

**CONTRIBUTION OF PORT LOGISTICS
DEVELOPMENTS FOR THE MARITIME
CONNECTIVITY OF A PORT**

Rupasinghe Arachchige Surandika Rupasinghe

(158029G)

Thesis submitted in partial fulfilment of the requirements for the
Degree of Master of Science

Department of Transport and Logistics Management

University of Moratuwa

Sri Lanka

July, 2019

DECLARATION OF ORIGINALITY

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or institute of higher learning and to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Signature:

Date:

COPY RIGHT STATEMENT

I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my thesis/dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books).

Signature:

Date:

STATEMENT OF THE SUPERVISOR

The above candidate has carried out the research for the Degree of Master of Science under my supervision.

Name of the supervisor 1 :

Signature of the supervisor 1 :

Date:

Name of the supervisor 2 :

Signature of the supervisor 2 :

Date:

ABSTRACT

Contribution of port logistics developments for the maritime connectivity of a port

Maritime connectivity of a port explains how well a port is connected to international maritime networks. When a container line selects a port of call, it takes into consideration maritime connectivity of the particular port. Therefore, port authorities strive to enhance the quality of services offered by ports with the assistance of suitable port logistics facilities.

This nature motivated to study the contribution of port logistics developments for the maritime connectivity of ports. The methodology adopted for the current study is comprised of two stages. First stage online mail survey based on the perception of senior managers attached to global container line agencies and local offices registered in Sri Lanka try to identify, which port logistics developments affect maritime connectivity of ports. The second stage quantitative data analysis was conducted using Pearson correlation method to validate the results of the mail survey. And simple linear regression analysis was performed to assess how significant is each port logistics development on the maritime connectivity of a ports.

Accordingly, port annual handling capacity, number of quay cranes available, number of reefer plugging facilities available, number of berths available, quay length and number of terminals are identified as significant port logistics developments to the maritime connectivity of a port. Due to the limitations in collecting required data the second stage analysis is limited only to the superstructure and infrastructure related port logistics developments.

This current study envisions new area on which port logistics developments affect maritime connectivity of a port. Therefore, this is beneficial for both port terminal operators and ship operators. Terminal operators will be benefited in identifying optimal development options to enhance port connectivity while container line network planners will be benefited in identifying which factors they should consider in identifying most connected hub ports for their container linear services.

Key words- Maritime connectivity, Port logistics, Intermediary ports, Container liner services, Hub ports

ACKNOWLEDGEMENT

I would like to offer my heartfelt gratitude to my research supervisors, Dr. Indika Sigera Senior Lecturer, Department of Transport and Logistics Management and associate professor Stephen Cahoon, University of Tasmania for continuously monitoring and providing me all the necessary supports and guidance throughout the research in achieving my final target. I have been fortunate to have both of them as my supervisors and without their encouragement, supervision and advices this may not have been a success.

A very special gratitude goes to the post-graduate research coordinator Dr. Varuna Adikariwattage for conducting research progress reviews and the immense support given through the process. It is my honor to remind the extensive guidance given by my research review panel represented by Dr. Mahinda Bandara, Dr. T. Sivakumar and Dr. Nalaka Jaykody for the reviews and the guidance given to succeed the study. Further I would like to express my profound gratitude to Dr. T. Sivakumar, former Head of the Department of Transport and Logistics Management of University of Moratuwa and the current Head of the department. Prof. Amal Kumarage for the opportunity given.

My heartfelt thank should deliver to the Dr. Premachandra, Managing Director of the Sri Lanka port authority and all other staff members of port authority who helped in providing necessary data. Further I would like to express my sincere gratitude towards the participants for questionnaire survey for providing their valuable responses and comments which helped to improve the quality of this thesis. I would like to express my heartfelt gratitude to the each and every person in shipping lines who made my effort on this thesis become a success.

I would make this an opportunity to deserve my sincere gratitude to staff members and the non-academic staff of the Department of Transport and Logistics Management. I am sincerely thankful to my family members, friends and all other people who have given me support, courage and guidance for the assistance they have given throughout the thesis.

Surandika Rupasinghe

LIST OF ACRONYMS

Abbreviation	Description
ASC	- Annualized Slot Capacity
TEU	- Twenty feet Equivalent Unit
ULCS	- Ultra Large Container Ship
EDI	- Electronic Data Interchange
SLR	- Simple Linear Regression
LSCI	- Liner Shipping Connectivity Index
JCT	- Jaya Container Terminal
SAGT	- South Asia Gateway Terminals
CICT	- Colombo International Container Terminal
UCT	- Unity Container Terminal
RORO	- Roll On Roll Out

TABLE OF CONTENTS

DECLARATION OF ORIGINALITY	II
COPY RIGHT STATEMENT	III
STATEMENT OF THE SUPERVISOR	IV
ABSTRACT.....	V
ACKNOWLEDGEMENT	VI
LIST OF ACRONYMS	VII
TABLE OF CONTENTS.....	VIII
LIST OF TABLES	XI
LIST OF FIGURES	XII
CHAPTER 1 – INTRODUCTION	1
1.1 Background	1
1.2 Rational of the study	5
1.3 Port of Colombo	8
1.4 Research Questions and Objectives	10
1.5 Research contribution.....	11
CHAPTER 2 - MARITIME CONNECTIVITY OF PORTS	13
2.1 Introduction	13
2.2 Liner Shipping Connectivity Index	14
2.3 Port connectivity in a maritime network	16
2.4 Port connectivity indexes	18
2.5 Different aspects on maritime connectivity	23
2.6 Port logistics as a key determinant of maritime connectivity of a port.....	25
2.7 Summary	29
CHAPTER 3- METHODOLOGY	30
3.1 Introduction	30
3.2 Research design.....	30
3.3 Online Survey- First stage data gathering	31
3.3.1 Methods of data gathering	31
3.3.2 Population and sample design for mail survey	33
3.3.3 Selection of respondents	36

3.3.4	Development of online survey questionnaire.....	37
3.3.5	Data analysis method	43
3.4	Second stage data gathering	43
3.4.1	Methods of Data Gathering.....	43
3.4.2	Population and sample design.....	45
3.4.3	Sample port selection	46
3.4.4	Data sources	49
3.4.5	Data analysis method	56
3.5	Summary	56
CHAPTER 4 - FIRST STAGE ONLINE SURVEY		58
4.1	Introduction	58
4.2	Demography of the mail survey	58
4.2.1	The respondents' profile	58
4.3	Significant port logistics developments	60
4.2.1	Superstructure and its operation related factors.....	61
4.2.2	Location related factors.....	64
4.2.3	Infrastructure related factors	66
4.2.4	Institutional factors	69
4.2.5	Time Factor.....	71
4.4	Summary	74
CHAPTER 5- SECOND STAGE ANALYSIS		75
5.1	Introduction	75
5.2	Description of selected ports	76
5.2.1	Details of port sample	78
5.3	Correlation Analysis between Maritime connectivity of ports and Port Logistics Factors	81
5.3.1	Port handling capacity in TEUs	82
5.3.2	Number of quay cranes	86
5.3.3	Number of berths	89
5.3.4	Quay length (m)	92
5.3.5	Number of reefer plugging facilities.....	95
5.3.6	Number of terminals	98
5.3.7	Terminal draft (m).....	102

5.3.8	Access channel draft (m).....	104
5.4	Correlation Analysis between Independent Variables	108
5.5	Simple Linear Regression Analysis	110
5.5.1	Port handling capacity in TEUs	113
5.5.2	Number of quay cranes	114
5.5.3	Number of berths	115
5.5.4	Quay length (m)	115
CHAPTER 6- CONCLUSIONS AND RECOMMENDATIONS.....		117
6.1	Introduction	117
6.2	Purpose of the research	117
6.3	Summary of the findings	119
6.3.1	First stage online survey	119
6.3.2	Second stage quantitative data analysis	120
6.3.3	Comparison between first Stage online survey analysis results and second stage quantitative data analysis.....	123
6.3.4	Port of Colombo.....	124
6.3.5	Recommendation on port logistics developments	126
6.4	Limitations of the study.....	126
6.5	Suggestions and recommendations for future researches.....	128
3.6	Summary	129
APPENDICES		137
Appendix A- Questionnaire.....		137
Appendix B - Homoscedasticity		140

LIST OF TABLES

Table 2-1 Literature review summary on port logistics development factors	28
Table 3-1 Leading container liner shipping companies by number of ships and total shipboard capacity deployed.....	34
Table 3-2 Question dimensions	38
<i>Table 3-3</i> Second stage data gathering sources	56
Table 4-1 Reliability analysis	61
Table 4-2 One-Sample Statistics-Superstructure and its operation related factors....	63
Table 4-3 One-Sample Statistics -Location related factors	65
Table 4-4 One-Sample Statistics - Infrastructure related factors.....	67
Table 4-5 One-Sample Statistics -Institutional factors	69
Table 4-6 One-Sample Statistics - Time Factor.....	71
Table 4-7 Significant variables	73
Table 4-8 Insignificant variables.....	74
Table 5-1 Ports considered for analysis	77
Table 5-2 Correlation analysis between maritime connectivity of ports and port logistics factors	81
Table 5-3 Pearson Correlation analysis between logistics factors.....	108
Table 5-4 Summary- Correlation between independent variables.....	109
Table 5-5 Regression analysis- Port maritime connectivity	112
Table 5-6 Coefficients- Port handling capacity	114
Table 5-7 Coefficients- Number of quay cranes.....	114
Table 5-8 Coefficient- Number of berths.....	115
Table 5-9 Coefficients- Quay length.....	116
Table 6-1 Summary findings- online survey	119
Table 6-2 Summary findings- Second stage data analysis.....	120

LIST OF FIGURES

Figure 1-1 Global Containerized Trade- 1996-2018 (Millions of TEU and Percentage annual change)	1
Figure 1-2 Container ship size Vs Number of liner shipping companies	3
Figure 1-3 Percentage share of transshipment TEUs handled in Colombo port.....	6
Figure 1-4 Liner shipping connectivity index.....	7
Figure 1-5 Percentage share of transshipment TEUs handled in Colombo port	7
<i>Figure 1-6</i> Port of Colombo throughput in 1000 TEUs	9
Figure 1-7 Demography of Colombo Port	10
Figure 3-1 Sample Port map	48
Figure 4-1 Respondents' profile	59
Figure 4-2 Work Experience.....	59
Figure 5-1 Variables for second stage data analysis	75
Figure 5-2 Sample Selection Criteria.....	76
Figure 5-3 Sample Overview by port type.....	78
Figure 5-4 Sample overview by shipping region	79
Figure 5-5 Port Maritime connectivity.....	80
Figure 5-6 Scatter plot- Port handling capacity by port type.....	83
Figure 5-7 Scatter plot- Port handling capacity by shipping region	85
Figure 5-8 Scatter plot- Quay cranes by port type	87
Figure 5-9 Scatter plot- Quay cranes by shipping region	89
Figure 5-10 Scatter plot- Berths by port type	90
Figure 5-11 Scatter plot- Berths by shipping region.....	91
Figure 5-12 Scatter plot- Quay length by port type	93
Figure 5-13 Scatter plot- Quay length by shipping region.....	95
Figure 5-14 Scatter plot- Reefer plugging facilities by port type	96
Figure 5-15 Scatter plot- Reefer plugging facilities by shipping region.....	97
Figure 5-16 Scatter plot- Terminals by port type.....	99
Figure 5-17 Scatter plot- Terminals by shipping region	101
Figure 5-18 Scatter plot- Terminal draft by port type.....	103
Figure 5-19 Scatter plot- Terminal draft by shipping region	104
Figure 5-20 Scatter plot- Access channel draft by port type.....	105
Figure 5-21 Scatter plot- Access channel draft by shipping region.....	106
Figure 5-22 Significant Port logistics Development variables	107
Figure 5-23 Hypothesis for SLR.....	110
Figure 6-1 Maritime connectivity -Port of Colombo	125