

# Analysis of Factors Considered by Shipping Lines and Agencies in Selecting a Container Terminal for their Operations within Colombo Port Complex, Sri Lanka

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**Abstract** - Proclivity of a shipping line towards a container terminal is imperative and it itself becomes a critical success factor which brings a competitive advantage to the terminal. The research was carried out with the objective of analysing the factors considered by shipping lines and agencies in selecting a container terminal for their operations within Colombo port complex Sri Lanka. Data were collected through a questionnaire survey, targeting two hundred Managerial and Executive level staff in selected Shipping lines/Shipping Agencies based on stratified random sampling method and 81.5% valid responses received with .928 Cronbach's Alpha value in Reliability Statistics of data. The Descriptive analysis of collected results has shown that "Efficiency in loading and discharging, Efficiency in terminal handling facilities and 24 hr. / 07 days a week service" as the significant factors in selection process. According to the Factor Analysis, Convenience Measures, Operational Efficiency, Port and Terminal Structure, Port Services, Logistic Services and Safety have been identified as terminal selection criteria in the Colombo port premises, Sri Lanka and Convenience Measures factor being the most significant criteria among the identified thirteen factors. The study has further suggested that the use of port marketing concepts as, direct marketing and more value added services such as, providing provisions, water, food and other recreation facilities, which help the terminals to develop a preference towards them among shipping lines.

**Keywords:** Factor Analysis, Container Terminals, Terminal Selection

## I. INTRODUCTION

International maritime trade is a chain that connects ports, inland-transport, terminals, shipping lines / agencies, freight forwarders and merchants. Maritime trade had begun in early BCE (Before the Common Era) and had developed with the technology and evolution of trade.

Containerization has gradually become one of the most important operations of international trade, which serve major markets.

A container Shipping Line operates ships that actually carry containers (owned or leased) from port of loading (POL) to port of discharge (POD). There are 130 Licensed Ships' Agents members are operating in Sri Lankan ports (CASA 2012).

The strategic geographical location of Sri Lanka has revolved Colombo as an important maritime hub in international trade. As Portuguese, Dutch and British, invaded the country, Port of Colombo had known to the Western World.

The requirements considered by shipping lines/agents in terminal selection in order to foster in the industry. Even though the past studies provide evidence that there is a gap between the above scenarios in the industry. Accordingly it is clear that a proper study is required to fulfil the gap between, the demand and the supply of the terminal operations and the shipping lines commercial requirements

With reference to the above situation the aim of the study has been generated to identify the most important factors that have direct impact on terminal preference by a shipping line with special reference to the Colombo port complex in Sri Lanka.

The significance of the study expanded towards to cultivate foreign capital investments, heighten productivity and to sharpen the trade by increasing the terminals' attractiveness.

The overall structure of the dissertation has designed to answer the research question, that is:

*What are the factors, considered by shipping lines and shipping agencies in selecting a container terminal for their operations within Colombo port complex in Sri Lanka?*

## II. METHODOLOGY AND EXPERIMENTAL DESIGN

### A. *Emergence of Maritime Trade In Port of Colombo*

As the maritime trade blossoms, many regulatory needs had arisen. Port authorities had formed to address the legal & regulatory needs of ports/terminals. Colombo Port Commission had established in 1913. The first stage of Jaye Container terminal (JCT) was built in 1985 and Unity Container Terminal (UCT) (1998) had started (SLPA 2014). The first modern private container terminal, South Asia Gateway Terminals (Pvt) Ltd. (SAGT) has established in 1999 (SAGT 2014). Finally, Colombo International Container Terminal (CICT) was built in 2013 (CICT 2012).

### B. *Variables For The Study*

As per the literature review, under efficiency, infrastructure, charges, political and regulatory, level of service, response, accessibility and usage of IT and has been identified as the key areas to refer in order to identify the variables as follows.

**Efficiency**-The earlier exploratory studies by Malchow & Kanafani (2004), Saeed & Aaby (2012), Park & Hokey (2011), Tai & Hwang (2005), Lu, Gong & Wang (2011), Langen (2006) and Macco, Diller & Clark (2004) had mentioned that "efficiency" as one of the major key factors in port choice.

**Infrastructure**-Chang, Lee & Tongzon (2007) had classified "six (06) groups of transportation infrastructure" as ports infrastructure, canals and waterways infrastructure, air infrastructure, rail infrastructure, road infrastructure and warehousing infrastructure. The studies of Wiegman, Hoest & Notteboom (2009), Murphy & Daley (1994), Lu, Gong & Wang (2011) and Tongzon (2007) had showed that the adequate infrastructure is an important factor in the port selection process.

**Charges**-Tongzon (2007), Bruse and Wilson (2006), Grosso & Monteiro (2008), Park & Hokey (2011), Chang, Lee & Tongzon (2007) and Slack (1985) has found that port charges, container-handling cost and terminal contract cost has identified as significantly affecting factor to the port selection decision.

**Response**-The earlier studies on "port choosing" have indicated that, 'behavioural factors' are similarly important in port choice. The studies conducted by D'Este & Meyrick (1992), Langen (2005), Ogwude, Ugboma & Ugboma (2006), Asperen (2009) and Murphy

& Daley (1994) have proved that the degree of responsiveness they get from the port has influential effect on selection process.

**Political & Regulatory**-Cheraghi, Khaligh & Naderi (2012), Malchow & Kanafani (2004), Tai & Hwang (2005), Saeed & Aaby (2012), Park & Hokey (2011), Yeo, Roe & Dinwoodie (2008), Olivier, Parola, Slack & Wang (2007), Felicio, Caldeirinha & Dionisio (2013) and Saeed (2009) have conducted a surveys aiming to determine carriers' selection criteria with the terminal layout policies and public privet terminal agreements.

**Level of Service**-The studies done by D'Este and Meyrick (1992), Felicio, Caldeirinha, & Dionisio (2013), Lu, Gong & Wang (2011) and Yeo, Roe & Dinwoodie (2008) have highlighted that frequent liner/feeder services, logistics value-added service, Container pre-declaration service, zero waiting time service are as one of the significant factors in selection criteria.

**Accessibility**-According to the studies carried out by Grosso & Monteiro (2008), Langen (2005), Yeo, Roe & Dinwoodie (2008), Toy & Cullinane (2000) and Slack (1985), they had reasoned that, a competent link between road, rail and port premises plays an important role in port selection process by reducing transport cost for freight transportation.

**IT Usage**-The studies conducted by Yeo, Roe & Dinwoodie (2008), Grosso & Monteiro (2008) and Park & Hokey (2011) have indicated that key factors for port competitiveness have shifted away from hardware and labour towards software and technology. The study has showed that the most competitive ports have depended on efficient hinterland logistics systems and information system.

**Other Factors**-D'Este and Meyrick (1992) have done a survey on investigating factors that contribute to choice of a port depending on its operational manner and port's reputation for cargo damage and cargo safety has popped up as an important tool in port selection.

### C. *Population and Sample*

The marked population of this research has been taken as the management level and executive level employees in shipping lines/agencies, which engaged in container transportation and operation in selected four terminals i.e. JCT, UCT, SAGT and CICT.

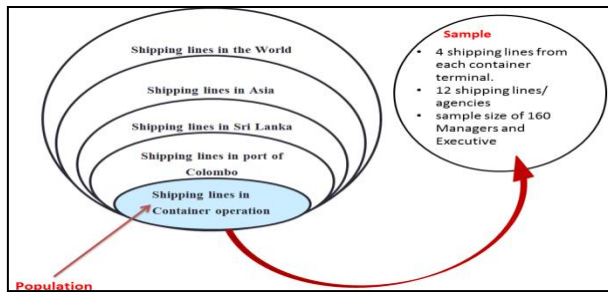


Figure 1. Population and the sample of the research;

The sample has been taken by selecting four (04) shipping lines from each container terminal. There were 160 Managers and Executives from Operations, Planning, and Sales& Marketing dept. of shipping lines/agencies have been used for the survey.

#### D. Sampling Method

As the survey addresses more than one stratum (groups) in the population, "Stratified random sampling" has been used as the sampling method.

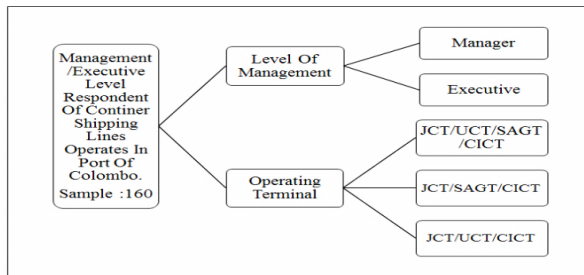


Figure 2. Sample of the research

#### E. Sources of Data Collection

In Sri Lankan proximity, there has been a shortage in availability of secondary data sources or researches related to this subject so that the research has been initialised by using primary data. Primary data has been collected by a questionnaire survey and books, journals and websites have been used as secondary data sources.

#### F. Methods of data collection

The questionnaire survey method has used to collect data. A structured questionnaire has personally handed to employees of shipping lines and agencies. One hundred and sixty (160) valid responses were received back from the distributed two hundred questioners marking 81.5 present (81.5%) response rates.

The questionnaire is consisted of two parts as Part A and Part B. General information about the shipping line was included to Part A and Part B is consisted of nine (09) main factors that have identified through literature

survey. There had been fifty-four (52) subordinate questions based on these main factors. The questionnaire has rated by giving it a weight from one (1) to five (5) according to the Likert scale (Likert 1932).

#### G. Data analysis tools and methods

SPSS, statistical software for social science has been used for statistical analysing of the collected data. Data coding has been done by converting qualitative data to numerical values. Cronbach's alpha test has been done to ensure the reliability of the data set Bartlett's statistic has been used to test the equal variance of the data and the Kaiser-Meyer-Olkin (KMO) has used to test the sampling adequacy of the data set to run a factor analysis. Descriptive statistics has been used to simplify the large amounts of data in a sensible way. The Crosstabs has provided a variety of measures in a two-way table. Factor analysis has been used as a statistical technique, and has created new factors to reflect the common idea of the cluster of variables used in the study.

### III RESULTS AND DISCUSSION

#### A. Descriptive Analysis

1) *Operating Terminal and Nature of Company Cross-tabulation:* The results have shown a percentage of 72.5 present (72.5%) has operated in all four terminals of the research area. The research sample has consist of 48.8 present (48.8%) main lines and 30.6 present (30.6%) of feeder lines and 20.6 (20.6%) present of shipping agencies. This result has concluded that the sample represent preferences of target population.

2) *Descriptive Statistics of Variables:* The analysis has denoted that 'Efficiency in loading and Discharging', '24 hr./07 days a week service' and 'Efficiency in terminal handling facilities' has considered as the primary influences of port choice factors. These three variables have the highest mean value (i.e. 4.68, 4.61, and 4.60) and the lowest Standard deviation values (i.e. 0.467, 0.625, and 0.516). The result has highlighted "Safety and security, No QCs per vessel" which laid around mean value of 4.60-4.50, as the secondary influential factors in port selection. The variables which has bested within mean value of 4.50-4.50 has been identifies as the tertiary influential factors in port selection process.

#### B. Factor Analysis

1) *Reliability Test:* The Cronbach alpha valve has occurred as .928 for 52 no of items, which has stated as an "Excellent Reliability figure" by proving the reliability of the data set.

2) *KMO and Bartlett's Test*: The KMO value of the data has appeared as .726. This value lay between  $0.7 \leq kmo < 0.8$  and has termed as "middling kmo figure". This proved that the data set could use for the factor analysis.

3) *Bartlett's Test of Sphericity*: Bartlett's test of Sphericity has given the significance level as .000 (<.05). This has indicated that the variables used in the study have been unrelated and unsuitable for structure detection.

4) *Total Variance Explained Using PCA*: As the study has requested that Eigenvalues greater than one (>1) has to be extracted as principle components, the analysis indicated that the study has 13 principal components. The Cumulative percentage column has given that the percentage of variance has accounted 78.488 for the first 13 components of the study. The Extraction Sums of Squared Loadings of the analysis have explained that the first 13 components of the study have 78.488 present (78.488%) of the variability. There is only 21.512 present (21.512%) loss in the total set. The Rotation Sums of Squared Loadings of the data set has ambient changes in the individual totals with comparing to the Extraction Sums of Squared Loadings.

5) *The Scree Plot*: The analysis has plotted all the principal components. The component on the steep slope best represents 13 first-rated principal components. The study has 39 components on the shallow slope, which has given a slight contribution towards selection process.

#### C Equation for Factors

The factor analysed of the study have resulted the above findings. These results have used to formulate equations with Component Score Coefficient Matrix values to express the relationship between observed variables and the generated components. As Extraction values of the Communalities table are higher than 0.5, hence the model is mathematically valid. The model is as follows;

$$F_i = \sum (z * \text{appurtenant variable of the component } i)$$

Here the i value has been the variable, (i = 1,2,3,4,5,6,7,8,9,10,11,12,13)  
'z' value has been the Component Score Coefficient Matrix of each variable.

#### D Principal Components Extracted from Factor Analysis

1) *Component 01-Convenience Measures*: This category have included 'Efficiency in customer declaration, Berth service capacity of ship size, No QCs per vessel, Quick

response to port user needs, Port policy and regulation, 24 hr. and 07 days a week service, Reliability in Estimated Time Of Departure (ETD), Length of berthing time, Length of operation time, Level of congestion and Reputation for cargo damage'. According to the study, the "Convenience measures" factors are highly significant in terminal selection with a 15.587 present (15.587%) variance.

2) *Component 02-Operational Efficiency*: The study has pointed out that 'Efficiency in loading and Discharging, Efficiency in terminal handling, Port tariff and Use of Terminal Information System' with a variance of 8.287%. Study has identified that those factors have a significant influence over the terminal selection criteria.

3) *Component 03-Port and Terminal Structure*: The component 03 includes 'Structure of port authorities, Terminal organisation structure, Recognition /reputation of terminal and Container terminal layout' with a variance 7.324%. As the study has highlighted such factors, it is confident that (Port and terminal structure) has a vital attribute towards terminal selection.

4) *Component 04-Port Services*: The port service factor has 6.884 present (6.884%) of total variance and includes, 'Pilot and tugs boat services, Zero waiting-time and berth on arrival, Promptness of document handling, E-commerce'.

5) *Component 05-Logistic Services and Safety*: Logistics and value added services, Container pre-declaration service and Safety and security measures have been clustered under one component named "Logistic Services and Safety" with a 6.509 present (6.509%) of total variance.

6) *Component 06-Accessibility and Storage*: Accessibility and storage includes 'Storage and warehousing facilities, Deviation from main shipping route and Access to alternate ports' and has a 5.749% of variance.

7) *Component 07-Customer Relationship Management*: The study has clearly segmented "Customer relationship component" with a total variance of 5.181 present (5.181%) and has included 'Personal Contacts, Privileged ownership contract, and Host customer seminars regularly'.

8) *Component 08-Container cargo rate*: 'Container cargo rate' has highlighted as an important individual factor in port and terminal selection process. It has total variance of 5.092 %.

9) *Component 09-Hinterland Transport and Container Service*: The component 09 has highlighted that 'Efficiency in hinterland transport, Inland transport price for road rail, Container maintenance service, and Rail road access /intermodal link' (variance of 5.028%) as port selection preferences of the study. Hinterland Transport is an emerging concept in port selection process in Sri Lanka.

10) *Component 10-No of Vessel Calls*: The observations of the study has pointed out that 'No main shipping lines in terminals, No feeder lines in terminals' as a single component which has an significant influence in port selection criteria with a 4.095 present (4.095%) of total variance.

11) *Component 11-Water Depth in Approach Channel and Berth*: 'Water depth in approach channel and berth' has identified as an individual factor in this study. In Sri Lankan port selection scenario, water depth of the port and approach channel has a significant influence with a variance of 3.487%. Most Ships arrive to terminals in port of Colombo has been laden hence; water depth has been a crucial factor in port choice.

12) *Component 12-Handling Special Cargo/ Service*: 'Handling special cargo/ service' has identified as an individual factor in this study with a total variance of 2.876 present (2.876%).

13) *Component 13-Shipping Alliance / Terminals Investment*: 'Shipping alliance and investment-dedicated terminals' has been found as an individual selection factor in Sri Lankan port choice scenario with a variance of 2.389%. 'The alliance of shipping lines and investment dedicated terminals' has been a decisive factor in terminal selection process, as it has a direct impact on the policy of the terminal and terminal selection policy of each shipping line/agency.

#### IV. DISCUSSION AND CONCLUSION

##### A. *Limitations of the Study*

The scope of the study has been limited to port selection behaviour of container shipping lines calling the main four (04) Container Terminals in port of Colombo only. Port selection behaviour of shipping lines/agencies calling in other ports in Sri Lanka, could be different from the findings of this survey. This limitation can be overcome by surveying shipping companies operate in all the ports around Sri Lanka.

There are other cargo ships, i.e. general cargo, Break-Bulk cargo and Tankers use Sri Lankan port for their

operations, but this study has been limited to the perspectives of container shipping companies only. Collecting information from shipping lines which are operated in other cargo transportation will be helpful to get an overall knowledge about the port selection preference of each cargo type.

The scope of the study has been limited to the port selection behavior of container shipping lines which are calling to port of Colombo only and the preferences of the total population who are engaged in maritime transport i.e. freight forwarders and shippers had not been considered for the current study. In future, surveying a reasonable population with various-respondents as mentioned above would be helpful to overcome the poverty of the sample.

##### B. *Conclusions and Recommendations*

The study has been carried out to identify the terminal selection factors of shipping lines and agencies that are currently operating in Sri Lanka. As there is a lack of such literature in the Sri Lankan port management sector, this study was aiming to identify the influencing factors and fulfilling the gap between, what terminals offer, and what shipping lines are really want. This study provides a framework for understanding container terminal services requirements from the shipping lines and shipping agencies' perspective.

As the statistical approach has declared terminal selection procedure in Sri Lankan concept has slightly lure towards convenience and efficiency of the port operations. The 'Convenience Measures factor' has a higher influencing ability than other factors in port selection process. According to the study, the most significant factor in terminal selection process in Sri Lankan approach has been the "Convenience in operations"

Secondarily 'Operational Efficiency' 'Port and Terminal Structure', 'Port Services', 'Logistic Services and Safety', 'Accessibility and Storage', 'Customer Relationship Management', 'Hinterland Transport and Container Service' and 'No of Vessel Calls' can be highlighted as persuasive factors. The 'Container cargo rate', 'Water Depth in Approach Channel and Berth', 'Handling Special Cargo/ Service' and 'Shipping Alliance/Terminals Investment' has identified as substantial.

By analysing the results of the study, the managers and the executives of the shipping line and agencies in Sri Lanka have demanded the need of "more efficiency and convenient operational opportunities" and "equipment with latest technology updated". The hinterland

connections and intermodal-link are emerging concepts in Sri Lankan port operations model. Considering the strategic location of Sri Lanka in Indian Ocean, The policy-makers should draw their attention towards "Port marketing concepts" than regulatory measures in order to compete in the highly competitive, globalized industry today,. The concept of free port has been a rather 'fair trick' to manoeuvre the shipping lines in Asia-Europe trade route, that are preferring other countries for their terminal operations.

The terminals should practice more "Value driven procedure" in "port/terminal marketing" with the efficient operational practices. By considering the geographical restrictions in JCT/UCT and SAGT terminals mega carriers prefer to choose CICT deep water terminal. These terminals accommodate much smaller vessels (with max draft > 14m). The container terminals that the study has been based, has achieved their best in operational related facilities only. Many respondents in this survey have mentioned that the shortage of a recreational facility in terminal premises. If the terminals tend to provide recreation facility, food and beverages for a reasonable price, to the shipping lines /agencies that are operating inside the terminal for a considerable period, will be a motivational factor for them in terminal preference.

Considering the Singapore, one of the major competitor to Sri Lankan ports, provides bunkering facility and provisions to the ships. By considering the geographical position of Sri Lanka, Sri Lankan terminals can provide all the above said facilities for a cheaper price than Singapore as Sri Lanka is rich with natural water sprinkles and agriculture. As Sri Lanka has been located in between the Singapore and Middle-East, Sri Lanka can provide Bunkering facility to ships as a another service. In much brighter point of view, if the distance considered, Sri Lanka can offer fuel at a lower cost than Singapore. Terminals in Sri Lanka should market themselves in more chromatic manner in combining with efficient operational activities.

As Indian Ocean is becoming energy and a trade channel to connect the Asia-Pacific region, Sri Lankan ports will be benefited, if they practice fair trade policy with new concepts and user-friendly environment to attract the fleets.

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