International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: RJIF 5.72
www.allsubjectjournal.com
Volume 3; Issue 6; June 2016; Page No. 323-327

An assessment of Indian major sea ports performance and efficiency

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Abstract
Sea ports are an essential strategic infrastructure which leads to export growth and merchandise trade. As per the Review of Maritime Transport 2015, the contribution of developing countries towards the world merchandise trade is around 40 per cent whereas India is in the sixteenth place for its maritime infrastructure. However, India's seaport performance is well below the benchmark of international productivity. Therefore, an attempt is made to assess the operational performance of ports in terms of vessel, container and total traffic handled during the last decade. As per the results among thirteen major ports, seven ports performance seems to be increasing but still inefficient with their existing infrastructure and other ports are efficient ports. Therefore, the optimum utilization of the infrastructure is needed for sustainable growth of the nation.

Keywords: Major Ports traffic, Operational inputs, Efficiency measurement, Basic Radial model

Introduction
Globalization of world economy has experienced a rapid growth in shipping industry and merchandise trade. Sea ports take a long gestation period for planning and development which involves a huge financial input and resources. During 2014, a major gridlock on the docks of world top ranking sea ports of Asia and America suffered from traffic congestion. Hence, the developing nations have shown interest in sophisticating their infrastructure to improve the operational efficiency through mechanization and to compete in International Maritime industry. India is one of the biggest peninsulars in the world, which is served by 13 major ports and 187 minor ports which facilitate global and Indian merchandise trade. The eastern and western coast lines have seven and six ports respectively. The growth in India is undoubtable; as it is placed among the top five manufacturing outsource destinations in the world trade. The ministry of external affairs has reported that the capacity utilization through 2014–15 was around 66 per cent and the turnaround time of 2.11 days which take only hours in various developing economies. This indicates a positive picture in the performance of Indian ports, but its productivity share was 1.7 per cent in world throughput which is well below the benchmark of international productivity.

Objective
The major objective of this study is to assess the efficiency of the major sea ports in India by analyzing the performance of 13 major sea ports during 2004-05 to 2013-14 based on the performance indicators.

Review of Literature
Jose L. Tonzen (1994) designed a model to determine port performance and efficiency, in which two variables are taken; one is terminal efficiency and the other is port performance strategies. It was proved that terminal efficiency is the significant contributor to enhance the port performance and there are various other factors like economic activity, geographical location and frequency of ship calls.

Patrick Fourgeau (2000) [7] referred the World Bank report which has defined the primary way of measuring port performances by framing certain basics like usage of port equipments such as cranes and quay operations with their performing capacities, average turnaround time of the ship and lead time taken for a particular shipment. The commodities handled can be segmented as dry bulk, break bulk, liquid bulk and containerized cargos for the measurement of their operations in a particular berth or quay.

Marlow P. and Paixao.A (2002) [8] applied the Data Envelopment Analysis for eight Japanese ports for 10 years in which Tokyo was found to be consistent in its efficiency whereas Yokohama, Kobe and Osaka were found to be inefficient. The ports input and output variables clearly defined the efficiency which resembled the earlier studies.

George Kobina van Dyck (2015) [1] had chosen six major ports of West Africa to assess the efficiencies through DEA model. The container throughput levels were identified as output variable. The terminal area, quayside cranes, number of yards, reach stackers, berth length of the terminals were taken as the input variables. Port of lagos, the largest in terms of size and throughput among the sample, resulted with 76 per cent of efficiency whereas the three landlocked ports were highly efficient in their performance. It concluded that the West African ports are reasonably efficient with the given resources.

Methodology
The operational performance of the ports is more influential than their financial performance for the ports management. In this study, the performance of major ports in terms of select indicators such as total traffic, container traffic and vessel traffic handled for the past 10 years from 2004 -05 to 2013-14 was assessed by Descriptive statistics and their growth was measured by Compounded Annual Growth Rate(CAGR). The performance output is the total cargo handled by the ports in

association with the operational inputs like berths, storage capacities and the equipments in ports. The Data Envelopment Analysis (DEA) model was applied to measure the port efficiency which was a popular and accepted model for measuring the port efficiency in earlier studies like Danijela pjevcevic and Aleksandar ranonjic (2011), Stefano Maria Osorio Nigra (2010) Ahmed Salem Al-Eraqi, Carlos Pestana barros and Adli Mustaffa (2007) [4].

Analysis

Total Traffic by All Ports

The Table 1 shows the year wise traffic handled by major and non-major ports in India during the period of study. The major ports handle the majority of the traffic when compared to non-major ports but the percentage share of the major ports is drastically declining from 2008-09. But the non-major ports are handling more traffic year after year and reached 42.89 per cent during 2013-14, revealing that the non-major ports are also performing on par to major ports and the major ports capacity utilization is diminishing gradually which is to be addressed immediately.

Table 1: Traffic Handled By Major and Non-Major Ports in India

Year	Major Ports (In Million Tonnes)	Non-Major Ports (In Million Tonnes)	Total (In Million Tonnes)	% 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	463.78	186.12	649.9	71.36	28.64
2007-08	519.31	203.62	722.93	71.83	28.17
2008-09	530.53	213.2	743.73	71.33	28.67
2009-10	561.09	288.86	849.95	66.01	33.99
2010-11	570.03	314.85	884.88	64.42	35.58
2011-12	560.13	353.02	913.15	61.34	38.66
2012-13	545.79	387.87	933.66	58.46	41.54
2013-14	555.5	417.13	972.63	57.11	42.89

Source: IPA E-magazine

Total Traffic Handled by Major Ports

The total traffic handled by the major ports of India for the period 2004-05 to 2013-14, is shown in Table 2. The Port of Kandla has the highest mean score of 70206 tonnes followed by Vizag 60934 tonnes and JNPT 54603 tonnes whereas the Port of Kolkata has the lowest mean score of 12190 tonnes. Among the 13 major ports, the high CV notified with Kamarajar port reveals the inconsistency in traffic handling whereas the low CV reported by New Mangalore port reveals the consistency in traffic handling. The CAGR analysis reveals the optimum growth rate of 23.59 per cent attained by Kamarajar port trust followed by Port of Paradip 17.70 per cent and Port of Kandla 15.93 per cent whereas, Port of Haldia and Mormagoa showed a negative growth with -4.70 per cent and -17.47 per cent respectively.

Table 2: Descrptive Statistics for Total Traffic Handled by Major Ports (in tonnes)

Year/Ports	Calcutta	Haldia	Paradip	Vizag	Chennai	Voc	Kamarajar	Cochin	New Mangalore	Mormugoa	Mumbai	Jnpt	Kandla
2004-05	9945	36262	30104	50147	43806	15811	9480	14095	33891	30659	35187	32808	41551
2005-06	10806	42216	33109	55801	47248	17139	9168	13938	34451	31688	44190	37746	45907
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
MEAN	12190	36846	48243	60934	54185	22896	13431	17045	34951	34070	52319	54603	70206
SD	1104	6876	12124	5856	5664	4805	5550	2562	2444	12204	7356	11911	18088
CV %	9.06	18.66	25.13	9.61	10.45	20.99	41.32	15.03	6.99	35.82	14.06	21.81	25.76
MAX	13741	48000	68003	68041	61460	28642	27337	20887	39365	50022	59184	65727	93619
MIN	9945	28084	30104	50147	43806	15811	9168	13938	31550	11739	35187	32808	41551
CAGR	5.30	-4.70	17.70	3.13	3.13	12.62	23.59	8.18	3.04	-17.47	10.96	13.70	15.93

Source: *www.ipa.nic*

Total Vessel Traffic

The Table 3 reveals the total vessel traffic handled by the major ports in India. The JNPT ranks first with a highest mean value of 2740 vessels whereas Kamarajar port registers with 260 vessels, which was the lowest vessel traffic during the study period. However, the Kamarajar Port has a CAGR of 23.4 per cent which was growing rapidly with high CV of 39 per cent in contrast the Port of VOC and Mormugoa have registered a negative growth rate of 3.15 and 6.92 respectively.

Table 3: Descriptive Statistics for Vessel Traffic Handled By Major Ports (In Nos)

Ports/Year	Calcutta	Haldia	Paradip	Vizag	Chennai	Voc	Kamarajar	Cochin	New Mangalore	Mormugoa	Mumbai	Jnpt	Kandla
2004-05	765	1889	1041	1704	1656	1517	166	1133	879	677	1800	2126	1823
2005-06	767	2086	1209	1843	1669	1479	171	1120	1067	664	1883	2324	1940
2006-07	767	2086	1330	2109	1857	1576	173	1225	1087	642	2153	2395	2194
2007-08	904	1889	1452	2099	2059	1533	201	1176	1039	699	2236	2775	2124
2008-09	1012	2373	1513	2346	2052	1602	213	806	1144	443	1709	3106	2598
2009-10	1057	2398	1536	2347	2078	1524	250	757	1184	435	1612	3096	2776
2010-11	1299	2163	1531	2406	2131	1414	273	872	1186	465	1639	2973	2517
2011-12	1327	2189	1506	2507	2181	1402	294	1255	1121	948	2156	3100	2692
2012-13	1222	1962	1342	2470	2043	1492	385	1382	1155	785	2057	2916	2714
2013-14	1234	1921	1279	2066	1928	1292	475	1367	1096	473	1949	2588	2734
MEAN	1035	2096	1374	2190	1965	1483	260	1109	1096	623	1919	2740	2411
SD	227	187	165	271	184	92	102	224	90	169	227	360	358
CV	21.93	8.93	11.98	12.37	9.37	6.19	39.14	20.22	8.24	27.16	11.82	13.15	14.83
MAX	1327	2398	1536	2507	2181	1602	475	1382	1186	948	2236	3106	2776
MIN	765	1889	1041	1704	1656	1292	166	757	879	435	1612	2126	1823
CAGR	10.03	0.33	4.20	3.92	3.08	-3.15	23.4	3.82	4.51	-6.92	1.60	4.01	8.44

Source: www.ipa.nic

Total Container Throughput

The Table 4 depicts the container throughput of major ports for the study period.

Table 4: Descriptive Statistics for Total Container Throughput of Major Ports in India (IN 000 TEU'S)

Ports/ Year	Calcutta	Haldia	Paradip	Vizag	Chennai	Voc	Cochin	New Mangalore	Mormugoa	Mumbai	Jnpt	Kandla
2004-05	2357	2029	31	635	9864	3205	2315	136	117	2571	28747	2754
2005-06	3234	1711	45	630	11756	3428	2539	149	105	1957	33777	2311
2006-07	4003	1918	31	799	14166	4011	2949	265	127	1580	40810	2778
2007-08	5139	2242	54	1133	18049	5630	3239	319	135	1632	51923	2639
2008-09	5483	5483	31	1362	20581	5482	3521	404	147	1291	50602	2143
2009-10	6646	2010	44	1678	23477	6599	3928	475	192	606	53095	2436
2010-11	6220	2835	61	2572	29422	8169	4299	568	182	653	56426	2586
2011-12	6818	2619	109	4214	30076	9227	4583	645	231	551	53095	2791
2012-13	6960	2869	171	4554	29708	9372	4607	692	213	829	57911	1935
2013-14	7062	2202	99	4916	28330	10129	4785	747	235	450	55234	452
MEAN	3714	1778	41	1290	13563	4190	2615	244	113	3256	31523	1894
MAX	7062	5483	171	4916	30076	10129	4785	747	235	8098	57911	2791
MIN	1411	51	0	94	2308	758	796	0	19	450	4069	452
SD	1680	1088	50	1702	7825	2580	898	221	48	712	10111	704
CV	45.24	61.19	121.3	131.99	57.70	61.57	34.34	90.71	42.74	21.87	32.07	37.18
CAGR	24.54	1.65	26.14	50.58	23.49	25.88	15.63	40.59	14.97	-29.43	13.95	-30.33

***Source*:** www.ipa.nic

Note: TEU-Twenty foot Equivalent Units

The CAGR of the port of Vizag is showing a tremendous growth of 50.58 per cent whereas the Ports of Mumbai and Kandla have registered a negative growth of 29.4 and 30.3 per cent respectively. JNPT holds the highest mean of 31523 TEU's and a maximum throughput of 57911 TEU's among all the major ports in India. Further, the CAGR was 13.95 per cent with a low Co-efficient of Variance of 32.07 revealing the stability in the container traffic throughput of JNPT. The Port of Chennai with a second highest mean value of 13563, CAGR of 23.49 per cent indicates that it is emerging as a container handling port trust in Eastern coastal lines of India next to Vizag.

Dea –Basic Radial Model - Efficency Measurement

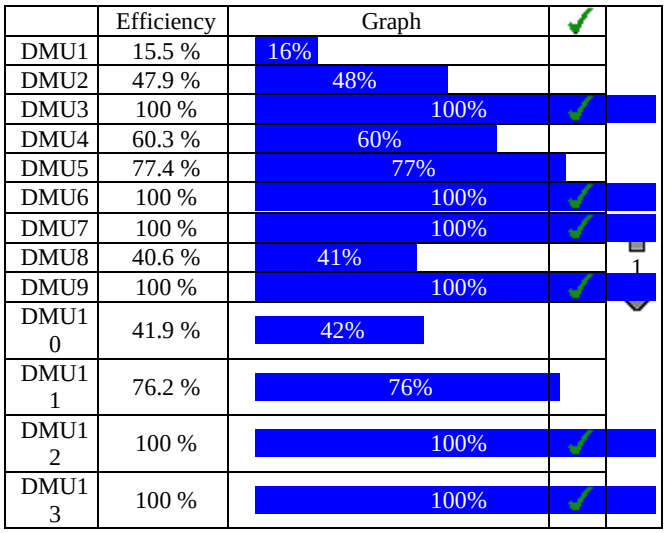
The DEA basic model was applied to measure the efficiency of ports by single period model with constant returns to scale. The Table 5 displays the input output variables taken for the analysis and Graph 1 explains the results with the efficiency scores of the ports. The Ports Paradip, VOC, Kamarajar, New Mangalore, JNPT and kandla are showing 100 per cent efficiency, and therefore, these ports are performing efficiently by optimum utilization of the available inputs and resources. The rest of the Ports productivity is more i.e. the output is more than the efficient ports but, they do not use the resources effectively.

Table 5: Input Output Variables of the Major Ports in India

Ports/I &O	Berth (I) (Nos)	Storage (I) (In Sq Mts)	Equipments (I) (Nos)	Traffic (O) (In Tones)	Efficiency %
Kolkata (DMU 1)	33	328981	93	12874	16
Haldia (DMU 2)	19	921840	39	28511	48
Paradip (DMU3)	18	2207476	14	68003	100
Vizag (DMU4)	23	3499988	44	58503	60
Chennai (DMU5)	24	596473	189	51105	77
Vizag (DMU6)	6	899645	20	28642	100
Kamarajar (DMU7)	15	1180964	0	27337	100
Cochin (DMU8)	20	273487	67	20887	41
New Mangalore(DMU 9)	16	109124	6	39365	100
Mormagoa (DMU10)	9	424380	11	11739	42
Mumbai (DMU11)	31	296290	65	59184	76
JNPT (DMU12)	12	4786562	513	62333	100
Kandla (DMU13)	27	1517824	31	87004	100

Source: IPA Profile

Note: I-Input O-Output



Graph 1: Efficiency Graph of the Major Ports

Port of Kolkata registers a very low efficiency score of 16 per cent though CAGR for the total tonnage of traffic handled by the port is positive. The overall traffic performance of this port is showing a positive trend though the efficiency is least. This reveals that the performance efficiency of the ports may not reflect in their operational output.

Ports of Haldia, Cochin and Mormagoa have 48, 41 and 42 per cent respectively, which are below 50 per cent but their tonnage handled are positive enough in their growth. These ports show very less handling of containerized cargo, and hence, they can inbuilt and increase their capacity to improvise it.

Port of Chennai and Mumbai have 77 and 76 per cent efficiency respectively wherein; the Chennai port has 23.4 per cent growth whereas the Mumbai port shows -29.43 per cent in container traffic. The traffic handled by these ports are positive but at a decreasing rate of 3.13 and 10.96 per cent for Chennai and Mumbai respectively. The vessel traffic handled is growing but at a very low rate of 3.08 and 1.60 per cent.

Suggestions

- The major ports share per cent was declining steadily from 2006-07 onwards, in turn the non major ports were gaining more share year after year. Hence, the Port management has to take it as a high time to regulate the work performing strategies and target oriented policies.
- The Container handling ports like JNPT, Chennai and Vizag stand at top positions, can invite private sector participation for development of the terminals to gain more traffic in future.
- The Port of Kolkata, Haldia, Cochin and Mormagoa were inefficient among the major ports as their efficiency scores were below 50 per cent. Moreover, these ports were not utilizing the existing resources like berths, equipments and storage space to an optimum level. The Strategic alliances with surrounding non major ports will enhance and enable resource integration but shared complementary functions can be done only by motivating the small ports and less efficient ports.

- The state can identify the prospective ports and make them specialize in certain type of cargos based on the Manufacturing sectors and industries which do foreign trade in that geographical region.
- Domestic private capital may be encouraged for small and medium size ports, which can develop its infrastructure and further, share the large ports traffic and reduce port congestions and promote inland water transport.

Conclusion

Growth in the merchandise trade is massively increasing in intra company trade by MNCs as they offshore their production to different parts of the world depending on the cost and other strategic considerations. India is aiming to be investor's hub especially in the manufacturing industry and the global trade supply chains expand rapidly in the foreseeable future with the growing customer needs which demand for up gradation of the infrastructure of the country. Modernization of Indian infrastructure and optimum capacity utilization of resources in sea ports are the need of the hour to cope up with the world standards. Hence, the ports and shipping industry is bound to undergo substantial changes in their maritime web. The study has measured the performance of the ports and has found that the efficiency of the ports may not reflect in their operational output. Further, the inefficient ports management has to concentrate on increasing their efficiency by optimum utilization of resources, capacity augmentation plans, suitable port development policies, effective time management strategies like reduction of average turnaround time and idle time to attain the benchmarks. Chinese port infrastructural development models were quite challenging through the way of private participation in ports and shipping industry. This provides a route map for India to attain the global standards in the infrastructure arena.

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