2001

Increased port productivity and its impact on the Jamaican economy : a case study of Kingston Terminal Operators Limited

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INCREASED PORT PRODUCTIVITY AND ITS IMPACT ON THE JAMAICAN ECONOMY

A case study of Kingston Terminal Operators Limited

By

KAREN JOY CLARKE
Jamaica

A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

MARITIME AFFAIRS

2001

DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personnel views, and are not necessarily endorsed by the University or Kingston Terminal Operators Limited.

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DEDICATION

This project is dedicated to:

The Light, my Lord and Saviour Jesus Christ, to whom I owe all that I have. He is the ‘staff’ that I lean on; without him I would.

My wonderful parents James and Doris Clarke, who has been a mortal ‘rock’ of strength and encouragement.

ACKNOWLEDGEMENT

I would like to express my gratitude to Noel Hylton, President of the Port Authority of Jamaica, for his life and works in whose name I received the scholarship so that I could complete my educational dream of attending the World Maritime University. Thanks also to the Noel Hylton Maritime Scholarship Committee for having nominating me and for seeing to my finances over the time of the course. My sincere thanks also to Kingston Terminal Operators Limited especially Robert Kinlocke, Managing Director for supporting the application and making it possible for me to attend.

My sincere thanks and appreciation to Professor Bernard L. Francou, my supervisor, who showed patience and diligence in correcting, commenting on, and giving suggestions for improvements to this dissertation as it progressed. I wish to thank the entire staff of the University who helped me, and especially the staff of the Library Susan Wangeci-Eklow and Cecilia Denne who were on constant lookout for articles and other publications they thought would assist me in completing this paper.

Special thanks, to my friends from the City of Malmö, who helped to make my stay much more comfortable, as they provided that ‘home’ away from home. Thanks also to my colleagues at the University who in many ways supported and encouraged me during my time studying there.

Finally, my deepest and eternal gratitude and appreciation to my family for making the sacrifices and suffering the disruptions created by my attending the University. Without you all, I could never have completed this course.

ABSTRACT

Title of Dissertation: **Increased Port Productivity and its Impact on the Jamaican Economy: A Case Study of Kingston Terminal Operators Limited.**

Degree: **MSc**

This dissertation focuses on ways of improving port performance and productivity at Kingston Terminal Operators Limited in Jamaica. Its purpose was to evaluate the organizational and managerial aspects, which affect port efficiency and effectiveness. It is the author's view that improved port performance and productivity is the key in achieving greater customer satisfaction and enhanced competitiveness.

The baseline of the study was to analyse the existing situation of the port in terms of performance and productivity by looking at port performance indicators. It identified and examined the problems and constraints operationally technically and structurally.

A brief look was taken of the different methods of calculating productivity and a comparison was made between the methods. Definition of the words productivity, efficiency and effectiveness were also looked at in a generic sense so that there could be a clear understanding of the differences between them.

Productivity was also viewed from an economical point of view as to the increase in productivity on the Jamaican economy. Future growth both worldwide and regionally was looked at from previous studies and in light of NAFTA, which is already in place, and the FTAA to be formed. Measures for the improvement of productivity were also viewed from human, technical and administrative and procedural aspects.

Critical Analysis of the level that the Terminal should be performing was also looked at and this level was arrived at by the use of theories, competitors and other port performances and from an empirical research carried out at KTO. The author also arrived at three alternatives for improving the port performance and multi-criteria analysis was used for selecting and ranking them.

The concluding chapter in support of the alternatives recommended additional ideas to KTO, which when adopt should serve not only to increase productivity but also sustain it.

KEYWORDS: Economic Impact, Increase, Multi-criteria, Productivity, Performance, Sustainability

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DMU	Decision Making Unit
FTAA	Free Trade Area of America
KTO	Kingston Terminal Operators Limited
NAFTA	North America Free Trade Agreement
PAJ	Port Authority of Jamaica
SAJ	Shipping Association of Jamaica

CHAPTER 1

Background and Significance of Study

1.1 Introduction

Kingston Terminal Operators Limited is Jamaica's premier port. It is located 17.58 degree due West latitude and 76.48 degree North longitude ('CSA', 1999, p.59) and is located 32 miles from the major East/West arterial trade route via the Panama Canal ('PAJ', 1998, p.3). The country is one of the third largest islands in the Caribbean ('Irie Internet' 2001, p.1) having a land area of approximately 11,424 sq. km. The island is 800km southeast of the State of Florida in the USA and 160km due south of Cuba. The entrance and exit to the container terminal is facilitated by the seventh largest natural harbour in the world. The Harbour is sheltered and therefore, provides a secure point of entry and exit for ships. The Harbour can accommodate large vessels of varying types, as it has depth of up to 90ft (27.45m) and a length of approximately twenty square kilometres of navigable waters ('PAJ', 1998, p.9). Because of Jamaica's position in the Caribbean, Kingston is very centrally sited and as such in an ideal situation to serve the Eastern and Western Caribbean, the Northern Caribbean and the Colombian and Venezuela sub region. Jamaica's locational advantage has enabled Kingston to develop into a major hub port in the Caribbean.

Kingston as a hub has served the country well for years both from economical and social points of views. Many businesses have evolved out of the port scenario e.g. the Container repair company, Zim's district office and the Free zone complex to name a few. The port has also helped to put Jamaica on the map internationally not only to seafarers but also to the general maritime industry.

However due to recent upsurge in competition from newly developed ports like Freeport (Bahamas), Manzanillo (Panama) and with Peurto Rico's recent ambition to be the fifth

biggest transhipment centre in the world ('Lloyd's List', 2001, p.1) and the many demands from shipping lines for more efficient operation, it is not sure for how long the hub status will remain with Kingston, given its poor port performances generally and productivity in particular for years. Thus it is valid to question ourselves about the future of the port from a quality point of view. Thus as far as this paper is concerned, the key factors for measuring and improving the terminal's performances and productivity will be the topic for later discussion. The strategic location, and helicopter view of the terminal can be seen below in figures 1.1-1.2.

Figure 1.1 Strategic Location of the Premier Hub (KTO)

Source: Kingston Terminal Operators Limited

Figure 1.2 Helicopter View of the North and South Terminals (KTO)

Source: Kingston Terminal Operators Limited

1.2 Background of the Study

The author for the last 13 years has been employed to Kingston Terminal Operators Limited (KTO for brevity) and worked with the input of data for calculating productivity for some time. Over this period and after, productivity fluctuated, resulting in complains from port users chiefly shipping lines, as their demands were many and towards faster ship turn-around time. The demands have however placed KTO in a competitive position.

Due to the terminal not being able to maintain higher productivity, shipping line such as Maersk/Sealand and Evergreen shifted all or most of their moves to other terminals in the region. Sealand shifted to San Juan (Puerto Rico) whereas Evergreen instead invested in the construction of the new container terminal, Manzanillo International Terminal (MIT) and since 1999 Freeport was opened by Hutchinson Whampoa Group, the world's largest independent port operator.

Although the terminal made efforts to improve and sustain productivity performance this has been an uphill struggle as the performances were not long lasting and were instead fluctuating in no time, as a constant growth path could not be achieved. In an effort to analyse the possible reasons for this erratic behaviour in productivity, the author is motivated to study the terminal's situation based on the high port performance and productivity of ports throughout the world.

Finally, based on the fact that Kingston Terminal Operators Limited has problems in improving and sustaining its productivity warrants an answer. Thus an evaluation is necessary to highlight what it is that the terminal needs to do so as to be among the major port productivity achievers. This is the thrust of the study.

1.3 Objectives of the Study

- To evaluate the port performance and productivity based on the internationally standardised indicators
- To identify and examine the main problems and constraints of the port to the efficiency and effectiveness of the port from analysing the indicators

- To identify the main causes of the problems and constraints
- To derive the conclusion and recommendations based on the above objectives that will serve to harness KTO with that competitive edge so that it can survive within the 21st century.

1.4 Significance of the Study

It is hoped that by analysing the terminal's port performance clear ideas can be gleaned as to what the terminal needs to do to increase port performance in general and quayside productivity in particular, which will impact on both the effectiveness and efficiency of the port so that the port can maintain its position as a major transhipment centre in the Central American/Caribbean region.

It is hoped that this investigation will enlighten KTO as to how other ports calculate their productivity and whether it is according to UNCTAD rules and regulations. This will help the terminal to determine if what they are doing is correct or if there are reasons for drastic changes.

The study will also try to ascertain the impact of an increase in productivity on the economy. This will definitely help the terminal to better understand ship-owners, shippers, truckers, consignees and shipping agencies complaints and how to effectively address them.

Finally, the study will serve to improve productivity in three main areas; those concerned with:

1. Human Aspects (labour and personnel)
2. Technical Factors and
3. Administrative and Procedural Matters

Thus we may derive our problem statement

TO WHAT EXTENT DO HUMAN ASPECTS, TECHNICAL FACTORS AND ADMINSTRATIVE AND PROCEDURAL MATTERS AFFECT THE LEVEL OF EFFECTIVENESS ON THE TERMINAL AND ITS IMPACTS ON THE ECONOMY?

1.5 Limitation of the Study

The study was however limited to the analysis of the dedicated container terminal in Jamaica, Kingston Terminal Operators Limited, that is providing transhipment service to many lines calling at the port. It was so limited, as it would be rather time consuming to look at all the ports in the island given the various sectors served and given the time constraint for completing this study. However being there are so many ports the opportunity still remains for future students to carry out assessment on other ports within the island.

Regardless the initial limit set by the author, she was also faced with the problems of obtaining data and information. For instance:

- The information regarding the reliability indicators from the terminal
- Substantial financial information that could have resulted in a more detailed analysis
- Recent written materials on port productivity and performance for comparison and substantive use, thus some examples and clarifications are more than ten years as research carried out in the past are rarely repeated as the general principle remains the same.

1.6 Literature Review and Research Methodology

Both primary and secondary information were used in this research. Theories and mathematical indicators were applied in trying to come up with and test hypotheses. Multi-criteria Analysis was also used for analysing port data and scenarios to come up with the best economical solution for the future of the company. It was also chosen to help the company prepare for changes and uncertainties because it was not possible to measure all the elements determining efficiency. Primary data was gathered through the

distribution of questionnaires to get the views on shipside, quay transfer, storage and receipt delivery operation from senior and middle managers, clerical, secretarial and technical staff as to how productivity impinge on the human, technical, administrative and procedural aspects within the port. The questionnaire was also used to verify and check the reliability of statistics and information gained from Kingston Terminal Operators Limited. Secondary information was also garnered from the internet, books, periodicals, magazines and other dissertations. The hypotheses were then tested so as to come up with the findings, which helped in the structuring of my conclusion and recommendations.

Conclusion

Finally it is hoped that by analysing the performances of KTO clear ideas will be gleaned that will not only help the author to better understands the major influential factors that impinge on quality services being demanded by port customers worldwide but will also help KTO to appreciate its customers' problems and put in place corrective measures to remedy them.

CHAPTER 2

An Overview of KTO and Future Growth Pattern

2.1 Background

Kingston Terminal Operators Limited was established in 1975 and its development was driven by the need to alleviate congestion and to move in line with the development of containerisation. The terminal was designed as a multi-user container terminal as it was the only one of its kind on the island and to take advantage of the growing container trade that had already being on the international scene for 15 years. The venture although very costly proved successful, as the terminal was soon to be graced with the arrival of some of the big shipping lines, ZIM Israeli Shipping, Sealand Services and Evergreen Shipping which are still in operation today.

2.1.1 Management

The terminal was set up as a tool port with KTO being the management company and the Port Authority (PAJ) responsible for the regulation and development of the port. To some observers the continued public management style of the Port Authority is a strength. To others the duality between the Port Authority and the private operating group could lead to a divergence in policies and strategies (‘PAJ’, 1998, p.12)

2.1.2 Labour

Labour for the terminal is supplied by the Shipping Association of Jamaica (SAJ), a registered employer’s trade union that is responsible for the supply and management of stevedoring labour at the Port of Kingston which includes maintaining adequate numbers of trained effective workers through their recruitment centre (‘PAJ’, 1998, p.30).

2.1.3 Marketing

The Port Authority along with top management at KTO undertakes marketing of the terminal. It is the Port Authority's responsibility to promote the terminal in a general sense so that the shipping community can be made aware of the port's advantages. In most ports whether landlord, tool or service ports a similar marketing policy can be seen. The Port of Antwerp in Belgium for example has a similar pattern of marketing.

Due to the terminal's unique location as already explained, marketing is directed at the transhipment trade as this type of traffic continues to command (70-80%) of the terminal's traffic. **In a report published by Louis Berger International Incorporated (1985, pp. X 11-22) states that the terminal's marketing effort should be focused on the marketing of transhipment cargo and not so much on the marketing of domestic cargo…marketing directed at domestic is essentially superfluous.** The readers may want to know how relevant this report is, but based on the revelation that the transhipment trade is so high on the terminal then the author can conclude that the recommended strategies are well in line with the study piloted then and thus reference can be made to it.

2.1.4 Inland Transport

Transporting cargo to and from the port is mainly by privately owned individual truckers across the 19000km road network with 70.7% of the roads paved ('World Bank', 2001, p.2). The island also possesses two privately owned internal airlines that operate between the two international airports and private airstrips throughout the island.

2.1.5 Hinterland

Being Jamaica is an island, the author would want to imagine that the island is KTO's hinterland but this is not true as KTO's local competitor, Kingston Wharves handles also 70% of the container traffic (PAJ, 1998, p22). Although different shipping lines uses both terminals, shipping agents have to employ different marketing strategies to gain one customer over the next. **According to Ma (2001, p.9) economically and from a logistic point of view, the hinterland of a port should be the area to and from where the cargo's total transit cost is the minimum compared with using any other ports.**

Based on the fact that shippers are more concerned about which shipping line can move their container within the time specified, service is weighed far more heavier than cost thus the hinterland can be anywhere in Jamaica.

2.1.6 Expansion

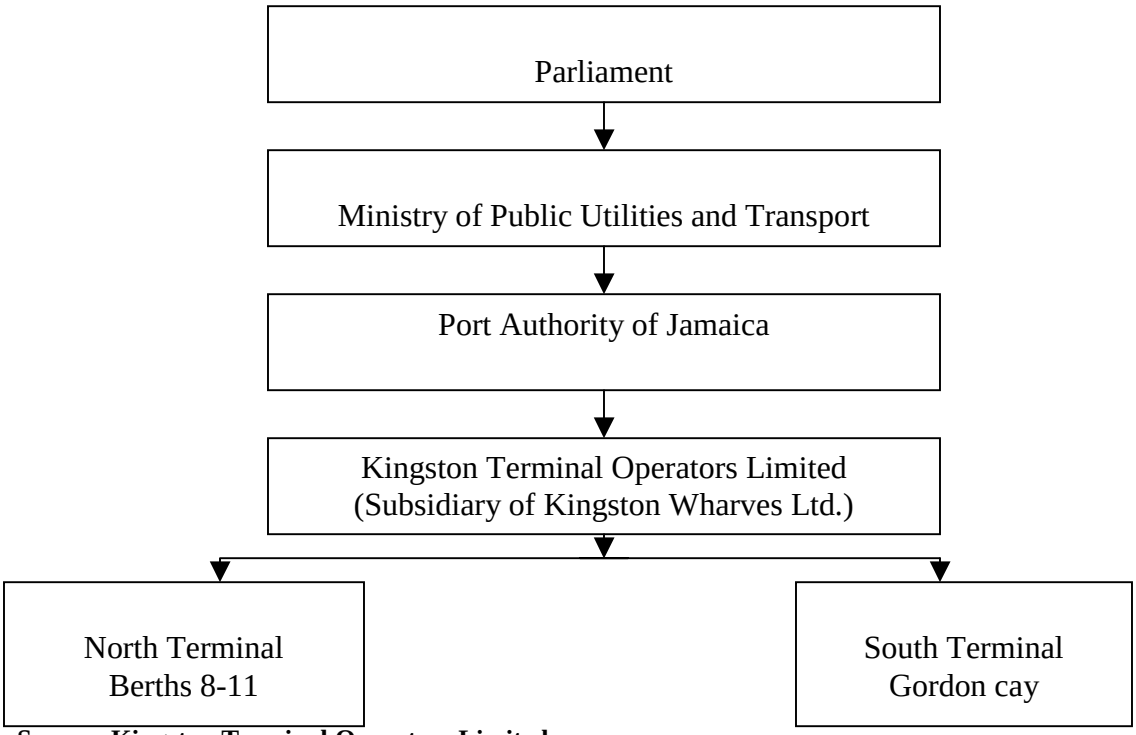
KTO continued vigilance to modernize and expand its facilities has seen the terminal grown from a four-berth facility to a seven-berth facility, three 300m and four 150m berths, which were carried out on a new site known as Gordon Cay (North Terminal) lying adjacent to the existing Container Terminal (South Terminal) (see figures 1.2, page 2). Expansion was undertaken on a phase basis and the first 2000ft (610m) of berth was completed and officially opened July 11, 1996. This new facility has added 2,000ft of new wharf under the phase one development and another 1,000ft (305m) was added in a subsequent phase, which was completed in year 2000.

The draught alongside the new wharf falls within the range of 42-48ft (12.8-14.6m). Today both post panamax and super post panamax vessels can be easily accommodated thanks to the modern ship-to-shore gantries in place (PAJ, 1998, p14). Container handling is supported by the straddle carrier relay system and due to the existence of the two separate container terminal sites, it is unlikely that this system will changed in the short or medium term. The efforts required for inter-terminal transfer are too considerable for this to happen quickly (‘De Monie, Hendrickx, Joos, Couvreur & Peeters’, 1998, p.55) The overall terminal operation and management systems at KTO are underpinned by Cosmos computer software (SHIPS for optimising vessel loading and discharge, SPACE for yard planning and TRAFFIC for the trucking of equipment and containers) bought from the Antwerp (Belgium) software specialist. Recently, a Global Positioning System (GPS) was installed for tracking container movement on the terminal.

Due to the recent expansion, KTO is now ranked as the second largest port after San Juan in the Central American/Caribbean region but is the most successful transhipment port in the Caribbean subgroup of the Association of Caribbean States (‘Lloyd List’, 2001, p. 2). Thus a greater impetus is now there to sustain and increase its position in light of the growing competition

An organizational chart of KTO can be seen in figure 2.1 below.

Figure 2.1 KTO Organizational Chart



Source: Kingston Terminal Operators Limited

Since KTO serves the vital interest of the country, the economy of which is oriented towards foreign countries, a closer look will now be taken of the Jamaican economy.

2.2 Economy

Jamaica's population growth for the last ten years ranges between a high of 1.2 and a low of 0.7 ('PIOJ', 1999, p.19.1). Tourism is the largest single earner of foreign exchange, exceeding the 1 million-arrival mark in 1999 ('CIDA', 2000, p.1) while bauxite is exported by a partnership between the Jamaican government and foreign companies. The main agricultural earner and employer of labour is sugar cane. Banana exports have provided the historical trade links to North America and Europe, while coffee, pimento, papayas and citrus have all had their place in the agricultural sector ('U.S. Embassy', 2001, p.1). For actual figures see table 2.1 as follows.

Table 2.1 Jamaica Economic Indicators

Population 2000	2.6 million
Population Growth 2000	0.90%
Rural/Urban Split 2000	44.4%: 55.6%
Key Economic Sectors 1999	
- Bauxite (10% of GDP)	US$690 million
-Tourism (17% of GDP)	US$1,162 million
- Agriculture (7% of GDP)	US$483 million
GDP 1999	US$6.9 Billion
GDP Growth	
-1998	-0.40%
-2000	1.50%
-2001 (expected)	2.40%
Balance on Current Account 1999	- US$3.9 Billion
Foreign Exchange Rate	
-1999	J$37.5:US$1
-2000	J$45.8:US$1
-2001 (expected)	J$53:US$1
Inflation	
-1999	6.30%
-2000	9.50%
-2001 (expected)	11.60%

Source: World Bank, Canadian International Development Agency, U.S. Embassy, The Economist Intelligence Unit, Herko Mission, Planning Institute of Jamaica.

2.3 The Significance of KTO to the Economy

Although KTO is a transhipment hub, approximately 20-30% of the traffic is for the national market. Based on this the terminal can be considered as catering both to the national and international markets. Therefore its economic impact is very high as there is both a direct and indirect effect which go beyond the national borders as the port is used as a logistical platform where administrative and logistic operations are performed such as multi-modal transport organization, trade and even repackaging or distribution centres.

In order for the author to help its readers to better understand KTO's impact on the economy the author will ask the question 'which activities exist thanks to the existence of the terminal?' In answering this question the author will look at the direct, indirect and induced impact of the port on the economy. The direct impact of the port on the economy can be seen in the every day running and management of the port as the terminal provides jobs for 399 persons in year 1999 and 486 in year 2000 an increase of 17%. Based on empirical research 56% of staff falls within the age group 26-35 years. Additional staff is however required to service vessels, service the cargo and for providing administrative

service to ships and cargo. The services required through pilotage, tugging, mooring/unmooring, custom clearance, banking and policing have provided employment to approximately 2000 persons.

The Port's indirect impact lies closely to the port but it is also visible in the wider communities of Jamaica. The impact is evident in manufacturing, electrical and irrigation factories that have been established to process raw materials imported from overseas and instead finished products are exported to these foreign countries, distribution centres and traders. However the induced impact of the direct and indirect activities on the other sectors of the economy is very great as the income generated by personnel working in the maritime sector is above industry standard which has allowed them to live comfortable. Although empirical evidence showed that only 56% staff is in agreement with this argument. Most importantly there is a multiplier effect as the incomes generated among port professionals take care of expenses, and these expenditures in turn become revenues to others ('Lipsey, Courant, &Ragan', 1998, pp. 502-504).

Kingston Terminal Operators Limited for years has also been one of the largest single contributor of gross foreign exchange earner to the maritime sector in particular and the Jamaican national economy in general. Foreign exchange earnings generated from 1.3 million container moves over the period 1998-2000 was approximately US$ 175 million. Surplus income over the years has enabled PAJ to undertake several port and free-zone development projects. Keys projects in this regard encompass dredging of the Kingston harbour, implementation of tug and towing service in Kingston and most importantly the expansion and improvement project as mentioned above on page 9 ('GOJ', 1993, p.2).

KTO serves lines that call over 100 ports in over 50 different countries and offers more ship calls and services than any other Jamaica ports. As Jamaica's busiest seaport, the port has a wide-ranging role and makes significant contributions both economically and socially. Below in tables 2.2 and 2.3 both Jamaica's and KTO's trade were analysed. Based on tables 2.3, for the year 2000, KTO handled US$ 72 million worth of trade. This was 1.2 and 2.7% of the total Jamaican imports and exports by value when KTO total imports and exports were compared in dollar value respectively.

Table 2.2 Evolution of Jamaica Export and Import by Value, 1998-2000

	1998	1999	2000
EXPORTS US$M (FOB)[1]	1,266	1,247	1,293
IMPORTS US$M (CIF) [2]	3,029	2,904	3,200
TOTAL BALANCE	**-1,763**	**-1657**	**-1907**

1. FOB - Free on board
2. CIF – Cost, Insurance and Freight

Source: 'Statistical Institute of Jamaica, 1998-2000'

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TABLE 2.3
EVOLUTION OF KTO IMPORT AND EXPORT BY VALUE, 1998-2000

	1998		1999		2000	
	Import	**Export**	**Import**	**Export**	**Import**	**Export**
Foreign Exchange Earnings:-	US$M	US$M	US$M	US$M	US$M	US$M
Transhipment	18.4	17.1	18.8	17.5	26.7	23.9
Domestic	8.8	8.3	9.0	9.1	8.6	8.5
TOTAL (US$)	**27.2**	**25.4**	**27.8**	**26.6**	**35.3**	**32.4**

Source: 'KTO Accounting Report, 1998-2000'

To further substantiate the earlier argument of the transhipment activity at KTO, table 2.3 also showed that 68-75% of the import earnings and 65-74% of the export earnings were also from transhipment activity with year 1999 import and export trade growing by 2% when compared to year 1998 and when year 2000 was compared to year 1999 growth was by 42% and 36% respectively. Whereas transhipment activity was growing, domestic activity remained fairly stagnant. Therefore, forecasting of future traffic should be for the transhipment cargoes. Thus, it is important for KTO to employ protective, maintenance and growth strategies so as to sustain and improve transhipment traffic as compared to its competitors.

2.4 Future and Actual Growth

Here the author will now assess future growth pattern within the container trade and look at KTO's performance over the years.

2.4.1 Future Growth

Based on past trend of world seaborne trade, growth is expected to continue into the future. **In support of this argument Ocean Shipping Consultants (1995, p.143) said**

that container port demand would increase since there were three decades of dynamic expansion and the world container port market showed no sign of slowing down. See Table 2.4 below for projects to 2010.

Table 2.4 Forecast Container Port Throughput to 2010

Million TEUs	1994	1995	1996	1997	1998	1999	2000	2005-I	II	2010-I	II
TOTAL	**127.53**	**141.60**	**154.57**	**168.89**	**186.15**	**203.55**	**222.26**	**334.74**	**305.96**	**465.10**	**391.06**
East Asia	**54.08**	**61.84**	**69.98**	**78.34**	**89.23**	**100.05**	**111.49**	**178.82**	**161.58**	**244.01**	**201.7**
Europe	30.28	33.06	34.71	37.00	39.46	41.90	44.75	62.33	60.09	86.97	80.85
North America	20.31	21.85	22.86	24.10	25.41	26.79	28.26	36.82	35.11	48.26	43.8
Australia/Oceania	3.20	3.46	3.67	3.88	4.08	4.28	4.50	5.75	5.64	7.35	7.22
Developed Markets	**53.79**	**58.38**	**61.23**	**64.97**	**68.94**	**72.97**	**77.51**	**104.89**	**100.84**	**142.57**	**131.9**
Caribbean/C. America	**5.05**	**5.39**	**5.83**	**6.40**	**7.03**	**7.72**	**8.48**	**13.48**	**12.32**	**21.44**	**17.86**
South America	2.54	2.76	3.07	3.42	3.80	4.23	4.71	7.76	6.76	12.79	9.71
M/E and Indian Subcontinent	8.02	8.58	9.31	10.16	11.04	11.97	12.94	18.81	15.79	27.40	19.4
Africa	4.06	4.66	5.14	5.61	6.11	6.60	7.13	10.97	8.67	16.88	10.55
Developing Markets*	**19.66**	**21.38**	**23.35**	**25.58**	**27.98**	**30.53**	**33.37**	**51.03**	43.54	**78.51**	**57.53**

***Except East Asia**
Figures may not sum exactly due to rounding
Source: Ocean Shipping Consultants Ltd – July 1995

For the last 20 years world seaborne trade has increased by almost 40% with liner shipping growing the fastest. **According to Peters (2001, p.3) containerisation has been a major and increasingly important element of not only maritime activity but also of world trade and of the entire global industrial structure.** According to the latest figures provide to me by Canamero (2001, p.1) of UNCTAD, it showed that world trade grew by 12.4% when year 2000 was compared with 1999 and further growth is expected for year 2001. Forecasted throughput to 2010 by Ocean Shipping Consultants Limited as can be seen in table 2.4 shows continued increase with some regions growing faster than other due to the trade liberalization policies adopted and the formidable transport and telecommunication technology development which have not only encourage trade but also saw to the enlarging process of economic globalisation

Professor Ma in his lecture on Maritime Economics (2000, p. 13) stated that:

> 'The development of new transport technology and the continuous decrease of transport cost, due to improved productivity, have led to the formation of the global integrated market place. International trade has expanded to the extent that lots of new grounds are created … Transport therefore is required for the safe delivery of goods. Time delay and the cost of the transport are therefore natural barriers to trade'.

Regionally, trade is also expected to grow also (see table 2.5). **According to Ocean Shipping Consultants Limited (1995 pp. 109-110) the main arena of future competition seems certain to be between the Dominican Republic, Panama, Kingston, Rio Haina, Miami, Port Everglades and Freeport in the Bahamas for main hauls**. The other small ports are likely to increase throughput on lower volume, feeder trades. Relations with the United States (especially the NAFTA region and the Free Trade Area of America-FTAA to be formed) will continue to be fundamental to achieving economic and trade growth in the Caribbean islands.

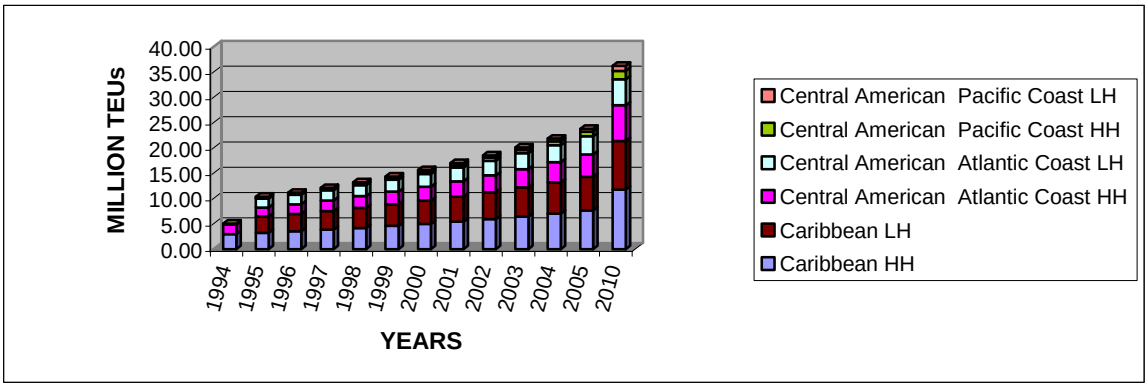
Table 2.5 Forecast Caribbean/Central America Container Port Demand to 2010

Million TEUs	Caribbean		Central American Atlantic Coast		Central American Pacific Coast		Total	
	HH	LH	HH	LH	HH	LH	HH	LH
1994	2.96		1.88		0.21		5.05	
1995	3.23	3.19	1.78	1.78	0.19	0.19	5.20	5.15
1996	3.52	3.43	1.89	1.89	0.21	0.21	5.62	5.52
1997	3.83	3.69	2.08	2.02	0.25	0.24	6.17	5.95
1998	4.18	3.97	2.29	2.17	0.30	0.28	6.77	6.42
1999	4.56	4.27	2.51	2.33	0.36	0.32	7.43	6.92
2000	4.97	4.60	2.76	2.51	0.44	0.37	8.16	7.47
2001	5.41	4.94	3.03	2.69	0.52	0.42	8.97	8.06
2002	5.90	5.32	3.33	2.89	0.60	0.46	9.83	8.67
2003	6.43	5.72	3.66	3.10	0.68	0.51	10.77	9.34
2004	7.01	6.16	4.02	3.33	0.77	0.56	11.81	10.06
2005	7.64	6.63	4.42	3.58	0.88	0.62	12.94	10.83
2010	11.76	9.56	7.09	5.11	1.68	1.02	20.52	15.69

HH-High hypothesis; LH-Low hypothesis
Figures may not sum exactly due to rounding
Source: Ocean Shipping Consultants Ltd – July 1995

We can however translate table 2.5 graphically into figure 2.2

FIGURE 2.2 Forecast Caribbean/Central America Container Port Demand to 2010



Source: Ocean Shipping Consultants Ltd – July 1995

2.4.2 Actual Performance

Actual Container moves at KTO can be seen in the previous table 2.6 from the years 1975 to 2000. Over the years there was an uneven growth path but significantly the terminal in 1997 handled over a thousand vessels for the first time and since year 2000 container moves have surpassed the half million mark.

Table 2.6 Evolution of Kingston Terminal Container Moves 1975-2000

YEAR	VESSEL CALLS	VOLUME*	% CHANGE BY CALL	% CHANGE BY VOLUME
1975	-	27,933	-	-
1980	-	72,029	-	157.86
1987	-	161,204	-	123.8
1988	320	70,285	-	-56.4
1989	200	50,648	-37.5	-27.94
1990	153	38,383	-23.5	-24.22
1991	279	69,522	82.35	81.13
1992	492	121,561	76.34	74.85
1993	595	175,121	20.93	44.06
1994	891	247,748	49.75	41.47
1995	906	265,106	1.68	7.01
1996	962	329,081	6.18	24.13
1997	1,053	384,948	9.46	16.98
1998	1,092	386,107	3.7	0.3
1999	1,071	423,733	-1.92	9.74
2000	1,194	521,521	11.48	23.08

***Figures include both domestic and transhipment moves**
Source: Kingston Terminal Operators Statistics Department – June 2001

On further analysis, in comparing KTO's performance against world and regional growth, based on UNCTAD reports for the periods 1993 to 1999, growth among developing countries including countries within the Caribbean fluctuated between a high

of 12.6% to a low of –8.6%, most times higher than world growth except in 1999 when UNCTAD upgraded China and Taiwan from a developing country status. See table 2.7 below. KTO's yearly container traffic performance as compared to world growth ranged between 1.5 and 2.4 times higher while comparing with developing countries growth it was 1.2 and 2.1 times higher. **UNCTAD's Review of Maritime Transport (2000, p.69) indicated that the growth in developing countries is uneven from year to year, owing sometimes to strong fluctuations in trade and sometimes to improved data or lack of data.** This however leaves the author not to think of KTO doing exceptionally well but to think of its achievement moving in line with the industry norm as there are still work that the terminal needs to do so as to be ranked among top ports that are moving a million moves and over per year.

Table 2.7 Comparison of KTO Traffic with World and Regional Growth

YEAR	WORLD THROUGHPUT (Million TEUs)	WORLD GROWTH %	DEVELOPING COUNTRIES THROUGHPUT	% CHANGE	JAMAICA THROUGHPUT (Million TEUs)	% CHANGE
1993	113.21	-	54.15	**-**	0.27	**-**
1994	128.32	13.3	62.68	15.8	0.34	27.9
1995	137.24	6.9	69.12	10.3	0.40	16.5
1996	150.75	9.8	76.18	10.2	0.48	21.0
1997	154.63	2.6	78.60	3.2	0.50	3.8
1998	165.01	6.7	88.49	12.6	0.57	15.5
1999	183.40	11.1	80.87	-8.6	0.65	14.0

Source: KTO& UNCTAD

Conclusion

In summarizing, it is evident that the trend in world trade has certainly revolutionized and has impacted on every region of the world but some more than others. Thanks to the strong economic activities evident in certain parts of the world and the integration among regions, which through cross trading, have promulgated trade beyond its borders. Worldwide, trade is very dynamic and credit must also be given to ship-owners, shippers, consignees and ports that have played their part in enhancing trade through out the world. However in such case all players especially ports should carefully monitor trade and its activities world wide, but more so regionally, so as to take advantage of the prevailing opportunities while simultaneously putting in place remedial actions to take care of any threats in the external environment.

CHAPTER 3

Economical Impact and the Significance of an Increase in Productivity

3.1 Introduction

After giving this general information about KTO and of Jamaica, the author will now try to define productivity and the associated words efficiency and effectiveness and focus on the economical impact and the significance of an increase in productivity on KTO.

3.2 Productivity, Efficiency and Effectiveness Defined

Throughout the remaining chapters of this study the words productivity, efficiency and effectiveness will be used interchangeably thus the author would now like to define productivity and the associated words, in their most generic sense so that all can be clear as to the differences between each. The oxford dictionary definition and explanation by Scholten (1999, p.5) on all three are as follows.

Effectiveness is an expression of the degree to which a system produce results that were intended, thus effectiveness can be regarded as being result oriented i.e.:

- $Effectiveness_{actual} = \frac{\mathrm{Re}\,sult_{actual}}{\mathrm{Re}\,sult_{norm}}$

Efficiency is, however, the ratio between output achieved and effort put in. In business and industry, efficiency is used in the sense of cost-effectiveness: the cost per unit of production, or the profit per unit of capital investment. The concept is just as useful in ports. Thus efficiency can be regarded as cost oriented i.e.:

- $Efficiency_{actual} = \frac{Cost_{norm}}{Cost_{actual}}$

Productivity, on the other hand, can be regarded as the quality of being productive or being able to produce. In economics, the ratio of the quantity of units produced to the labour per unit of time. The purely economic definition is, the ratio of output to labour input, to produce more goods with the same amount of human effort or the rate at which goods and services are created.

In other words, it is the efficiency with which resources such as capital, time and personnel are utilised to produce a valuable output. Productivity is traditionally defined by the production function, which correlates quantities of input with quantities of output. The ideal is to increase output while keeping input constant. Thus productivity can be regarded as a product of normalised productivity, actual efficiency and effectiveness i.e.:

- $\mathrm{Pr}\,oductivity_{actual} = \mathrm{Pr}\,oductivity_{norm} \times Effectiveness_{actual} \times Efficiency_{actual}$

$$= \frac{\mathrm{Re}\,sult_{norm}}{Cost_{norm}} \times \frac{\mathrm{Re}\,sult_{actual}}{\mathrm{Re}\,sult_{norm}} \times \frac{Cost_{norm}}{Cost_{actual}}$$

From this equation it can be seen that productivity at a particular cost will yield a particular result. However there is a difference between productivity and output. A port for example could handle more cargo at a berth by employing more men per gang, more gangs, more equipment and building more storage space. You will certainly be increasing berth output but not necessarily improving productivity. The exact capital investment and running cost could actually put up the cost of each increase in productivity. In other words, increased cargo handling does not necessarily improve productivity. You can only achieve lower cost per move by maintaining output while using fewer resources (fewer men, straddle carriers etc.) or by increasing output using existing resources, to so organize and supervise operations that the same men and equipment handle more cargo per shift. Whichever option taken by KTO the main aim is to increase and sustain productivity.

We must now spend some time considering the structure of KTO costs at this stage, to throw some light on the relationship between output and cost.

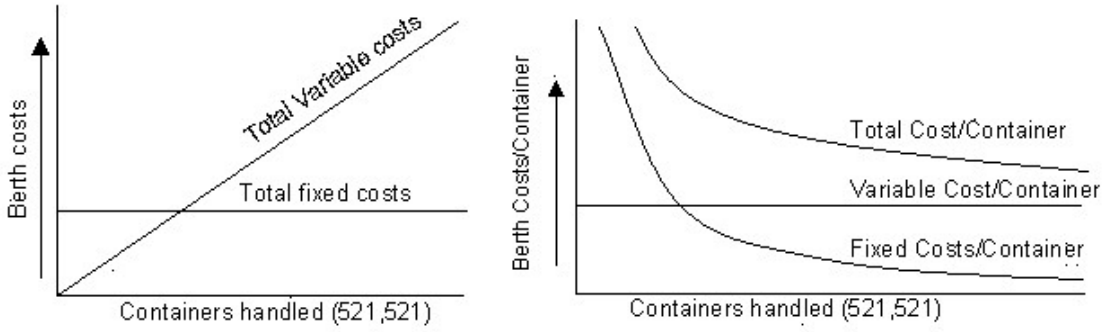
3.3 The Nature of Port Cost

Based on the management arrangement at KTO, the port authority charges a management fee to KTO on a monthly basis for operating the facilities. The revenue of KTO is generated from cargo-handling, terminal-handling charges while expenses are due to salaries, labour charges, etc. Separate to KTO's earnings, the port authority levy dues on ships and cargoes for the use of the facilities and provision of common services such as general administration, maintenance and development of port premises, police, security, fire brigade, anti-pollution systems, etc. Specific charges for services are also levied by the PAJ for pilotage and towage**.**

Port Cost at KTO like any other industry has two components: fixed cost and variable cost. Fixed Costs are independent of the output, performance or utilization. However, they have to be paid whether a berth handled 1 or ½ million containers a year. Variable Costs on the other hand are directly related to output and they increase with the quantity of cargo handled. Both cost added together give the total cost. From analysing KTO statistics it was seen that increasing berth throughput puts up total berth cost, though by proportionately less than the throughput increase and total variable cost in direct proportion to the throughput increase but leaves total fixed costs completely unchanged, see figure 3.1.

For cost per container, however, the situation is quite different. Total cost per container falls as output rises, as does the fixed cost per container, a more pronounced decrease, but the variable cost per container, of course, is unchanged see figure 3.2. However it was also observed that if labour was paid for overtime at higher than standard wage rate, then variable cost per container increased. Likewise the extra wear and tear on equipment increased maintenance cost, adding to this rise in variable cost per container. If some, at least, of this extra cost could have been avoided, the benefits of increased throughput, in terms of cost per container, would have been greater. This is however an important point to be taken note of by KTO.

Figure 3.1 Berth Cost Analysis **Figure3.2 Container Cost Analysis**



Source: Kingston Terminal Operators Limited

However, having discussed the aspect of cost, the author will now address the economical impact and the effects of an increase in productivity. This will be viewed from the microeconomic level using the demand and supply function within shipping. However grouping productivity into the sphere of microeconomics does not exclude its relationship with macroeconomics thus the usage of the traditional production function methodology will also be applied in order to find out the nature and strength of the explanatory variables as it affects the spatial production units of seaports in general and KTO in particular.

3.4 Economical Impact

Productivity within ports varies from one to another. No two ports in the world are identical, neither in their physical setting nor in their economic and operational environment, thus productivity differs. A good port is unnecessarily a big port but certainly an efficient one. A small or middle-sized port can hardly catch big ports in cargo volume but they can beat them in efficiency and productivity as in the case of the Port of Aarhus doing 50 moves per gross hour. Big ports have now realized that volume should not be the only most important indicator for measuring the port performance. **According to Ma (2001, p.12) due to increase awareness from an economical stand point it is evident that the fast increase in container ships' size and sailing speed is directly linked to the productivity and efficiency improvement of container handling at major ports.** Port of Felixstowe and Manzanillo handling rates have led to the working of each vessel 2.7 times faster than that of the Port of Kingston.

Ports that are more efficient are often chosen over ports that are less efficient and this is an important point that KTO should take note of. What is worst is when these highly competitive ports exist in the same region as aggressive competition is bound to exist.

A ship-owner in deciding to call at a port, think of three things: availability, safety and efficiency. As a matter of fact, the problem of safety and especially the problem of availability are straightforward which means that if the port is not deep enough or if some particular services such as ship repair do not exist, then the ship will simply not be able to call at the port. But the problem of efficiency is another matter. If the first two conditions are fulfilled, a ship can always call at the port even if it is an inefficient port. Nevertheless, for the ship-owner it is at an economic decision whether or not to call at a less efficient port. Such port related economic decisions are made based on the relationship between the daily revenue and the cost of the shipping company (‘Ma’, 2001, p.12)

3.4.1 The Significance of an Increase in Productivity

An increase in productivity will definitely improve the quality service provided by KTO to its customers. It also leads to port competition, have effects on the export trade competition and on the prices of import goods. As to how much the customers may value the change can be explained by the elasticity of demand and supply. Price elasticity of demand or supply is the percentage change in quantity demanded or supplied divided by the percentage change in price that brought it about (‘Lipsey’, 1998, p. 91). According to the laws of demand and supply, the quantity of demand and supply vary as the price changes. In the case of port productivity as the level of productivity increases the cost of operating/staying in ports reduces by ship-owners and vice versa. The cost is eventually passed on to shippers in the form of reduced freight charges thus the outflows of countries money is reduced to foreign ship-owners. **In support of this argument, Farrel (1995, pp. 231-234) has written in the Maritime Policy and Management that ‘… savings in ship’s time in port and increased productivity directly benefits ship-owners … more widely, economic wise, it could reduce the sea fright rates…’**

For export shippers, the reduction in freight rates help the exporters products to be much more marketable in the international market. The savings among each shipper is instead used for the purchase of other items or is retained for example in Jamaica as savings. However the major influential factors on the price elasticity include the economic utility of the product or service, the cost structure of the product and the situation of substitution. Economic utility and substitution will be discussed below but the cost structure has already been dealt with under the sub-heading 'the nature of ports cost'.

3.4.1.1 Economic Utility

According to Samuelson & Nordhaus (1998, p. 80) economics relies on the fundamental premise that people tend to choose those goods and services they value very highly. The word utility denotes satisfaction. More precisely it refers to how consumers rank different goods and services. If Port A for example has higher utility than Port B for a ship-owner, this ranking indicates that the ship-owner prefers A over B. Utility is also the subjective pleasure or usefulness that a person derives from consuming a good or service and is a scientific construct that economist use to understand how rational consumers divide their limited resources among the commodities that provide them with satisfaction. Thus if the author should look at the productivity figures only for KTO then the terminal would be poorly ranked but based on its location, modern facilities volume and its draught, the terminal is ranked much more higher than most ports within the region.

3.4.1.2 Substitution

The main determinant of demand elasticity is the availability of substitutes. KTO for example has quite close substitutes such as the Ports of Manzanillo, San Juan and Freeport. A change in the productivity of KTO with the productivity of the substitutes remaining constant can be expected to cause much substitution. An increase in productivity meaning a fall in price leads ship-owners to want to remain at KTO and even expand its business as it is more attractive to remain at KTO. On the other hand when productivity falls thus there is an increase in prices, ship-owners will want to stay less at KTO and instead divert most if not all of its moves to anyone of the competing ports. KTO having such close substitutes tends to have an elastic demand.

Theoretically this sounds easy but in practice although ship-owners may want to shift to another port, oftentimes there are so many factors that have to be borne in mind. One is a contract that binds the ship-owners for sometime thus they will have to wait for the contract to be completed. However in the Maersk/Singapore case, Maesrk did not wait for their contract to be finished. But how many shipping lines are this powerful? Two, depending on the substitute, that port may not be able to service that new customer at the same level of present port productivity and three the published port's productivity may not be consistent but fluctuate for certain types of vessel as is the case at KTO.

This now leads the author to address certain issues that affect the demand and supply function and other variables that an increase in productivity affects.

3.4.2 Demand/Transport Price/Ship Size

Many of the developments in sea trade depend on the economics of shipping and port operations. Raw materials will only be transported from distant sources if the cost of the shipping and port operations can be reduced to an acceptable level or some major benefits is obtained in quality of product. Over the last century, improved efficiency, bigger ships and more effective organization of the shipping and port operation have brought about a steady reduction in transport costs and higher quality of service. In fact the cost of shipping a container from the Atlantic to the Pacific hardly changed between 1950 and nowadays. This was achieved by using bigger ships as will be explained under scale economies and technically modern port facilities that are able to reduce time in ports. The less time ships spend in ports, the more cargo they can carry over a fixed period of time. Thus port time will be less than a third as was the case in the past. Such changes has had shipping lines demanding for higher and improved cargo handling productivity, as is the present case with KTO. It is important to note that as cargo handling becomes quicker, cargo's transit time has also been sensibly reduced an achievement by both ports and ship-owners. **Branch (1997, p.5) in support of the ship owners' claim stated that, 'It is important that where there are capital-intensive port system, dock labourers should attain high productivity'.** In spite of the fact that handling operation is a part of productivity you cannot however reduce productivity to only the handling operations as spelt out in the definition of productivity.

3.4.3 Supply/Scale Economies

Although shipping is one of most ancient economic activities in the world, the industry has probably witnessed the most significant improvements in productivity experienced over the years. Such an improvement is attributable to two technical breakthroughs occurred in the shipping industry: specialized bulk shipping and containerisation in liner shipping. Because of these changes, large ships have been put in service in order to achieve economies of scale. Supported by the incontrovertible basic theory of scale economies, the size of containerships has increased continuously. Normally breakeven load factors will be lower for the larger vessels due to the lower unit costs that larger vessels achieve through economies of scale. In the short term there is an increase in utilization and in the long run there is a reduction in cost. It is commonly supposed that unit costs of transport service decrease with increments of vessel size. A corollary is that earnings per unit of transport service increase with increments of vessel size if freight rates hold steady.

It is also true that there is economies of scale in the process of building larger vessels, as building costs do not rise in direct proportion to cargo capacity increases. Accordingly, major liner operators on the mainstream trade routes have no alternative but to go for large and economical containerships if they want to stay competitive. The larger ships accrue economies both in operating and building costs (‘Lim’ 1998, p. 363).

Theoretically, the larger the ship is, the cheaper the cost per teu/mile. On the other hand, the situation most often is the larger the ship, the lower the actual utilization. The customers of the lines (i.e. shippers and consignees) require a fast and reliable service at regular (and high) intervals of frequency. Therefore it is not easy for an individual line to be able to generate sufficient cargo to fill the large (6000 + TEU) ship on a frequent basis. Hence the recent realignment of consortia into global alliances between major lines will assist in achieving this objective by spreading the marketing load. Some ship-owners are also quick to point out that the effect of scale economies is only limited by the physical and technical conditions such as sailing channel access and cargo handling speed.

Thus ports are required to play their part and KTO is no different. First gantry cranes of farther reach are needed to handle these vessels and ports with deeper draughts are required. Although vessels are larger, ports are required to deliver high productivity rates so that the vessel spends limited time in port. Often times more cranes are being deployed or a higher consistent productivity is required from port operators. By using bigger ships, shippers may pay less sea freight, but the capital cost of cargo tends to increase, sometimes considerably, due to the consequent slower ship and cargo turn-around time. If ports are able to bring down cost for example KTO, this will however lead to an increase in port calls once all the other criteria remain constant as the cost of handling the bigger ships are lower, and turn-around time is faster. Productivity rate of KTO on the mainliners are much higher compared to the feeders but still not at the rate published by its competitors. This is however an issue that needs to be worked out by KTO as increase productivity provides a competitive edge to the port. **Frankel (1987, p.30) claims that ' … benefits that can be recognised from developing a port are savings in shipping costs due to the economic of scale in vessel size, reduction in ship's time savings in investment cost, etc….' (under-lining mine).**

In general, competition in operational effectiveness shifts the productivity frontier outward, effectively raising the bar for everyone ('Samuelson', 1998, p.14). But although such competition produces absolute improvement in operational effectiveness, it leads to relative improvement for no one. Customers and suppliers are the ones however capturing the resulting major productivity gains.

3.4.4 High Value Cargo

As the competitive advantage of maritime transport is in its low cost and disadvantage in its long transit time, the high value and time sensitive cargo tends to use other modes of transport, while relatively low value and cost sensitive cargo seems more suitable to be transported by sea. However, even within maritime transport, distinction should be made between low and high value cargo. This is due to the fact that in volume terms general cargo constitutes only about 15% of the world total traffic, while in value terms it makes more than 70% of the world total. Owners of high value cargo are willing to pay more for faster ships and owners of low value cargo will prefer to use slower ships and pay less.

This is due to the fact that when ships sail faster, shippers tend to be willing to pay more as they save capital cost of cargo, in other words owners will then get more and better deals. Similarly, shippers will be less willing to use the service or pay less if ships sail slower because owners will have less or poorer business (‘Ma’, 2000, p. 59).

Even though there may be low value cargo, the port generally and KTO in particular, however, cannot afford to delay the handling operation in port as customers often times want the cargo as it is discharge from the vessel to be delivered to them. Thus the coordination at quayside and on the terminal has to be so synchronized so that high productivity is sustained. Should productivity be low, cargo would end up piling on the terminal for an undue period. Presently KTO has a dwell time of 8 days and should there be any delays the dwell time may increase to about two weeks and more.

Another point of note is that cargo sitting on the terminal is loss revenue. Charges such as receipt and delivery will not be able to be collected and as pointed out in investment appraisal, money collected today is worth more than if it is collected tomorrow as KTO will be able to invest this money immediately thus increasing its worth. Economically, savings would be increased in the country.

3.4.5 Intermodalism and Transhipment

Shipping is only one link in the transport chain. The aim of shippers is to obtain better and cheaper transport over the whole distance from origin to destination. To meet this need, in recent decades the world has evolved a transport system which provides fast and cheap access to almost every corner of the globe. The system consists of roads, railways, inland waterways, shipping lines and airfreight services. In practice the system falls into three zones, inter-regional transport, short sea and inland transport. To date the sea-leg continues to be the most frequently used means of transport and this is due to the reduced cost achieved through economies of scale and modern technology (‘Stopford’, 1997, p. 8). Packaging, in particular, as pointed out by Branch (1997, p.5) has brought higher productivity as it ensures that products reach customers without losing their value, an increase in efficiency, and in an effective way. An increase in the productivity can only further increase service and reduce cost to customers.

With regard to the business of transhipment only few ports are chosen as hubs. Transhipment is generally associated with international transit ports and transhipment operations are marginal and represent additional income for almost marginal costs. Besides the strategic location, modern facilities and harmonious labour relations, sustaining or increasing productivity is essential for the port to maintain their hub status as more and more ports are aggressively improving their facilities and trying to persuade certain shipping lines in using their facilities with the hope of becoming a hub.

Zim Israeli Line, for example, as early as 1987, took the decision to use KTO as a transhipment port. Based on operations research techniques it concluded that a hub, located at an intermediate point along a pendulum-type route, would be twice as efficient as a port at either end, one to the United State East Coast/Mediterranean and another to California and the Far East. A ship turning back from the Caribbean could only offer one of these, so Zim's feeders could either go twice the distance or be twice the size, enjoying lower unit cost ('ECLAC', 1999, p.1). Because alliances use large vessels of 5,000 to 6,000+ TEUs the number of ports served must be minimized. According to Fairplay (6 February 1997, pp.22-23) if a vessel of 6,000+ TEUs calls at six European ports to load and discharge containers and is in port three days at each, the elimination of three ports would generate voyage savings of around US$200,000 to US$250,000, less any on-carriage cost for cargoes. Mediterranean Shipping Company (MSC) for example uses the Port of Felixstowe (UK) as its European export hub and the Port of Antwerp (Belgium) as its hub for European imports. It avoids additional ports of call through the employment of integrated land and ocean transport services ('Fairplay, 6 February 1997, pp. 26-27).

3.5 Production Function

The production function represents the relationship between factor inputs and output for some production process. For the cargo handling operation the process takes place during the port visit. Productivity as explained earlier may be measured as output of factor input. Factor inputs as it relates to KTO are capital and labour and these are applied in the observation of the visit while output is throughput, which is the amount of cargo loaded and discharged.

Over the years as more modern technology is added by KTO and with increase efficiency, a reduction is obvious in the level of employment. Does this mean that the increase in productivity is negative? Obviously not, it is simply the transferring of resources to more productive areas. **As stated by Schumpeter (1987, p.75) the man, who conceives or takes charge of an enterprise, sees and exploits opportunity and is the motive force for economic change and improvement.** However, beyond the conventional wisdom in production economics, ports, unlike other manufacturing decision making unit, represent a spatial production system which cannot be fully understood simply by the quantity of labour and capital alone, even under equal demand conditions. One must probe deeper into the natural geo-navigational settings in which a port is situated. The adversity or favourability of the inherent locational features of a port ultimately dictate the desired amount of capital expenditures which significantly affect the efficiency of operation at various layers of management, not necessarily all in the port complex. Thus, the mere amount of capital is not sufficient. What is important is how this capital is allocated and utilized in order to enhance port performance. But in the case of a spatial DMU like KTO, the optimal combination of geo-navigational and strategic factors, along with current labour, are ultimately responsible for port performance rather than the mere amount of capital.

Conclusion

In concluding the author would like to point out that port productivity on the Jamaican economy has an indirect impact rather than a direct impact. An increase in productivity affects ship-owner, shipper and consignees rather than the economy in general. Whatever ship-owners, shippers and consignees decide to do with their monetary gains then that in turn will affect the economy either positively or negatively. Although productivity indicator is the only indicator that measures efficiency and cost effectiveness of berth operation and how effectively labour**,** equipment, buildings and land are being used, a port that is only efficient cannot survive. Rather it needs the combination of efficiency and effectiveness to withstand the vagaries of the factors that impact on a company's success.

CHAPTER 4

Port Performance Indicators Analysis

4.1 Description

Port performance indicators can be simply defined as measures of the various aspects of the port's operations. Therefore the purpose of this chapter is to introduce certain basic points about the operational area then an analysis of the topic, which requires greater emphasis as it appears to give a fairly representative and reasonable picture of port efficiency. **The port operation system as indicated by Professor Francou (2000, p.5) consists of the aquatorium, berthing and the information system.** For the purpose of this study the author will concentrate on the berthing system only. Besides port performance indicators earlier predictions, it will also help the author to identify the competitive position of KTO, as they are good signals to both ship-owners and the port.

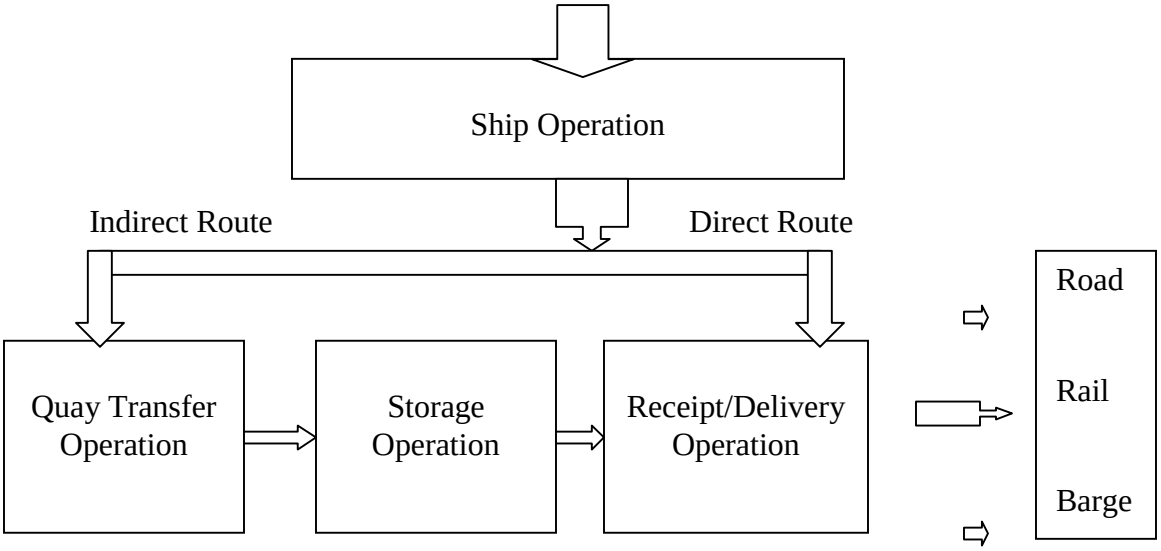
4.2 Berthing System

The berthing system has four major sequences of activities, which are very much linked or overlapping but are fairly readily distinguished. They are:

- Ship Operation
- Quay transfer Operation
- Storage Operation and
- Receipt/Delivery Operation.

These however can be further divided into shipside and landside activities. Ship Operation is concentrated at shipside whereas storage operation and receipt/delivery operation are on the landside. Quay transfer operation is shared by both the ship and landside activities. All four operations, as mentioned, can be seen in figure 4.1 below.

Figure 4.1 Berth Operation Flow



Source: UNCTAD

Although the chart above may depict an even flow of cargo, in reality the ship, quay transfer, storage and receipt/delivery operations do not necessarily work at the same rate thus a primary cause for poor port performance ('UNCTAD', 1982, 43). Base on this likely hiccup in the daily operation of vessels, there arises the need for the evaluation of port performance indicators. A careful analysis of KTO operation will now be assessed through the use of output, utilization, service and productivity indicators as they affect the berth, handling, storage operation and quality of service in general and KTO in particular.

4.3 Port Performance Indicators

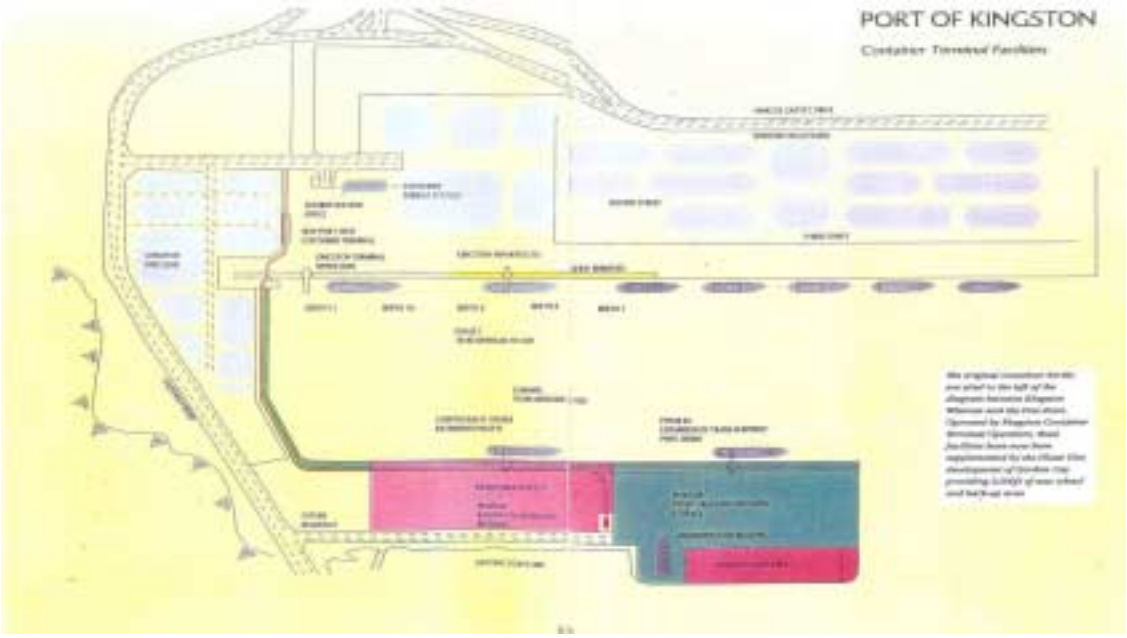
Port performance indicators (PPI) are the signs that assist in measuring performance of the port, identifying the problems, and looking for the possible solutions. **According to UNCTAD (1987, p.3) port performance indicators tell us how much cargo is handled, at what rate, and at what efficiency.** Thus the tools for identifying performances, quality of services, investment and input for negotiations are referred to as the performance indicators. The importance of port performance is to compare actual performance of the port with targets set. Besides, it also assists the port in comparing past trend with current performances.

A study of indicators on the overall services, from quayside to inland transport provides far better result than if each area is studied in isolation as all areas are interlinked. Therefore, the author through the use of UNCTAD recommended indicators would evaluate the performance of KTO in order to assess the port's efficiency level.

4.3.1 Berth Indicators

Actual performance of ships at or before berthing at KTO is affected by how the vessels are planned for and handled on the vessels' arrival in the port area thus the factors that are stipulated to enhance berthing at KTO are being looked at. Each ship's expected time of arrival at KTO is communicated seven days in advance in line with the berthing policy of the terminal, by shipping agents to the planning department along with the declared amount of containers to be handled. Final notice is given within 24 hours before vessels come alongside. This information is used to allocate berths to the expected vessels and the harbour master is informed of the ships' docking positions. All berths 8-14 can accommodate container vessels but berths 8 and 9 are better suited for the feeder vessels (see figure 4.2 for terminal layout).

Figure 4.2 Layout of KTO (North and South Terminals)



Source: Kingston Terminal Operators Limited

Pilotage is compulsory and tugs are requested on demand. For every ship calling at the terminal there are certain procedures that must be adhered to. The intention of the terminal is to treat all customers fairly and that the administration and implementation of the berthing policy be transparent and beyond reproach. The policy is set up so as to enable better planning both by the terminal and by lines using its facilities. Fairness is achieved through:

- The 'first come first served principle
- Preferential treatment to transhipment vessels over domestic carriers
- Maintenance of a 7-Day Schedule of all projected vessels known as 'the line up'
- Continuous work on a vessel is the norm.

Other stipulations by KTO are that before any vessel can commence working, quarantine must take place and also dangerous cargo certificates must be submitted. It is required that crew list, maritime declaration of health signed by the captain which includes de-ratification information and international certificate of vaccination for each crewmember must be submitted to the quarantine officials. Late arrival of quarantine officers to clear vessels has been a problem and has resulted in delays to the commencement of work.

Vessels carrying dangerous cargoes will not be permitted to come alongside any ship in the harbour or docked at any wharf until the Harbour Master and Collector of Customs are satisfied that the cargo comply with the requirements of the IMO Dangerous Goods Code and are of that quantity that will not pose any threat to the terminal and its environs. Non-compliance of customs procedures by shipping lines has resulted in vessel delays, which impact on the terminal's productivity. Careful analysis of the terminal's berth indicators is now retained to be discussed in turn.

4.3.1.1 Berth Output

By the use of two to three gantry cranes to discharge/load vessels depending on the size, a total of 521,521 containers were handled at KTO in year 2000. This was an increase of 23.08% moves over the previous year. On average, 74,503 moves per berth were handled. A closer look at the evolution of the percentage change of berth output from 1995 saw an erratic but positive growth rate over the five-year period with a low of 0.30% to a high of

24.13%, see table 4.1. **The calculation of the berth output was based on the definition provided by Francou (2001, p.5), which states that it is the total quantity of cargo handled at a berth throughout the year.** This indicator is very useful for the port planner, because it assists in evaluating the performance of each berth and determine the port capacity.

Table 4.1 Berth Output of Kingston Terminal Operators Limited

Description	1995	1996	1997	1998	1999	2000
Berth Output (Containers)	265,106	329,081	384,948	386,107	423,733	521,521
No. of Berths	4	6	6	6	6	7
Avg. Berth Output	66,277	54,847	64,158	64,351	70,622	74,503
% Change of Berth Output	-	24.13%	16.98%	0.30%	9.74%	23.08%

Source: KTO Statistics Department, 2001

4.3.1.2 Berth Service

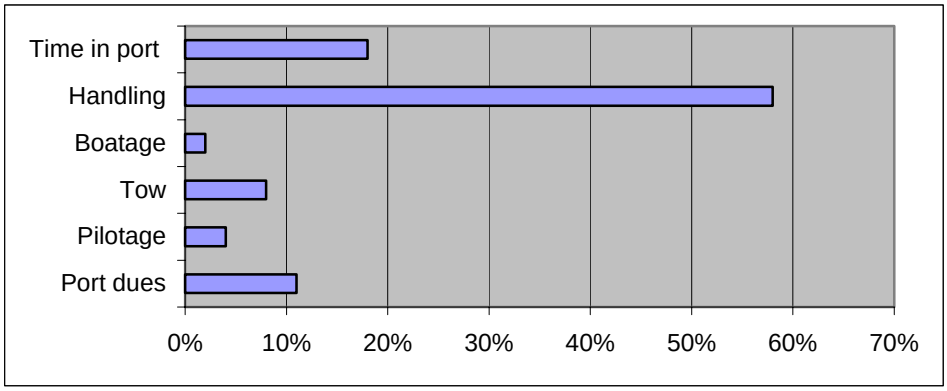
Since the Berth Service indicators are the measurement of quality service that the port provides to ship-owners directly and shippers indirectly, KTO constantly analyse the berth service indicators to ascertain whether the terminal is delivering as promised. **The berth service indicators are important as stated by Francou (2001, p.7) as ship-owners and shippers are responsible for the payment of the time ships spend in port especially in the case of chartered vessels because demurrage has to be paid.** The berth service indicators that KTO constantly analyse are the ship turn-around time and grade of waiting time.

4.3.1.2.1 Ship Turn-around Time

The ship turn-around time is an accumulation of the two critical times, ship service time at berth and waiting time or the time the ship spends in port from its arrival within the limits of the port up to its departure ('Francou', 2001 p.8). Based on statistics provided by KTO for the last two and a half years, 1999-2001, ships' turn-around time was equivalent to the ships' service time at berth as there was no waiting time. This indicator is one of the most common measurements of port performance in the world because the survival of ports totally depends upon the satisfaction of the ship-owner its primary customer. The shortest ship turn-around time is the most advantageous for the ship-owners because their profits are highly influenced by the time spent in port. Thus the shorter the staying time of ships in ports the higher the profit. **Based on Francou (2000, p.2) time in port is**

approximately 18% of distribution of port expenses, see table 4.2 below. Ship turn-around time however includes waiting time, manoeuvring time between the entrances to the berth or mooring point, ship service time at berth, shifting time between berths and manoeuvring time to leave the port.

Table 4.2 Distribution of Port Expenses



Source: Lecture Notes, Bernard Francou

- **Waiting Time**

Waiting time is the time when a ship arrives in the port area and is waiting for an available berth. Due to the stringent pre-planning, the terminal knows in advance the vessels that will arrive and as such plan the berthing of vessels accordingly. Because of this the terminal is not presented with surprises and over the last six months in 2000 no vessels had to wait to be berth. Another factor is that the average daily vessel arrival ranges from 2.4 to 4.7 vessels per day, which is less than the amount of berths available, see table 4.3 below. Even during the peak days Mondays and Tuesdays, the terminal comfortably handles the vessels calling. Obviously, waiting time at KTO is outside the terminal's jurisdiction as shipping lines must arrange better scheduling of their mainliners so that feeder vessels do not have to wait to be served.

Table 4.3 Vessel Arrival Rate, Year 2000

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Arrival Rate	2.4	4.7	4.2	3	3.3	2.7	2.7

Source: KTO Statistics Department, 2001

In the author's observation the terminal has been doing a lot to reduce waiting time by eliminating the human elements of the mistakes and trying to reduce the consequences of

technical and physical constraints within the port. Since 1998, for example, the terminal has taken the decision to provide a 24-hour working period instead of the 23-hour work period that prevailed for years. This has definitely led to an increase in working time at berths, which has freed up berths for other vessels to work. The terminal has also set up an EDI network between principals and agencies for better communication and to receive timely information. The other factor of increasing cargo-handling productivity is the next hurdle that KTO needs to overcome**.**

- **Service Time**

Service time is the time spent by the ship at berth that is from the time of berthing up to the time of departure. So whether the vessel worked or not, this time is also included once the ship is at berth. Based on table 4.4 below, the average total gang idle time at KTO was 29%, with an average working time of 71%. The total gang idle time was due to awaiting docking, quarantine clearance, down time at the end of each worked vessel, as gangs were not transferable to other shipping lines and operational delays. Over the period January 1999 to June 2001, there was an increase in service time to vessels by 12%, i.e. an increase from 1.04 to 1.16 service time per day for each vessel, which also increased the turn-around time of the vessels in the port. With the terminal's aim to reduce vessel stay in port this does not augur well for the terminal and careful examination is needed at this point in time.

Table 4.4 Service Indicators Jan 1999 - Jun 2001

Service Indicator	Formula	Result						
		1st Half 1999	2nd Half 1999	1st Half 2000	2nd Half 2000	1st Half 2001	Avg	Growth/ Half Year
Waiting time (hrs)	Cumulated waiting time/Total no. of ships	0	0	0	0	0	0	0
Service time (hrs)	Cumulated service time/Total no. of ships	25	25	26	28	28	26	12%
Turn-around time (hrs)	Cumulated waiting and service time/Total no. of ships	25	25	26	28	28	26	12%
Grade of waiting	Cumulated waiting time/ Cumulated service time	0	0	0	0	0	0	0
Working time of ships	Total actual worked time for all ships/total service time	68%	69%	72%	70%	74%	71%	9%
Gang idle time	Total idle gang time/gross gang time	32%	31%	28%	30%	26%	29%	19%

Source: KTO Statistics, 2001

4.3.1.2.2 Grade of Waiting time

For commercial reasons the grade of waiting time is frequently calculated by ports to assess their competitive position while ship-owners on the other hand use it to evaluate the quality service provided by ports. Ship-owners do not usually accept any waiting time for container vessels and rightly so KTO was able to offer such service. However, beyond this zero limit, ship-owners usually investigate if the congestion is provisional or permanent. If permanent, the ship-owner may take certain decision to defray its expenses by either increasing freight rate to shippers, apply a surcharge to ports or call at another port. This indicator is the percentage of cumulated waiting time to cumulated service time ('Francou', 2001, p. 8).

4.3.1.3 Berth Utilization

Based on Professor Francou (2001, p. 9) the berth utilization indicators indicate the actual intensity of use of the berths. The berths efficient utilization depends on good planning and coordination of resources and facilities. The more efficient the utilization of resources and facilities, the more perfect the berth utilization will be. Berth utilization embraces berth occupancy and berth work time.

4.3.1.3.1 Berth Occupancy

Berth Occupancy is the ratio of berth occupied hours to the total berth hours during a specified period. The result of this indicator shows the degree of utilization that is either above or below the average. Berth occupancy levels for the period under review showed an average of 48% with little variation, which would imply an absence of seasonal peaks. The four holidays as celebrated by the terminal each year were also taken into consideration when calculating the ratio, see table 4.5.

Table 4.5 Summary of Berth Occupancy Ratio, Jan 1999 - Jun 2001

Period	1999	2000	2001						
			Jan	Feb	Mar	Apr	May	Jun	Average
Berth Occupancy	43%	52%	51%	43%	46%	46%	53%	53%	48%

Source: KTO Statistics, 2001

According to historic data of the port, from 1995 to present, berth occupancy fluctuated between 35 and 58% with an increase above 55% the first time since the terminal recent

expansion during July to October 2000 and by November the occupancy level was back to 46%. **Based on Francou (2001, p.27) maximum occupancy ratio according to UNCTAD for a terminal having seven-berth is 77%.** In assessing the situation it is very clear that the terminal has enough space to accommodate vessels at any time and it will take years for the occupancy to reach the limit. If however the traffic within the port is increased substantially then this space could be used up in no time. However for the meantime, the terminal has to take due consideration of the under-utilized space and its effect on revenue.

4.3.1.3.2 Berth Working Time

Berth working time is the ratio of the total time the vessel worked compared with the total service time of the vessel. At KTO over the period 1999 to the first six-months of year 2001, the ships were effectively operated for an average time of 71%. The target of the terminal lied between 70 and 75%. However for the year 1999 performance was slightly below the 70% target see table 4.4 above.

4.3.2 Handling Indicators

Unlike the berth indicators that looked specifically at the infrastructure, the handling indicators instead look closely at the equipment for operations from sea to shore or inversely, land equipment for the transfer of cargoes from/to storage area and labour force. The author will first analyse the efficiency ratios when serving the ships and then the efficiency ratios of the input mobilized for performing the handling tasks.

4.3.2.1 Ship Output

According to Francou (2001, p.13) ship output is the total cargo handled to and from a vessel at berth, which indicates how good the operations are within a particular time frame. The major commercial argument for a port is the ship output as the ship-owners require short calls. What a ship-owner wants to know is the total number of teus or containers that a port can handle within a day. Based on table 4.6 below, when containers handled per worked hours were looked at, KTO was able to handle 72 containers with the use of 3.1 gangs in 1999 and 84 containers with the use of 3.7 gangs in 2000. A point of note is that, if KTO is to increase productivity it needs to keep the

input constant while the output increases i.e. 3.7 gangs is maintained at 3.1 gangs. Effectively when the ratio containers/gang was calculated there was no increase from one year to the next. However for the ratio, containers/ship at berth, the handling rate was below the previous ratio by 32 and 29% respectively. This was due to the non-operational and operational delays that were included in the service time. Operations managers at KTO therefore use the ship output indicator as their guide to ascertain whether the rate of performance is as promised to shipping lines and are therefore in a position to put corrective actions in place. Sometimes the problems are outside their control due to the type of vessels and containers being handled. For instance older generation vessels are much harder to work likewise vessels with transverse containers. Due to these problems the terminal has categorised vessels into classes based on their difficulty to handle.

Some ports have also gone beyond their normal operational hours to complete or facilitate work/containers for vessels that are to arrive or currently in ports working. The number of cranes that are used for working vessels has also increased. The Port of Amsterdam for example has designed berths that are able to handle the ship from both sides as the author observed, so instead of three cranes working on the ship, six cranes are performing operational task on the vessel, which reduces service time and produce happy customers. **According to UNCTAD (1987, p.37) crane allocation is, however, very much tied to the ship's size, the number and distribution of the containers over the various bays and the port's gantry crane potential, compared to the total requested number of cranes for a specified work period.** Table 4.6 below however shows the handling indicators for the ship, gang and crane.

4.3.2.2 Gang Output

At KTO the average output per gang per hour is calculated as a ratio between the total containers handled and the number of gangs and the hours worked. The ratio can be calculated for a day or shift depending on what information the terminal is actually looking for. For the two years 1999 and 2000, the rated gang output was 23 moves while the effective output was 16 moves. The main reasons for this was due to the idle time explained earlier and the skill of each crane driver.

Table 4.6 Handling Indicators, 1999-2000

Handling Indicator	Formula	1999		2000	
Ship:					
Container per ship worked hours	Cumulated container handled/ Cumulated worked hours	72		84	
Container per ship at berth	Cumulated container handled/ Cumulated service time	49		60	
Container per ship in port	Cumulated container handled/ Cumulated hours in port	49		60	
Gang:		**1999**		**2000**	
		Rated	**Effective**	**Rated**	**Effective**
Average output per gang per hour	Cumulated container handled/ Cumulated gang times hrs worked	23	16	23	16
Average number of gangs per ship	Cumulated No. of gangs/ Number of ships	3.1		3.7	
Utilization ratio:		**1999**		**2000**	
Rate of utilization of cranes	No. of worked hours/No. of available hours	73%		76%	

Source: KTO Statistics, 2001

In a majority of cases, the gang output is frequently used as an indicator of productivity as the output is similar to the ship crane or gantry crane output because each gang uses one or either of equipment to get the work done. Thus we usually speak of moves per hour. Base on this measurement of performance it is now easier for different ports to compare performance as every port has its own mix of forty and twenty feet containers.

Gangs nowadays although reduced, are expected to perform far more effectively than stevedores 4-5 decades ago. KTO, for example, is opened 24 hours a day, using a three-shift system to accommodate vessels anytime during the day and night. The Europe Combined Terminal (ECT) on the other hand is using only seven stevedores as against fourteen at KTO and more in other ports around the world. With this system and the willingness of labour to work, ships are able to spend more time at sea than in port covering far more ton-miles

Although labour definitely plays a decisive part in port productivity, it is altogether wrong to assume that labour alone is to be blamed for poor productivity results. It may well prove that lack of appropriate supervision and organizational work, including work discipline, is directly linked to curtailing port productivity. Further discussion on labour as to the empirical research carried out, is reserved for discussion in chapter 5.

4.3.2.3 The Utilization Ratios of Input

With the modernization of seaports and the development of container terminals, a large amount of money has gone into the purchasing of handling equipment such as gantry cranes, straddle carriers, rubber-tyred gantry crane, rail mounted gantry and terminal tractors and for the training of staff to handled the variety of equipment. These equipment are not only expensive at the purchasing stage but have proved to be very costly operating and maintaining them. **According to UNCTAD (1990, p. 6) the life cycle cost of one straddle carrier can exceed US$3 million while that of a gantry crane can be as much as US$16 million.** With ports having to spend so much, the author has decided to look more closely at equipment and labour utilization indicators so as to ascertain how the resources at KTO have been utilized. For labour the indicators that could be worked out from the limited information provided were discussed under ship and gang output while for equipment, the indicators are the availability ratio and rate of utilization and they will be discussed as follows.

4.3.2.3.1 Equipment Availability

The availability of equipment is the time (hours) when the equipment is ready for work or use. In other word, it is the time when the equipment is ready for work at the time it is needed. The formula for availability is the total possible hours minus the down time. Availability of equipment depends upon the down time rate. The higher the down time rate, the lower the availability will be.

Based on information provided by KTO, the percentage monthly availability falls between 70-81%, which is in effect very low considering the cost of purchasing and maintaining these modern equipment, see table 4.7.

Table 4.7 Equipment Availability, Jul – Dec 2000

Month	Equipment possible hours	Delays	Availability of Equipment	% Availability of Equipment
July	744	216.9	527.1	70.85%
August	744	218.8	525.2	70.59%
September	720	203.6	516.4	71.72%
October	744	199.9	544.1	73.13%
November	720	135.0	585.0	81.25%
December	720	185.2	534.8	74.28%

Source: KTO Statistics, 2001

Low availability is perhaps the most damaging result of poor maintenance and the one with the greatest immediate impact on operational performance and profitability. Too few units of equipment of the required type to meet the daily requisition leave supervisors to resort to unsatisfactory and unsafe methods of cargo handling, increasing the risk of injury to port workers and of damage to cargo, vessels and port structure. Also if equipment is regularly out of service, undergoing repair or waiting for spare parts, for example, it will perform far fewer hours during the year than it was designed or purchased to do. So its total life worked, will be lower than planned and its hourly operating cost over its lifetime will be higher thus the return on that particular investment will be significantly reduced ('UNCTAD', 1990, pp. 7-8).

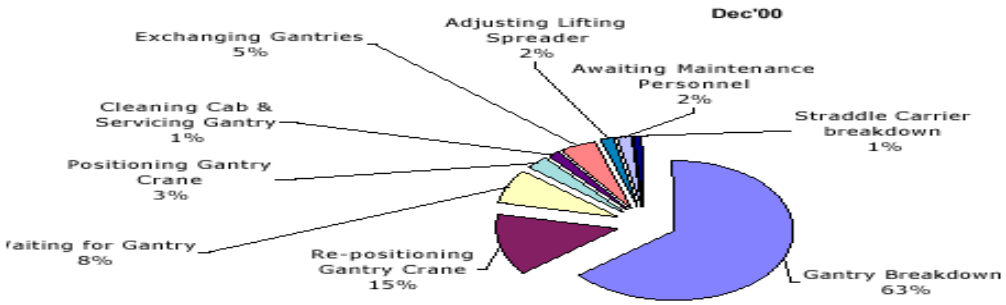
Thus it can be theorized, that with the availability of sufficient equipment, flexibility and high utilization can be achieved. Because, as it is known, the utilization is mainly depending on using the right type of equipment, sufficient number of units and good organization of its use. For instance, at KTO, the low availability of gantry cranes has led to a lower level of utilization. Consequently productivity is lower than other ports achieve, thus the cost to ports and customers eventually increase. In view of the above, further light can be shed in chapter 5 based on empirical research findings.

4.3.2.3.2 Down Time

Down time is the time when the equipment is broken-down or out of order and not accessible for cargo handling operations and other operations. This down time is known by KTO as the 'maintenance period'. This could be as a result of schedule preventive or corrective maintenance. According to the downtime information provided by KTO, for

the last six months of year 2000, equipment down time was as a result of nine factors with gantry breakdown being two-third of the total delays see figure 4.3 below. However based on the empirical evidence, staff was of the perception that the straddle carriers were the most frequently broken down equipment as will be discussed in chapter 5. Equipment delays as compared to the total operational delays were 27.7%.

Figure 4.3 Equipment Downtime



Source: KTO Statistics, 2001

At KTO the engineering department is responsible for the daily activities of planning and coordinating preventative and corrective maintenance for all the equipment on the terminal. They work along with the Operations Department to plan schedule maintenance. With this system in place, the Operations Department can know which machines they should not plan work for.

The terminal tries to keep the standard of maintenance with the demands of modern plants and so is regulated with a maintenance schedule to avoid build-up of machinery for maintenance. The machines going for repairs can be grouped as those, which suffered wear and tear, and those, which are due to accidental damage. Since August 1996, the terminal has put in place an incentive program to reduce the amount of accidental damages. Employees are often cautioned as to the way they drive the equipment and sometimes are sent back into training.

Proper maintenance is not inexpensive so it should be factored in at the budgetary stage. However good the maintenance program may be, without carefully measuring the useful life of the equipment, frequent breakdowns will take place, as was the case at the terminal

in the last six months in 1998. Twelve of the thirty-straddle carriers, which were bought before 1990, had serious breakdowns, which put a terrible strain on the terminal's performance as was evident in the productivity.

4.3.2.3.3 Utilization of Equipment

Equipment utilization is the actual time worked by the equipment out of the total possible working hours during a specific time often a year. The possible working hours differ from port to port depending on whether the machines are maintained in first-class reliable condition ('UNCTAD', 1990, p.6). For instance, at KTO the possible working hours is the total time of the equipment that exclude the non-operating time due to no vessel in port or corrective or preventive maintenance and non-working time when vessels are at berth, which are times awaiting vessels to be docked and dead gang hours. Few months ago refreshment breaks would have been included but due to how labour is organized work continues through meal breaks thus this delay is excluded. For the years 1999 and 2000, gantry cranes were utilized 73 and 76% of the time respectively, see table 4.6 above. A point of note is that each gantry crane has different availability hours because no two gantries are alike. However, each type of gantry at KTO is grouped together.

4.3.3 Storage Indicators

4.3.3.1 General Description of Storage Operation

Port storage is a vital stage in the exchange of cargo between sea-borne and inland transport ('Horck', 2000, p. 15). A good controlling and management of storage operation plays a big role to maximize the availability of storage and saves the port from congestion. As it is known, congestion causes under-utilizing of resources, declining of the productivity, prolonging of the ship turn-around time and increasing of cost per ton.

The advantages of storage are first and foremost, to make ready export cargo for loading on board ahead of time of the ship's arrival. Second, to breakdown and segregate imported cargo especially for large numbers of small consignments in order to make ready for distribution to consignees. Third, to consolidate small packages and parcels of cargo of both import and export origin. Fourth, to accommodate the imbalance between

cargo carried by a ship and delivered by inland vehicles. Fifth, to secure the cargoes that were delayed due to say late arrival and finally, to reduce the risk of ship/shore imbalances ('Horck', 2000, pp. 15-16).

The total terminal area at KTO is 117 acres or 473,500 sq. meters with a holding capacity of 16, 448 teus. This storage is very important for facilitating the port operation in an efficient manner. Containers are stacked one over one for both import and export containers so as to reduce the amount of double handling of containers. However empty containers are stockpiled according to lines since the terminal has the choice of choosing containers based on type rather than numbers. The storage system follows the typical terminal layout with exports to the quayside and imports to the landside. The storage system is synchronized with the terminal's computerized aided management program so as to know the actual location of containers. In the working of vessels for containers stored in the yard, the terminal try as best as possible to match with the productivity of containers coming from the shipside so as to avoid any hack up (congestion) under the crane. KTO also has a Container Freight Station but recent decision has been taken to close and demolish the building. The space will be used instead for stacking containers on the north terminal. This decision will also result in containers passing through the terminal much faster. There are also special areas for dangerous and refrigerated cargoes.

4.3.3.2 Storage Utilization

Daily evaluation of the storage utilization is very important for maximizing storage capacity. At KTO a yard planner is assigned the task of identifying the available storage area and for assigning space for placing containers being offloaded from vessels. This is very important as certain shipping lines occupy certain area, for an efficient usage of the terminal and for ensuring that containers to be loaded on upcoming vessels are not mixed with containers coming from vessels in port. Prior to the working of every vessel the storage area must be assigned and for each straddle carrier deployed for working a particular vessel is updated with the area that they are limited to. On the parking of the containers the straddle carrier drivers call in the parked position to someone in the office.

As stipulated by Horck (2000, p. 2) good storage management depends not just on sound planning procedures but also on close supervision. Unless storage regulations and policies are strictly applied wherein day-to-day operations are properly supervised, the consequence will be the worst and the risk will be high due to poor utilization of space, poor accessibility to consignments, delays in identifying container and storage congestion. Consequently, ship operations, cargo handling operations and receipt/delivery of cargo will be slowed down considerably or come to a halt.

Normally, containers have a high turn-around time due to the high percentage of transhipment containers handled, thus the average dwell time ranges between 3-4 days, see table 4.8. Regardless of this the terminal still gives a 7-day free storage to all customer. **According to Horck (2000, p.24) and sanctioned by UNCTAD, the realistic free storage period should be between 3 to 5 days.** At KTO, a weekly dwell time report is printed on all shipping lines so that the terminal can advise the lines when they are approaching the critical 30-days period. A look at a report printed January 8, 2001 for the previous two months showed that 3,635 containers or 22% were beyond the critical time. Although the terminal is approaching it storage limit, land area is being prepared on the south terminal, which will hold another 1,125 teus. In the future, if space becomes limited, dwell time has to be seriously reduced or containers are stacked higher. Factors that are likely to affect the dwell time are custom clearance delay, shippers' abilities and capacities of storage and the tariff policy.

Table 4.8 Storage Data, Jul – Dec 2000

Months	July	August	September	October	November	December	Average
Holding Capacity	16448	16448	16448	16448	16448	16448	16448
Occupancy level	12845	13972	13861	15557	15114	14737	14348
% Occupancy level	78%	85%	84%	95%	92%	90%	87%
Average Dwell time-Days	4	4	3	13	12	12	8
Average reefer dwell time	6	6	6	6	7	6	6

Source: KTO, 2001

- **Customs Clearance**

Customers perceive the procedure of checking goods by Customs as long and bureaucratic. As a result, quite a few containers are obliged to stay longer in the storage area. Although Customs has the use of computers, coordination is poor as truckers,

consignees, shipping agents still have to await the processing of documents in-house whereas if it had been done online, the process would have been much faster. As can be seen from table 4.8 above, dwell time of containers was three times above normal period due to the increase in Christmas barrels being received from abroad.

- **Shippers' Abilities and Capacities of Storage**

Of the total domestic cargo being handled at KTO the larger percentage are FCL containers. Most of the shippers are of large and reputable companies that have quite a bit of storage space for storing the containers. Otherwise the containers are placed outside their premises with tight security control until the cargo is off-loaded. Available storage space is not really a shippers' problem but more so the money for clearing the containers.

- **Tariff policy**

Tariff policies within ports depend to a large extent on the type of port bodies. Port operators' objectives are different from that of port authorities even though the port authorities views may be similar. Often times one may pursue macro economic objectives while the other focus is at the micro economic level. **One popular view as specified by Canamero (2001, p.11) is that port authorities are purely commercial undertakings and, sometimes pursue micro economic objectives such as maximizing revenue, which is not far from port operators overarching objective to maximize profits of shareholders.** Another view regards port authorities as engines of economic development and employment for a region and, therefore, should pursue macro-economic objectives such as cargo throughput, level of employment etc. In real life it is more complex. A survey of US port authorities indicates that they follow more general objectives such as revenue, market share and economic development.

At KTO the tariff policy objectives are more in line with what competitors are doing in the region coupled with a sophisticated pricing technique due to the large volumes of transhipment cargoes handled. Ship-owners are however demanding a total package including third party services (a single bill) instead of the many bills detailing each individual tariff items. However KTO is yet to cater to the demand even though this is an added competitiveness to ports. Nowadays there is also a shift towards using strategic

pricing i.e. pricing based upon market considerations. The concept of using this method of pricing to promote new businesses is widely recognized, as a means of collecting surpluses from profitable trades. However it remains an informal process and the full range of strategic pricing choices has not yet been explored except in the largest ports.

4.3.4 Quality of Service Indicators

The quality service indicator, like the physical service indicator, is very important to analyse the quality of services offered by the port. Ship-owners on a whole are more interested in and give priority to the indicators of quality service. In fact, physical service indicators in and of itself cannot give a competent and efficient measurement of the port unless it is combined with quality service. For example, a ship operator also when selecting a port, his primary focus is to look at the consistent high cargo-handling rate and guaranteed turn-around time while secondarily his concerns may be the social climate, reliability or the services provided to crews and shippers. However, any decline in the quality of service offered will seriously reduces the attractiveness of the port to ship operators and cargo owners, ultimately leading to fewer calls and less cargo to handle ('UNCTAD', 1990, p. 6). Some of the previously addressed physical indicators of quality of services are waiting time, turn-around time, handling productivity, storage grace period and working hours in port, however the author will now look at the non-physical quality service indicators such as flexibility and reliability indicators as they do complement the physical indicators.

4.3.4.1 Flexibility Indicators

- **Working Hours**

Flexibility of working hours is the co-ordination of administrative and physical operations. **According to Professor Francou (2001,p.21) the flexibility is the measurement for the capacity of the port services to adopt the requirements of the shippers and ship owners.** The flexible working hours of KTO was on average 8 hours for the straddle shift, which took care of the administrative functions and queries whereas 24 hours for the operational aspect, which provided limited responses to functions outside the operational area. This indicates that the port is open for 24 hours for cargo handling operation but its co-ordinated working hours with some of the other service organizations

such as banks, insurance companies was only 8 hours. While this time frame may be acceptable for organizations such as banks, it is more and more becoming unacceptable for shipping agent, principal, freight forwarders who are working hard to catch up with countries of different time zone.

The customs and receipt/delivery offices oftentimes open late to facilitate stripping and stuffing and late arrivals of containers. Based on table 4.9 below, KTO had an average opening hours of 14.4 and a ratio of non-co-ordinated hours of 2. This is in effect low as worldwide a target for simultaneous opening hours for all the services is the ultimate aim.

Table 4.9 KTO Opening Hours as compared to Non-Coordinating Hours

Service	Opening Hours	Non- Co-coordinated Hours
Tugging/pilotage	0 - 24	0
Handling	0 - 24	0
Custom clearance	8 - 16	16
Receipt/delivery	8 - 16	16
Port office	8 - 16	16
Average hours	**14.4**	**16**

Source: KTO, 2001

- **Punctuality**

Ship-owners and shippers are very concerned by the capacity of the port to respect the forecasted time schedule especially for container vessels. KTO on the other hand is the one that suffers from vessels' late arrivals, which the terminal in turn should be charging a penalty to lines arriving late. As can be seen from table 4.10 below, KTO had to wait an average 72% of the times for vessels calling at the terminal. This is one example of the imbalance in services vis-à-vis shipping lines and ports wherein ports are suffering.

Table 4.10 Rate of Punctuality of Vessels calling, Jan 1999 – Jun 2001

Punctuality Ratio	Formula	Result					
		1st Half 1999	2nd Half 1999	1st Half 2000	2nd Half 2000	1st Half 2001	Average
KTO awaiting vessel arrivals	Cumulated delayed time/ Number of vessel calls	80%	75%	56%	68%	80%	72%

Source: KTO Statistics, 2001

With regards to departures, it is up to the agents to monitor vessels' completion and in turn order pilot and possible tugs to take the vessel out of the port area within a timely manner.

4.3.4.2 Reliability Indicators

- **Security**

The security for ships and cargoes is essentially for ship-owners and shippers. At KTO a 24 hours security is provided by both the port and national securities, which are trained specifically for monitoring the port area. The vigilant security measures has become ever more important especially since 1988 after the port lost cargoes from Evergreen due to their concern about drug smuggling and pilferage at the time. However accidents do happen and based on statistics from KTO, casualties between 1998-2000 totalled 114 averaging 38 incidents per year. This was further broken down into 15 KTO staff and 99 port workers. This can be regarded as very high. However, not all damages warrant an action in courts but those that do are dealt with under the heading litigation.

- **Litigation**

The litigation right is one of the factors for work reliability. However due to lack of information the indicator could not be measured. From the authors experience the perception on the terminal is that the litigation ratio is fairly reasonable. Damages are due mainly to containers falling from gantries as a result of twist lock problems or equipment e.g. straddle carriers damaging containers. Pilferage is negligible due to the tight security that is maintained on the terminal. All the terminal's assets are fully insured and with the assistance of a Claims Manager who has put tight reporting actions in place, the truth surrounding each incident is derived. At present, the port decree to take full responsibility for the risks of all cargoes handled thus ensuring good order and condition. This does add to the quality service and reputation of the port.

- **ISO 9000**

Although there is not yet an objective way to measure quality, KTO has adopted the ISO 9000 series. This is another way that the port is seeking to assure port users of how serious the terminal is in providing the quality services they are demanding.

4.3.5 Indicators of productivity

It is universally acknowledged among economists that productivity is very difficult to measure. Attempting to quantify an intangible quality is not the easiest of tasks, and it is even harder to use these numbers to justify any kind of business decision. It goes without saying that measures of productivity vary from industry to industry, and even among these differentiations, there are finer divisions and problems of standardization ('Robinson', 1999, p. 11).

This seems to be especially true of the container shipping industry as stated by Robinson (1999, p.11) and as earlier mentioned, that people primarily speak of physical productivity, i.e. throughput, but they are equally interested in the productivity gained from capital investment and the effective utilization of resources. The two are difficult to link and the measurement of physical productivity has had experts fraught due to the varying levels of measurement.

4.3.5.1 Productivity Problems Diagnosed

Unfortunately, productivity measures for example are all completely different from one another, and confusion is rife. The total lack of standardisation is peculiarly endemic in the container shipping industry. Every unit in use, whether it is moves/hour, moves/berth, lift/hour, containers moved/labour hour, lift /ship hours, etc, is open to interpretation, and everybody has a different idea of what these things mean.

In any other industry where measurements are necessary, this kind of situation would have had serious repercussions. Chaos would ensue if every hospital began to use their own units of measurement, and neglected to clarify those units in publication. Progress as we know would quite simply be impossible.

In an investigation carried out by UNCTAD on twenty-one terminals, working second and third generation container ships they were found to be quoting productivity of unbelievable rates and using measurements that were also not standardised. With regards to productivity rates as pointed out by UNCTAD, it was easy for terminals to quote-large rate of productivity but the reality differed ('UNCTAD', 1985, pp. 53-54). The terminals quoted productivity of 700 TEUS and above but on closer examination of each terminal it

was found that all except one terminal was able to sustain a productivity of 749 teus per day for several months. This finding has caused many terminals to be reluctant in accepting publications on productivity figures so much so that it has triggered debates on a standard ship handling contract similar to the standard Bill of Lading and other uniform instruments of trade used in the industry so as to have all terminals using one method of calculating productivity.

Professor A Ashar, Group Manager, Port and Intermodal Operations, from the National Port and Waterways Institute of America in an article titled 'Counting the Moves' also tried to address this growing concern by looking at the different ways productivity can and have been calculated in terminals. From discussions with terminal managers and line representative, it became evident that there was no agreement on the definition of ship handling productivity. Lines and operators used different definitions for productivity.

It was also found that some terminals started calculating productivity when a ship arrives at the entry buoy and ended when the ship passes the buoy on the way out, after finish loading/unloading its cargo. Other adopted the net/net gang time, which is the extreme of the one mentioned above.

He further stated that one or more gangs do the actual handling of cargo with the assistance of a shore based or ship-based crane. The times and activities from which the productivity is derived are generally divided into those related to the ship itself, and those related to the gangs and cranes working the ship ('PdI' November 1997, pp 25-28). In an attempt to do away with the ambiguity surrounding productivity measurements, Ashar recommended the adoption of the following clearly defined units and quantities. See also figure 4.4 for further explanation.

Productivity based on Ship Times

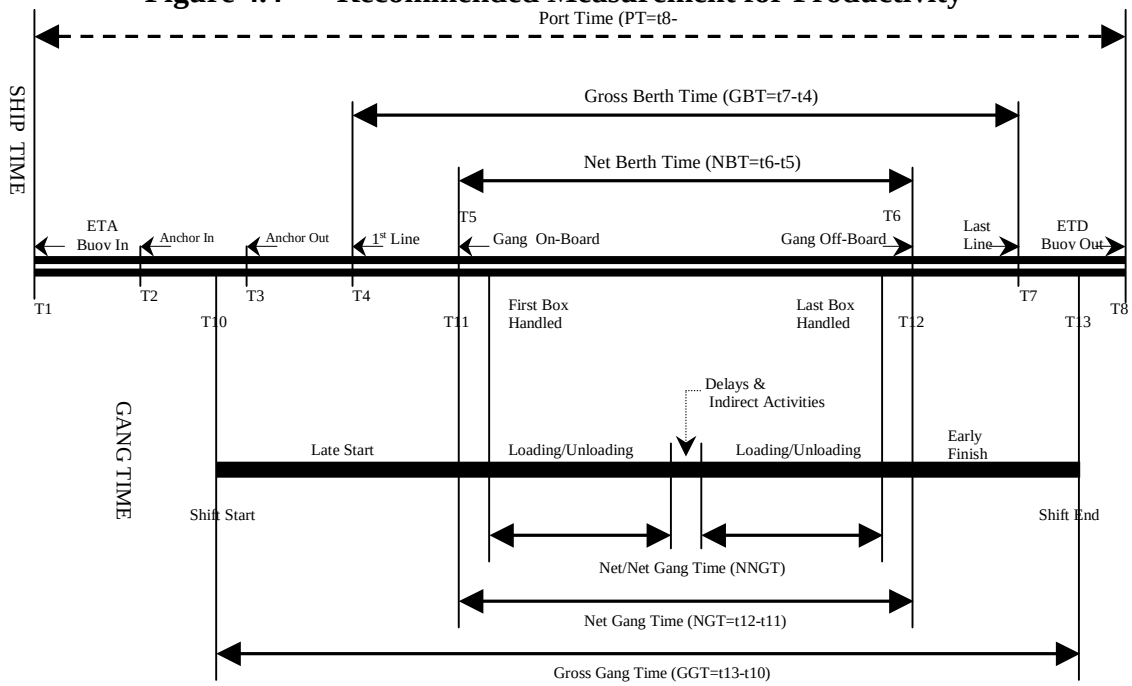
- **Port Time:** The buoy-to-buoy time; the total time that a ship spends at a port, including ship waiting for berth, downtime, pilot, tug, bad weather etc.
- **Gross Berth Time:** The first-to-last time (line); the total time that a ship is at berth, including ship preparations, waiting for documents, gangs, beginning of shift, change of shift, availability of cargo etc.

- **Net Berth Time:** The first unlash-to-last lash time; the working time of a ship at berth during which gangs load/unload the containers and perform related activities such as lashing/unlashing, placing/removing cones, opening/closing hatch covers, etc. The Net Berth time includes minor during-work interruptions due to the availability of cargo, equipment breakdowns etc.

Productivity based on Gang (Crane) Time

- **Gang Gross Time:** The start of shift to the end of shift; the time that the gang is available (assigned) to work a ship and for which the gang is paid, including waiting times before and after work (stand-by) and interruptions during work.
- **Net Gang Time:** Gang on-board to gang off-board; the time that a gang is actually working, including handling boxes and performing other indirect activities, along with minor interruptions during work.
- **Net/Net Gang Time:** First box handing to the last box handling; the same as net gang time, but only including the time that a gang is actually handling containers, excluding all other activities and interruptions.

Figure 4.4 Recommended Measurement for Productivity



Source: 'PdI', 1997

Using these units, Ashar then outlined six indicators of productivity, which can be seen in table 4.11 below.

Table 4.11 Recommended Indicators of Productivity

INDICATOR	DEFINITION
Port Accessibility	The difference between Port Time and Gross Berth Time
Gross Berth Productivity	Moves (boxes transferred between the ship and the dock/yard) divided by the ship's Gross Berth Time (the time between the first and the last line)
Net Berth Productivity	The same as Gross Berth productivity, but using Net Berth Time
Gross Gang Productivity	Moves divided by Gross Gang Time
Net Gang Productivity	The same as Gross Gang Productivity, by using Net Gang Time
Net/Net Gang productivity	The same as above but using the Net/net Gang Time

Source: Ashar, A. 'Port Productivity Revisited' Pdl, Nov. 1997

Of these six performance indicators, there are certain ones that are of particular interest to different parties. For example, factors that are out of the terminal operator's control have the least impact on net/net productivity, making it the most useful measure for terminals. Alternatively, shipping lines will be more interested in net berth productivity, which gives them an idea of how long their ship will spend in port. However, net gang productivity he suggests would be a more constructive and informative measure for the terminal to use for handling charges.

The author is quite sure that its readers would want to know how much Ashar's recommended method differs from UNCTAD's. From the authors observation it was clear that although the same factors and indicators were noted under UNCTAD's method, however the lines of demarcation spelt out in Ashar's case were much more pronounced,

which leaves the author to thinks of UNCTAD's method as being too general when compared to Ashar's method which was more specific. Whereas Ashar's method measured more defined points such as 'buoy to buoy or first to last line', UNCTAD's method instead looked at 'arrival in the anchoring area', which leaves a lot of assuming to be done by port operators throughout the world as to where the anchoring area begins or ends. For some it can be the first, middle or last buoy in that area. Thus using UNCTAD's method we are sure to see a continuation of the ambiguity of measurement in circulation today.

Now the author will conclude this chapter by looking at the evolution of the physical productivity of KTO and the different types of delays impinging on port performance and productivity.

4.3.5.2 Terminal Handling Productivity

Overall productivity published by KTO was 22 moves/gross hour/crane but on closer examination an average 15-19 moves/gross hours (ghr) was achieved per month although the cranes have the technical capacity to achieve 40 moves /ghr and above, making the actual effectiveness of the terminal falling between 37.5% and 48%. For the first six months of 2001 monthly productivity moves were up to 20.4 and 21 moves/ghr/crane. On a per vessel basis however the terminal achieves up to 27 moves/ghr/crane a higher handling rate on the mainliner vessels e.g. Evergreen and Zim as against a low 10 moves/ghr/crane on the feeder vessels with awkward lifts and first generation vessels. This is due to the fact that the first generation vessels have no cell guides and thus is slower to handle. When all the high and low productivities were added together, moves/ghr/crane turned out to be very low, see table 4.12 and figure 4.5 below.

Based on a report published by GTPD (1994, pp. 20-22) it was found that low effectiveness was attributable to the age of employees, remuneration, motivation, supervision, training, vessel operation and communication. With the terminal having such vital information, KTO in turn asked SAJ to assist in improving the situation surrounding stevedores while KTO internally put in place strategic actions to correct performances among workers. Over the last seven years the labour pool has employed

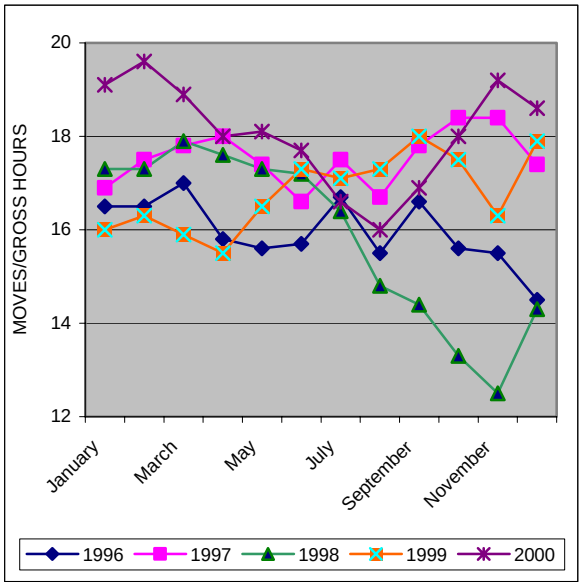
younger men and has offered early retirement to stevedores who are almost at the age. Training of these men is carried out at the local maritime institution and on the job.

Table 4.12
KTO Moves/Gross Hours/Crane 1996-2000

	YEARS				
MONTHS	**1996**	**1997**	**1998**	**1999**	**2000**
January	16.5	16.9	17.3	16.0	19.1
February	16.5	17.5	17.3	16.3	19.6
March	17.0	17.8	17.9	15.9	18.9
April	15.8	18.0	17.6	15.5	18.0
May	15.6	17.4	17.3	16.5	18.1
June	15.7	16.6	17.2	17.3	17.7
July	16.7	17.5	16.4	17.1	16.6
August	15.5	16.7	14.8	17.3	16.0
September	16.6	17.8	14.4	18.0	16.9
October	15.6	18.4	13.3	17.5	18.0
November	15.5	18.4	12.5	16.3	19.2
December	14.5	17.4	14.3	17.9	18.6

Source: KTO Statistics Dept, 2001

Figure 4.5



KTO's main weakness as stated earlier lies in the area of increasing and sustaining productivity as the moves/ghr/crane varies among vessel resulting in a dismal performances at the end of each month as the figures are well below published and international standards. KTO productivity fluctuates between 22 to 10 moves/ghr/crane while major competitors Manzanillo and Freeport fluctuate between 30 to 24 and 60 to 50 moves/ghr respectively which are much higher and more consistent see table 4.13 below.

Table 4.13 Gross Moves Per Hours (Ghr) Compared, 2000

PORTS	G (HR)
Kingston, Jamaica	22
Rio Haina, Dominican Republic	25
Freeport Bahamas	30
San Juan, Puerto Rico	40
Manzanillo, Dominican Republic	60
Felixstowe	60

Source: KTO, Port of Rio Haina, Port of Felixstowe, De Monie, Hedrickx, Joos, Covreurs & Peters

4.3.4.3 Delays

Delays occurring due to the loading and discharging of ships at KTO can be divided into controllable and uncontrollable delays. Controllable factors relate to the proficiency of planning, organizing, operating and maintaining terminal labour, facilities and equipment. Uncontrollable factors are first ship related as they affect the type and number of ships, number of moves per call and per bay and stowage plan. **According to University of Cardiff', (1989, pp. 14-15) controllable delays include activities that affect the availability of working berths, yard planning, supporting services, storage facilities, adequacy of transport connections, meal breaks and lack of equipment and method of yard operations, while un-controllable delays are due to bad weather, ship's configuration, even distribution of cargo, oversize/awkward lift cargo requiring special rigging for discharge, checks made under cranes to damaged containers etc, late arrival of stowage information and close proximity of cranes.** At KTO, all delays occurring during the discharging and loading operation are grouped according to what triggered the delay. Therefore the operational delays are grouped under berthing, labour, equipment, pre and post preparation, yard and weather. The weather delay for the period under review was due only to rain, which was 7.2% of the total delays. All delays except equipment delays will be looked at as it was already dealt with under equipment downtime. Figures 4.6 to 4.9 highlight the reasons for delays under each category and their percentage of the total.

Figure 4.6
Berthing Delays Jul-Dec 2000 (5%)

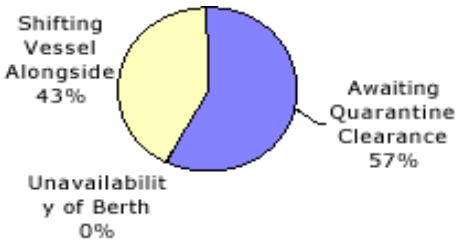


Figure 4.7
Labour Delays Jul-Dec 2000 (10.4%)

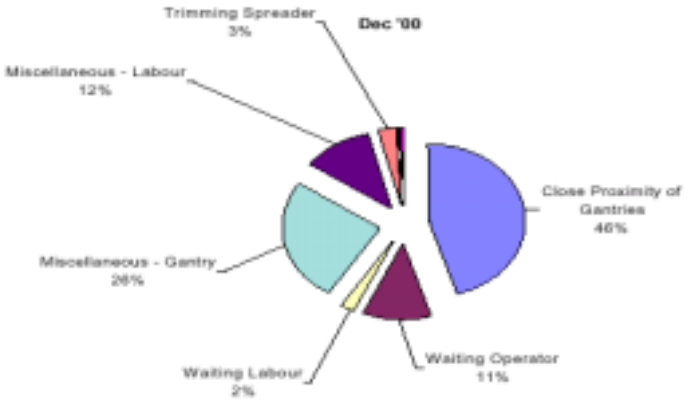


Figure 4.8
Pre & Post Preparation Delays (42.5%)
Jul-Dec 2000

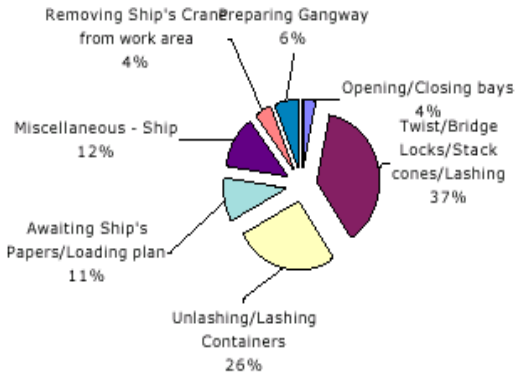
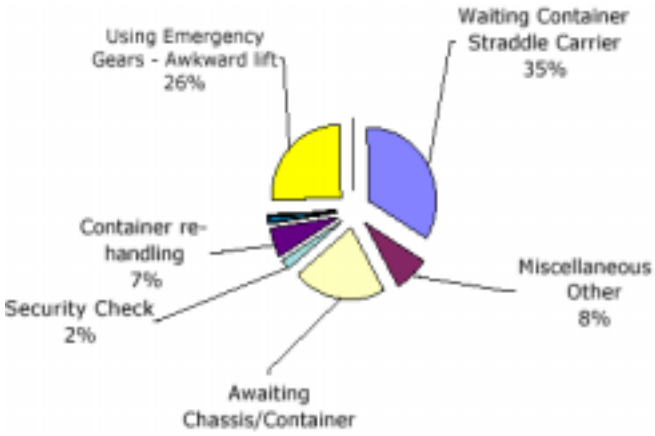


Figure 4.9
Yard Delays (7.2%)
Jul-Dec 2000



Source: KTO Statistics Dept, 2001

Conclusion

In summarizing, although performance indicators will not pinpoint the causes, it will definitely show up the symptoms of poor cargo handling. Therefore productivity improvement can only be realized through an efficient management system, operation pre and post planning, good coordination, competent supervision and by getting out on the quay, in the storage area and at the gate to observe cargo handling operations**.**

CHAPTER 5

Measures for Productivity Enhancement and Determining the Critical Level

So far the emphasis of the study has been on the terminal's port performance, the impact of an increase in productivity on the economy and how other ports have been calculating their productivity and the existing problems. However it would be wrong to ignore the core resources of KTO that are essential for an increase and or sustenance of productivity when gradual and specific changes are made. Measures for the improvement of productivity requires careful examination of the human, technical and administrative and procedural aspects as equipment, building, land and money cannot be fully and strategically employed without people and processes playing a vital role for maximum benefits to be achieved. All three aspects as it affects KTO will in turn be analysed both from empirical research and observation from years being at the terminal.

5.1 Human Aspect

As pointed out by Francou (2001, p.3) human beings are effectively the main factor of production. When one speaks of capital, it is the creation by human beings. When one speak of innovation it is the result of skilled men or women and workers are themselves a labour force. Humans are not inert and in fact reacts to events, have got a history, a culture, philosophy, religion, customs and an environment. Thus the conditions of their survival are their adaptation to new situations and environmental conditions. Managerial concerns should therefore consist of helping employees to evolve towards the new needs of the market and to accept this evolution. This evolution will be accepted the more employees are motivated to do so. Experience in many ports and also at KTO has shown that the productivity of labour and of clerical personnel depends not only on their professional skills but also to a great extent on how far they are satisfied with the conditions of their work, and whether they are really interested in that work. Based on

empirical research carried out through the form of a questionnaire with a response rate of 8% the findings on the human aspects are as listed in table 5.1

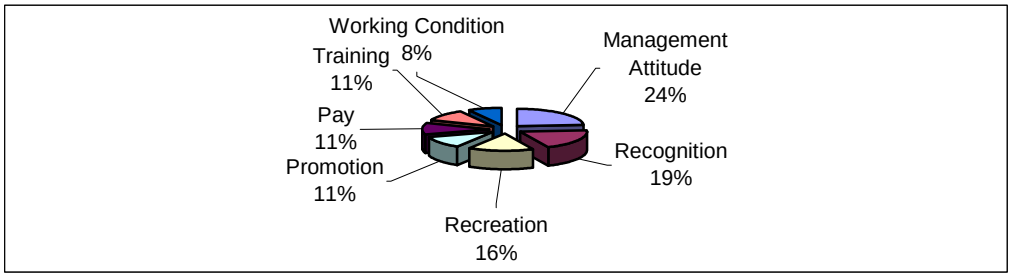
Table 5.1 Rating of Human Factors at KTO

Factors	Yes	No
Properly Compensated	56%	44%
Adequately trained	62%	38%
Adequate Recreational Facility	0%	100%
Fair Hearing	54%	46%
Management openness to discussion	62%	38%
Receive Recognition	17%	83%
Potential for Progress	48%	52%

Source: Empirical research gathered at KTO, 2001

When the employees were asked to rank the factors that most negatively affect them, management attitude and recognition were seen to be the most de-motivating factors. See figure 5.1.

Figure 5.1 Factors Most Negatively Affect Performance



Source: Empirical research gathered at KTO, 2001

5.2 Technical Aspect

KTO in an effort to maintain its hub status and in order to keep up with the demands of its customers is highly mechanized. However the choice and combination of equipment is important given the climatic condition and terrain that the equipment has to operate in. KTO from time to time has to carry out resurfacing to ensure the safety of its drivers and to eliminate the slowing down of operation. Based on the empirical research, the most frequently broken down equipment was the straddle carrier 46% of the time followed by the ship to shore gantry and stevedoring chassis 32% and 22% respectively. However most of the problems occurred under the gantry crane and the farther away, the fewer problems there were. This could be due to the fact that higher pressure for performance is

required at this point thus closer monitoring and supervision are needed to be done by the terminal. The percentages as it affects each node are as follows: gantry cranes 43%, in the storage area 27%, at the interchange point 19% and at the gate 11%. The reasons for the problems were mainly due to frequent breakdown 38% of the time, lost containers 27%, tedious customs procedures 19%, slow processing at the gate 11% and slow response to deliveries 5%. However Table 5.2 provides answer to four other crucial questions given by employees.

Table 5.2 Employees Views on Certain Technical Aspects

Questions	Yes	No
Is there a preventative maintenance programme in place?	92%	8%
Is the workshop adequately staffed?	32%	68%
Is there adequate supply of spare parts?	16%	84%
Is the port equipment of the right combination?	76%	24%

Source: Empirical research gathered at KTO, 2001

From the table it can be seen that the terminal needs to heighten awareness among staff as to the programmes in other departments. The lack of staff in the maintenance department is cause for concern as over worked staff will never be happy staff and eventually lead to frustration, de-motivation and resignation. Also the short supply of spares will lead to cannibalisation of equipment and tying up of expensive resources. These factors in and of them selves will definitely lead to continued poor productivity. Regardless the problems as pointed out, the terminal needs to put in place technical training programmes for supervisors, the labour force and union officials including visits to ports in developed countries.

5.3 Administrative and Procedural Aspect

The third measure those for the improvement of procedures and organization includes some issues that are likely to bring about a considerable increase in throughput and productivity and for enhancing the smooth transit of cargo through the port. Specific measures included trucking, customs and documentations. Answers provided in this section were incomplete which signifies that most persons were not familiar with the administrative and procedural aspects for clearing containers within the port. Thus the answers may not depict the actual truth. However based on the findings, almost 50% of

staff believe that 10-20 minutes was spent clearing each container which in the author's estimation is too long. If say for e.g. 300 containers are to be cleared, this would take the terminal at least 2 to 4 days, which is far too long. Likewise more than 60% of staff members are of the opinion that customs begin to clear containers and cargoes after truckers or consignees present their documents. Fifty (50%) of staff also believes that the documents are simple to be filled out but at least 3-5 papers are required for completing the withdrawal process. Based on these information it is now understandable why the processing of containers has a delay process, which should not be the case given the state of the art gadget and apparatus in modern ports.

5.4 Other Procedural Matters

Ideally also for KTO to maintain and increase productivity careful planning is required by management to ensure that each stage of the operation matches each other, the appropriate use of gang and technology are in place and retooling is done whenever necessary. Thus each will be looked at as they serve to compliment the choice of equipment and other aspects that the terminal would already had in place.

5.4.1 Matching of Operation

Achieving a high rate of productivity cannot be obtained in isolation thus there is the need to match operations from quayside straight through to despatch. **According to UNCTAD (1985, p.54) the most important links are between the ship cargo-handling system and storage, and, later, between storage and onward transport.** The first pair of linked operations, unloading from the ship and placing in storage, must be matched on an hourly basis, otherwise one operation will have to wait for the other, or containers will pile up in the operational area and cause congestion. The other linked operation, retrieving containers from storage for onward transport cannot be matched with the placing of containers in storage either on an hourly basis or even on a daily basis. Customs clearance and delivery formalities take time and their duration may vary considerably. But the capacity to despatch containers from the transit storage areas must match the flow of cargo from quay to storage on, say, a weekly basis otherwise storage areas will become overfilled, which may result in a low productivity.

Based on the specificity that is required in the matching of operation, each area need to be accessed by supervisory staff as to the strategies needed to be employed in preventing rather than correcting problems. Although KTO has a stringent yard management system in place, from the empirical research 84% of the cause of problems were shared by frequent breakdowns, lost containers and tedious customs procedures which points to a slow operation from shipside straight through to deliveries/receipt operation. At shipside the straddle carrier was the most frequently broken down equipment, working 0.7 times slower than the gantry cranes meaning that for every two containers being discharged, there is one straddle carrier short to handle the containers thus the gantry operator is either forced to wait on the container removal or instead adjusting the landing position either to the left or the right of the other container. This for sure results in lost time, thus lower productivity.

Although the terminal tries to ensure that each container position is updated, containers continue to be lost either during the initial positioning in storage or during reconsolidation. This is often due to transposing errors and due to the fact that more than one person is completing the updating. With the global positioning system in place hopefully there should be a reduction in lost containers in the near future. This is definitely a step in the right direction.

Also from the empirical research it was seen that it was not until the truckers presented the document before customs starts it processing, another delay in the matching process. However strong lobbying is required by KTO to bring about a change in this area. Change as stated above has to be synchronized thus a through package needs to be put in placed by KTO, which will speed up operation from shipside straight through the gate.

5.4.2 Appropriate use of Gang and Technology

The introduction of more capital-intensive methods of handling cargo and the use of larger and more expensive ships make it more important than ever to ensure that the most effective methods are used, that ships are not kept waiting for labour more than is necessary. **According to UNCTAD (1985, pp. 54-55) the high cost of labour in many**

industrialized countries, has justified the use of more advanced techniques of mechanization and automation. However at KTO a balance has to be struck between cost and output given modern day requirements. Moreover a shortage of skilled and consistent operators are even more important and qualified technicians to maintain the advanced equipment. It is believed among many ports and also KTO that the local temperature has definitely held output down below what can be achieved in temperate climate. Manufacturers are ardently working with ports in the hot regions to adjust features and rewrite manuals prevention care as pointed out to the author on field trip to Kalmar, Sweden. It is thus vital not only to make sure that productivity targets are realistic for the local conditions, but also that the suppliers of equipment can refer to its successful introduction in similar port conditions elsewhere. **UNCTAD (1985, p. 55) also stated that 'unless there is definite experience to go on, ports are advised to reject offers of untried equipment and go for proven equipment only.**

5.4.3 Retooling

The need for modern equipment in ports is necessary in order to keep pace with modern technologies and to satisfy customers. Although KTO can be regarded as being very modernised compared to other ports in the region, the terminal needs to bench mark couple ports in the industrial world as to their innovation and copy from them where necessary so as to provide the terminal with that added competitive edge.

Now that the workers have given their perspective of KTO, the author will now decide on the critical operational level for the terminal.

5.5 Critical Analysis

Based on the analysis of the performance indicators in Chapter 4, and earlier revelations, the author is now able to determine the weaknesses of KTO port performances thus determining the critical level at which the terminal should be operating so as to remain competitive in the Central American/Caribbean region. The recommended critical level is based upon port performance theories and examination of other port performances in and outside the region. Even though all the indicators are important a choice has been made as to the most important ones that KTO should be seeking to improve at this time and

they are as listed in table 5.3 below. The actual performance of each variable and the critical level are also included of which a detailed analysis was made.

Table 5.3 Critical Level

INDICATORS	ACTUAL PERFORMANCE	CRITICAL LEVEL
Ship turn-around time	28 hrs	24 hrs
Berth occupancy ratio	52%	60-70%
Berth work time ratio	71%	90%
Utilization ratio	76%	90%
Move/gross hours/crane	22 moves	60 moves

Source: KTO Statistics Dept & findings in the study, 2001

5.6 Critical level Diagnosis

5.6.1 Ship Turn-around Time

Based on ship-owners' desire for short stay in port, the ideal time for them is 1 day or part thereof of a day. From the statistics provide by KTO, the terminal was handling vessels in 1.2 days, which is higher than the critical level being demanded. Since service time is the component of turn-around time that is more directly under the terminal's control then KTO needs to look more seriously at this indicator.

5.6.2 Berth Work Time Ratio

The berth work time ratio is closely related to the ship turn-around time. KTO's berth work time is presently 71%, which can be considered very low even though the terminal is current meeting its target. If instead, a 90% work time were achieved, then vessel turn-around time would work out to be less than a day making most of all ship-owners happy.

5.6.3 Moves per Gross Hour per Crane

The productivity measurement, moves per gross hour per crane is also related to ship turn-around time. The higher the productivity the shorter vessel stay will be in ports. From the table this is the worst performance indicator, which will possible take years before the terminal reaches gantry cranes potential level of 40 moves/ghr, worst the critical level of 60moves/ghr. Since there is little or nothing ports can do about the type of ships at berth, the terminal therefore needs to carefully choose the type of equipment and other resources e.g. gang compliment that will enhance the working of vessels

5.6.4 Berth Occupancy Ratio

With regard to berth occupancy the tendency is to think that a high berth occupancy value is desirable and that it indicates high berth efficiency. Contrary to the notion it does not indicate an efficiently run berth. Low berth occupancy on the other hand indicates an under-use of resources especially for terminals operating at 50%. ('UNCTAD, 1982, pp. 21-22). These terminals can be viewed as wasting resources. A look at KTO berth occupancy shows that the terminal is just operating above the 50% mark, which according to UNCTAD's theory is uneconomical in terms of return on investment. The safest target of 60-70% should be the limit most terminals aim to operate at. So berth occupancy is an indicator that should be used with caution.

5.6.5 Utilization Ratio

The handling indicator, utilization ratio, looks at how efficient equipment is used on terminals. Due to the high cost of equipment, as explained in chapter 4, a higher percentage of 90% should be aimed at. This is one way of getting the most out of equipment thus saving costly resources while staggering the purchase of new ones.

In summarizing, the functional values of port performance indicators appear to give a fairly representative and reasonable picture of port efficiency however in order to help KTO in deciding what actions to be taken so as to increase and sustain port performance in general, and productivity in particular, a set of alternatives will be looked at.

5.7 Alternatives

Being KTO is a well established organization with departments that interlink, it was only fair that the decision be based on a consensus thus multi-criteria analysis was chosen for aiding in the decision making process.

5.7.1 Multi-criteria analysis in decision-making

Due to the many and varied problems within KTO, multi-criteria analysis was however thought of being the best tool for structuring the problems identified so as to arrive at the optimal decision. The author therefore thought of constructing a multidisciplinary team which would be comprised of at least 6-8 managers one or two from the departments;

operations, finance, administration and maintenance. To each department certain criteria and coefficients would be assigned. It was further assumed that the coefficients be weighted based on the importance that each department attached to the alternatives. As a result the coefficient given to operations was 40, finance 10, administration 20 and maintenance 30 all adding up to 100%. It was also assumed that each department would give ratings no more than 100% and their decision could be based on how much benefits the alternatives would have brought to their departments in terms of financial gains or losses, company current objectives, knowledge of the impending problems and how much the alternative would enhance each department individually and in a general sense. Based on the above the alternatives were then chosen.

5.7.2 Alternatives Chosen

In order to boost productivity at KTO three alternatives were arrived at based on the findings in the study. The **first** was to: stock adequate supply of spare parts and to employ more maintenance staff; the **second** was to: carry out vigorous training throughout the organization with greater emphasis in some area; and **finally,** to refit some of the cranes with telescopic spreaders and buy two additional straddle carriers.

5.7.2.1 Alternative 1 – Adequate Spare Parts and Maintenance Staff

The equipment breakdowns predicted by staff showed breakdowns occurring more than one third of the time while statistics provided by KTO showed a somewhat closely related figure. Empirical research also showed that only few spare parts were stocked and maintenance staff was short in tending to the impending problems thus the author has decided on this alternative, which is very vital for modern port operation. On a container terminal, the size and weight of containers and the need for specialised lifting attachments means that there are few plausible alternatives if equipment is not available.

According to UNCTAD (1986, p.45) no matter how well equipment is looked after, spares will be needed and availability will suffer if parts are not in stock. However, spares are expensive and over-stacking wastes money, so a good stock control and spare parts purchasing system must be set up. Stock levels must be appropriate to replacement rate and delivery time, and suitable budget allowed for them. As a rule of thumb, a sum

equivalent to about 12% of the purchase price of a straddle carrier needs to be set aside for maintenance each year, and about 5% for a gantry crane. Good records are essential in this respect especially information on how frequent parts are replaced, and on delays in delivery. Needless to say the correct spares must be carried and equipment specification needs to be checked carefully before purchase. Standardization on a few types of machines preferably from the manufacturers, help spare parts control considerably. Adequate staff on the other hand is necessary for returning equipment to work area in the shortest possible time however too much staff can put a strain on the financial budget.

5.7.2.2 Alternative 2 - Training

The need for vigorous training throughout the organization giving greater emphasis in some area is another alternative, which is important for the terminal's success. Training also can be very expensive but the benefits to be derived are many. For e.g. staff motivation, commitment and improved work performance. Training should be provided for both existing and new staff. General training for clerical and technical staff can be carried out in-house and supported with classes at the local institutions. Advantage should also be taken, when purchasing new equipment, of training schemes offered by suppliers. Supervisors and managers on the other hand could be trained locally and those within selected areas could be trained abroad to bring new thinking to the work environment. Management in an effort to wheel unions into modern port operations and thinking could extend invitation to them for visits to foreign ports.

5.7.2.3 Alternative 3 – Refitting and Purchase of Equipment

Another quick way of improving KTO's performance is by purchasing straddle carriers and or refitting one or two gantry cranes, for relieving stressed operational areas within the port. Presently KTO has 10 ship-to-shore gantry cranes, 58 straddle-carriers 12 rubber-tyre gantries and 32 yard-tractors. Given the distance to be travelled between the north and south terminal a lot of trucks and straddle carriers are used up in the transferral process. Also due to the long distance to return to shipside this impacts negatively on the machine efficiency. **According to UNCTAD (1985, pp.144-146) approximately 6 straddle carriers are required for each ship-to-shore gantry cranes and this type of equipment has an economic life of 6yrs.** However handling of containers is required in

the receipt/delivery area, which the author will assume are handled by the rubber-tyre gantry. Since the critical point of the terminal is from shipside to storage the author recommends that 2 additional straddle carriers be bought, and 2 of the older gantry cranes be refitted with telescopic spreaders for handling two twenty feet containers at the same time. Cost for this venture is estimated to run between US$2-3 million taking into consideration inflation, workmanship and allowance for difficulty in installation ('Crook', 2001, 1).

5.7.3 Result of Analysis

Based on the scenarios discussed, each alternative was analysed and the finding can be seen in table 5.4

Table 5.4 Alternatives Analysed

Options	Operations	Finance	Administration	Maintenance	Overall Results
Coefficient	**40**	**10**	**20**	**30**	**10000**
Alternative 1	100	60	50	90	8300
Alternative 2	70	40	80	20	5400
Alternative 3	90	50	20	60	6300

Source: From author's findings (Rates out of 100)

5.8 Conclusion: Selection of alternatives and conditions for success

In light of the fact that all alternatives were important for the organizational's success, the author recommends that each alternative be adopted by KTO in the order selected even though that alternative may not be the most important one. From the table it can be seen that with a total maximum 10000 points that could be gained, alternative 1 was selected as being the best option followed by alternative 3 and then alternative 2.

Conclusion

Decision making in big port sectors like KTO can be tedious and time consuming given the many variables that span across various departments. With one department having the idea is good, but support is needed from others to make the idea realistic. Therefore decision of this nature should not be taken by any one person but by all through team effort as the future of the company does not rest with one person but with everyone within the organization.

CHAPTER 6

Conclusions and Recommendations

6.1 Conclusion

Ports are national gateways. They impact significantly on national socio-economic structures and are an accurate measure of the economic well being of any country. Thus their effective control and operation is of fundamental importance to nations.

The role of KTO in light of the above is to provide quality services thus improving port performances despite the many changes necessary in administrative, managerial, operational and maintenance systems. As Francou rightly puts it, as far as the quality of services is concerned, the indicators are to be found, and universally adopted, as the actions warranted will impact on both workers and human behaviour and only a subtle mix of indicators put together can give the planners a good estimate of the actions to be taken. Therefore final decisions rest with the terminal to put in place the necessary corrective measures that will serve to improve its services so as to satisfy its customers and harness itself with that competitive edge to be the largest and main hub provider in the Caribbean.

The problems encountered at KTO are no different from those faced by ports in other developing countries. However, the solutions to its problems lie in the consideration of its own particular set of resources and circumstances.

Based on the initial statement it can be said that the achievements gained by KTO will not rest only with the terminal, but will also be transferred to the nation. The port has the resilience to respond to the demands and changes therefore, **Kingston Terminal Operators Limited is poised to make a difference – the Caribbean port of the 21st century.**

6.2 Recommendations

In light of the alternatives to be implemented and the mere fact that there are other corrective actions to be taken in other areas of the company, it is therefore recommended

that in order to improve and sustain productivity at KTO the following should be adopted under the following headings in the short to medium term.

6.2.1 Human Aspects

- On going training of both managers and staff especially those in operations, maintenance and information technology department. Continuous training of gantry operators is essential to the terminal success. Having one or two operators performing at the required level is not good as most if not all operators should be at or above the average.
- Combine the daily use of the gantry crane operations with practices on simulators so as to sustain an even cargo handling performance by all operators, as was the norm in the Port of Le Havre. This should aid in an increase in the effective output.
- Categorise and grade all operators based on their performance and reward hard working operators. Low performers should be sent back into training even more frequently. Names of top operators should be posted for all to see and management should seek to personally praise them, which will help management to be seen in a positive light.
- Lobby Unions to allow for the flexibility of gangs between different shipping lines calling at the terminal, as this will reduce the downtime per ship and result in more effectively used gangs.
- Put in place recreational facilities, which will serve to stimulate the minds of workers and boost the mentality of management/workers relationship, as greater interaction will occur.
- Develop a team culture within the organization among management, staff, unions and stevedores.
- Train operators and stevedores to be multi-skilled so that operators will spend no more that four hours on gantry cranes within an 8-hour shift.
- Ensure a reduction in the amount of casualties by seeing to it that proper protective clothing are worn at all times as the many incidents do not augur well for the terminal’s image.

6.2.2 Technical Aspects

- Lobby shipping lines to arrange better scheduling of their mainliners so as to prevent feeder vessels form having to wait to be served.
- Continue with corrective and preventive maintenance programme while taking into consideration the useful life and sourcing of spares even after the project.
- Continue to upgrade and buy new equipment and get rid of the old one, possibly through sale to other ports.
- Invest in gantry with telescopic spreader so that two 20 feet containers can be lifted simultaneously so as to avoid losing time adjusting to different sizes.
- Due to the long distances travelling between the two terminals, get a truck relay system designed to carry at least five containers at a time given the yard surface can support it. Similar system can be seen at ECT.
- In order to speed up the gate function on-line pre processing system can also be installed which would be aided by camera and laser to process trucks on arrival at the gate. Most of the basic systems are already in place it is just to take it a step further. The Port of Aarhus could be of help in this area.

6.2.3 Procedural and Organizational Aspects

- Sensitise Customs and Quarantine to work with the terminal by giving incentives to workers with the aim of eliminating delays. Also encourage customs to put in place on-line pre-processing systems to reduce in-office checking.
- Increase berth-working time above the 75% mark set by the terminal to at least 90% while at the same time sustaining performance. This can be achieved by:
    - Reducing idle time especially among pre and post planning which is 50%
    - Using faster cranes and faster and consistent operators
- Constantly monitor dwell time on the terminal so as to discourage lengthy usage of space by shipping lines/consignees. Carry out further analysis to know the type of container, whether domestic or transhipment and the reasons for them being there. Apply a scale payment by week so as to deter this behaviour.
- Benchmark Felixstowe or Bahamas and find out what Hutchinson is doing to sustain 60 moves/gross hour/crane in every port it operates

- Review the current pricing strategy and examine how feasible it is for the terminal to apply the single billing process. Also benchmark one of the large ports e.g. ECT to see how the strategic pricing is applied and then carry out an analysis locally to see how profitable it would be in our Caribbean scenario.
- With 72% of vessels arriving late at KTO, it is recommended that the terminal charge a graded 30-minute penalty to those vessels for their late arrival.
- Increase overall effectiveness of productivity performance by at least 40%, which presently fall between 37.5 and 48%. With most of the items already specified e.g. continuous training, healthier machines etc. then the target could be achieved.
- Continue to classify vessels based on their difficulty of handling and published productivity figures for mainliners separate from feeder vessels
- Continue to forecast and market transhipment traffic only. Also embark on an intensive marketing programme so as to increase traffic through the terminal: For example forging links with ports within the United States through which new distribution corridors can be created that will serve the trading needs of both consumers and the manufacturing community in the US while increasing container throughput
- Employ protective, maintenance and growth strategies so as to sustain and improve transhipment traffic as compared to competitors.
- Get all lines to feed information via EDI and not just some lines as is now obtained as this will speed up the planning of container operation.

Conclusion

In concluding, it is clear that KTO has taken positive steps over the years in providing a good port system, from which ship-owners today can benefit. The most outstanding one is the non-waiting time situation, which has being achieved and is a criterion many ports would have loved to have as one of their marketing tools. However the company is not without faults and there are many things still to be done as pointed out in the recommendations. Thus the recommendations are in no way exhaustive and it is now left to the managers of Kingston Terminal Operators Limited to amend and adopt those strategies that will help to positively serve the company's well being.

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APPENDIX 1

May 2001

Dear Colleagues

I am seeking your co-operation in completing this questionnaire, which seeks to get your views on the ‘reasons why productivity at Kingston Terminal Operators Limited is at an all time low’.

All individual responses are completely confidential.

This survey is required in order to satisfy the requirements of the World Maritime University Port Management Masters Degree Programme. The information is collected for the sole purpose of this study.

Each member of staff is invited to participate by completing a questionnaire and leaving it, folded and stapled, at KTO with Mr. Ronald Salmon by Monday, June 25, 2001, addressed to Ms. Karen Clarke.

A final report will be available for examination upon request.

Thanks for your co-operation.

Yours truly,

Karen Clarke

Please tick as appropriate

PERSONAL DATA

AGE GROUP

18-25 Years	☐	Senior Manager	☐
26-35 Years	☐	Middle Manager	☐
36-45 Years	☐	Clerical	☐
46-55 Years	☐	Secretary	☐
Over 55 Years	☐	Other	☐

2 JOB DESCRIPTION

SEX

Male	☐	Female	☐

How long have you been working with your Company?

Less than 1 year	☐	4-5 years	☐
1-3 years	☐	5+ years	☐

HUMAN ASPECTS

Do you think you are properly compensated for the job you perform?

Yes	☐	No	☐

Explain why? _____

_____

Do you think you have been adequately trained?

Yes ☐ No ☐

If No, why and what do you suggest to improve training?

_____

_____

How would you rate the accident prevention measures?

Well organized ☐ Poorly organized ☐

Fairly organized ☐ Not organized at all ☐

Explain your Answer?

_____

_____

How do you describe the opportunities for advancement in the company?

Very Good ☐ Only for favoured employees ☐

Good ☐ Poor ☐

What do you suggest to improve it?

_____

_____

Are you satisfied with your progress or potential for progress within the Company?

Yes ☐ No ☐

If No, why not? (Tick the appropriate box(es))

Company rarely promotes from within ☐

Been overlooked for promotion several times ☐

Supervisor does not like me ☐

Promotions only go to favoured employees ☐

Already at top of career in Company ☐

Being discriminated against ☐

Sexual discrimination ☐

Strict qualification requirements ☐

Other (mention it) ☐

Do you think by working harder you are likely to be rewarded with a promotion?

Yes ☐ No ☐

If No, which incentive do you suggest employees working harder should be rewarded with?

Are you provided with adequate recreation facilities?

Yes ☐ No ☐

Is there a fair hearing or just settlement of grievances and complaints by management/supervisors?

Yes ☐ No ☐

Comment:

Do you feel welcome to discuss problems, concerns and suggestion with management?

Yes ☐ No ☐

Have you ever receive any form of recognition from your supervisors/management for doing a good job?

Yes ☐ No ☐

On a scale of 1-7, with 7 being the highest and 1 the lowest, indicate which factor most negatively and least negatively affect your performance.

Please indicate by numbering the boxes 1-7.

Promotion ☐ Working Conditions ☐

Pay ☐ Management Attitude ☐

Recognition ☐ Recreation ☐

Training ☐

TECHNICAL ASPECTS

Is there a preventive maintenance programme in place?

Yes ☐ No ☐

Is the Work Shop adequately staffed?

Yes ☐ No ☐

Is there adequate supply of spare parts?

Yes ☐ No ☐

Is the port equipment of the right combination?

Yes ☐ No ☐

Which equipment breaks down more frequently?

Straddle Carrier ☐ Ship to Shore Gantry Crane ☐

Stevedoring Chassis ☐ Rubber- tyre Gantry ☐

Forklift ☐ Stevedoring yard tractor ☐

Does quayside operation matches with yard operation?

Yes ☐ No ☐

If No, explain why?

_____

_____

Where do most of the problems occur?

Under the Ship to Shore Gantry Crane ☐

In the storage area ☐

At the interchange point ☐

At the gate ☐

What are the causes of the problems?

Frequent breakdowns ☐

Lost containers ☐

Slow response at deliveries ☐

Slow processing at the gate ☐

Tedious Customs procedures ☐

Other ☐

If other, please explain _____

_____

_____

_____

ADMINISTRATIVE AND PROCEDURAL ASPECTS

How much time does it takes a trucker to get a container?

Less than 10 minutes ☐ 30- 60 minutes ☐

10 – 20 minutes ☐ Over 1 hour ☐

20 – 30 minutes ☐ ☐

How soon does Customs start processing documents for domestic containers?

Before the ship arrives ☐ When the shipping agency makes request ☐

While the ship is in port ☐ When the trucker presents the documents ☐

After the ship leaves ☐ ☐

How simple are documents for withdrawing container?

Very Complicated	☐	Simple	☐
Complicated	☐	Very Simple	☐

How many documents are involved?

1-2 Documents	☐	5-10 Documents	☐
3-5 Documents	☐	Over 10 Documents	☐

What do you suggest to simplify operations?

_____

_____

In your estimation why is it quayside productivity at KTO continues to be at an all time low?

_____

_____

_____

_____

_____