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Journal of Transport and Logistics Researches for industrial Development

June, 2013, Young Professionals' Forum, Chartered Institute of Logistics and Transport Sri Lanka

The Young Professionals' Forum (YPF) exists to strengthen the appeal of the Chartered Institute of Logistics and Transport Sri Lanka to young professionals working in the logistics and transport sectors. The YPF aims to engage the interest and involvement of young professionals by emphasizing the benefits the CILT has to offer them, and to create an environment that is meaningful and supportive for young members whom are keen to develop their careers.

The Journal consists of extended abstracts by seventeen young researchers on Logistics and Supply Chain Management, Sea Transport, Air Transport and Land Transport. All abstracts are commended by an expert evaluation panel. The LTRS 2013 aims to provide an interactive platform for young researchers and industry practitioners to present their research findings.

YPF, CILT Sri Lanka

First Floor, NCCSL Building, 450, D.R. WijewardenaMawatha, Colombo 10, Sri Lanka

Tele: 94-11-5657357, Fax: 94-11-2698494

E-mail: ypf@ciltsl.com Web: http://www.ciltsl.com/ypf/

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FROM THE EDITOR…

Even though the Transport and Logistics industry in Sri Lanka has steadily emerged as a focal point of future national growth, students and researchers in this field have long experienced the lack of a suitable local space to showcase their research findings.

The initiative to commence a Logistics and Transport Research Symposium (LTRS) by the Chartered Institute of Logistics and Transport's Young Professionals' Forum is a timely endeavor. It will provide a platform to disseminate and share research findings by young professionals and aspiring young professionals. No doubt, this will lay a much needed platform to promote research in this growing field without which Sri Lanka's vision of becoming a regional hub will be constrained. Furthermore, such initiatives also go a long way towards developing much needed quality human capital required by industry.

The inaugural Logistics and Transport Research Symposium (LTRS) hopefully will become an annual event that will become a vehicle which promotes research among young professionals enabling them to take the lead in transport and logistics research in the world arena.

Senior (Prof). Amal S. Kumarage
Chief Editor, 'LTRS 2013', Journal of Logistics and Transport Researches for Industrial Development', Young Professionals' Forum, CILT Sri Lanka.

June2013

A MATHEMATICAL DIAGNOSTIC OF THE DESIGN AND RESOURCE UTILIZATION OF A WAREHOUSE

K. R. Perera and Prof. Amal S. Kumarage

Department of Transport and Logistics Management, University of Moratuwa, Sri Lanka
Tel No.: 0718483030, E-mail: krishanirp@gmail.com

Abstract: The main concern of this research is to address the problem of identifying contributory factors in making warehouse spaces functional and efficient, while providing a safe and comfortable environment for workers to increase productivity and control, reduce operating costs, and improve customer service. Therefore, the research was initially to identify impacts from implementing a warehouse management system and adjust the space utilization schemes accordingly as supported by the system and moreover to identify further possible improvements.

In this study, initially, the before and after study of WMS implementation was conducted at a selected warehouse, and it was basically concerned with five major performance measures: service level, resource utilization, space utilization, cycle time and stock integrity. Under each area, different KPIs were evaluated separately and altogether there are sixteen KPIs. Some areas were further analyzed within sub sectors, individually, for instance average number of hours between customer order receipt and dispatch of goods was further analyzed with five stepsof the operational process; issue MRN - dispatch approved summary, picking process - stacking at cross dock, scanning picking items, loading items to the lorry, and dispatch from the gate.

The findings were explicit; fourteen KPIs out of sixteen KPIs were improved while twelve out them were significantly improved. The research paper further discusses about improvement required areas, which may create significant output from the investment. With the findings of initial analysis, a mathematical model will be derived which is benchmarked with the key performance measure of cost efficiency. Moreover, required knowledge, skills of employees and physical equipment requirements were identified by way of conducting this research.

Key words: Warehouse Management System (WMS), Key Performance Indicator (KPI)

INTRODUCTION

In today's competitive environment, Supply Chain Management has become an essential element for operational efficiency as well as cost leadership. The warehouse is a focal point of any supply chain and represents one of the most costly elements of the supply chain. Therefore, proper design of a warehouse and effective utilization of resources play significant role in this context. Nowadays millions of dollars worth investments are under taken to construct and implement the newest technological systems to improve operational efficiency while achieving cost efficiency in the long term. A WMS is more than a stock control system, or a data collection system. It is actually a system that helps to 'automate' warehousing operations as much as possible.

The continuous measurement of performance is obviously necessary to monitor process improvement where the warehouse itself is mostly conceived as the last link in the supply chain. Performance measurement of warehouses has thus become critical for many organizations which are trying to simultaneously achieve a number of objectives, such as cost minimization, on-time dispatches order

accuracy and so on. (Rushton et al., 2010)

METHODS & MATERIALS

Data collection for the research was basically done as a work study and almost all data was primary data and rest was gathered from warehouse records. Since this research falls into the case study category, sample sizes were defined based on the warehouse operational patterns, so the sample sizes for each KPI differed according to their nature of them.

Analysis was carried out before and after WMS implementation based on the selected sixteen KPIs and analysis was composed of both qualitative and quantitative approaches. Primary observations and verbal interviews with warehouse personnel were used for qualitative analysis and actual gathered data was used for quantitative analysis. Minitab was used for the mathematical process of determining the increase/decrease of the considered KPIs performance as an analysis of mean comparison and significance value (p value analysis) consideration (Klapper et al., 1999).

RESULTS & DISCUSSION

According to the summary of Quantitative analysis fourteen out of sixteen KPIs have improved with the implementation of WMS. Moreover, twelve KPIs have significantly improved which has led to increased overall performance of the warehouse. However, warehouse performance does not entirely depend on a system, but also external factors too have a significant impact on that.

The following factors could be identified as critical external factors which imposes a significant impact on warehouse performance.

No.	*KPI*	*Sample Mean*		*Standard Deviation*		*F value*		*P value*	*Requirement*	*Remark*
		Before	*After*	*Before*	*After*	*Test Statistic*	*Table Value*			
1	Percentage of orders dispatched on time	68.42	92.00	47.11	27.69	5.090	3.998	0.028	Increase	Increased
2	Percentage of orders fully satisfied	37.99	43.10	32.12	12.46	0.560	4.016	0.455	Increase	Decreased
3	Stock availability in the warehouse	64.76	44.93	18.66	13.93	20.500	4.001	0.000	Increase	Increased
4	Order lead time	3.82	1.24	1.89	1.39	27.440	4.052	0.000	Decrease	Decreased
5	Number of cases picked per person hour	1.84	7.21	0.95	4.00	45.520	4.052	0.000	Increase	Increased
6	Number of order lines picked per person hour	0.19	1.49	0.21	0.90	51.400	4.057	0.000	Increase	Increased
7	Equipment uptime	98.31	98.76	2.46	0.99	0.610	4.079	0.440	Increase	Increased
8	Percentage of pallet storage capacity used in racks	86.09	98.81	4.24	0.84	69.170	4.057	0.000	Increase	Increased
9	Percentage of pallet storage capacity used in block stacking	43.40	75.92	7.44	5.48	99.070	4.057	0.000	Increase	Increased
10	Percentage of number of hours per day equipment is used – Reach Trucks & Fork Lifts	0.33	0.49	0.13	0.20	13.990	3.996	0.000	Increase	Increased
11	Percentage of number of hours per day equipment is used – Pallet Pickers	0.78	0.85	0.14	0.10	4.930	3.978	0.030	Increase	Increased
12	Percentage of number of hours per day equipment is used – RDTs	0.73	0.86	0.15	0.09	16.990	3.957	0.000	Increase	Increased
13	Number of standard hours worked	0.80	0.87	0.14	0.10	5.340	3.978	0.024	Increase	Increased
14	Percentage of locations with wrong stock	0.03	0.06	0.06	0.04	3.330	3.986	0.072	Increase	Increased
15	Percentage of SKUs with wrong stock	2.51	0.05	12.37	0.07	2.210	3.986	0.140	Increase	Decreased
16	Average number of hours between arrival of goods on site and putaway to storage location	0.0027	0.0004	0.0006	0.0001	66.280	5.591	0.000	Decrease	Decreased

Table 1: Summery of analysis of before & after study of the WMS

1. Higher rate of employee resigning and recent new recruitments
2. Recent absenteeism of employees and inability to work due to personal problems of them
3. Errors in demand forecasting of the inventory department
4. Lack of real time information
5. Cancellation of incoming shipments
6. Data entry errors and delays
7. Dedicated equipment for doors
8. Delays in transferring goods from bond warehouse to distribution centre
9. Workforce ignorance on their job
10. Not having enough time to charge equipment (Late work and/or early work)
11. Equipment shortage
12. Company policies
13. Labour turn over (Due to recent labour changes, new pickers are not familiar with the places where the items are stored.
14. Lack of attention of management
15. Mismanagement of shipment allocation and not having outgoing shipments
16. Reduction of customer demand
17. Storage space availability issues
18. System failures

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A STUDY OF LEAN SUPPLY CHAIN MANAGEMENT IN SRILANKAN COMPANIES

R. S. Liyanage
Department of Transport and Logistics Management, University of Moratuwa, Sri Lanka
Tel No: 0714103544, E-mail: Ramindu.liyanage@fonterra.com,

Abstract: In the present competitive environment companies always strive to have a competitive edge over their rivals and in today's global market the main focus of competition is not only between different companies but also between supply chains. So the companies are keen to effectively manage their supply chains which could become a catalyst for their development and for their sustainability. Lean supply chain management is an effective tool for managing the supply chains of companies

The objectives of this research were to discover whether Sri Lankan companies practice lean supply chain management concepts and to identify the industry sectors that are most successful in the implementation of lean supply chain management. The range of the selected companies was limited to companies that operated in 9 different industry sectors which are food manufacturing, textiles, manufacturing, beverages, footwear, tea, retail, 3PL and the telecommunications industry.

The research finding for the first objective was that the companies were performing strongly in the areas of supplier relationships, demand management and waste reduction principles. Considering the different industry segments, it was established that Food Manufacturing, Textiles, Beverages and Manufacturing were the best performing industries in applying lean management principles in their companies, which answers the second research objective.
Therefore it was noted that Sri Lankan companies do practice the key principles of lean supply chain management to a certain extent. Considering the fact that this is an era where different supply chains compete with each other and not individual companies, companies which are practicing lean supply chain management principles will have a competitive advantage over others which will enable the companies to respond to market changes in a more effective and efficient manner.

Key Words: Supply Chain Management, Lean Practices, Lean Supply Chain Management

INTRODUCTION

According to Vondermbse et al. (2006), lean supply chain was defined as "a supply chain, which employs continuous improvement efforts which focuses on eliminating waste or non-value steps along the chain". As per Shah et al. (2007) many companies have implemented parts and pieces of lean practice, often in the manufacturing process. But companies have not given attention to use lean in the whole supply chain. The main objectives of this research were to identify, how lean supply chain management practices are currently implemented in Sri Lankan companies and to identify the business sectors that are most successful in practicing these concepts.

MATERIALS & METHODS

The research was limited to companies that operated in 9 different industry sectors. They are food manufacturing, textiles, beverages, footwear, tea, retail, 3PL manufacturing, and the telecommunications industry. First, it was required to identify the major concepts that need to be followed in a lean supply chain management environment. For this a thorough literature survey, was conducted in relevance for this

research. Through the literature survey it was identified that for a company to be successful in lean supply chain management, they need to practice six major principles. They are Supplier Relationship, Customer Relationship, Company Culture, Information Sharing, Demand Management and Waste Reduction. Based on these findings a research questionnaire was formed where questions were categorized under the six principles of successful lean supply chain management.

RESULTS & DISCUSSIONS

It was noted that the companies were performing strongly in the areas of supplier relationship, demand management and waste reduction principles. This could have been due to long term relationships with the supplier base, familiarity with lean manufacturing practices, more emphasis provided to Sales & Operations planning, demand forecasting etc. In terms of company culture and information sharing principles, the industries were performing moderately but with customer relationship the majorities were below average in scale. This could have been due to customers not providing feedback on quality and delivery, not getting involved in current and future product requirements, companies not engaging customers effectively etc. Considering the different industry segments it was established that Food Manufacturing, Textiles, Beverages and Manufacturing were the best performing industries in applying lean management principles in their companies. This could have been due to familiarity with lean manufacturing practices, shorter lead time in product life cycle, top management support in establishing the company culture, maintaining a good working relationship with both suppliers and customers by obtaining their ideas on new product development & current practices etc.

So it was noted that Sri Lankan companies are partially practicing the key principles of lean supply chain management. Considering the fact that this is an era where different supply chains compete with each other and not individual companies, companies which are practicing lean supply chain management principles will have a competitive advantage over others which will enable them to respond to market changes in a more effective and efficient manner.

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A STUDY ON 3PL WAREHOUSE SELECTION CRITERION OF SRI LANKAN FMCG FIRMS

Duminda De Zoysa
Department of Transport and Logistics Management, University of Moratuwa, Sri Lanka
Tel No: +94 0716352 370, Fax: +94 0114838850, E-mail:duminda.tlm@gmail.com

Abstract: Scope and Objectives –The purpose of this research was to study and identify the factors that have to be considered when selecting a third party warehouse. The focus of the study was limited to the FMCG industry in Sri Lanka. There were two objectives of this study. The first one was to identify and priorities 3PL warehouse selection criterion in Sri Lankan FMCG firms and the second was to test the hypothesis that, Sri Lankan warehouse customers consider service quality more than the price when selecting a 3PL warehouse for their business.

Methodology –The research method was a combination of a case study approach and a quantitative approach. Data collection was done via literature study and surveys.

Findings and Results - The research it identified and prioritized the 15 most significant third party warehouse selection criterions of Sri Lankan FMCG firms. The research also revealed and discusses important relationships between selection criterions and their behaviors. The impact of the price and service quality, on selecting a warehouse was also discussed in depth. The findings of the research will be very important for both warehouse service providers and customers to shape their businesses in a more competitive manner. A considerable input was given to service providers to strengthen their customer base and customers can use the findings as a framework when selecting a service provider.

Keywords: Warehousing, Outsourcing, FMCG, Sri Lanka

INTRODUCTION

"A chain is strong as its weakest-link" Accordingly, to be competitive and to survive in the challenging market, each and every partner of today's supply chains have to perform their roles more efficiently and more effectively than before. Warehousing is known as the most commonly outsourced business function in most of the supply chains. Even though warehouse outsourcing has gained revolutionary achievements worldwide, the Sri Lankan third party warehousing industry is still in a developing stage. This paper presents an empirical research conducted in the third party warehousing industry in Sri Lanka, focusing more on the warehouse outsourcing practices related to the FMCG industry. The research addresses the research question, *"Are there specific facts which are considered by customers when selecting a third party warehouse supplier".* For any business, attracting, satisfying and retaining customers are the key challenges to be competitive in the market. Same as any other business, there are specific facts which attract customers to a warehouse in general. Identifying those particulars correctly will be very helpful for service providers to cope with the above challenges successfully.

The objectives of the research are to:

1. Identify and prioritises 3PL warehouse selection criteria in Sri Lankan FMCG firms and,
2. Test the hypothesis that, Sri Lankan warehouse customers consider the service quality more than the price when selecting a 3PL warehouse for their business

MATERIALS & METHODS

To achieve the above objective, a unique research methodology was adopted which was a combination of both case study and quantitative methods. Identification of warehouse customers' expectations was done via a very comprehensive literature survey and consulting a set of industry experts representing both the categories of warehouse service providers and customers. Through this, 34 warehouse selection criteria were identified initially. These factors were processed through a three stage screening process including an evaluation done by a panel of experts. With that the 15 most prominent warehouse selection criteria were identified which are relevant to the FMCG industry. The 15 identified factors were presented to a set of selected organizations in the Sri Lankan FMCG industry through a survey. By analyzing the collected data, the significance of the factors was ascertained. The data and facts required to test the hypothesis were also gathered via the same survey. For the testing of the hypothesis, three variables and two relationships were defined, and analysis was done using linear regression, quadric regression and cubic regression analysis methods.

RESULTS & DISCUSSION

The findings of the research are significant for both warehouse service providers and warehouse customers. The findings will help to fine tune their business to a more improved level. As the final outcome of the research, it identified and prioritized the 15 most significant third party warehouse selection criteria of Sri Lankan FMCG firms as summarized in the figure 1. Other than that, the research also revealed and discusses the important relationships between selection criteria and their behavior. The impact of the price and service quality, on selecting a warehouse was also discussed in depth.

Rank	WH selection criterions	Mean	SD
1	Costs	4.45	0.76
2	Responsiveness	4.4	0.68
3	Security	4.35	0.67
4	Location	4.3	0.86
5	Reliability	4.25	0.64
6	Ability to provide value-added services	4.2	0.83
7	Accessibility	4.15	0.81
8	Quality of management	3.8	1.20
9	Space availability in the warehouse	3.6	0.88
10	Physical infrastructure	3.6	1.10
11	Financial stability	3.45	0.94
12	State-of-art technologies	3.05	1.05
13	Other customers	2.95	1.15
14	Reputation	2.9	0.97
15	Quality awards	2.8	1.36

The 7 most important factors. Mean > 4.1 SD < 0.9

Figure 0.1: Most signified third party selection criteria

With various interpretations of the research findings, a number of recommendations were made to the Sri Lankan warehousing industry to minimize the gaps between supplier and customer, and to increase the standards of the industry in general.

The importance of each factor also changed from one customer to another. It was revealed that, in most cases the key purpose of outsourcing was to gain a cost reduction. But analytically there were 7 factors which can be identified as core for all the respondents. Alternately, by closely reviewing these core factors, it was possible to conclude that, both cost and quality related factors were equally important when taking an outsourcing decision. Another important factor which was revealed was that, most customers were not very confident in outsourcing 100% of the operation to a third party. It was also unearthed that, in general, customer satisfaction regarding the third party warehousing industry was not encouraging. The main reason for this was the due to the non- availability of the exact requirements of customers.

RECOMMENDATIONS AND CONCLUSION

The recommendations and conclusions of the paper suggest several effective methods to increase business opportunities and create better value to customers.

The recommendations also provide insights on selection of business locations, designing a marketing campaign and the importance of service differentiation.

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AIRLINES' AND FREIGHT FORWARDERS' EXPECTATIONS TOWARDS DEVELOPING THE COLOMBO INTERNATIONAL AIRPORT AS A CARGO HUB IN THE SOUTH ASIAN REGION

I.K.D. Damsirini

Department of Transport and Logistics Management, University of Moratuwa, Sri Lanka
Tel No: 0716883624, E-mail:
damsirinik@srilankan.com,

Abstract: International Air Cargo movements have increased rapidly together with the new trends in Supply Chain Management to fulfill customer requirements on time. This study examines the possibility of and requirements for in developing Sri Lanka as a cargo hub in the South Asian region. The aim of the research is to identify the attributes that airport users expect when they identify an airport for hub operations. The requirements are ranked according to the degree of importance perceived by users, and their satisfaction on the current context in Sri Lanka is assessed through their stated views on key attributes. The survey method was used to identify the perspectives of two major user groups of this study, namely, Airlines and Freight Forwarders. Out of all, attributes listed under terminal operations such as on time delivery capability, rapid cargo tracing capability, EDI, safe cargo holding capability and consistent delivery service capability, etc. were first-rated on importance. The output of the research will be beneficial for Sri Lanka to improve its competitiveness in the Air Cargo industry to develop as a hub in the South Asian region.

Key Words: Air Cargo, Hub, Airlines, Freight Forwarders

INTRODUCTION

After the global economic downturn of 2008 and 2009, the demands for air cargo transport have rebounded sharply during 2010 and keep on improving despite in 2012. Also it is forecast to double over the next two decades compared to 2011, and the air freight fleet is expected to increase by more than 80%. Moreover, it is estimated that half the value of all international trade will be moved by air within the next decade. Using the opportunity presented through the global trend plus the strengths over the other regional countries, through this research it is intended to investigate on attributes that airport users expect from a hub and the potential within the existing system of in Sri Lanka towards achieving these expectations.

MATERIAL AND METHODS

The methodology adopted here is the survey approach and carried through a questionnaire based interviews for a sample size of 30. The main target user groups were Airlines and Freight Forwarders operating in Sri Lanka. A Literature survey was conducted to identify the user requirements and the questionnaire was finalized through a pilot survey. The data were analyzed, using descriptive statistics analysis (Importance) and binomial distribution analysis (Satisfactory Level). The user requirements were mainly categorized under 3 aspects; Attributes related to terminal operations (T), Factors in terms of facilitation (F), and Factors in terms of country (C).

RESULTS AND DISCUSSION

Firstly all the attributes under each of the three categories above were ranked according to the whole user perspective based on importance (Table1) when selecting a hub airport. Items with the highest Mean and the lowest SD have the highest priority. The satisfaction on the existing system of Sri Lanka is also presented on the same. According to the findings, the attributes related to terminal operations (Listed under category 'T') has obtained priority over the others. On Time Delivery Capability, EDI, Consistent Delivery Service Capability and Crises Management Capability can be identified as the urgent improvements that should be focused on the Sri Lankan context in order to face the competitiveness of the air cargo market.

Due to the inherent differences of users in the nature of the structure of the delivery service operations such as Combination Carriers, All Cargo Carriers, Freight Forwarders, etc…, it is foreseeable that the Colombo airport cargo terminal would be unable to satisfy all the demands of each user type. Therefore, whenever airport management plans to build a new airport or to expand the existing airport, the items which both airlines and FF consider important are priority factors to be looked at.

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Rank	Variable		Mean	SD	Satisfaction
1	On Time Delivery Capability	T5	4.9	0.31	No
2	Geographical Location of the country	C1	4.83	0.38	Yes
3	Rapid Cargo Tracing Capability	T11	4.7	0.47	Yes
4	Electronic Data Interchange (EDI)	T2	4.63	0.49	No
5	Safe Cargo Holding Capability	T12	4.6	0.5	Yes
6	Airport Quality	F2	4.53	0.57	No
7	Trade Facilitation	F4	4.53	0.57	No
8	Consistent Delivery Service Capability	T14	4.47	0.68	No
9	Crises Management Capability	T1	4.43	0.68	No
10	Communication with Customers	T3	4.43	0.68	No
11	Facilities for terminal operations	F1	4.3	0.76	No
12	Choice of Delivery Speed &Cargo Holding Time	T6	4.23	0.73	No
13	Internet Processing Document Management	T13	4.23	0.9	Yes
14	Compensation for Damage or Lost Goods	T9	4.17	0.75	No
15	Efficiency of Internal Operations	T4	4.13	0.94	No
16	Professional Knowledge & Capability	T10	4.1	0.8	No
17	Clear &Comprehensive Operational Procedures	T8	4.03	0.77	No
18	Government Rules &Regulations	C2	3.97	0.72	No
19	Competitiveness of the home base carrier	F3	3.87	0.82	No
20	Industry Competition	C3	3.8	0.9	No
21	Suitability & Convenience of Office Location	T7	3.43	0.94	Yes

Table 01: Mean Rating & Standard Deviation for Identified Variables on Degree of Importance &Satisfactory Level on SL context).

ANALYSIS OF FACTORS AFFECTING EXPORT AND IMPORT CONTAINER THROUGHPUT AT THE PORT OF COLOMBO

P. L. P. Chathurangika
Department of Logistics and Transport, Faculty of Management, CINEC Maritime Campus, Malabe, Sri Lanka.
Mobile: +94777498930, Email: prasha077@yahoo.com

Abstract: The domestic container volume handled at the Port of Colombo is a significant contributor to the Sri Lankan economy. Hence, this paper intends to investigate the factors that affect export and import container throughput at the Port of Colombo and attempts to identify the most significant contributors to domestic container throughput. The relationship between export and import container throughput and a series of specified macroeconomic factors are analyzed using descriptive and inferential statistical techniques and three multiple linear regression models are used to determine the nature of their relationship with domestic container throughput. Research findings indicate that industrial GDP (Gross Domestic Product), government expenditure, total exports, FDI (Foreign Direct Investment), average exchange rates and interest rates have a significant impact upon total export-import, export and import container throughputs at the Port of Colombo.

Keywords: Port of Colombo, Container Throughput, Macroeconomic Factors, Regression Analysis.

INTRODUCTION

Containerization is an important transportation system in the rapidly growing domain of international trade, especially in a country like Sri Lanka where the economy is dominated by both imports and exports. Container movements are essentially a direct result of cargo flows. A port facilitates the growth of its hinterland and regional economy, whereas the growth of the hinterland pushes the development and evolution of its port (Cheung and Yip 2011). The annual container throughput is a central indicator of the economic performance of a country as well as the operational performance of its port. Therefore, identifying factors influencing local container throughput is crucial for both the government and private sectors for planning and managing future development strategies. Only a few studies have been conducted to identify the relationship between the container through put of the Port of Colombo and the economic factors. In the light of the above consideration, this paper attempts to give some insights on the area of container throughput and related studies in Sri Lanka.

One may question the need for separating transshipment containers from the total container throughput. The transshipment container volumes handled at the Port of Colombo are almost totally dependent on the volume coming into and going out of India. It is not advisable to depend on a single customer, for the major share of the business. While this is generally the case, it is important to determine what drives the economic momentum of the country by analyzing the determinants of export and import container throughput not only from a port view point, but also from the perspective of the domestic export and import industry.

METHODOLOGY

Three normal response variables, namely, total export-import container throughput, export container throughput and import container throughput at the Port of Colombo were specified as dependent variables. Fifteen factors offering potential influence to local container throughput, namely population, GDP, per capita GDP, agricultural GDP, industrial GDP, service GDP, government expenditure, total exports, total imports, unemployment rate, FDI, average exchange rate, interest rate, tax revenue and fixed asset investment were specified as independent variables for the purpose of analyzing their relationship with local export and import container throughput at the Port of Colombo. Analysis was conducted based on a secondary data set collected from the Sri Lanka Ports Authority (SLPA) and the Central Bank of Sri Lanka (CBSL) for a thirty year period from 1982-2011.

Hypothesis testing was conducted under a five percent level of significance to determine the nature of the correlation of each independent variable upon the three dependent variables. The study was carried out guided by the following hypotheses.

Hypothesis A

H_0: Total export-import container throughput is independent from i^{th} variable

H_1: Total export-import container throughput is dependent from i^{th} variable

Hypothesis B

H_0: Export container throughput is independent from i^{th} variable

H_1: Export container throughput is dependent from i^{th} variable

Hypothesis C

H_0: Import container throughput is independent from i^{th} variable

H_1: Import container throughput is dependent from i^{th} variable

Where; $i = 1, 2, 3, \ldots 15$

Then, three multiple linear regression models were fitted for the three dependent variables using Ordinary Least Squares (OLS) since all three response variables are normal response variables and as they show an approximately linear relationship with each dependent variable.

RESULTS AND DISCUSSION

As per the hypothesis test results population, GDP, per capita GDP, agricultural GDP, industrial GDP, service GDP, government expenditure, total exports, total imports, unemployment rate, FDI, average exchange rate, tax revenue and fixed asset investment are significantly correlated with each of the dependent variables. Thus, the total export-import container throughput, export container throughput and import container throughput are dependent upon the factors taken into consideration in the study except the interest rate.

According to the empirical findings of the study, six out of the fifteen specified explanatory variables, i.e. industrial GDP, government expenditure, total exports, FDI, average exchange rate and interest rate, have statistically significant relationships with the three dependent variables with estimation models that revealed extremely high correlations when their collective impact on each dependent variable was considered. The regression model summary is presented in Table 1. Industrial GDP, total exports and average exchange rate show positive relationships with the three dependent variables while government expenditure, FDI and interest rate show negative

	Dependent Variable	Coefficients of Independent Variables						$\overline{R}^2$
		Industrial GDP	Government Expenditure	Total Exports	FDI	Average exchange Rate	Interest Rate	
01	Total Export-Import Container Throughput at the Port of Colombo	34.67	-47.78	90.32	-179.24	2658.35	-3403.47	0.999
02	Export Container Throughput at the Port of Colombo	20.51	-27.28	46.46	-95.26	1202.70	-1494.52	0.999
03	Import Container Throughput at the Port of Colombo	14.16	-20.51	43.85	-83.98	1455.66	-1908.95	0.999

Table 1: Regression Model Summary

relationships. The $\overline{R^2}$value of 0.999 of the three models states that about 99.9 percent of the variations in total export-import container throughput, export container throughput and import container throughput at the Port of Colombo are explained by variations in industrial GDP, government expenditure, total exports, FDI, average exchange rates and interest rates.

This study was subject to several limitations which necessitate further research. First, the scope of this study was limited to the Port of Colombo, so that the research outcomes may be affected by factors specific to the Port of Colombo such as congestion and yard capacity restrictions. Secondly, a noteworthy effect upon export and import container throughput may be caused by other factors such as port particulars, demographic, social and infrastructural aspects. Next, the impact of recent government policies and international trade agreements such as the influence of political stability, end of the civil war in 2009 and the removal of GSP+ tax concession for garment exports to USA and European countries have not been covered within the frame of this study.

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ANALYSIS OF FACTORS CONTRIBUTING TO CONTAINER PORT THROUGHPUT WITHIN THE ASIAN REGION

B. M. J. Basnayake

Department of Logistics and Transport, Faculty of Management, CINEC Maritime Campus, Malabe, Sri Lanka

Email: jayathri_b@yahoo.com

Abstract: Container port production is both an important and complicated element in the modern-day global economy with extreme development in containerization which supports nations to grow. The enormous progress in the shipping industry with regard to containerization has created a vast experimental lab. Having the aforementioned in mind this paper undertakes to estimate the effects of land and equipment, infrastructure and superstructure factors on the container throughput of a sea port considering a sample comprised of 30 container ports in the Asian region for the year 2011, utilizing linear regression analysis. This paper aims at identifying infrastructure and superstructure factors which have crucial impacts on the throughput of a container port. Moreover this study expects to guide future researches in order to improve the shipping industry in view of the fact that this is not a common subject under discussion, among researchers. Hence this study aims to attract the attention of researchers and to motivate them to investigate this concealed area further to support the advancement of container shipping and guides for stakeholders of the industry to take advantage of this highly competitive containerization era.

The scope of the study had to be limited to physical and technical factors available in a container port, avoiding the human resources factor, and considering some of the empirical studies undertaken to analyze throughput capacities of container ports. This is due to the sensitivity of the human resources data.

Container throughput was essentially chosen as the output variable and draft, number of quay cranes, number of berths, numbers of yard cranes etc. were chosen as explanatory variables to analyze the response variable, container throughput. Variable selection can be expressed further with the assist of appendix A. Analysis was carried out employing a multiple linear regression model with backward elimination criteria and it can be concluded according to the findings of the study that some factors such as number of berths and number of quay cranes have significant positive impacts on port performance.

Key terminology: container throughput, quay, berth, draft

Container throughput: The total number of container boxes handled in a terminal or a seaport that is either from arrival at the port to load onto a vessel or from discharging of a vessel to be exit from the port, usually in a year.

INTRODUCTION

Free trade, simulated with the effects of the globalized and liberalized world economy, has led to an increasingly growing demand for transportation where shipping plays such a key role that the world economy simply could not function if it were not for ships and the shipping industry because without shipping, international trade, the bulk transportation of raw materials and the import and export of manufactured goods would simply not be possible.

The innovation of containers by Malcolm McLean in 1960 revolutionized ocean shipping with the beginning of the

containerization era of the shipping industry and it became the major element of the whole shipping industry. Containers are now a universally accepted standard unit of cargo above all other forms of products largely because of the numerous technical and economic advantages it possesses over traditional methods of transportation.

Discussing the growth of shipping, the significance of a seaport cannot be ignored as ports are the essential links to transfer goods and passengers between ships and shore and/or between ships. While fulfilling this most basic function, ports form a vital link in the overall trading chain and, consequently, a port may have to provide sound service to vessel operators on the one hand and satisfactory service to cargo or inland transport operators on the other (Liu 2010). With the accelerating trend of containerization nowadays, container terminals have become the representation of a modern port. In view of the advantages provided by containerization over traditional port operations, in an attempt to enhance port productivity, liner shipping companies and container ports are respectively willing to deploy dedicated container terminals, ships and efficient container handling systems.

MATERIALS & METHODS

The enormous development in the shipping industry which stimulates the economies of the world has induced researchers to explore this concealed subject. Having the aforementioned in mind, in an attempt to analyze the extreme progress taking place in the shipping industry with regard to containerization, this paper undertakes to explore the effects of land and equipment, infrastructure and superstructure factors on container throughput and a sample comprised of 30 container ports in the Asian region were taken into consideration for the year 2011 for analysis to be carried out, employing linear regression analysis. The sample for the study was selected taking into account empirical studies and the Asian region is targeted here because the centre of maritime gravity has been moving to Asia in recent years. Further, Asia is known as the home to the world's largest port (Shanghai), busiest port (Singapore) and for some of the most efficient ports (e.g. Port Klang in Malaysia and Dubai in the United Arab Emirates). In addition, there are many new Greenfield ports are being built, and existing facilities, are being expanded (Review of Maritime Transport 2011- UNCTAD publication).

The scope of the study had to be limited to physical resources and technical factors available in a container port considering the sensitivity of human resources data in accordance with empirical studies that have been executed regarding the analysis of container ports.

All the required data were collected from secondary sources such as the official web sites of terminals and ports and from their annual reports, as well as from the Ports Authority of Sri Lanka. Secondary data sources were selected because such data are readily available and can be obtained without any delays, saving time and costs.

Container throughput, the most analytically tractable indicator and the representative measurement of the output of a container port, was chosen as the output variable and the number of forklifts, the draft, the number of quay cranes, the number of berths, the numbers of gantry cranes, total quay length and yard storage capacity were chosen as explanatory variables. The basis of selecting the independent variables and the dependent variables can be expressed with the assist of

appendix A (Please refer to Table 1: Variable specification in appendix A).

Descriptive analysis of summary statistics has calculated in the study. Hypothesis testing was carried out to check the dependency between container throughput and the explanatory variables listed above. The correlation between container throughput and other explanatory variables are identified using hypothesis testing using Pearson chi-square values. R squared value, ANOVA table, normal probability plot and residual plot were have been used as model diagnostics tools.

RESULTS & DISCUSSION

Since the response variable is a normal response variable, analysis was carried out employing a multiple linear regression model with backward elimination criteria and it can be concluded according to the findings of the study that factors such as number of berths and number of quay cranes have significant positive impacts on container throughput while other factors namely yard storage and quay length imply negative relationships with the response variable. Findings of the study provide significant insights to policy makers in the process of making investment decisions with regard to port facilities. With the use of this information, policy makers can make strategic decisions on at which rate the government or the ports authority should invest on port infrastructure and superstructure.

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Appendix A

Author	Dependent Variable	Independent Variable
Cullinane (2004)	Throughput (TEU)	Land factor Total quay length, terminal area Equipment factor Number of quay gantry cranes Number of yard gantry cranes Number of straddle carriers
Cullinane (2006)	Container Throughput (TEU)	Terminal length Terminal area Number of quayside gantry cranes Number of yard gantry cranes Number of straddle carriers
Wang and Cullinane (2006)	Container Throughput (TEU)	Terminal length Terminal area Equipment costs
Hee Jung YEO (2010)	Container Throughput (TEU)	Number of berths Berth length Berth depth Terminal area Crane shore Crane yard CFS area
Qianwen Liu	Container Throughput (TEU)	Berth Length Total terminal area Storage Handling Capacity
Tongzon (2001)	Container Throughput (TEU)	Number of cranes Number of container berths Number of tugs Terminal area

Table 1: Variable Specification

BULLWHIP EFFECT IN THE SUPPLY CHAIN OF FAST MOVING CONSUMER GOODS (FMCG) IN SRI LANKA

D.H.I. Wickramasinghe

Management Trainee, Policy Review & Monitoring Department, Central Bank of Sri Lanka
Tel No: 0772642267, E-mail: hansy_w@yahoo.com

Abstract: The tendency of order amplification upward the supply chain or the so called "Bullwhip Effect" is a frequent dilemma observed in present day supply chains owing to distortion of demand information across multiple partners. This paper discusses the nature of this phenomenon in the Sri Lankan Fast Moving Consumer Goods (FMCG) segment. The main focus of the study is to quantify demand variability levels in FMCG supply chains for a selected group of four-tier linear chains; manufacturer, wholesaler, retailer and the customer, in the selected product channels of milk powder, soap, biscuits and shampoo. Demand amplification is significantly visible in the channels of Soap and Biscuit where the orders get amplified more than twice when they reach the upstream end of the manufacturer. Erroneous forecasts made in anticipation of future demand, is the primary cause that creates such demand amplifications in the Sri Lankan FMCG market.

Keywords: Bullwhip Effect, Demand Propagation, Fast Moving Consumer Goods

INTRODUCTION

The bullwhip effect is significant system dynamism in today's supply chains. As demand information moves upward the chains, they get distorted due to a variety of reasons. Usually, in Sri Lanka, the market adapts a forecast driven approach where supply chains are managed through projections and estimations. Also, goods pass through lengthy chains with various intermediate involvements. Moreover the minimum usage of Point of Sale (POS), Electronic Data Interchange (EDI) technologies reduces access to real time information. All these together provide a high possibility for demand amplification in upward supply chains causing the Bullwhip Effect to be present in the Sri Lankan market. This research is aimed at investigating the presence of the dilemma of the Bullwhip Effect in the Sri Lankan FMCG sector. The main objective of the study was to quantify demand amplification patterns across a selected group of FMCG supply chains and identify the intensity of the Bullwhip Effect in these diverse chains.

METHODOLOGY

Following a similar methodology to Lee et al. (1997) an exploratory approach was adopted in this study. A sample of 25 wholesalers and 125 retailers were selected on a random basis from the selected four -tier channels of milk powder, biscuits, soap and shampoo, and Customer Demand, retailer's order to wholesaler and wholesaler's order to manufacturer at time T was identified at respective tiers over a period of one month. The Bullwhip Index was quantified accordingly as the ratio of order variance against the variance in demand at each echelon. The overall BWE index for a supply chain was obtained multiplying individual BWE Indices at these two echelons.

BWE (Amplification)

$$=\frac{Variance of Orders\ (Qt)}{Variance of Demand\ (Dt)}$$

BWE>1 indicates a high variance of orders

against demand which in other words implies the presence of the Bullwhip Effect. BWE ≤1 says the order variance is equal or less than the demand variance which indicates there is no upward amplification.

RESULTS AND DISCUSSION

As revealed by the study, demand amplification across supply chains begins from the foremost tier of retailer itself. In the supply chains of soap, biscuit and shampoo, the BWE Indices surpass 1 at retailer's level which says that the demand levels get doubled or more as they move upward. Comparatively, Milk Powder supply chains show a BEW Index less than1. The same pattern continues at the Wholesaler's tier with more amplification. Following these magnifications at the two echelons, demand levels get doubled or more when they reach the upstream end. Table 1 below summarizes the BWE Indices as identified by the study for individual supply chains.

Supply Chain	*BWE Index*		
	Retailer	***Wholesaler***	***Overall SC***
Milk Powder	*0.97*	*1.4*	*1.4*
Soap	*1.74*	*1.4*	*2.4*
Biscuits	*1.72*	*1.1*	*1.9*
Shampoo	*2.07*	*1.3*	*2.7*

Table 1: BWE Indexes

Anticipated future demand or forecasting is the main cause for amplified demand information across supply chains. Making erroneous forecasts on the demand from downstream vendors place augmented orders upstream creating the Bullwhip Effect. In addition, pricing incentives offered at various echelons encourage participants to go for amplified orders to enjoy such benefits. With all these findings it can be concluded that the Bullwhip Effect which exists in Fast Moving Consumer Good supply chains in the Sri Lankan market is mainly created by erroneous forecasts about anticipated future demand. This kind of significant amplification could have a huge impact over industry performance with increased Manufacturing costs, Increased inventory levels/ inventory costs, Extended lead times, High transportation costs, Underutilized capacity, etc. Hence it is of utmost importance to pay attention to this issue and take remedial actions to improve supply chain performance.

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FATIGUE DRIVERS OF FLIGHT CREW REGISTERED IN SRI LANKA

A. Fernando and D. Piyathilake

University of Moratuwa, Sri Lanka

Tel Phone: 0773098129, E-mail: aranthi.fernando@tollgroup.com

Abstract: A perception base study was conducted to identify fatigue drivers of flight crew registered in Sri Lanka. Demographic factors, actual-flight related factors and fatigue-factors are the three main fatigue driver categories. The level of fatigue of the flight crew was identified according to a scale. In addition, symptoms related to various levels of fatigue were also used to further understand the effects of fatigue. A factor analysis was used to validate the fatigue-factors and ensure reliability. Chi-squared analysis was also used to determine the factors which make a significant impact on fatigue. Pearson correlation was used to analyze the relationship between the variables. Irregular work patterns, crossing time zones, lack of sleep, work changes, quality of sleep on board, flight duration/ region and aircraft type were the fatigue drivers identified in this research.2200 – 0559 is the most tiring flight starting duration, 23 per cent of the flights are night flights which make the pilots more fatigued. On average, a pilot spends 44 per cent of the time on flying daily. The most strenuous/exhaustive routes are Middle East turnaround flights, night departures to Kuala Lumpur and Singapore, London flights and Far East turnaround flights.

INTRODUCTION

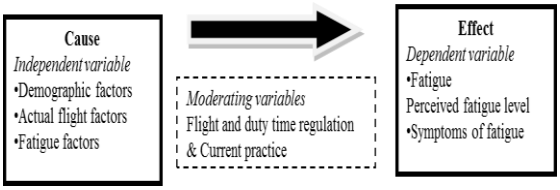
The regulators have imposed on both Sri Lankan crew flight and duty time – ANS23 to ensure safe operations. It has a significant influence on the economy of airline operations. Crew costs contribute the biggest portion of the airline operating cost and it impacts on the regulation which limits the flight duration and required rest times. Therefore, fatigue has appeared as a main factor on the negotiating table. Therefore, it is a threat to the safety of airline operations. Thus the main objective of the research was to identify the key fatigue factors which affect pilots operating in Sri Lanka.

METHODOLOGY

The study conducted by Bader (1973) was the key literature of this study. The supportive literature on fatigue drivers were Bader, 1973; Yen et al., 2005; Harding and Mills, 1983; Dongen et al., 2003 cited in Bank, 2012 and those on symptoms of fatigue were Burgess and Bowen, 2002.

The data was primarily collected from flight crews, operators and the regulator. A survey was carried out by a questionnaire which was sent through e-mails among the flight crews. A semi structured interview was held with the operator and the regulators. 31 flight crew members responded to the questionnaire. In addition, the flight data points were expanded to 180. The entire population is considered as the sample where 5 operators and 3 regulators, when considering the operator and regulator who were interviewed. Factor analysis is used to identify the validity and reliability of data, chi-squared analysis was used to determine the factors which make a significant impact on fatigue and Pearson correlation was used to analyse the relationship.

Research framework



RESULTS AND DISCUSSION

The following fatigue drivers showed a relationship with the level of fatigue.

Demographic factors – A positive weak relationship is proven by the years of experience on the job. Flight crews who are more experienced were given more responsibilities. This led them to experience more levels of fatigue. According to the current roster, captains are exposed to more fatigue when compared to co-pilots. This is verified through the chi-squared test value between current position and fatigue symptoms- p value 0.029 (p<0.05).

Actual flight factors – A positive moderate relation is proven by flight duration/region, aircraft type, departure aerodrome, and different flight patterns. In addition, the pilots are faced with higher levels of fatigue when flying longer durations with wide body aircraft (highest in A340).
Most tiring flight patterns;

- Middle East turnaround flights - higher traffic density, night time flying, flight departure time is between 2200 – 0559, lengthy flight duty time, delay leaving from Middle East and the reporting time.
- Night departure to Kuala Lumpur and Singapore - hectic schedule with several short sectors and accumulated fatigue due to many landings and take offs.
- London flight - limited rest, flying up word, whole night with two man crew, midnight departure (departure at 2200 – 0559), flying over China and ATC procedure is difficult due to language difference, and flying in to the sun.
- Far East turnaround - Departure time and end route weather.

Fatigue-factor – A positive relationship was proven for, flight deck work load, irregular work pattern, departure delay, vibration, comfort of the flight deck, effect of boredom, crossing time zone, flight duty period, lack of sleep, work changes and changeable flight patterns. Temperature, humidity, quality of sleep on board, and sudden increase in tension shows no relationship between the perceived levels of fatigue. However, the above factors show a positive relationship between the fatigue symptoms proving a scientific relationship with the level of fatigue. Crossing time zones has a significant impact on the Circadian rhythms of the human body which leads to fatigue.

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Person correlation - fatigue drivers

	Perceived fatigue level		***Fatigue symptoms***	
Variable	**r value**	**p value**	**r value**	**p value**
Flight deck work load	0.215**	0.004	0.203**	0.006
Irregular work pattern	0.300**	0.000	0.218**	0.003
Crossing time zones	0.356**	0.000	0.298**	0.000
Flight duty period	0.496**	0.000	0.419**	0.000
Arrival delay			-0.029	0.697
Departure delay	0.209**	0.005	0.156*	0.036
Temperature			0.245**	0.001
Humidity			0.206**	0.006
Noise			0.034	0.650
Vibration	0.176*	0.018	0.072	0.340
Comfort of the flight deck	0.234**	0.002	0.128	0.086
Lack of sleep	0.430**	0.000	0.494**	0.000
Changes of working stress	0.293**	0.000	0.303**	0.000
Effect of boredom	0.182*	0.014	0.238**	0.001
Oxygen content			0.008	0.917
Quality of SLEEP on board			0.327**	0.000
Emotional disturbance			0.132	0.078
Sudden increases in tension			0.196**	0.008
Number of landing and take off			0.026	0.725

Person correlation - Demographic and flight related factors

	Perceived fatigue level		***Fatigue symptoms***	
Variable	**r value**	**p value**	**r value**	**p value**
Age	-0.099	0.187	-0.012	0.874
Current position			-0.031	0.677
Status			-0.056	0.455
Experience on the job	0.149*	0.047	0.021	0.780
Accumulated flying hours	0.079	0.294	0.142	0.057
Flight duration/ region	0.353**	0.000	0.405**	0.000
Aircraft type	0.261**	0.000	0.151*	0.043
Departure time	0.109	0.147	0.052	0.488
Departure airport	-0.278**	0.000	-0.144	0.054
Fatigue level			0.630**	0.000

MANAGING BLOOD SUPPLIES: A SRI LANKAN PERSPECTIVE

T.L. Rupasinghe and W.A.D.N. Wickramarachchi
Department of Transport and Logistics Management, University of Moratuwa, Sri Lanka
Tel No: 94-71 800 8561, e-mail: tharaka21@gmail.com

Abstract: This research was designed to understand to what extent the concepts of supply chain are used along the Sri Lankan blood transfusion supply chain. Main objectives were to study the current blood supply chain in Sri Lanka, to identify potential areas of improvement along the blood supply chain, and to find ways and means of improving such areas in terms of time and other critical parameters so as to improve the blood supply chain. Research is limited to data gathered at National Blood Centre Narahenpita, and conducted as a descriptive case study. Some areas were identified as improvement areas such as marketing, minimizing wastages and suggestions were made.

Keywords: Supply chain, Blood, Perishable

INTRODUCTION

Supply chain management is not an extremely new concept to the health sector. Especially areas like inventory management and storage are highly beneficial for organizations like hospitals. From a supply chain viewpoint, having the right product, at the right place, in the right quantity, at the right time with the right quality is a matter of life and death. Out of perishable health sector products, human blood is a vital product, since it carries lives of people. It is a highly perishable product where it can be divided into components which their shelf-lives range from five days (platelets) to one year (Frozen Plasma). It is collected in units of one pint per donor at different locations and after a series of tests; blood is ready to be distributed to various hospitals and blood banks. Blood supply is very hard to predict. Demand for blood products also volatile in nature. It is still challenging to forecast the amount of blood to be collected for the subsequent month. The variation of blood products consisting eight blood groups makes it more and more complex to manage demand and supply. Shortages of blood products are always a cost for the society, creating extra days of hospitalizations, costing more for patients, sometimes postponements of surgeries or even increase in mortality rates. However wastages of blood products also can't be justified since blood donors are a precious asset for a society.

MATERIAL AND METHODS

Once the basic research topic was well understood and research scope was set, an extensive literature review was carried out to enhance the research. The research was designed to be conducted as a case study, considering the research objectives and since the topic has not attracted previous research attention. Since this is a descriptive case study, data used in the research are mostly qualitative in nature when collecting data, structured and open-ended interviews, questionnaires, reviews of documents, past records, and reports were used. These basic data collection methods were combined in an appropriate manner.

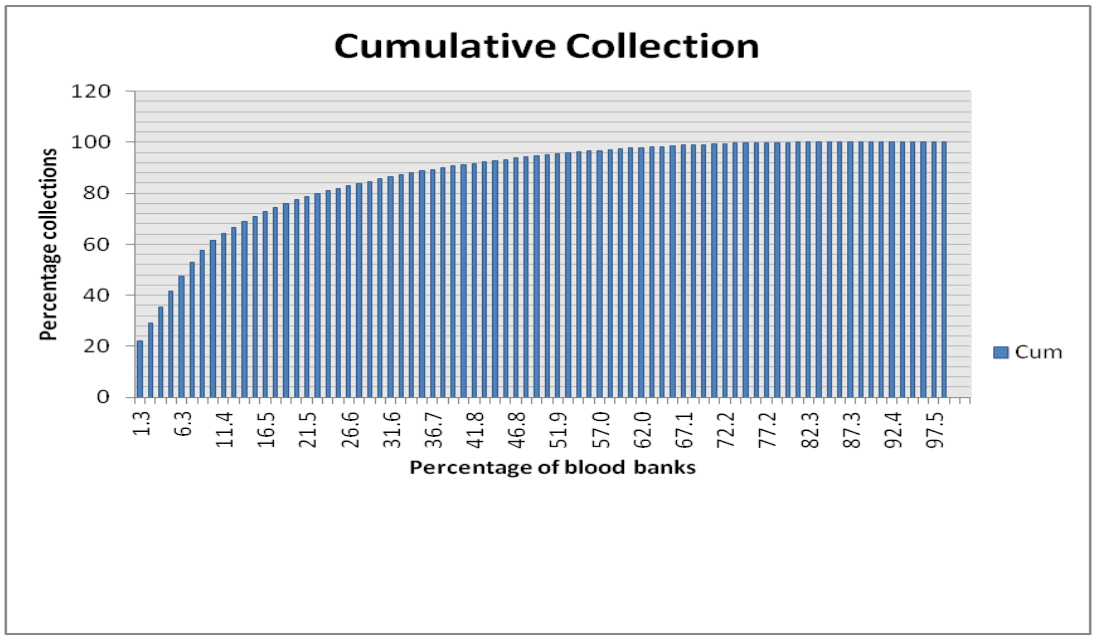

Figure 1: Percentage of collection Vs percentage of blood banks

RESULTS AND DISCUSSIONS

The main finding was the identification of the blood supply chain from the collection point to the patient. (Figure 2) Correlation analysis was done to identify the relationship between the population of the country and blood donations. Results show that for the considered period (2007-2011), there is no significant relationship between amount of blood collected and the midyear population. Entire blood banks were ranked according to their total collections during the year; top 5 banks were NBC (National Blood Centre), CIM (National Cancer Institute Maharagama), Kurunegala, Anuradhapura and Kandy. The Pareto diagram shows that 6% of blood banks have collected 47.47% of total units (Figure 1). Assuming the blood usage is equally distributed throughout the year, it was concluded that a blood transfusion or a reservation is done every 40 seconds in Sri Lanka.

There are some activities which don't add any value to the chain, but are essential to perform. A good example is storage. Having an adequate stock of blood is always important, even though in the storage area no value addition is done. Discarding is also an important non-value adding activity that has to be performed.

Areas such as marketing, minimizing wastage, supply chain collaboration; IT, staff training, and creating a database of blood donors can be further improved along the blood supply chain.

To deliver a safer product, it was concluded that health authorities try their best to promote voluntary donations. This reduces the potential risk coming from replacement donations.

A proper communication on how the donated blood was used can be used as an effective motivational factor to promote donations.

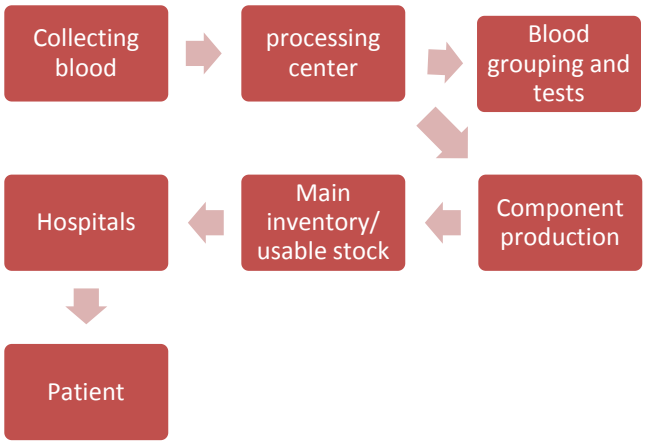

Figure 2: Blood Supply Chain in Sri Lanka

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MODELING AIR CARGO IMPORT AND EXPORT DEMAND AND TREND ANALYSIS IN SRI LANKA

A.M.I. Atapattu

Department of Transport and Logistics Management, University of Moratuwa, Sri Lanka
Tel No: 071 591985, Email: isuruatapattuuom@gmail.com

Abstract: Forecasting is essential for key decision making and planning processes for all stakeholders in the air cargo market because uncertainty creates severe issues throughout the entire operation from consignor to consignee. The key objective of this paper is to develop the best fit forecasting models for both import and export through understanding and analyzing the air cargo market. A study on air cargo volume forecasting has not been done in Sri Lanka at the time of conducting this research paper. Import and export models are calibrated using multiple regression analysis separately avoiding spurious regression and minimizing errors with Gross Domestic Product (GDP) at constant Price, World GDP, Monthly Average Exchange Rates (MAER) and Foreign Direct Investments (FDI) as independent variables (IV) and Trade Policy Agreements and Terrorism Impacts are used as dummy variables with 22 years of data from 1990 to 2011 based on data availability. The study clearly emphasized the effect of the aforementioned factors on air cargo demand and their contribution on forecasting.

Key words: Uncertainty, Air Cargo Forecast, Multiple Regressions

INTRODUCTION

Suppliers are concerned more on time than on cost because air freight is highly expensive and time sensitive. Factors which affect cargo movements and factors considered in imports and exports change over time. Highly volatile and dynamic characteristics in the cargo market will pave the way for high demand variation. All unpredictable factors which discussed as independent variables in the study of air freight market paved the way for forecasting models.

MATERIALS & METHODS

The population is divided in to two stratified samples as such population 1: Air cargo import market volume wise and Dependent Variable (DV) is real import volume (excluding transshipments), population 2: Air cargo export market and DV is the real export volume without transshipments. World Gross Domestic Product (GDP), Foreign Direct Investment and Monthly Average Exchange Rate are Independent Variables (IV) or the export model; GDP Constant Price is an IV for the import model and the Trade Agreement. Selected sample size is 22 years of air cargo volume for both import and export.

Terrorism Act is used as a dummy variable for both models. Analysis was done by using multiple regression analysis with defined regression assumptions for import and export separately. (Cargo volume in MT)

RESULTS & DISCUSSION

The industry relies on a less effective daily forecast, suggested models are long term solutions to face and prepare for future trends. The histogram and the normal P-P Plot of regression satisfied the autocorrelation, normality and homoscedastic of selected models confirmed the regression assumptions and

final criteria performance (R2 near 1 and lower RMSE) and the post fact analysis (plotted behaviour between actual data and forecasted data) proved that the selected export and import models were the best fit models.

Real Import Volume (free from transshipment double counting error) is severely affected by GDP Constant Price (0.855). World GDP (0.906), Foreign Direct Investments (0.274), Monthly Average Exchange Rate (0.902), Trade & Policy agreements (0.145) and Global & Domestic. Terrorism (0.327) affects air cargo export volume with correlation values. Calibrated models for export and import are shown below. Export model calibration:

REV = -22303.947+ (1.483E-09) WGDP+ 2352.507 FDI+ 402.891 MAER- 289.587 TA - 22636.046 T

Where,

REV = Real Export Volume

WGDP = World GDP, FDI = Foreign Direct Investment, MAER = Monthly Average Exchange Rate, TA = Trade Agreement (1, 0), T = Terrorism Act (1, 0)

Import model calibration:

RIV = -5423.290 + 27.879 GDP_CO + 2844.256 TA -11768.495 T

Where,

RIV = Real Import Volume (free from transshipment double counting error)

GDP_CO = GDP Constant Price

TA = Trade Agreement and Policies

T = Terrorism Act

Following results of Post Fact analysis method shows that both export and import models' proved criteria performance and are best fit models.

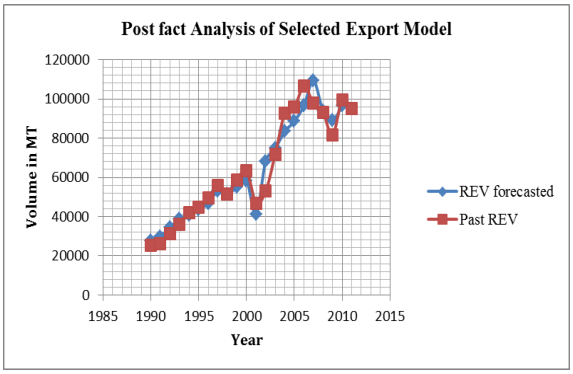

Figure 01: Post fact analysis – Export model

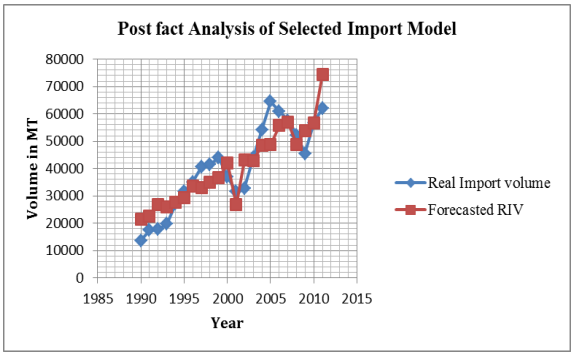

Figure 02: Post fact analysis – Import model

Stake-holders can increase the accuracy by eliminating the double count effect of transshipments and by updating the models frequently.

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MOVING TO MOVING INVENTORY – A CASE STUDY ON APPLYING LEAN SUPPLY CHAIN CONCEPTS IN THE LOCAL APPARELS INDUSTRY

I. C. Wijethunga
MAS Linea Clothing Division, BOI, Pallekele, Kandy, Sri Lanka
Tel No: 0814487399, Fax: 0814487390, E-mail: IsuruW@masholdings.com

Abstract: In the last few years, the local apparels industry has been challenged by other apparels manufacturing countries in the region including China, Bangladesh, Vietnam, etc. Low cost labor, infrastructure and a strong supply chain from design to delivery (which provided them with shorter lead times) are the key factors keeping them on top of the competition. MAS Linea Clothing is a local apparel manufacturer which tested and implemented lean (TPS) concepts into their supply chain to outpace this competition. This case study is about how those implementations helped them to reduce their inventory levels and lead time by almost 50 percent without any large capital investments.

Keywords – Moving Inventory, Internal/External material flow, Just in Time, Total logistic solution.

INTRODUCTION

Linea Clothing is an intimate apparels manufacturing facility located in Pallekele, Kandy, Sri Lanka which is an SBU of MAS Intimates (Pvt) Ltd, an arm of MAS Holdings. MAS Holdings is the forerunner in terms of introducing lean manufacturing concepts (TPS – Toyota Production Systems) to the local apparels manufacturing industry. The MAS Intimates Linea Clothing Division is the first plant in MAS Holdings which implemented lean manufacturing concepts in 2005. After having significant benefits through lean manufacturing concepts inside their manufacturing facility, in 2007 they extended their lean effort towards the supply chain with the concept of moving inventory.

THEORETICAL BACKGROUND

The main theory behind the concept of moving inventory is the Just in time strategy, which is one of the two main pillars of the lean house. The concept of continuous flow and downstream pull are the two main sub theories behind this concept. According to 'lean production.com', continuous flow is "Manufacturing where work-in-process smoothly flows through production with minimal (or no) buffers between steps of the manufacturing process[1]." Downstream pull discusses about how the manufacturing process works as the pace maker of the extended value stream.

MATERIALS AND METHODS

The implementation of the moving inventory concept can be summarized as the synchronization of the various internal and external replenishment cycles of the materials movement, to reduce the variations in between those cycles of the extended value stream. The first step of this implementation is drawing the extended value stream map, which gives a bird's eye view of the customer, manufacturer and the supplier. By considering the Takt time of the downstream, the material turnaround cycles for all the other internal and external (upstream) material movements are calculated. After defining the internal material cycles then it must work out to the external cycles, and at this stage it has to

have considered the supplier capabilities to define their turnaround time. After defining the external turnaround cycle, the next implementation is the total logistics solution to cater to the standardized requirements of the different cycles defined. Under this, the on-site and zonal manufacturing concepts have been implemented and the label supplier has installed a mini plant inside the factory. Thread and packing material suppliers also maintain a shop inside the factory which enables payment for consumption on the production floor. Many other suppliers followed the same concept and made their move to suitable locations inside the BOI zone. The other vital part of the total logistics solution (TLS) is transportation where the milk run concept has been introduced and all the external turnaround cycles have been synchronized to the milk run, where both the supplier and manufacturer have a huge cost and operational advantage. The hub and spoke model is the next implementation under the TLS, which synchronizes the capabilities of different suppliers while reducing the logistics handling cost.

Linea Clothing religiously obeys one rule, which is that materials do not flow alone; it flows with information. Scheduling and planning (MRP) is the foundation of this whole concept. To improve the accessibility and visibility of information, the information flow is also developed parallel to the materials flow. The supplier web portal has been introduced to instantly share the materials related information with the suppliers. Materials availability visual display panels were implemented as a result of these improvements to the information flow.

The next step of the implementation would be the introduction of "right size the equipment" to support materials kitting at the hub introduced by the hub and spoke model. With this there will be modifications to the containers to support the devices defined based on their replenishment cycles.

RESULTS AND DISCUSSION

Before implementing the moving inventory concept there were about 12 replenishment cycles in the production floor for 12 different materials. But after some effort of standardization (Quantity / Quality) with the suppliers, it has now been reduced to 4 replenishment cycles. With this WIP (work in progress) inventory levels in the manufacturing floor has reduced by about 70 percent when compared to the earlier situation. As a result of all these initiatives it has reduced the dock to dock inventory from 30 days to 15 days which has drastically reduced the cash tied up on materials inventories where it can pay for materials as they use.

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PASSENGER CHOICE BETWEEN LOW COST AIRLINES (LCA) AND FULL SERVICE AIRLINES (FSA) IN SRI LANKA

G.K. Pathirana & Mrs. D. Piyathilake
University of Moratuwa, Sri Lanka
Tel No: 094779640785, E-mail: gayanpathirana25@yahoo.com

Abstract: The study investigates the Sri Lankan air travel market to identify the major factors influencing passenger choice of an airline in the regional and short-haul air travel market with the aim of differentiating passenger characteristics based on their choice for two different business models, FSAs and LCAs. The questionnaire survey method was used with the aim of capturing primary data of passenger choice in a hypothetical market scenario. Statistical methods and a discrete choice model were used to analyse the primary data. Passengers valued each airline attribute such as price, food on board, travel comfort, reservation services and baggage allowance in different circumstances. The age and employment grade of the passengers show significant positive relationships with airline choice. Furthermore, a discrete choice model is estimated using trip purpose, and travel frequency as significant predictors for airline choice. The airline brand name plays a significant role in passenger choice.

Keywords: Airline passenger choice, Low Cost Airlines, Full Service Airlines, Multinomial Logistic Regression

INTRODUCTION

LCAs have changed the competitive stance in the airline industry across the world by creating a different market segment of passengers willing to fly with no frills for a low cost. The LCA concept was observed to be entering the Sri Lankan regional and short haul travel markets recently. Therefore, passengers have different types of airlines to choose in their short-haul journeys. As a result, identifying passengers' choices between LCAs and FSAs became a necessity as it would provide airlines, airports and regulators to take critical business decisions on facilitating Indian Sub continental travel.

MATERIALS & METHODS

Studies on the LCAs development elsewhere in the world (O'Connell, 2006-2007; Mason, 2000; O'Connell &Williams, 2005; Park, 2007; Fourie & Lubbe, 2006; Pereira et al., 2007), provided the theoretical and empirical grounds for the research. 417 passengers who have flown at least once during the last two years were presented with a scenario of 3 airlines to choose from - on a single sector itinerary from Colombo (CMB) to Chennai (MAA). Passenger socioeconomics and demographics were collected along with travel related information. Mean, mode, and ANOVA tests were used to identify the factors influencing passenger choice and characteristics of passengers choosing each airline model. Cross-tabulation and Chi squares tests were used to identity meaningful interpretations among each variable for decision making. Moreover, the Multinomial logit (MNL) model was used to find most significant predictors for passenger choice and to find the probability of choosing each airline.

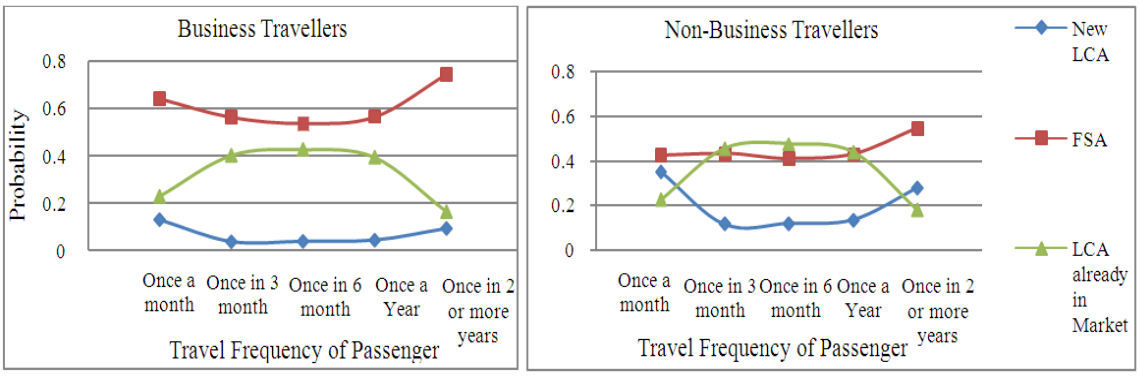

Figure 1: Probability of selecting airlines by passengers with respect to travel frequency

RESULTS & DISCUSSION

The study justifies that price is the key determinant for all passengers selecting an airline. Passengers choose a FSA over a LCA; placing significant importance to travel comfort and free baggage allowances. However, food on board is insignificant across all passenger categories choosing LCAs and FSAs in the short haul travel market. As a result of that, airlines should incorporate the importance of airline attributes when developing and promoting products to attract passengers. Similar to the European context (O'Connell & Williams, 2005), young travellers prefer to select LCAs in the South Asian region as well. The older the passengers, the more prefer FSAs over LCAs. Passengers in higher grades of employment prefer FSAs to LCAs even though the ticket is paid by the company or by themselves. As shown in figure 1, Business travellers, who have once a month travel frequency, have higher probability of selecting FSAs than LCAs mainly because of the travel comfort on FSAs. Furthermore, most of those passengers are in middle/senior management employment categories. Similarly, in-frequent business passengers have a higher probability of choosing FSAs because of on-board comfort and the airline brand name.

Non-business travelers show an almost similar pattern except in the once in 3 and 6 month categories. It is important to know, how passengers' choices vary based on their socioeconomics, demographics and travel related information to offer customised service to attract each market segment.

There is a significantly high tendency for passengers to shift from choosing an LCA to an FSA when brand identity is known. Passenger who chose FSAs have strong loyalties towards the FSA model in Sri Lanka.

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STUDY OF THE ARRIVAL BAGGAGE HANDLING SYSTEM AND BAGGAGE CLAIMING PROCESS AT BANDARANAIKE INTERNATIONAL AIRPORT

V. K. Tharaka & A. S. Kumarage

Department of Transport & Logistics Management, University of Moratuwa, Sri Lanka
Tel No: +94715812395, E-mail: kasunitharaka@gmail.com

Abstract: Introduction of New Large Aircraft (NLA) clusters large amounts of passenger and baggage volumes into airports within short periods of time, generating the necessity of an efficient baggage handling system (BHS) for arrival passengers. This research aims to study the time taken for each step involved in arrival baggage handling and baggage claiming process of wide-bodied and narrow bodied aircraft during peak and off-peak hours separately, based on the analysis carried out using the obtained data attributed to Bandaranaike International Airport (BIA), Sri Lanka. Passenger and baggage arrival, departure patterns were observed and a questionnaire survey was carried out in-order to verify the results. A delay of around 9 minutes occurs during peak hours in both wide-bodied and narrow-bodied aircraft in total, with mean baggage processing and baggage claiming more time than during off-peaks as clearly implied by the results.

Key Words: Baggage Handling Performance, Arrival Baggage, Baggage Claiming Process

INTRODUCTION

The baggage handling performance of arrival passengers is basically measured by the delivery times of "first bag" and "last bag" as they are considered as KPIs[1] for that particular airport. According to Correia and Wirasinghe (2010), the LOS[2] of the baggage claim facility is critical and is highly affected by the performance of baggage handling.

The duty of airport staff is to deliver arrival baggage in the shortest possible time, in order to avoid any unnecessary waiting after disembarkation. Baggage handling performance, which is dependent on the conditions of each operation, is constantly being reviewed and improved to guarantee that passenger belongings are handled with the utmost care.

Currently there are six baggage conveyer belts installed at BIA. Baggage delays and unplanned belt allocations make passengers dissatisfied during peak hours. Therefore this research is to study the current performance of the arrival baggage handling system and the baggage claiming system at BIA.

MATERIALS & METHODS

Primary data were obtained through surveys carried out at the baggage claiming area and the baggage processing area at BIA. It included a staff and passenger questionnaire survey and a passenger and baggage observation survey. Aircraft of three different sizes and three different regions were randomly selected for that purpose (Asian-A320, Europe-A330, Middle-East-B747). The Baggage processing data were obtained as secondary data from Sri Lankan Airlines ramp performance office and Airport and Aviation Services (Sri Lanka) Limited. The times taken for each step of arrival baggage handling was analysed

[1]Key Performance Indicators
[2]Level of Service

separately using hypothesis testing.

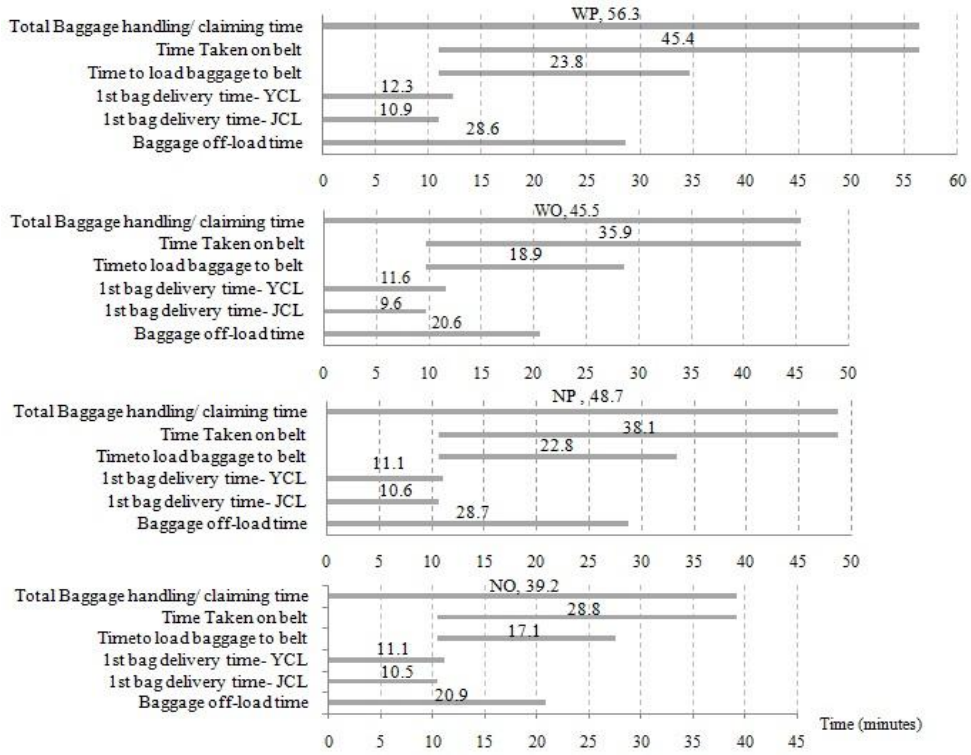

Figure 1: Summary result-baggage processing times

RESULTS & DISCUSSION

From the hypothesis tests carried out, it was concluded that a significant delay occurs during peak hours during baggage processing. According to figure 1, it takes a longer time to process baggage from wide-bodied aircraft than narrow-bodied aircraft. The mean baggage waiting time during off-peaks is higher than that during peak hours which is a deviation from the initial hypothesis and was further proven from the answers obtained from the staff.

Further, belt allocation efficiency and labour performance during off-peaks are low. Considering the current scenario at BIA, the mean first bag delivery time is less than 11minutes whilst the current target is to be within 10 minutes of chocks-on, and the mean last bag delivery performance is less than 35 minutes during peak hour and less than 29 minutes during off-peak (Figure 1).Times taken was compared among four situations namely, WP, WO, NP, NO[3]. Handling baggage as ULD[4]s has significantly reduced the baggage processing time of wide-bodied aircraft. Regression equations in Equations 1 depict the relationship among the variables[5], which have shown 0.000 p-values and more than 95% R-squared values, describing a variation of 95%- 100% in the last bag

[3]WP (Wide-body aircraft in Peak hours), WO (Wide-body aircraft in Off-peak hours), NP (Narrow-body aircraft in Peak-hours) and NO (Narrow-body aircraft in Off-peak hours)
[4] Unit Load Device
[5] T_1 -Average transport and waiting time, T_2 -Baggage off- loading time, T_3- Time taken to load baggage to belt and Last bag delivery time

delivery time.

$$\text{Last bag delivery time (NO)} = 3.69 + 0.974\ T_1 + 0.543\ T_2 + 0.478\ T_3$$
$$\text{Last bag delivery time (NP)} = 4.34 + 1.06\ T_1 + 0.586\ T_2 + 0.396\ T_3$$
$$\text{Last bag delivery time (WO)} = 0.864 + 1.34\ T_1 + 0.735\ T_2 + 0.318\ T_3$$
$$\text{Last bag delivery time (WP)} = 6.65 + 1.14\ T_1 + 0.456\ T_2 + 0.468\ T_3$$

Equation 1: Relationship among variables

Aircraft		Asian- UL102 (A320)	Europe- UL504 (A330)	Middle-East- SV788 (B747)
No. of CMB Passengers (excluding transfer pax)		48	206	393
No. of CMB Baggage		64	285	628
No. of baggage per arrival passenger		1.33 bags/pax	1.38 bags/pax	1.59 bags/pax
Time, 1st passenger	Entered claim area	12 mins	12 mins	10 mins
	Left claim area	15 mins	17 mins	20 mins
Time, 1st bag	Arrived on belt	7 mins	12 mins	16 mins
	Retrieved from belt	12 minutes	17 minutes	16 mins
Time, last bag loaded to the belt (Time after chocks-on)		18 mins	42 mins	64 mins
No. of passengers entered claim area before baggage		0	2	23
Time to clear	50% of baggage	23 mins	44 mins	48 mins
	85% of baggage	28.5 mins	53 mins	72 mins
	100% (or max. no.) of baggage	33 mins	58 mins	89 mins
Bags remaining on the belt		No	Yes (8)	Yes (6)
Belt	No	03	03	05
	Service Time	24 mins	46 mins	73 mins
	Cycle Time	2 mins 40 sec	2 mins 40 sec	3 mins 40 sec
	Frontage Length	51 m	51 m	51.8 m
Throughput Rate		5.3 bags/ min	9.5 bags/ min	13.1 bags/ min

Table 1.1: Summary results- baggage and passenger observation surveys

Results of the questionnaire survey reveal that Middle-East flights record the highest number of baggage related issues, such as baggage losses and mishandled baggage and those flights signify the longest times to clear baggage which is more than an hour. In Europe flights, there are more OOG baggage, such as wheel chairs, baby strollers, surfing boards etc. which need more attention and care while handling.

All the results reflect that BIA is in need of improving its arrival baggage handling system especially as a small airport when other large airports (eg: Changi airport targets: the first bag within 12 minutes of chocks- on and the last bag within 25 minutes for narrow-bodied aircraft and within 29 minutes for wide-bodied aircraft) tend to deliver their baggage within even shorter periods of time

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STUDY ON CAUSES OF DEPARTURE FLIGHT DELAY: CASE STUDY OF BANDARANAIKE INTERNATIONAL AIRPORT, SRI LANKA

M. Ranatunga

Department of Transport & Logistics Management, University of Moratuwa, Sri Lanka
Tel No:0719144877, E-mail: madhavi.ranatunga@gmil.com

Abstract: This research mainly focuses on identifying the significant causes for departure flight delays occurs at Bandaranaike International Airport (BIA). A qualitative analysis method was used to categorize the causes of delay. Descriptive statistical methods were used to identify the delay patterns and significant causes. It was found that the significant causes for flight departure delays were airline related reasons and flight delays were associated with the departure time, day of the week, weather situation and social factors.

Key words: Departure flight delays, Airport performance

INTRODUCTION

Departure flight delay is the time gap between the scheduled and actual times of departure of an aircraft. It is a quite critical issue in the air transportation industry since it leads to inefficiency in the airline network, a revenue loss to the airline; and scatters customer perception of the airline, while it turns down airport performance. The Federal Aviation Administration found that 76% of delays occurred during the departure phase, while gate delay and taxi-out delays contributed 50% and 26% respectively (Bureau of Transportation Statistics (BTS),United States Department of Transportation, n.d.)). The Bandaranaike International Airport (BIA) recorded 27.3% of its total departing flights as delayed in the first quartile of the year 2012. Therefore it is essential to identify the causes of delay to mitigate the occurrence of delays.

MATERIALS AND METHODS

The research is primarily based on secondary data sources which are airline delay reports and flight schedules. A literature study was carried out to identify and classify the causes of delay. EUROCONTROL, 2007 and delay codes of International Air Transport Association, was used as key literature. Eight categories of causes of delay were identified: Passenger convenience related causes, Airline related causes, Airport related causes, Air Traffic flow Management related causes, Weather related causes, Late Incoming of aircraft (LIAC) and Miscellaneous causes. 1520 departure flights of 9 airlines which depart more than 2 minutes and less that 240 minutes late from its Scheduled Time of Departure (STD) during a period of 92 operating days between 01st March 2012 and 31st May 2012 at BIA, were analyzed using a frequency analysis method to identify the patterns of departure flight delays and to determine the significant causes of delay.

RESULTS AND DISCUSSION

The highest number of delay occurrences is observed on Mondays, Thursdays and Saturdays, during the 0700hr- 1259hr time slot, which are the peak days and peak hours at BIA (Figure 1 and Figure 2). Airline related causes; airport related causes and late incoming of aircraft are the significant causes of delay of flights of departing flights in the Sri Lankan context (Figure 3).

The majority of “Airline related delays”

occur due to passenger transfers while airport related delays occur due to bottlenecks in airport operations and ramp handling (Table 1). Late incoming of aircraft happen due to air traffic flow related reasons occurring at their departure airports or en-route. It has been found that airport operational issues in baggage screening and gate operations and ramp handling were highly dependent on the peak days and hours of the airport due to inadequate infrastructure and human. Therefore it can be concluded that the number of aircraft departure movements has a significant influence over the number of departure delay occurrences. In addition, occasional situations like festival seasons (Sinhala Hindu New Year season: 11th April 2012 – 17th April 2012), sudden weather changes (Monsoon Rains) also could cause increments in departure flight delays (Figure 4).

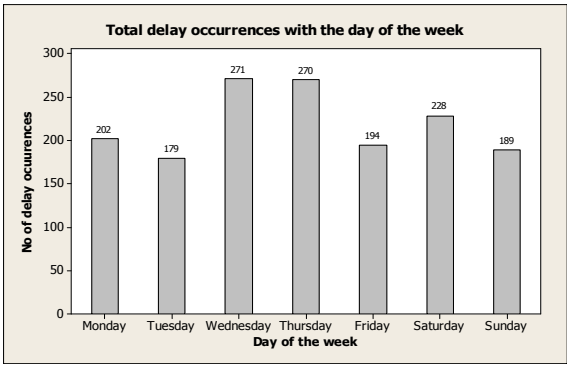

Figure 1: Total delay occurrences with the day of the week

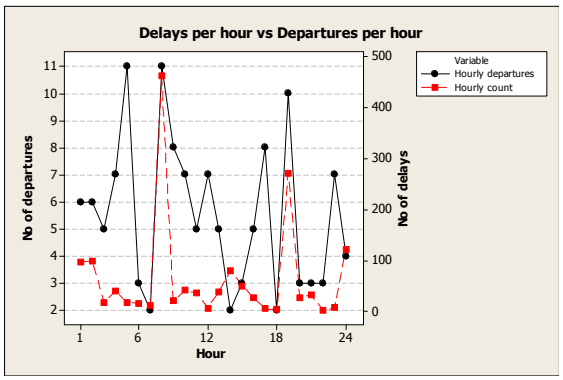

Figure 2: Average departure movements per hour Vs. Departure delay occurrences per hour

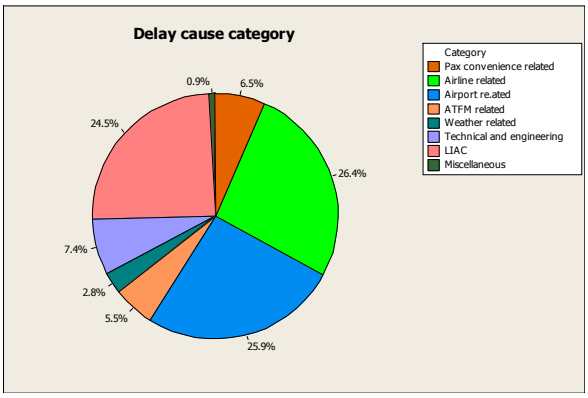

Figure 1: Percentage of delay occurrences with the delay cause

Table 1-1: Percentages of causes of delay

Delay cause category	**Sub category**	**Delay occurrence percentage**
Airline related causes	Passenger transfer	47.3%
	Flight operations and crew	20.6%
	Airline operations	16.9%
Airport related causes	Airport operations	74.1%
	Ramp handling	21.6%
	Government influence operations	4.3%
Late Incoming of aircraft causes	ATFM related reasons	29.4%
	Technical and engineering reasons	27%
	Origin airport related reasons	20.9%
	Weather related reasons	14.7%

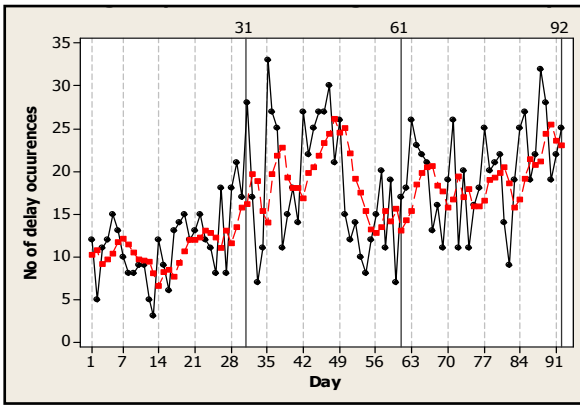

Figure 4: Delay occurrence behavior with the day

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STUDY OF FEASIBILITY OF CONTAINER TRANSPORT BY RAILWAY

P.E. Jayarathne

Department of Transport & Logistics Management, University Of Moratuwa, Sri Lanka
E-mail: punthilajayarathne@yahoo.com

Abstract: The Objective of this research is to identify the benefit of using an alternative mode to transport containers and to analyse the benefits of rail based intermodal container transportation over road transportation. Further to investigate the benefits gained by shippers and other road users with the usage of an alternative mode. Analysis reveals that the saving in travel time due to removing container movements from urban corridors generates economic benefits for other road users in terms of VOT and VOC. In the shippers' perspective, rail based intermodal transportation is supported by lower haulage cost.

Key Words: Congestion, Rail based Intermodal transportation, Value of Time (VOT), Vehicle operating cost (VOC)

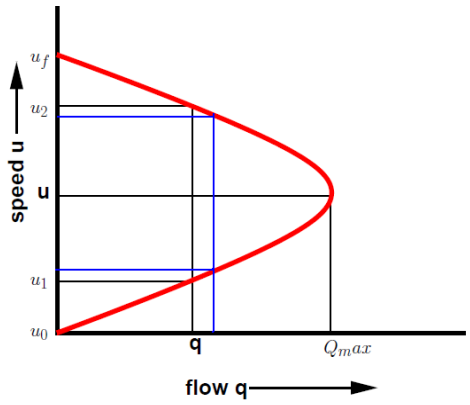
INTRODUCTION

There is a potential growth in domestic container movements due to the Colombo port which is the main gateway of Sri Lanka located inside the urban centre (Multimodal Transport Project,Asian Development Bank, 2011). Some transportation planners have recognized potential opportunities to move freight by rail as an alternative way to decrease deterioration of existing highways, while positively affecting congestion.

When the freight flow is determined by shippers, they do not generally consider the effect of their decision on highway congestion, air quality or other public concerns. But when transport planners come into scene, it is important to consider both public and private benefits when evaluating alternative modes.

METHOD RESULTS & DISCUSSION

Benefit analysis was aligned with the framework proposed in the report *Assessing Public Investment in the Transport Sector by* the Department of National Planning Sri Lanka, 2001. Speed saving within a selected section of road on a major corridor (ΔU) is derived by using a speed flow relationship based on fundamental traffic flow theory. Possible speed saving along the different sections of the selected corridor was computed for peak and off peak hours.



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[$\Delta U^6 = Speed\ at\ flow\ with\ existing\ traffic\ mix(U2) - Speed\ at\ flow\ without\ heavy\ vehicles\ on\ the\ traffic(U1)$]

[1] It is assume that Only heavy vehicle changes the status from 2 to 1

VOT is calculated based on monthly income rate.

*Hourly Income rate of user group (Rs/Hr) = Mean hourly Income of User Group (Rs/month)*12(Months/Year) /2000(hrs/year)*

*VOT saving for each user group per selected section = ADT * % of User group* VOR[7] * distance of the sector (km) * Adjusted VOT of user group (Rs/Hr)*

VOC is determined by the reduction of the haulage fare due to speed saving.

Average daily VOC saving per each vehicle group =ADT % of User group * distance of the sector (km) * VOC saving per Unit vehicle* (Mltimodal project,Asian Development Bank, 2011) *(Rs/km)*

Only the haulage fare per TEU-km was considered, rather than evaluating total logistics costs, to compute haulage fare savings for shippers.

Significant average daily savings of VOT and VOC can be seen for urban road users due to the elimination of container movements along the road. Average daily savings of VOT for other road users in the sample road section is Rs.6, 431, 676.93 and the VOC saving is Rs.3, 825,619.96. The shipper benefitted by the haulage fare saving through the rail based intermodal option. The rail based intermodal transport option can be justified in terms of shippers' haulage fare saving and economic benefits for the other road users due to speed saving. This result can be further strengthened by evaluating the social cost of alternative options and the total logistics costs with inventory costs and transit point costs.

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[2] Vehicle occupancy rate [VOR]

SUPPLY CHAIN RISK MANAGEMENT CAPABILITIES – ENHANCING FIRMS' PERFORMANCE IN EXTENDED SUPPLY CHAINS

N. Fernando
511/A, 8th lane, Lunawa, Moratuwa, Sri Lanka
Tel No: 0773887656, E-mail: nishanthatlm@gmail.com

Abstract: This research examined the effects of Supply Chain Risk Management (SCRM) capabilities and Logistics Outsourcing on firm performance in the context of Sri Lankan manufacturing industries. The objectives of the research include; defining a general framework for SCRM through the identification of relevant SCRM capabilities, to purport actionable recommendations to enhance firms' performance through healthier SCRM capabilities.
First, the literature review established a general review of the evolution and the concept of supply chain risk. The literature research points out that firms can use different types of approaches and strategies to tackle uncertainty: securing the supply-chain and developing resilience. The research focused on identifying particular supply chain risk management capabilities a firm should possess in order to deal with modern day uncertainties and presents an analytic model to analyze the relationship between supply chain risk management capabilities, firm performance and outsourcing. The results showed a strong positive relationship between supply chain risk management capabilities and firm performance, however, no mediating effect of logistics outsourcing was identified.

Key Words – Supply Chain Risk Management, Firm Performance, Logistics Outsourcing

INTRODUCTION

As firms' operations have become increasingly global and complex, the potential risks to which firms' supply chains are exposed have grown accordingly, making it imperative to re-calibrate supply chains and understand how to manage associated risks. These supply risks can significantly affect the ability of an organization to achieve desired level of performance success. As a result, a single incident in a supply chain can affect many firms down the line in the supply network, and these points out the importance of this study (Souter, 2000). The logic of the paper is based on the framework with four positive hypotheses (H) as illustrated in Figure 1.

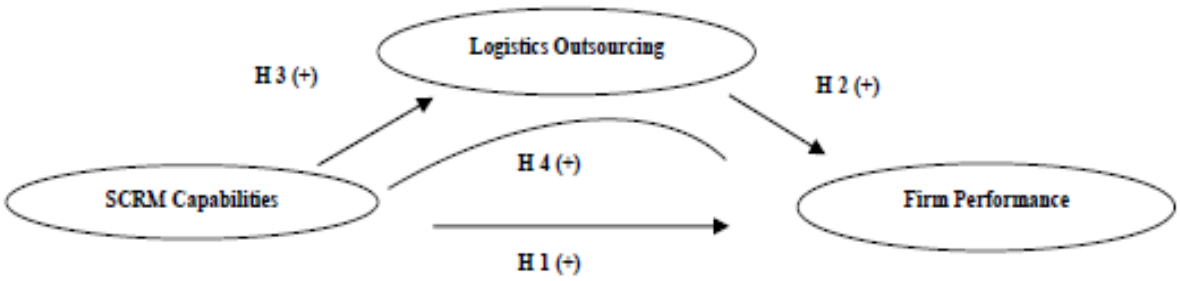

Figure 01: Conceptual Framework

METHODOLOGY

The literature review explored the evolution and concepts of supply chain risk and it was found that firms can use different types of approaches and strategies to tackle uncertainty: to secure the supply-chain while developing resilience (Jüttner, 2005). Therefore, a critical challenge for modern day managers is to create an organization-wide risk awareness mindset and to devise sound organizational tactics and strategies.

The help of an expert panel which consists of prominent professionals in the relevant industries was used in finalizing a list 13 SCRM capabilities under four main categories that a firm should possess in order to deal with modern day uncertainties; namely, Strategic Sourcing, Supply Base Management, and Enterprise Risk Management. The research methodology incorporates both quantitative and descriptive research methods. A questionnaire and an interview protocol were used as the primary research instruments to arrive at a sample of 83 questionnaires and 10 interview scripts covering FMCG, Food and Beverage, Electronics and Apparel industries. A Likert scale was used to collect information.

A Reliability Analysis was performed to validate the data using the Cronbach's Alpha (α) method (Cronbach, 1951). The dependent variable; firm performance, was evaluated against the independent variable; SCRM capabilities and the logistics outsourcing variable was considered as a dichotomy (Baron and Kenny, 1986)

RESULTS

Hypothesis Testing – Results Analysis showed that only H1 and H2 were acceptable. The analysis showed a strong positive relationship between supply chain risk management capabilities and firm performance, however, no mediating effect of logistics outsourcing on the above relationship was found (Holmbeck, 1997).

Further analysis into SCRM responsibility sharing in a firm and inter-organizational SCRM showed that most of the organizations were in the development stage and in the early parts of learning what is meant by SCRM; and hence do not take the inter-organizational risk mitigation efforts into their strategies often. Furthermore, the results showed that there still are many areas to be improved in terms of achieving excellence in SCRM for many organizations. A framework for successful supply chain risk management was proposed as a four step model that attempts to address SCRM in a systematic manner.

Figure 2: Proposed Supply Chain Risk Management Frame work

DISCUSSION

Sharing of SCRM responsibilities and Inter-organizational SCRM are the two main domains to be improved by Sri Lankan manufacturing organizations in their journey towards building resilient supply chains, and the research findings recommends; the creation of risk awareness in the organizations, striking a balance between the practice of modern day supply chain concepts and supply chain risk management, proactive utilization of risk

management tools and methods, adding agility to raise resiliency, appointment of a supply chain risk manager.

Future research avenues are plenty and it would be useful to identify how to quantify the benefits of supply chain risk management for an organization. In addition, the role of supply chain risk management capabilities together with other capabilities of the firm should be assessed against firm performance (Ellinger et al, 2000).

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THE IMPACT OF STRATEGIC PURCHASING & SUPPLIER INVOLVEMENT ON FIRM PURCHASING PERFORMANCE (A STUDY ON MANUFACTURING SECTOR IN SRI LANKA)

R.H.R. Damayanthi

Department of Transport and Logistics Management, University of Moratuwa, Sri Lanka
Tel No: 071 9464502, E-mail: rasikadamayanthi77@gmail.com

Abstract: The purpose of this study was to understand the current nature of purchasing and to find out the impact of strategic purchasing (Communication, Limited number of suppliers, long term orientation) and supplier involvement on firm purchasing performance. Hypotheses were developed to find the relationship between strategic purchasing and purchasing performance, supplier involvement and purchasing performance and tested using a chi-squire test through a field research on a sample of 30 purchasing professionals. The analysis statistically proved that supplier involvement and Strategic purchasing are positively related to firm purchasing performance. It indicates that strategic purchasing and supplier involvement have the ability to improve purchasing performance through minimizing cost, improving quality, on time delivery and managing inventory levels effectively.

Keywords: Strategic Purchasing, Supplier Involvement, Purchasing Performance

INTRODUCTION

As manufacturing companies struggle to increase customer value by improving performance, many companies are turning their attention to purchasing and supplier involvement. In the manufacturing sector, the percentage of purchases to sales averages 55% according to literatures done previously. Therefore the purchasing function of the manufacturing industry came to be regarded a strategic function for achieving a competitive advantage since the mid-1980s (Chen, Paulraj, Lado, 2004). The purchasing function is associated with top management and communication, long term relationships with suppliers, and supply base optimization. Hence, involvement of suppliers will make the purchasing function more strategic (Supplier relations and supply chain performance in financial services processes, 2008).

MATERIALS AND METHODS

This research was conducted on the large scale food, tobacco and beverage manufacturing industry in Sri Lanka and reviewed research papers published previously, lecture materials and books as literature. A questionnaire was designed with closed ended questions having five Likert scales, structured questions and filled by 30 purchasing professionals in manufacturing companies having more than 300 employees. Descriptive statistics and chi-squared test was conducted to achieve the research objectives.

SUMMARY AND DISCUSSION

Results show that 93% of manufacturing companies have separate departments for purchasing, and hence, it is obvious that these companies have identified purchasing as a strategic function. Quality of materials, cost of materials, on time delivery and inventory performance of the materials are the key factors which lead to the overall

purchasing performance of the organization. A chi-squared test was done to verify the hypothesis statistically at 0.05 significance levels. For the hypothesis 1, the calculated Chi-squire value is 16.93 greater than the table value 9.49 at significant level of 0.05 and discount factor 4. This proved that communication, supply base optimization, long term orientation have positive relationships with firm purchasing performance. For the hypothesis 2, the calculated Chi-squire value is 12.50 is greater than the table value 9.49 at significant level of 0.05 and discount factor 4. This proved that the supplier involvement have a positive relationship with firm purchasing performance. Strategic purchasing cannot be acquired accidently; comes from the level of dedication at all levels of management of the organization. It is important to focus more on communication with suppliers since the results show that there is lack in this area in the Sri Lankan context.

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