LEX LOCALIS-JOURNAL OF LOCAL SELF-GOVERNMENT
ISSN:1581-5374 E-ISSN:1855-363X
VOL. 23, NO. S3(2025)

EVALUATING STAKEHOLDER SATISFACTION AND OPERATIONAL EFFICIENCY: A COMPARATIVE STUDY OF SELECTED INDIAN SEAPORTS

Ms. N. Jasima Yaasmin[1], Dr. A. Muthusamy[2]

[1]Ph.D Research Scholar (Full-Time), Department of International Business, School of Management, Alagappa University, Karaikudi, India
[2]Professor and Head, Department of International Business, School of Management, Alagappa University, Karaikudi, India,

jasimayaasmin@gmail.com[1]
Muthuroja67@rediffmail.com[2]

ABSTRACT
The ports incur higher monetary expenditures and have a lengthy gestation period for organization. A large number of the world's busiest seaports in Asia and the Americas had traffic jams in 2014. Because of transportation problems reaching coastal ports, landlocked nations trade 30% less, which slows their growth rate. There is no substitute for marine transport when it comes to cost-effectiveness, connection, and flexibility, especially for landlocked countries. In seaports, operational efficiency and stakeholder satisfaction are closely related; when efficiency is high, satisfaction is high, and vice versa. Stakeholder involvement, technological advancements, and infrastructure are critical intersections of these two elements. Stakeholder satisfaction may be increased by the improvement of infrastructure, especially access roads and rail lines, which can decrease congestion and improve turnaround times. In a similar vein, digital data interchange and Port Community Systems (PCS) are great tools for streamlining processes and improving communication, which in turn increases efficiency and delights stakeholders. Significant ports' efficiency has been evaluated in the research. Because of overcapacity, major Indian ports have very high TRT and poor productivity compared to other ports throughout the globe. Additionally, Indian ports have not been upgraded to accommodate novel cargo kinds. By doing this kind of evaluation, ports will be able to gauge their level of efficiency and implement strategies to address their weaknesses, allowing them to achieve or exceed internal criteria.

Keywords: Stakeholder , Satisfaction , Operational , Efficiency , Seaports

INTRODUCTION

The transportation sector and item commerce have both been profoundly affected by the globalization of the global economy. The ports incur higher monetary expenditures and have a lengthy gestation period for organization. A large number of the world's busiest seaports in Asia and the Americas had traffic jams in 2014. Thus, countries have shown an interest in modernizing their ports to improve their operational viability via the use of machinery and the international maritime sector. Among the world's peninsulas, India is among the finest.

There are 200 ports in India that are not listed as significant. Seven hundred forty-four million tons of cargo passed through India's main ports in the fiscal year 2020. Foreign direct investment (FDI) in port and harbor maintenance and building is welcome in India, according to the government. Businesses involved in the construction, upkeep, and operation of ports, inland ports, and inland waterways are also eligible for a tax holiday lasting ten years. An alternative port for shippers in the Andaman and Nicobar Islands was proposed by India in August 2020, when the country announced an investment of 10,000 cr to construct a transhipment port on Greater Nicobar Island. This would be a major advance in the port business in India. The enhancement of seaport performance, a decrease in the involvement of the public sector, and ownership restructuring are recurring themes. More private sector involvement and autonomous seaport regulatory bodies have emerged since the government stepped back from running ports (Brooks et al. 2017). As a result of port reforms, the

landlord port model of governance has become the de facto standard. The World Bank (2001) states that under the landlord seaport model, the private sector takes over port operations, and the terminal operator then put money into the superstructure, which is cargo-handling technology. During the concession period, the terminal operator may reap the benefits of the investments made. The port authorities, private companies, or public-private partnerships pay for shared port infrastructure under the landlord model. This is different from the public service seaport paradigm that was prevalent before to port reforms. When it comes to public service seaports, the responsibility for planning, managing, and operating the port falls on the port authority. A public-private partnership, the port authority, or a single private firm may provide nautical-technical services including pilotage, towage, mooring, and perhaps dredging. Alternatively, many private firms might compete for these contracts.

Role of maritime transportation plays in promoting economic development

Asia's competitive advantage in cheaper shipping of goods is the reason for its dominance in container ports, with nine of the ten busiest ports situated there. This benefit depends on having developed transportation systems. Making informed decisions and appreciating the critical role that maritime transportation plays in promoting economic development require an understanding of this importance. When comparing coastal and landlocked nations, ports are clearly important to economic development. Landlocked countries grow at a slower rate because they trade 30% less, mainly because of transportation issues getting to coastal ports.

Stakeholder satisfaction and operational efficiency in seaports

In seaports, operational efficiency and stakeholder satisfaction are closely related; when efficiency is high, satisfaction is high, and vice versa. Stakeholder involvement, technological advancements, and infrastructure are critical intersections of these two elements. Stakeholder satisfaction may be increased by the improvement of infrastructure, especially access roads and rail lines, which can decrease congestion and improve turnaround times. In a similar vein, digital data interchange and Port Community Systems (PCS) are great tools for streamlining processes and improving communication, which in turn increases efficiency and delights stakeholders. Building trust, which affects efficiency and satisfaction, and detecting and resolving operational issues need a collaborative strategy to stakeholder management that includes frequent meetings and open communication.

Buildings and the Real World:

Congestion: Ship turnaround times, container dwell periods, and supply chain efficiency are all negatively affected by port congestion, which is a common source of stakeholder dissatisfaction.

Solutions: Improving access roads and rail lines, increasing port capacity, and modernizing cargo handling equipment are all examples of infrastructure upgrades that may reduce congestion and boost stakeholder satisfaction.

Technology and Digital Systems:

Port Community Systems (PCS): A well-planned PCS may enhance communication between port stakeholders, simplify customs processes, and enable electronic data interchange, all of which contribute to happier customers and more productive operations.

Digitalization: Automated gate systems, electronic data exchange, real-time cargo monitoring, and other digital technologies may improve communication, cut down on paperwork, and increase efficiency.

Stakeholder Engagement and Collaboration:

Importance: The port industry relies on a wide variety of stakeholders, such as shipping companies, terminal operators, freight forwarders, and customs agents.

Collaboration: Port authorities and stakeholders may improve operational problems, efficiency, and satisfaction by fostering strong partnerships and open communication channels via joint projects, frequent meetings, and the like.

Measuring Efficiency and Satisfaction:

Performance Indicators: Turnaround time, berth occupancy, revenue per ton of cargo, and the number of gangs engaged are indicators used to quantify the efficiency of terminal operations.

Stakeholder Surveys: Finding out how satisfied stakeholders are and where you can make improvements may be done using regular surveys and feedback systems.

OBJECTIVES OF THE STUDY

1. To research seaport operational effectiveness and stakeholder satisfaction
2. To research how marine transportation contributes to economic growth

RESEARCH METHOD

The study's approach is based on relevant information gathered from port specialists. The functional work of the Indian major remains exceptional. The performance of major ports is evaluated in proportion to the amount of vessel and container traffic they manage. Data from 2004–05 to 2018–19 have been included in this study. The ongoing commercialization of port authorities (PAs) and the increasing demand from stakeholders on PAs lead to the development of new port performance measures. In addition to satisfying the port authority's need for information on port performance, these new indicators are significant for stakeholders with socioeconomic interests in a port. The operational efficiency of India's major ports is primarily determined by the following efficiency parameters: IT, TRT, PBD time, and AO per ship-berth-day (MoS, 2018). The AO per ship-berth-day is the AO for loading and unloading a ship at a berth every day. In order to generate a CPI that assesses the overall performance of many ports, the indicators AO, ATRT, DTOR, and IT are assigned relative weights in the current research, as seen below.

With i = 1, 2, …, k, j = 1, 2, …, c, let wi be the indicator's weight and yij be the data-value of the ith indication for the jth port. Therefore, we use the following phrase to get the CPI, expressed as a percentage, for jth port for a given year.:

$$CPI(j) = \frac{1}{\sum_{i=1}^{k} w_i} \left\{ \sum_{i=1}^{k} w_i \times \left\{ \frac{\left(y_{ij} - \min_j y_{ij}\right) \times I_{1[i]} + \left(\max_j y_{ij} - y_{ij}\right) \times I_{2[i]}}{\max_j y_{ij} - \min_j y_{ij}} \right\} \right\} \times 100, \quad j = 1, 2, \ldots, c,$$

where the indicator functions $I_1[i]$ and $I_2[i]$ are as follows:

$$I_{1[i]} = \begin{cases} 1, & \text{if larger value of } y_{ij} \text{ indicate better performance, for the } i^{\text{th}} \text{ indicator} \\ 0, & \text{if smaller value of } y_{ij} \text{ indicate better performance, for the } i^{\text{th}} \text{ indicator,} \end{cases}$$

and

$$I_{2[i]} = \begin{cases} 1, & \text{if smaller value of } y_{ij} \text{ indicate better performance, for the } i^{\text{th}} \text{ indicator} \\ 0, & \text{if larger value of } y_{ij} \text{ indicate better performance, for the } i^{\text{th}} \text{ indicator.} \end{cases}$$

Remember that AO performs better with a higher yij, but the other indicators do not. According to the CPI expression in (1), a port that performs best across all categories receives 100%, whereas a port that performs worst receives "0."

The modified scoring function standardised composite performance index (SCPI) may be used to compare port performance:

$$SCPI(j) = \frac{CPI(j) - \underset{j}{mean}(CPI)}{\underset{j}{sd}(CPI)}, \quad j = 1, 2, \ldots, c,$$

for the j^{th} port, whose value may be understood in this way:

Average performance is indicated by a SCPI of 0, above average performance is shown by a SCPI > 0, and below average performance is indicated by a SCPI < 0. More precisely, if SCPI > a (a > 0, a real constant), the CPI is "a" times higher than the standard deviation of all CPIs, and if SCPI < -a, it is "a" times lower. Therefore, for any given year, the SCPI-value shows the level of performance quality for each port. It shows each port's absolute location as well as its relative status.

DATA ANALYSIS

Shipping and Port Operations in India

Over 90 percent of India's total exchange volume—77 percent in terms of value and 97 percent in terms of its foreign exchange volume—occurs via sea. The Indian has a 7000-kilometer coastline, 12 major ports, and 205 operable smaller ports, and is located between the Atlantic Ocean in the west and the Pacific Sea in the east. The 12 major ports handled over 75% of port traffic in 2018–19. Only seven are regarded as important compartment ports, even though the majority of important ports handle holders. The Indian maritime sector was likewise under economic control at the time. There aren't many medium-sized and big shipping enterprises in this sector. Approximately 80% of India's overseas commerce is conducted by private entities. More crude oil and gas carriers have emerged as a result of India's increased crude oil imports.

Total Traffic by All Ports

The traffic handled by India's main and small ports throughout the research period is shown in Table 1. Comparing major ports to non-major ports, the former handle greater traffic. The non-major ports also experience increased traffic year after year, reaching 22.81 percent in 2018–19. This indicates that the non-major ports are performing similarly to major ports, while the major ports' limit utilization is gradually declining, which needs immediate attention.

Table 1: Indian Major and Non-Major Port Traffic

Year	Major Ports (In MT)	Non-Major Ports (MT)	Total	Share of Major Ports	Share of Non-Major Ports
2004-05	383.75	137.83	521.58	73.57	25.57
2005-06	423.56	145.53	569.09	74.43	25.57
2006-07	530.53	213.20	743.73	71.33	28.67
2007-08	519.31	203.62	722.93	71.83	28.17
2008-09	463.78	186.12	649.90	71.36	28.64
2009-10	570.03	314.85	884.88	64.42	35.58
2010-11	561.09	288.86	849.95	66.01	33.99
2011-12	545.79	387.87	933.66	58.46	41.54
2012-13	560.13	353.02	913.15	61.34	38.66
2013-14	555.50	417.13	972.63	57.11	42.89
2014-15	650.70	517.13	1058.77	70.42	29.58
2015-16	632.12	484.17	1029.03	67.04	32.96
2016-17	687.86	583.04	1118.25	77.19	22.81
2017-18	669.28	550.08	1088.51	73.81	26.19

2018-19	613.54	451.21	999.29	65.23	34.77
$\bar{x}$	589.70	334.81	845.56	66.56	34.67
$\bar{x}$.Dev.	72.56	134.56	168.28	5.08	5.12
MAX	645.56	534.56	1342.25	56.45	34.56
%P50	534.14	315.02	923.15	56.42	45.58
MIN	367.75	156.83	545.67	45.16	34.71
σ	56.34	134.67	156.7	4.67	5.78
CV	0.09	0.13	0.56	0.08	0.17
CAGR	3.56%	10.08%	5.45%	0.67%	-0.89%

Source: Indian Port Association – Annual Reports compiled (2004 to 2019)

Major ports' total traffic

Table 2 shows India's principal ports' traffic. Kandla got the highest mean score of 84583.35 tons, followed by JNPT (63491.19 tons) and Vizag (63433.95 tons). Kolkata had the lowest at 32814.13 tons. Updated Mangalore port performance was constant. Kamarajar Port grew 17.70% and Kandla Port 15.93%..

Total Vessel Traffic

Number of ships handled is carefully studied. JNPT handled more vessels. With 260 boats, Kamarajar port saw less vessels. The CAGR for Cochin port was 3.84 percent. In example, Haldia and VOC ports had negative CAGRs of -1.94 and -2.13. An unusual identity is assigned to each vessel, and a timestamp is included to indicate the date and hour of the vessel's arrival or departure, taking into account the amount of time spent in port. Tasks are arranged in a manner that considers both the arrival and departure of the vessel.

Table 2: Major Port Traffic Statistics (tonnes)

Year /Ports	Calcutta	Haldia	Paradip	Vizag	Chennai	VOC	Kamarajar	Cochin	Mangalre	Mormug oa	Mumbai	JNPT	Kadla
2004-05	10806	42216	33109	55801	47248	10806	42216	33109	55801	47248	10806	42216	33109
2005-06	9945	36262	30104	50147	43806	9945	36262	30104	50147	43806	9945	36262	30104
2006-07	12596	42454	38517	56385	53414	18001	10714	15257	32042	34241	52364	44815	52982
2007-08	13741	43541	42438	64597	57154	21480	11563	15810	36019	35128	57039	55756	64893
2008-09	12280	48000	46412	63908	57491	22011	11500	15228	36691	41681	51876	57281	72225
2009-10	13045	33378	57011	65501	61057	23787	10703	17429	35528	48847	54541	60763	79500

2010-11	12540	35005	56030	68041	61460	25727	11009	17873	31550	50022	54586	64309	81880
2011-12	12233	31012	54254	67420	55707	28105	14956	20091	32941	39001	56186	65727	82501
2012-13	11844	28084	56552	59040	53404	28260	17885	19845	37036	17693	58038	64490	93619
2013-14	12874	28511	68003	58503	51105	28642	27337	20887	39365	11739	59184	62333	87004
2014-15	13156	27976	69418	66434	58742	31508	21448	21547	36861	27650	63230	74157	101836
2015-16	13332	26363	73268	67433	59571	33074	22905	22365	37208	26483	65214	77713	107587
2016-17	13507	24750	77118	68433	60400	34640	24363	23183	37555	25315	67198	81268	113338
2017-18	13683	23137	80968	69433	61228	36206	25820	24002	37902	24148	69181	84823	119089
2018-19	13859	21524	84818	70433	62057	37772	27277	24820	38250	22981	71165	88379	124839
$\bar{x}$	13858.60	48000.00	84818.12	70432.98	62057.05	13858.60	48000.00	84818.12	70432.98	62057.05	13858.60	48000.00	84818.12
$\bar{x}$. De v.	845.56	6430.78	15623.89	4542.40	467.67	856.78	656.56	11456.50	478.30	4321.40	845.67	6452.78	15623.70
MAX	12629.40	32814.13	57868.03	63433.95	56256.30	12629.40	32814.13	57868.03	63433.95	56256.30	12629.40	32814.13	57868.03
P50	12874.00	31012.00	56552.00	65501.00	57491.00	28105.00	14956.00	19845.00	36691.00	30659.00	57039.00	64309.00	82501.000
MIN	9945.00	21524.07	30104.00	50147.00	43806.00	15811.00	9168.00	13938.00	31550.00	11739.00	35187.00	32808.00	41551.000
σ	1066.68	7913.38	16833.13	5808.27	5318.98	6792.45	6815.51	3571.88	2274.22	10358.56	9180.31	15860.64	25134.95

CV	0.08	0.24	0.29	0.09	0.09	0.25	0.40	0.19	0.06	0.33	0.16	0.25	0.30
CAGR	2.24%	-3.42%	7.15%	2.29%	2.35%	5.98%	7.30%	3.84%	0.81%	- 1.90%	4.81%	6.83%	7.61%

Source: Indian Port Association – Annual Reports compiled (2004 to 2019)

Data Envelopment Analysis (DEA) –Basic Radial Model – Efficiency Measurement

In a competitive market, most ports examine production. The current research used a yield-arranged DEA model to address the need. The efficacy of India's major ports is calculated using it. Port quality is assessed using this method. The data yield factors are in Table 5. Main port efficiency scores were shown in Graph 1. Vizag, Kamarajar, JNPT, and Kandla offer excellent berthing, storage, equipment, and traffic. Kolkata Port is the least efficient, with 16% of amenities accessible. Inefficient resource utilization lowers port efficiency. The present port competency evaluation focused on compartment throughput and overall traffic. The port of Cochin underperformed during study. Mormugao, Tuticorin, Mormago, and JNPT led the DEA CCR rankings. Chennai Port (6th) and Paradip Port (5th) follow.

Table 3: Variables for Input and Output at India's Main Ports

Posts/I&O	Berth(I) (Nos)	Storage(I) (In Sq Mts)	Equipment (I) (Nos)	Traffic(O) (In Tons)	Efficiency %
Kolkata(DMU1)	38	424380	14	68003	42
Haldia(DMU2)	14	296290	93	58503	76
Paradip(DMU3)	16	4786562	39	51105	100
Vizag(DMU4)	22	1517824	6	12874	41
Chennai (DMU5)	21	328981	11	28511	60
Vizag(DMU6)	8	921840	65	11739	100
Kamarajar (DMU7)	19	899645	513	59184	100
Cochin(DMU8)	19	1180964	31	62333	77
New Mangalore(DMU 9)	17	273487	189	87004	100
Mormagoa(DMU10)	8	109124	20	28642	16
Mumbai(DMU11)	29	2207476	0	27337	48
JNPT(DMU12)	10	3499988	67	20887	100
Kandla (DMU13)	25	596473	44	39365	100

Source: Indian Port Association – Annual Reports compiled (2004 to 2019)

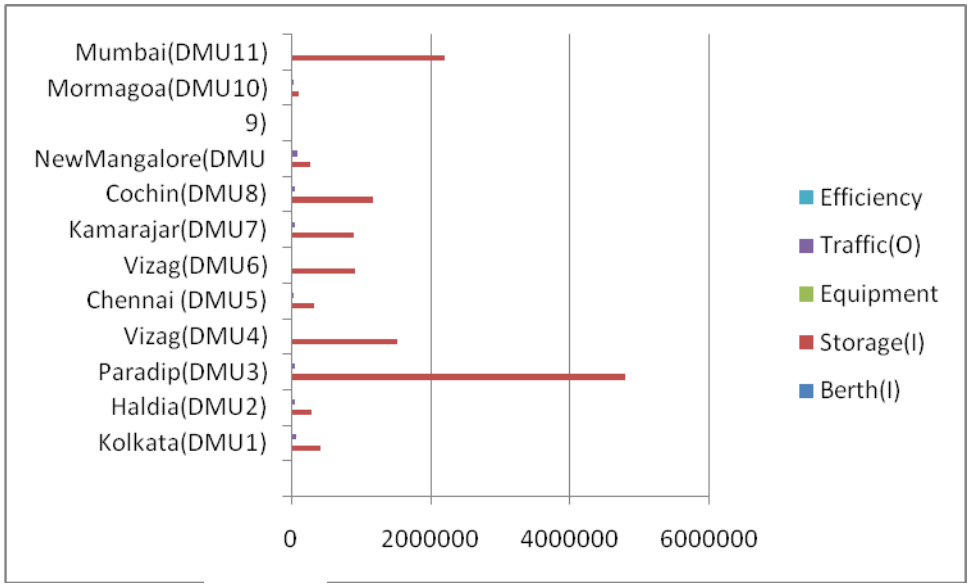

Figure 1 Port Efficiency on a Large Scale

Port of Kolkata receives a score of 16%, which is considered to be a very poor efficacy level. However, the compound annual growth rate (CAGR) for the total volume of traffic that the port processes is positive. Despite the fact that this port's overall traffic execution is exhibiting a good trend, the productivity is at its lowest. Consequently, this reveals that the operational output of the ports may not be reflective of the presentation productivity of the ports. The ports of Haldia, Cochin, and Mormagoa each have a percentage of 48, 41, and 42 percent, respectively, which is lower than fifty percent; nonetheless, the weight that is taken care of is sufficient to be favorable in their development.

India's ports of Chennai and Mumbai each have a productivity rate of 77 and 76 percent, respectively. There has been a surge of 23.4 percent in cargo traffic at the Chennai port, while the Mumbai port has seen a gain of 29.43 percent. The traffic that is handled by these ports is good; nonetheless, it is decreasing at a pace of 3.13 percent for Chennai and 10.96 percent for Mumbai separately. Although the traffic that is being handled is growing, it is doing so at a slow pace of 3.08 and 1.60 percent annually correspondingly.

Table 4 CPI and SCPI values of different ports

Port	CPI *(%)*									
	2009-2010	*2010-2011*	*2011-2012*	*2012-2013*	*2013-2014*	*2014-2015*	*2015-2016*	*2016-2017*	*2017-2018*	*2018-2019*
Kolkata(DMU1)	5.45	6.67	9.09	12.45	7.34	7.56	0.67	6.78	3.89	14.00
Haldia(DMU2)	30.43	25.99	22.54	19.13	24.77	27.59	31.72	35.67	24.92	20.49
Paradip(DMU3)	42.02	40.50	40.41	40.44	34.78	50.40	59.28	66.72	57.31	69.86
Vizag(DMU4)	35.00	44.09	40.13	39.80	41.57	52.43	56.84	55.31	41.87	51.12
Chennai (DMU5)	99.00	99.00	96.05	95.14	93.17	94.23	91.23	81.08	94.00	90.73
Vizag(DMU6)	76 SS	35 50	40	111	38.53	48.47	62.27	63.16	50.77	61.31
Kamarajar (DMU7)	23.41	24.09	22.72	9.67	31.31	31.22	46.46	48.56	30.67	41.06

Cochin(DMU8)	47.91	49.08	54.61	52.84	36.87	30.33	26.87	17.19	41.35	58.85
New Mangalore(DMU	55.54	59.27	63.46	63.77	6725	81.06	99.10	99.37	74.48	97.81
Mormagoa(DMU10)	36.38	35.09	36.05	35.60	47.65	52.81	64.78	68.16	67.27	72.39
Mumbai(DMU11)	56.25	55.26	56.71	50.32	51.81	62.54	73.77	78.20	64.85	72.62
JNPT(DMU12)	22.94	22.71	23.61	6.36	23.14	29.93	47.07	46.77	40.54	47.90
Kandla (DMU13)	28.69	27.39	30.40	25.38	39.08	50.61	69.35	73.82	54.43	53.96

Port	SCPI(%)									
	2009-2010	*2010-*	*2011-*	*2012-*	*2013-*	*2014-*	*2015-*	*2016-*	*2017-*	*2018-*
Kolkata(DMU1)	-1.55	-1.51	-1.46	-1.04	-1.61	-1.76	-2.17	-2.00	-2.00	-1.85
Haldia(DMU2)	-0.44	-0.65	-0.86	-0.78	-0.80	-0.89	-0.96	-0.86	-1.09	-1.61
Paradip(DMU3)	0.09	0.01	-0.05	0.10	-0.33	0.11	0.10	0.36	0.30	0.50
Vizag(DMU4)	0.70	0.86	0.98	1.05	1.20	1.46	1.64	1.63	1.04	1.69
Chennai (DMU5)	-0.77	-0.80	-0.81	-	-0.88	-0.78	-0.37	-0.42	-0.42	-0.44
Vizag(DMU6)	0.73	0.67	0.68	0.50	0.47	0.65	0.66	0.81	0.63	0.61
Kamarajar (DMU7)	0.35	0.39	0.59	0.60	-0.23	-0.77	-1.15	-1.58	-0.38	0.03
Cochin(DMU8)	2.71	2.70	2.58	2.50	2.61	2.17	1.49	1.19	2.14	1.52
New Mangalore(DMU	-0.61	-0.22	-0.03	0.03	-0.15	0.03	022	0.22	0.02	0.13
Mormagoa(DMU10)	0.22	0.12	-0.02	0.11	0.08	0.16	0.12	-0.05	-0.32	-0.26
Mumbai(DMU11)	-0.75	-0.74	-0.85	-1.16	-0.49	-0.73	-0.39	-0.35	-0.84	-0.73
JNPT(DMU12)	-0.17	-0.24	-0.25	-0.10	0.28	0.22	0.31	0.41	0.73	0.60
Kandla (DMU13)	-0.51	-0.59	-0.50	*() 52*	-0.13	0.12	0.49	0.63	0.18	-0.18

Source: Indian Port Association – Annual Reports compiled (2004 to 2019)

For the purpose of evaluating the relative overall performance of various ports on a yearly basis, the current study involves the development of a CPI. This is accomplished by giving relative weightages to the indicators, AO, ATRT, DTOR, and IT. The Delphi technique, which was developed by Dalkey and Helmer in 1963, was used to disseminate a questionnaire to five experts who had extensive experience and competence in port operations. The questionnaire was about the assignment of relative weightages to various performance indicators. It was requested of each of them to give relative weightages to each and every option for a pair of indications available. It was decided to disperse their replies among themselves in the event that they want to make the necessary adjustments to their responses. The experts did not reveal their identities to one another. A final view on relative weightages was taken into consideration, and the average was calculated. Following that, an analytical hierarchy procedure (Saaty, 1980) was used to the opinion that was obtained in order to ascertain the priority vectors (normalized main eigen vectors), which ultimately resulted in the weightages of various indicators. The country of Mormago has been seen to be doing very well over the course of the years, with a high average CPI during the period of 2003 to 2013, followed by J.L. Nehru. J.L. Nehru and New Mangalore are the ports that come in second and third place, respectively, with a SCPI that is consistently higher than 1.

Ports such as Paradip, Visakhapatnam, Mumbai, Kandla, Cochin, Mormugao, and Chennai have all had varying degrees of success throughout the course of their respective histories. However, Haldia, Tuticorin, and Kolkata regularly perform poorly year-round, with SCPI values just below the negative threshold. Table 5

shows CPI and SCPI scores from 2003 to 2013. The table indicates whether ports' overall performance increased or declined throughout data collection. J.L. Nehru had the highest CPI from 2012 to 2013 at 97.81%, 1.69 times the standard deviation over the mean. As demonstrated by its SCPI-score, Mormugao's overall performance was comparable to that of all other ports, with a mean CPI that was average. It was observed that HDC and Mormago saw a decline in their CPI from the previous year to the current year, whilst all other ports shown an improvement. In this research, the CPI was designed to accurately expose the overall performance of the ports, and it was shown to be a reliable index for measuring the overall performance of the ports over any given period of time..

Table 5 Assessing port internal consistency vs AO*

Port	*Mean*	*SD*	*95% lower confidence limit*	*95% upper confidence limit*	*Coefficient ofvariation (9)*	*% belts% mean*	*(mean SD)*	*% below (mean - SD)*
Kolkata(DMU1)	3,881.25	601.58	3,50839	4,254.11	15.50	70%	3,279.67	10%
Haldia(DMU2)	8.774	618.74	8390.95	9,157.95	7.05	50%	8,155.71	20%
Paradip(DMU3)	9,671.25	620.68	9,286.55	10,055.95	6.42	*50%*	9,050.57	10%
Vizag(DMU4)	10,497.59	259.95	10,336.47	10,658.71	2.48	50%	10,237.64	10%
Chennai (DMU5)	4,617.16	343.83	4,404.05	4,830.27	7.45	40%	4,273.33	20%
Vizag(DMU6)	6,161.50	1,002.40	5,540.20	6,782.80	16.27	50%	5,159.10	20%
Kamarajar (DMU7)	36,087.10	4,102.95	33,544.07	38,630.13	1137	40%	31,984.15	20%
Cochin(DMU8)	9,352.55	535.64	9,020.56	9,684.54	5.73	40%	8,816.91	10%
New Mangalore(DMU 9)	13,712.30	895.90	13,157.02	14,267.58	6.53	60%	12,816.40	10%
Mormagoa(DMU10)	15,885.02	4,068.53	13,363.32	18.406.7I	25.61	50%	11 816 49	30%
Mumbai(DMU11)	13,128.00	1,622.65	12,122.27	14,133.73	1236	50%	11,505.35	10%
JNPT(DMU12)	4,988.25	936.75	4,407.65	5,568.85	18.78	60%	4,051.50	10%
Kandla (DMU13)	7,910.70	602.34	7,537.37	8,284.03	7.61	60%	7,308.36	10%

Source: Indian Port Association – Annual Reports compiled (2004 to 2019)

When taken together, the various data that are shown in Table 2 provide an overall picture of the internal regularity in AO that was seen in each port. An interval of confidence with a mean of 95% has been calculated, and its lower and upper bounds have been determined. In addition to that, the CV that represents the relative dispersion of AO for each port has been shown. According to the findings, Visakhapatnam has the highest level of consistency in AO (with a cv of 2.48%), whereas Mormugao has the highest level of inconsistency (with a cv of 25.61%) among all ports throughout the period of 2003-2013. The same is true for ATRT Tuticorin, Cochin, and Visakhapatnam; in thirty percent of instances, they have exceeded their own limit of (mean + standard

deviation). Ports like as Mormago, Paradip, Chennai, New Mangalore, Mormugao, J.L. Nehru, and Kolkata have surpassed the limit in twenty percent of the instances. In ten percent of the instances, the limit is surpassed in the areas of Haldia, Mumbai, and Kandla. As far as the DTOR is concerned, New Mangalore has never gone above its limit during the whole of the research." Next in line are the cities of Chennai, Cochin, and J.L. Nehru, which had excess in 10% of instances. In twenty percent of the situations, the remaining ports have exceeded their capacity. Throughout the whole of the research era, Tuticorin has never exceeded its limit in terms of information technology. In ten percent of the instances, the locations of Cochin, New Mangalore, Mumbai, and Mormugao have exceeded their bounds. There have been twenty percent of instances in which the limit has been exceeded in Paradip, Visakhapatnam, Mormago, Kolkata, J.L. Nehru, and Kandla. In thirty percent of the instances, both Haldia and Chennai have surpassed their own (mean plus standard deviation).

Findings

However, the rate component of the significant ports is essentially falling from 2008-2009. This is despite the fact that the significant ports handle the majority of the traffic when contrasted differently in reference to lesser ports. In spite of this, the ports that are not very major are seeing an increase in the volume of traffic year after year, which reached 22.81 percent during the 2018-2019 fiscal year. The amount of traffic that major ports are able to manage is indicative of their efficiency. The average score for Kandla port is 845483.35 tons based on the data. More traffic is being handled by the Kandla port as a result of this. The capacity of the Port of Kolkata was 32814.13 tons. A total of 23.59 percent of the compound annual growth rate is achieved by the Kamarajar port trust. It is followed by the port of Paradip, which accounts for 17.7 percent, and the port of Kandla, which accounts for 15.93 percent. The port of Haldia and Mormagoa had a negative growth rate of -4.70 percent and -17.47 percent, respectively, indicating that they experienced a negative growth rate.

CONCLUSION

This study's main goal is to show that Indian ports need criteria to enhance their performance in the present economic situation. Ports must fulfill performance standards to proceed. Annual performance indicators were used to eliminate seasonality in this study. Classifying by CPI/SCPI overall indicator appropriately represents operational parameters. Overcapacity causes key Indian ports to have high Turnaround Time (TRT) and low productivity. Indian ports lack modernization to accommodate new freight. Ports can use this study to evaluate their efficiency and improve to meet or exceed internal standards. Government measures are needed to help Indian ports compete worldwide and follow international standards. The research examined main port effectiveness. The port's operating depiction was inaccurate. Precision via resource usage, limited development plans, port upgrade scheduling, and effective time management affect suboptimal port operations' aggregate loading needs. Port infrastructure investment and turnaround time reduction must be assessed. The ports' operating efficiency would improve. With skill, we can build and expand ports on India's coasts.

REFERENCES

[1] Quintano, Claudio, Paolo Mazzocchi, and Antonella Rocca. "A competitive analysis of EU ports by fixing spatial and economic dimensions." Journal of Shipping and Trade5.1 (2020): 1-19.

[2] Abdoulkarim, Hamadou Tahirou, Seydou Harouna Fatouma, and Elijah Musango Munyao. "Dry Ports in China and West Africa: A Comparative Study." American Journal of Industrial and Business Management 9.03 (2019): 448.

[3] George Kobina, Van Dyck. Assessment of Port Efficiency in West Africa using Data Envelopment Analysis. American Journal of Industrial and Business Management. 2015; 5:208-218.

[4] Ziaul Haque Munim, Mohammad Hassan Shakil, Mashiyat Tasnia, Md. Kazi Golam Azam. Operational and Financial PerformanceAnalysis ofChittagongPort Authorityin Comparison with the Maritime and Port Authority of Singapore. European Journal of Business and Management. 2014, 6(38).
[5] Pjevcevic D, Radonjic A, Hrle Z, Colic V. DEA analysis for measuring port efficiencies in serbia. Promet- Traffic & Transportation, 2012; 24(1):63-72.
[6] Ahmed Salem Al-Eraqi, Carlos Pestana barros, Adli Mustaffa, Ahamad Tajudin Khader. Evaluating the Location Efficiency of Arabian and African Seaports Using DataEnvelopment Analysis (DEA), 2007. WP 09/DE/UECE
[7] Khalid, Bichou. Review of port performance approaches and supply chain framework to port performance benchmarking. Research in Transportation Economics. 2006; 17:567-59.
[8] ChandrasekaranN,MohankumarS.aWhitepaperonseaports:challengesandissuesin India, Confederation of Indian industry, 2005.
[9] Patrick,Fourgeau.Measuringportperformance,TheWorldBankreport,2000.
[10] Sehgal.P, Kumar.B, Sharma.M, Salameh A.A, Kumar.S, Asha.P (2022), Role of IoT In Transformation Of Marketing: A Quantitative Study Of Opportunities and Challenges, Webology, Vol. 18, no.3, pp 1-11
[11] Kumar, S. (2022). A quest for sustainium (sustainability Premium): review of sustainable bonds. Academy of Accounting and Financial Studies Journal, Vol. 26, no.2, pp. 1-18
[12] Marlow P, Paixao A. Measuring Lean Ports Performance. Proceedings of the International Association of Maritime Economists, Panama, 2002, 13-15.
[13] Martinez-Budria E, Diaz-Armas R, Navarro-Ibanez M, Ravelo-Mesa T. A Study of the Efficiency of Spanish Port Authorities Using Data Envelopment Analysis. International Journal of Transport Economics. 1999; 26:237-253.
[14] Terminals Using Data Envelopment Analysis. International Journal of Integrated Supply Management, 1, Jose L.Tongzon Determinants of port performance and efficiency.Pergomon, 1994; 29-A (3):245-252.
[15] Talley, Wayne K. Performance indicators and port performance evaluation, Logistics and Transportation Review. 1994; 30(4):339-345.
[16] Basic Port Statistics of India (2011–2012) Transport Research Wing, Ministry of Shipping, Govt. of India, New Delhi.
[17] Bichou, K. and Gray, R. (2004) 'A logistics and supply chain management approach to port performance measurement', Maritime Policy and Management, Vol. 31, No. 1, pp.47–67.
[18] Bryan, J., Weisbrod, G. and Martland, C.D. (2007) 'Rail freight as a means of reducing roadway congestion: feasibility considerations for transportation planning', Journal of the Transportation Research Board, Vol. 2008, pp.75–83.
[19] Dalkey, N. and Helmer, O. (1963) 'An experimental application of the Delphi method to the use of experts', Management Science, Vol. 9, No. 3, pp.458–467.
[20] De Langen, P.W. and Sharypova, K. (2013) 'Intermodal connectivity as a port performance indicator', Research in Transportation Business and Management, Vol. 8, pp.97–102.
[21] De Langen, P.W., Nijdam, M. and Van Der Horst, M.R. (2007) 'New indicators to measure port performance', Journal of Maritime Research, Vol. 4, No. 1, pp.23–66.
[22] Deshmukh, A. (2011) 'Indian ports-the current scenario', Working Paper No. 14, Dr. Vibhooti Shukla

Unit in Urban Economics & Regional Development, pp.1–22.
[23] i-maritime (2003) India Port Report: Ten Years of Reforms and Challenges Ahead, i-maritime Consultancy Pvt. Ltd., Mumbai [online] http://www.imaritime.com (accessed 14 December 2014).
[24] Indian Port Association (IPA) (2014) [online] http://www.ipa.nic.in (accessed 3 December 2014)
[25] International Chamber of Shipping (ICS) (2015) [online] http://www.ics-shippinp.org (accessed 2 July 2015).
[26] Jung, B. (2011) 'Economic contribution of ports to the local economies in Korea', The Asian Journal of Shipping and Logistics, Vol. 27, No. 1, pp.1–30
[27] Kasypi, M. and Muhammad, Z.S. (2006) 'A regression model for vessel turnaround time', Tokyo Academic, Industry & Cultural Integration Tour, December.
[28] Lee, S.W. and Kim, C.H. (2006) 'Performance evaluation of Asian port distriparks using factor analysis', Ocean Policy Research, Vol. 21, No. 1, pp.52–82.
[29] Marlow, P.B. and Paixao Casacaa, A.C. (2003) 'Measuring lean ports performance', International Journal of Transport Management, Vol. 1, No. 4, pp.189–202.
[30] Ministry of Shipping (MoS) (2010) Performance Audit of Functioning of Major Port Trust in India, Report No. 3 of 2009–2010, Chapter V, pp.1–15.
[31] Ministry of Shipping (MoS) (2014) [online] http://www.shipping.nic.in (accessed 4 December 2014).
[32] Puiga, M., Wooldridgeb, C. and Darbraa, R.M. (2014) 'Identification and selection of environmental performance indicators for sustainable port development', Marine Pollution Bulletin, Vol. 81, No. 1, pp.124–130
[33] Saaty, T.L. (1980) The Analytic Hierarchy Process, McGraw Hill International, New York
[34] Sanchez, R.J., Hoffmann, J., Micco, A., Pizzolitto, G.V., Sgut, M. and Wilmsmeier, G. (2003) 'Port efficiency and international trade: port efficiency as a determinant of maritime transport costs', Maritime Economics and Logistics, Vol. 5, No. 2, pp.199–218.
[35] Trujillo, L. and Nombela, G. (1999) Privatisation and Regulation of the Seaport, Industry Policy Working Paper 2181, World Bank, Washington DC.
[36] UNCTAD (1976) Port Performance Indicators, United Nations, New York
[37] UNCTAD (2013) Review of Maritime Transport, United Nations, Geneva.
[38] ADB. (2020). Smart Port in the Pacific. (pp. 1-38). Asian Development Bank. https:/ /www.adb.org/publications/smart-ports-pacific
[39] Andrew, A., Ragin, C. C., & Becker, H. S. (1992). What do cases do? Some notes on activity in sociological analysis. Ragin Charles C. & Becker Howard S. (Eds),What is a case, 53-82.
[40] Bhandari, P. (2022, January 3). Triangulation in Research | Guide, Types, Examples. Scribbr. https://www.scribbr.com/methodology/triangulation/
[41] Bichou, K. (2007). Review of port performance approaches and a supply chain framework to port performance benchmarking. In Brooks, M. R., & Cullinane, K. (Eds.), Devolution, Port Governance and Port Performance. (pp. 567-598). Elsevier, London.
[42] Cahoon, S. (2007). Marketing communications for seaports: a matter of survival and growth. Maritime Policy & Management, 32(2), 151-168. doi: 10.1080/ 03088830701240342
[43] Deerod, Kanchisa. (2018). Developing port marketing strategies: a case study for Bangkok Port, Thailand. World Maritime University Dissertations.
[44] Dubois, A., & Araujo, L. (2007). Case research in purchasing and supply management: opportunities and challenges. Journal of Purchasing and Supply Management, 13(3), 170-181. doi:

10.1016/j.pursup.2007.09.002
[45] Duran C. A., & Cordova F. M. (2016). Conceptual model to identify Technological Synergic Relationships of strategic level in a medium-sized Chilean Port. Procedia Computer Science, 91, 382-391. doi: 10.1016/j.procs.2016.07.100.
[46] Dwarakish, S., & Salim, A. M. (2015). Review on the role of Ports in the development of a Nation. Aquatic Procedia, 4, 295-301. doi: 10.1016/j.aqpro. 2015.02.040.
[47] Indian Brand Equity Foundation (IBEF). (2021, December 1). Indian Ports Analysis Industry Analysis | IBEF. India Brand Equity Foundation. https://www.ibef.org/ industry/indian-ports-analysis-presentation
[48] Indian Brand Equity Foundation (IBEF). (2022). Shipping Industry: Largest Port in India | IBEF. India Brand Equity Foundation. https://www.ibef.org/industry/portsindia-shipping
[49] Parola, F., Pallis, A. A., Risitano, M., & Ferretti, M. (2018). Marketing strategies of port authorities: A multi-dimensional theorisation. Transport Research Part A: Policy and Practice, 111, 199-212. doi: 10.1016/j.tra.2018.03.012
[50] Press Information Bureau. (2022). Ministry of Ports, Shipping and Waterways.