matrix. This approach enabled the systematic evaluation of four established port governance models: service port, tool port, landlord port, and privatized port.

The procedure began by utilizing the normalized RII values as decision weights. These weights reflected the relative significance of the eight evaluation factors.

In the survey's second part, respondents were asked to rate the performance of each governance model against these factors on a five-point Likert scale (1 = Very Poor, 5 = Excellent). The average score for each factor under each model was then calculated.

The weighted score for each governance model was obtained using the following formula:

$$WSM_j = \sum_{i=1}^{n} (W_i \times S_{ij})$$

Where:

- WSM_j= Weighted score of governance model j
- W_i = Normalized weight of factor i factor
- S_{ij}= Average score of governance model j on factor i
- n = Total number of factors considered

III. RESULTS

After a thorough literature review on port administration and management, eight key factors for assessing port governance models were identified. All studies have consistently identified these factors as determinants of port performance. They are particularly relevant to developing country contexts like Bangladesh. Lastly, they align with Matarbari Port's strategic objectives as a future regional hub. These three considerations led to the identification of these factors as the most significant. This results section is divided into two parts: one exhibits the finalized factors, and the second part examines the results of the Relative Importance Index.

A. Finding the factors based on the literature review

After a thorough analysis of the literature review, 8 factors have been finalized, which are shown in Table 2.

B. Finding the ranks and weights of the factors

The eight critical factors were systematically prioritized using RII, as seen in Table 3.

TABLE 2:
FINALIZED FACTORS INFLUENCING THE SELECTION OF AN OPTIMAL ADMINISTRATIVE MODEL

Factors	Explanation	Reference
Cost efficiency	When choosing a port governance model, cost efficiency must be a top priority. It rates the model's efficiency in reducing operational expenses (such as those associated with cargo handling and vessel turnaround).	[7], [19], [20].

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Revenue generation potential	Because the model determines how a port generates revenue and manages its finances, revenue creation is a crucial consideration when selecting a port governance model.	[21], [13],
Decision-making flexibility	Flexibility in decision-making evaluates flexibility in response to changes in the market and changes in regulations	[22], [13].
User satisfaction	When deciding on the best port governance mode, user satisfaction should be in your priority list. For shippers and carriers, it aids in tracking service quality.	[23], [24]
Infrastructure and port facilities	Assessing the capacity for modernization and maintenance is aided by considering infrastructure and port facilities. Consistent funding for deep-draft infrastructure is guaranteed	[25], [26]
Financing and investment options	Assessing the availability of funding for growth is the focus of Financing and Investment Options. It retains ownership of public assets while utilizing private investment.	[27], [28]
Regional economic development	The generation of jobs and the ease of trade are both impacted by regional economic development. Efficiency and regional growth are brought into harmony.	[10], [22].
Operational efficiency	Operational Efficiency assesses productivity (such as TEU throughput).	[21], [29]

TABLE 3:
COMPREHENSIVE RII RANKING OF PORT GOVERNANCE SELECTION FACTORS

Factor	RII Score	Rank
Operational efficiency	0.933	1
Cost efficiency	0.747	2
Financing & investment options	0.707	3
Regional economic development	0.693	4
Infrastructure & port facilities	0.667	5
Revenue generation potential	0.587	6
Decision-making flexibility	0.520	7
User satisfaction	0.427	8

The Relative Importance Index (RII) values for each of the eight factors that were identified were then normalized into comparable and usable weights, as seen in table 4. This was crucial for the following stage of the analysis, in which the performance of several port governance models were assessed using the elements in a weighted scoring matrix. Normalization guarantees that the weights add up to 1.

TABLE 4:
FINAL NORMALIZED WEIGHTS

Rank	Factor	RII Score	Normalized Weight (W)
1	Operational efficiency	0.933	0.177
2	Cost efficiency	0.747	0.141
3	Financing & investment options	0.707	0.134
4	Regional economic development	0.693	0.131
5	Infrastructure & port facilities	0.667	0.126
6	Revenue generation potential	0.587	0.111
7	Decision-making flexibility	0.520	0.098
8	User satisfaction	0.427	0.081
	Total		1.00

C. Evaluating port governance models against the factors

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A weighted scoring matrix shown in Table 5 was used to thoroughly assess the four main port governance models (service ports, tool ports, landlord ports and completely privatized ports) in relation to the RII-ranked variables.

IV. DISCUSSION

From the weighted scoring matrix, landlord port model received the highest score followed by private, tool and service port model (Table 5, Fig. 1).

With a weighted total score of 2.265, the *service port model* received the lowest overall score. Its dismal performance in

TABLE 5:
WEIGHTED SCORING MATRIX FOR GOVERNANCE MODEL EVALUATION

Factor	Weight	Service port	W×S	Tool port	W×S	Landlord port	W×S	Private port	W×S
Operational efficiency	0.177	2.067	0.366	2.933	0.519	4.867	0.861	4.333	0.767
Cost efficiency	0.141	1.867	0.263	2.867	0.404	4.800	0.677	4.133	0.583
Financing & investment options	0.134	1.467	0.197	2.533	0.339	4.733	0.634	4.267	0.572
Regional economic development	0.131	3.667	0.480	3.067	0.402	4.133	0.541	2.733	0.358
Infrastructure & facilities	0.126	2.400	0.302	3.000	0.378	4.800	0.605	4.267	0.538
Revenue generation potential	0.111	2.533	0.281	2.867	0.318	4.133	0.459	4.067	0.451
Decision-making flexibility	0.098	2.067	0.203	2.667	0.261	4.000	0.392	4.867	0.477
User satisfaction	0.081	2.133	0.173	2.800	0.227	4.333	0.351	4.267	0.346
Weighted total score	1.00	-	2.265	-	2.849	-	4.52	-	4.091

All things considered, the *tool port model* performed moderately, earning a total score of 2.849. It did somewhat well in operational efficiency (0.519), which was bolstered by coordinated governmental investment. But regional economic development (0.402), revenue generation (0.318), infrastructure & facilities (0.378), cost efficiency (0.404), financing and investment options (0.339) were mediocre. Decision-making flexibility (0.261) and user satisfaction (0.227) received the lowest scores. Overall, it lacks the strategic capability for extensive contemporary port development and is still in the transitional phase, although it is more capable than the service model.

The *private port model* performed well with a total weighted score of 4.091, in a number of categories, including operational efficiency (0.767), cost efficiency (0.583), financing & investment options (0.572) and infrastructure & facilities (0.538). It also did moderately well with decision-making flexibility (0.477) and revenue generation potential (0.451). Regional economic development (0.358) and user satisfaction (0.346) displayed lower scores, raising questions about public support and the long-term effects on national growth.

Despite being effective, the private port model is still not the best fit for Matarbari's situation due to its narrow emphasis on public value.

The *landlord port model* consistently performed well across all eight parameters, earning the highest total weighted score of 4.52. It had significant private sector appeal with scores of 0.861 in operational efficiency, 0.677 in cost efficiency, 0.605 in infrastructure & facilities and a leading 0.634 in financing & investment options. Along cost efficiency (0.263), financing & investment options (0.197) and operational efficiency (0.366) reflected its inefficiencies and lackluster attraction to private capital. Revenue generation potential (0.281), user satisfaction (0.173), infrastructure & facilities (0.302) and decision-making flexibility (0.203) also demonstrated poor results. Regional economic development (0.480) was the only area that was relatively strong, most likely because it focused on the public sector. All things considered, the approach falls short of Matarbari Port's requirements for efficiency and investment flexibility.

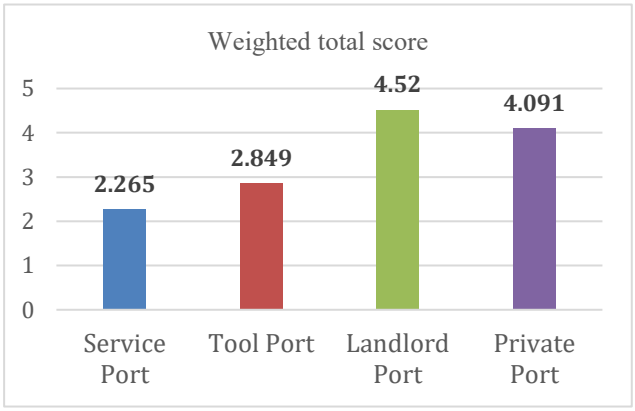


Fig 1: Weighted Total Score

with strong scores in revenue generation potential (0.459), decision-making flexibility (0.392) and user satisfaction (0.351), it also scored highly in regional economic development (0.541). This study's results show that the landlord port model is the best governance structure for Matarbari Port because of its balanced performance, which demonstrates its capacity to match operational excellence with national strategic goals.

V. CONCLUSION

The study examined the key factors that affect the choice of port officials and policymakers to choose the optimal administrative model for Matarbari Port. This study used the Relative Importance Index (RII) methodology and weighted scoring matrix to comprehensively evaluate four port governance alternatives for Bangladesh's Matarbari Port. Using key operational parameters such as operational efficiency (RII=0.933), cost efficiency (RII=0.747) and financing & investment options (RII=0.707), the results clearly showed that the landlord port model was the best option. Bangladesh has the perfect foundation to develop Matarbari as a strategically important national asset and a commercially viable deep-sea hub because to this hybrid governance system, which combines public infrastructure stewardship with operational knowledge from the private sector. The most practical administrative strategy is the model, as it has been shown to be successful in international

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settings, such as Rotterdam and Singapore, and is in line with Bangladesh's institutional capabilities and development objectives.

This study contributes to the body of literature by giving stakeholders and decision-makers in the maritime sector useful advice and new insights into the port governance model selection process. The study did, however, reveal some possible limitations, namely the small size of the study group and reliance on expert opinions. Further research could provide deeper insights into the functioning of port governance selection by examining additional parameters and incorporating a broader range of perspectives. All things considered, this paper advances the understanding of marine logistics and provides valuable insights for enhancing shipping operations when selecting port governance architecture.

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