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The research on container operations at container freight station and RFID implementation

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The Research on Container Operations at Container Freight Station and RFID Implementation

(With a Case from Hyderabad, India)

By

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INDIA

For

MASTER OF SCIENCE

INTERNATIONAL TRANSPORT AND LOGISTICS

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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 personal views, and are not necessarily endorsed by the University.

…………………….
(K.N.C.MOHAN)
…………………….

Supervised by
Professor XU DAZHEN
Shanghai Maritime University

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ABSTRACT

Title: **The Research on Container Operations at Container Freight Station and RFID Implementation (With a Case from Hyderabad, India)**

Degree: **MSc**

In order to improve the operational efficiency and productivity of the Container Freight Station, Kukatpally run by the Central Warehousing Corporation and to improve services, CWC needs to modernize its operations. This research paper on "The research on container Operations at Container Freight Station and RFID Implementation" enumerates the objectives of the project, analyses the various operations at the CFS and provides recommendations to Central Warehousing Corporation to improve the operational efficiency, competitiveness and customer satisfaction by implementing RFID technology in the CFS Hyderabad, India. The paper gives a brief introduction on the containerisation, its growth, the dry port concept, the function and role of Container Freight Station, the current practices and operations in the CFS and identifies areas of improvement therein. It gives a historical overview of the CFS Hyderabad, the procedures that are followed at the CFS and at the gateway ports with respect to Import/Export cargoes. The application of the Radio Frequency Identification (RFID) technology in the yard is evaluated in the areas of Access Control; Container Security; Container Identification and Location and Activity Tracking to improve the visibility of operations. The report acknowledges the tangible benefits of use of RFID technology to improve the operational efficiency of CFS.

The CFS Hyderabad still uses traditional methods of record keeping and use of technology is very limited. Use of Computers is limited. It still uses traditional methods of files and manual entries for record keeping. An integrated approach is required to modernize the operations at the CFS and for CWC to become a holistic logistics service provider. Computerization of all documentation, record keeping and for clearances is required. E-payment channels have to be opened for payment of duties and charges. Electronic data interchange has to be enabled at the CFS. Improvement in efficiency/ responsiveness of logistics chain through adoption of new technologies such as RFID (radio-frequency id) tags, sensors etc. can improve the efficiency of the CFS in locating the containers and tracking of all movements. These recommendations would help Central Warehousing Corporation and CFS Kukatpally to improve the operational efficiency and productivity of the Container Freight Station and to take scientific warehousing and CFS operations to the next level as required by the demands of the times.

Key words: CFS, Hyderabad, RFID, Quantitative and Qualitative Analysis.

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LIST OF ABBREVIATIONS:

ICD	Inland Container Depot
CAGR	Container Average Growth Rate
CFS	Container Freight Station
CY	Container Yard
CWC	Central Warehousing Corporation
CONCOR	Container Corporation of India
NVOCC	Non Vessel Owning Container Carrier
RTG	Rubber tyred Gantry
RFID	Radio Frequency Identification
DGFT	Director General of Foreign Trade
CBEC	Central Board of Excise control
EIR	Equipment Interchange Receipt
TEU	Twenty Foot Equivalent Unit
FEU	Forty Foot Equivalent Unit

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Chapter 1 INTRODUCTION

1.1 Research Topic Source and Introduction

Shipping is truly the lynchpin of global economy and international trade. More than 90% of world merchandise trade is carried by sea and over 50% of that volume is containerised. In today's era of globalization, international trade has evolved to the level where almost no nation can be self-sufficient and global trade has fostered an interdependency and inter-connectivity between countries. Shipping has always provided the most cost-effective means of transportation over long distances and containerisation has played a crucial role in world maritime transport.

The CFS Hyderabad still uses traditional methods of record keeping and use of technology is very limited. Use of Computers is limited. It still uses traditional methods of files and manual entries for record keeping. An integrated approach is required to modernize the operations at the CFS and for CWC to become a holistic logistics service provider. Computerization of all documentation, record keeping and for clearances is required. E-payment channels have to be opened for payment of duties and charges. Electronic data interchange has to be enabled at the CFS. Improvement in efficiency/ responsiveness of logistics chain through adoption of new technologies such as RFID (radio-frequency id) tags, sensors etc. can improve the efficiency of the CFS in locating the containers and tracking of all movements. These recommendations would help Central Warehousing Corporation and CFS Kukatpally to improve the operational efficiency and productivity of the Container Freight Station and to take scientific warehousing and CFS operations to the next level as required by the demands of the times.

The Container Freight station is located in Hyderabad. It is the Capital city of the state of Andhra Pradesh, India. Greater Hyderabad has an estimated metropolitan population of 6.7 million, making it an A-1[1] status city and the second largest (in terms of area) in the country. It is also the sixth largest metropolitan area in India. Hyderabad is known for its rich history,

[1] The Status of Indian cities comprises two ranking systems used by the Government of India to allocate compensatory allowances to the cities in the country. With effect from 1st September 2007, Hyderabad is classified as 'A-1' class city for the purpose of House Rent Allowance/ Compensatory (City) Allowance to the Central Government employees. Source: Circular No: 17(68)/2005-E-II dated 10.10.2007 by "Council of Scientific & Industrial Research, India".

culture and architecture representing its unique character as a meeting point of North and South India, and its multilingual culture, both geographically and culturally. Hyderabad is today one of the most developed cities in the country and a modern hub of information technology, ITES and biotechnology. Situated on the Deccan Plateau, Hyderabad has an average elevation of about 500 meters above sea level (1640 feet).

The development of a township with state-of-the-art facilities called HITEC prompted several IT and ITES companies to set up operations in the city. An aggressive promotion of growth in this area has led civic boosters to call the city "Cyberabad[2]". Hyderabad has also been referred to as the second Silicon Valley of India next to Bangalore. There have been extensive investments in digital infrastructure within the city promoting the setting up of several campuses by a vast array of companies within the city. This list includes several multinational corporations having established their development centers in the city. Hyderabad is home to some of the best Fortune 500 Corporations.

All this development in the past decade has led to enormous growth across all sectors and therefore associated growth in consumer demand, better infrastructure etc. This phase has correspondingly seen higher container movement also.

The Hyderabad growth story also means higher trade and logistics need making scientific warehousing is a potential growth engine.

Container Freight Station, Kukatpally started functioning from 1998 with a capacity of 33713 MT including open storage. From April 2007 to March 2008, it has handled 13077 Teu's[3].

In order to improve the efficiency and provide better customer satisfaction, the CFS has to improve its present facilities and adopt new technological ways.

The network of the entire operations of the CFS is based upon the application of Radio Frequency Identification (RFID). The performances of RFID are evaluated in terms of reductions in Operation Timings and the Cost and Capital Recovery method for the investment. The example of CFS at Kukatpally, Hyderabad is used to illustrate the feasibility of the proposed model.

[2] The name Cyberabad comes from Information Technology word “Cyber” and the original name Hyderabad combined to form and now is known as “Cyberabad”.

[3] Information obtained from the internet website of Hyderabad CFS.

1.2 Literature Review

Studies include the Cost Benefit Analysis of Radio Frequency Identification (RFID) Implementation[4] at the Naval Postgraduate School's Dudley Knox Library by Tiu, Joel D. ;Bahk, Shawn S. The paper includes both the qualitative and Quantitative analysis for implementation of RFID in a Library.

The functions of RFID have been applied to warehouse operation (e.g. Anonymous, 2003a, 2003b, 2003c), supply chain management (e.g. Anonymous, 2002, 2003d; Brewer, Sloan, & Landers, 1999; DeLuca, 2003; Ka¨rkka¨inen, 2003; Roberti, 2003), bogus drug precaution and tracking (e.g. Cottrill, 2004; Greengard, 2003; O'Connor, 2005), and passengers' baggage delivery (e.g. Boyle, 2000; Croft, 2004a, 2004b; Farmer, 2004; Field, 2004; Pilling, 2004).

" Applying RFID to reduce delay in import cargo customs clearance process"[5] by Chaug-Ing Hsu *, Hsien-Hung Shih, Wei-Che Wang explores the customs clearance process of import cargos in international air cargo terminals, and constructs a network to analyze cargo, information and human flows in the import cargo process.

Various studies have been conducted on application of RFID in supply chain management, retail and hospitality services[6], logistics field, air terminals, highway transportation, library services and book dealers and their warehousing. Few studies have investigated the application of RFID in the container freight systems.

However, the functions of RFID may be utilized to overcome the difficulties involved in the import process, export process, empty container handling process and custom bonded operations which comprise of complicated procedures and various operation units, and improve cargo-handling efficiency. This study attempts to construct a network so as to explore the components and properties of the above indicated operations and formulate an analytical model for investigating the process-delay of cargos. Then, the network is

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[4] Information obtained from National Technical Information service, website:"http://handle.dtic.mil/100.2/ADA460461"

[5] Information obtained from: Hsu, C. -I. et al., Applying RFID to reduce delay in import cargo, Computers & Industrial Engineering (2008), doi:10.1016/j.cie.2008.02.003

[6] Zaragoza, S. 2005 "Tandy using RFID on Wal-Mart shipments", Dallas Business Journal February 11, http://www.bizjournals.com

reconstructed due to applying RFID technology, and used to evaluate the benefits of RFID in terms of reductions in Operation Times.

In order to show the feasibility of RFID implementation in the CFS, the financial analysis demonstrates the cost recovery methods assuming a certain loss of containers in a period of year and then estimating the Return on Investment, clearly identifies the need for a CFS like the Hyderabad CFS which still uses the traditional ways for various operations and activities to improve and use the latest technological methods already available in the market.

1.3 Research Content of This Dissertation

The objectives of the paper are

- Study the operations and Analyze the procedures at CFS Kukatpally, Hyderabad
- Conduct Process Improvements
- Evaluate process optimization by use of Radio Frequency Identification (RFID)
- Provide Recommendations to CWC for attaining higher operational efficiency

Radio Frequency Identification (RFID) systems have been successfully used in transportation and manufacturing since the mid-80s and its use is growing rapidly as costs come down and benefits are recognized. However its use in a port facility/ container yard is limited mainly because of the high initial costs involved and lack of awareness of its benefits in a container yard and warehouse. The primary advantage to RFID in a port/terminal application is that it is an ‘automatic’ data collection technology.

The two direct benefits of this are- Accurate and Complete data collection and better utilization of employee’s time. In addition, security measures can be significantly enhanced through the use of RFID. The report makes a cost benefit analysis of the RFID implementation using semi active RFID tags and its return on investment and other tangible benefits.

The author does the analysis in 2 parts:
1. Analyze the work flow of various operations at CFS Kukatpally, Hyderabad
First of all, the paper analyzes layout and cargo-handling technology of the container freight station, equipment and operational characteristics. Especially pay attention on Import and export process.

2. An object oriented model of the study on CFS is done as follows:

- Understanding the operational aspects and their performances of CFS Kukatpally, Hyderabad.
- Performing the Qualitative[7] and Quantitative[8] Analysis for the implementation of RFID in the CFS.

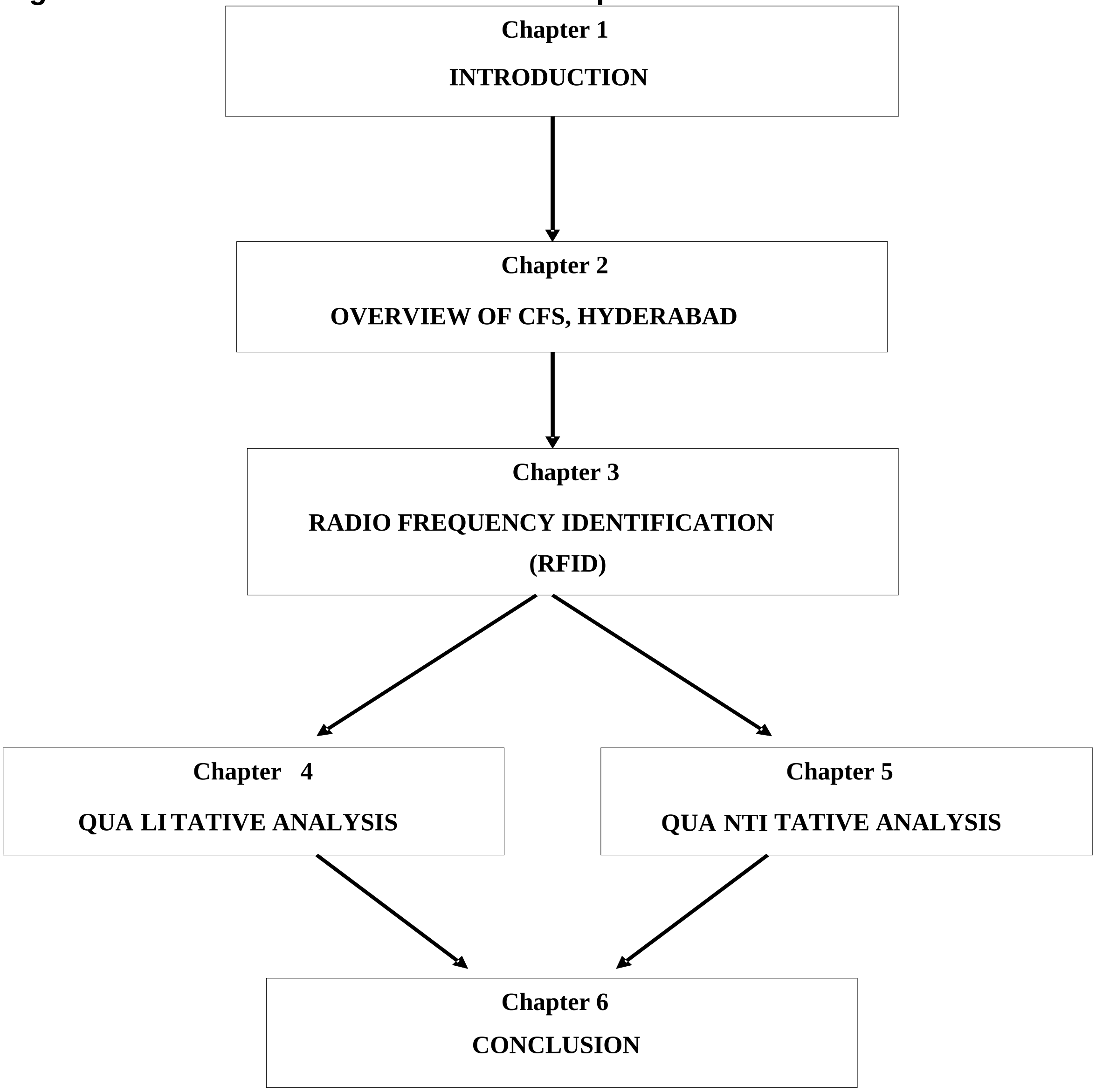
1.4 Organization & Structure of the Dissertation

The organization of this dissertation is as follows. Chapter 1 is the introduction of the thesis where the Research topic source .literature review on Hyderabad CFS, research objectives, methods and creative points are covered. Chapter 2 highlights the Overview of Hyderabad CFS, a short description of CWC, Traffic flows, the layout of facilities and the equipment presently available. Chapter 3 gives the description of the Radio Frequency Identification (RFID), technology overview and the ways of implementation in the CFS. In Chapter 4 the author makes an analysis which is Qualitative and describes the various operations presently going on. RFID operating plan is incorporated so as to make the RFID implementation feasible. Chapter 5 deals with the Quantitative analysis in which the author makes use of Monte Carlo Simulation Technique and drives the ROI and presents the feasibility for RFID implementation in the CFS. Finally, chapter 6 gives the conclusions that have been derived from the research and also recommendations which the author wish to recommend to CWC for improvement of CFS.

[7] Qualitative analysis is done using the Flow Chart and Graphical Analysis

[8] Quantitative analysis is done using the Monte Carlo Simulation technique and predicting the ROI assuming the certain number of loss of containers annually.

Figure 1.4.1: Structure of the Research Paper



Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008)

Chapter 2 OVERVIEW OF CFS, HYDERABAD

2.1 Introduction of Central Warehousing Corporation

Central Warehousing Corporation (A Government of India Undertaking)[9] is a Public Sector Undertaking of Department of Food under the Ministry of Food & Consumer Affairs. It has its Corporate Office at New Delhi with 16 Regional Offices and 502 Warehouses spread all over the country.

Central Warehousing Corporation is a Schedule 'B', Category I public sector having largest warehousing network under single management.

• It operates 515 warehouses with storage capacity of 10.3 million MT.
• It operates 30 CFS/ICD to help import export trade of the country.
• The bonded warehousing facility at 83 locations in ports and ICD is its forte.

The Central Warehousing Corporation is committed to build and pursue to provide Scientific Storage Facility for more than 400 commodities. CWC's 6600 trained personnel offer top of the line storage facilities for all notified commodities including sensitive perishables through Temperature Controlled Warehouses, Liquid Storage and Custom Bonded Warehouses. The Corporation has devised and implemented Customer Friendly Systems & Procedures to ensure cost effectiveness of operations by adopting latest technology and optimum utilization of resources with an objective to encourage innovative and good performance at all levels and develop team spirit with sense of belongingness amongst all employees.

The objective of the Corporation also ensures that not only technical quality and services achieved but also the services delivered in a speedy courteous and friendly manner. CWC had envisaged the problems in the movement of imported and exportable goods to and from the

[9] CWC-Container Warehousing Corporation is a Government of India undertaking organization and has the largest warehousing network in India. CWC provides warehousing services for a wide range of products ranging from agricultural produce to sophisticated industrial products. Information obtained from http://www.cewacor.nic.in.

port towns and transcended the hurdles by developing an extensive infrastructure of Container Freight Stations & Inland Clearance Depots throughout the country. Today CWC operates 33 CFSs/ ICDs where composite services for containerized movement of import/export cargo are provided.

Container traffic flow of India

figures in 000's Teu's

YEAR	IMPORT	EXPORT	TOTAL
1993-1994	5396	6853	12249
1994-1995	7196	8162	15358
1995-1996	8113	9505	17618
1996-1997	9109	11481	20590
1997-1998	10488	12632	23120
1998-1999	11699	12083	23782
1999-2000	13611	14079	27690
2000-2001	15621	16601	32222
2001-2002	17938	19291	37229
2002-2003	19949	23723	43672
2003-2004	23866	27136	51002
2004-2005	26653	28108	54761
2005-2006	29757	29970	59727
2006-2007	31951	32655	64606

Table 2.1.1: Container Traffic flow of India
(Source: Information collected from internet websitehttp://www.ipa.nic.in/oper.htm)

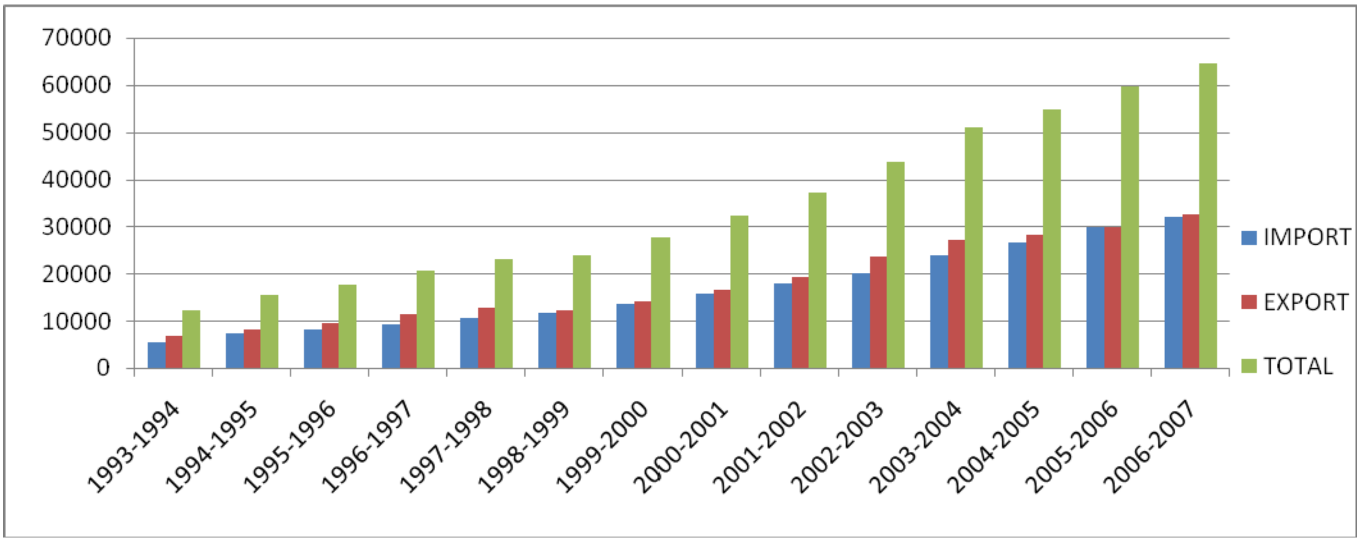


Figure 2.1.1: Container Traffic flow of India

Source: Graphical presentation made by the author on information from the numerical data obtained from internet: http://hyderabadcustoms.ap.nic.in/customs/asp/cwc.asp

2.2 Introduction of CFS at Kukatpally, Hyderabad

The CFS, Hyderabad was set up on 27.11.1990 with a view to extend port facilities right at the door step of exporters and importers of Hyderabad and industries around it. Initially the movement of Import and Export Containers was handled both by Rail and Road movement by Container Corporation of India Ltd. and was restricted only to rail as per the customs notification dated 18-01-1991. Subsequently, in view of representations from Importers, Exporters, Liners and CONCOR[10], the movement of containers by Road between gateway port to ICD Hyderabad and vice versa was permitted by road through Concor vide public notice dated 27-07-1995.

By 1998, the entire movement of containers by road and rail from gateway ports to the ICD Hyderabad was being done through CONCOR and the CFS managed by CWC was appointed as custodians of imported goods while CONCOR was permitted to deal with Export cargo. CFS at Sanathnagar managed by CWC was only handling Import cargo and the movement of containers was through ICD Sanathnagar. Taking into consideration the on growing traffic of both import and export cargo at Hyderabad and in line with the Ministry's open up policy,

[10] Container Corporation of India Ltd. (CONCOR) was incorporated in March 1988 under the Companies Act, and commenced operation from November 1989 taking over the existing network of 7 ICDs from the Indian Railways. CONCOR website: "http://www.concorindia.com."

CWC represented for expansion of their operations in Export side also as they received lot of representation from Trade, Shipping Lines etc.

In view of various representations from Trade and Industry, Shipping lines and taking into consideration of great demand for containerization at Hyderabad, CWC requested Customs to permit for setting up a fully fledged CFS at Kukatpally by proving all modern infrastructure and equipment facilities. Subsequently, the Commissioner of Customs Hyderabad felt the need for creation of such CFS and declared the entire area of CWC complex at Kukatpally as customs area for the purpose of CFS to handle both Import and Export cargo and movement of containers by rail through ICD Hyderabad and by Road directly from gateway ports and vice versa to CFS. Since then, the CWC started acting as custodians of the import and export goods at CFS Kukatpally. However, the movement of loaded containers as well as empties by rail from the gateway ports to ICD Hyderabad and vice versa continues to be undertaken by CONCOR only.

In case of containers with import cargo received by rail at ICD Hyderabad, the importer can clear the same from the CFS Kukatpally. Therefore it is mandatory on part of CONCOR to lift on the containers to the trailers placed by the CFS Authorities at CONCOR for movement from ICD to CFS Kukatpally within reasonable time of two hours from the time of placement of CFS trailers at the ICD for the purpose of movement of Import Cargo.

The CONCOR is responsible for the imported good till such time they are properly handed over to CWC in respect of containers moved by rail. In case of containers with Import Cargo by road, CWC takes over the sealed containers from gateway ports after obtaining the written consent of the importer for moving the same from gateway ports to CFS, Kukatpally directly by road and CWC is responsible for safe custody of such Imported Container received from gateway ports till clearance of cargo to Importers at CFS Kukatpally. CWC is alone held responsible for any revenue implications arising on account of loss, pilferage and damage during transit period, if any on such imported goods.

The CWC, in case of containers moved from ICD Sanathnagar as Custodians is responsible for safe custody of Imported Goods from the time of taking over the same from CONCOR till the goods are cleared for home consumption or for warehousing after duly passed (Out of Charge) by customs Authorities.

For export goods, CONCOR is responsible for transportation of export containers by rail / road based upon exporters option, timely availability of rake etc and CWC is allowed to export containers with export cargo directly by road as per the request of exporter. CWC is responsible for the receipt, storage and handling of Export Goods at CFS and make arrangements for customs examinations/ inspections etc. Such export goods for which Customs give “Let Export” after examination of the goods shall be stuffed into the export containers under customs supervision and CWC will act as custodians till the goods are stuffed and cleared by road to the gateway ports. In respect of Export containers to be moved by rail, CWC is responsible for export goods till the containers are handed over to CONCOR, Sanathnagar. Once the export containers pertaining to rail movement are handed over to ICD, CONCOR is responsible for the safe custody of export goods/ containers.

However in respect of export containers by road movement, CWC is responsible for the safe delivery of stuffed container at gateway ports. It is also mandatory on part of Concor to lift-off the export loaded containers from the trailers brought by CWC to ICD within reasonable time of two hours for onward dispatch by next immediate available container rake to gateway ports.

2.3 Traffic flow at CFS, Kukatpally, Hyderabad

Container Freight Station, Kukatpally started functioning from 1998 with a capacity of 33713 MT including open storage. From April 2007 to March 2008, it has handled 13077 Teu’s.

Table 2.3.1 : Yearly Container flow at Hyderabad CFS.

YEAR	TOTAL TEU'S
1998-1999	3628
1999-2000	5326
2000-2001	5080
2001-2002	4807
2002-2003	6069
2003-2004	7567
2004-2005	9923
2005-2006	10896
2006-2007	11302

2007-2008	13077

Source: Information obtained from the official website of Hyderabad customs. http://hyderabadcustoms.ap.nic.in/customs/asp/cwc.asp

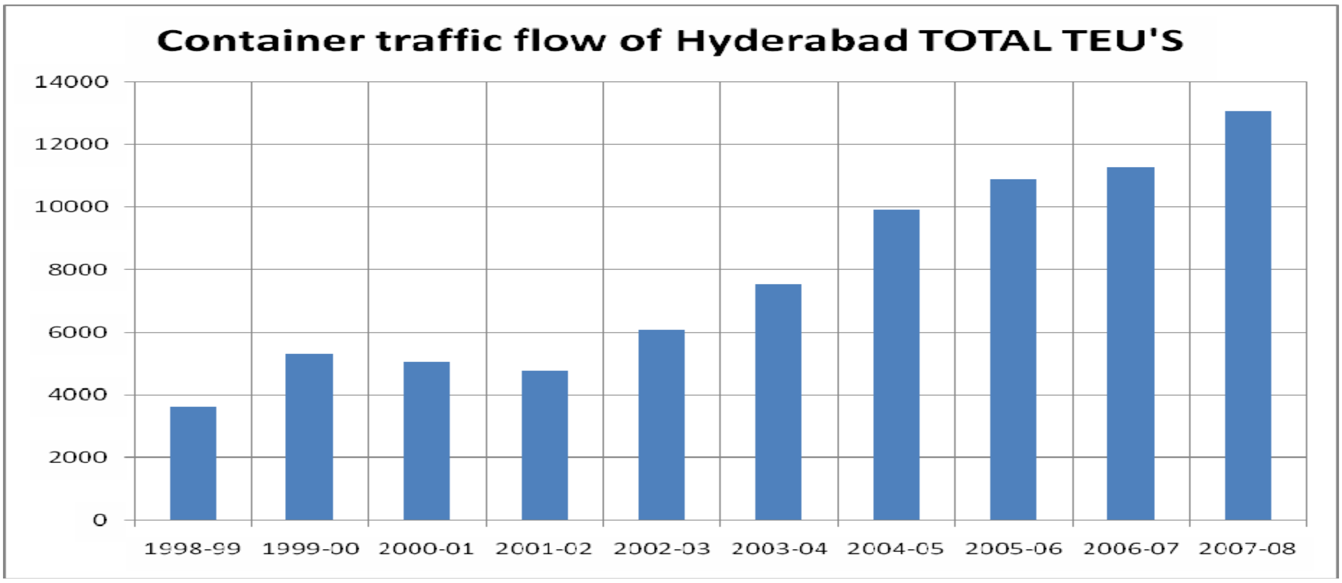


Figure 2.3.1 Container flow at CFS, Hyderabad

Source: Graphical presentation made by the author on information from the numerical data obtained from internet: http://hyderabadcustoms.ap.nic.in/customs/asp/cwc.asp

2.4 Lay out of facilities at CFS, Kukatpally

The following[11] are available at CFS, Kukatpally Hyderabad.

1 (i) Covered CFS Area 2758 Sq. Mtrs.

(ii) Container Parking yard 9300 Sq. Mtrs.

(iii) Covered Bonded Area 3863 Sq. Mtrs.

(iv) Open Bonded Area import 2835 Sq. Mtrs

2 Covered & open bonded area for import Cargo facility clearance on deferred payment of custom duty.

3 Telephone / Fax Facility Available.

4 Free parking of empty containers up to 30 days.

5 Transportation loaded export / import containers to gateway ports & vice versa.

6 Trained personal for clearance of import I export cargo.

[11] Information obtained from the real observation and from the internet source: http://hyderabadcustoms.ap.nic.in/customs/asp/cwc.asp

7 Office of the Asst. Commissioner of Customs available in the premises.

8 Necessary infrastructure facilities like cranes, forklifts, trucks are available for handling the cargo containers, available by appointing H&T contractor.

9 LCL Import Cargo/ Handling Facility from CFS Virugambakam to CFS Hyderabad.

10 Four days free time allowed for import / export containers for destuffing/stuffing.

11 Stuffing /destuffing of export / import cargo and inventory.

The CFS Entrance and Gatehouse

A CFS entrance and gatehouse corresponds with the main CFS terminal entrance/gate. The entrance is staffed with security personnel to control access to the CFS. The entrance contains a gatehouse or cabin for security.

The Road Vehicle Parking Area

The vehicle parking area is located between the gate and the administrative office. Vehicles are parked here while drivers, CHA's register at CFS reception for instructions to the appointed loading or unloading position. Access routes for road vehicles are separated from routes for terminal transport. This is accomplished by keeping each group of traffic to one side of the CFS. There is an additional parking area set aside for private vehicles.

The Reception and Administrative Office

The reception office is where CHA's present their documents and to receive directions on where to go. It is located at one end of the storage building along with managerial, supervisory and clerical staff offices. The CFS also provides office space for customs staff. The proximity of the offices allows convenient communication between the various parties involved in CFS operation and administration.

The Open Storage and Operational Area

An open yard takes up a significant portion of the CFS.
It serves several CFS functions[12]:

- It provides storage space for various types of cargo: for packages too large to be stored in the shed, for those that are difficult to handle without special equipment, for some dangerous cargoes and for bulk and dirty cargoes. The areas are marked out and labeled clearly so that records can be kept of where each consignment of cargo is being stored.
- In a convenient part of this area there is a sort of be a fixed ramp, to allow lift-trucks and other equipment to pack the cargoes into, or unpack them from, containers on

[12] The author explains the facilities available at the CFS

trailers or chassis. The ramp also permits cars or other wheeled vehicles to be driven into containers for loading aboard ship in this protected form, and to be unloaded from import containers.

- The open yard also has some space set aside for the temporary storage of containers – empty boxes waiting to be packed or to be returned to the terminal's empties stacks, and possibly full containers waiting unpacking or transfer to the export stacks.
- There is also be space for parking trailers used to transfer containers between the container yard and the CFS, and for the loading of out-of-gauge cargoes onto (and unloading them from) platforms and flat racks; this terminal service is often provided by the CFS.

The Storage Shed (GODOWNS[13])

The storage shed is the predominant CFS facility. Cargoes are temporarily warehoused here while they wait for onward transport. The roof is made of asbestos thereby avoiding the need for many pillars, which impede the storage area beneath it. The roof overhangs the sides and possibly the ends. This serves to provide protection for workers and cargo against weather in transfer operations. Each bay is numbered clearly and bays are provided along one end of the shed to accommodate any unloading.

Inside the shed, the majority of the floor area is dedicated to cargo storage. Storage blocks are indicated by painted lines and numbered or lettered markings on the walls of the warehouse. The common element is that the dimensions of each block tend to be related directly to the dimensions of a standard pallet – 1000 mm x 1200 mm. The blocks are separated by aisle ways and a main aisle way runs the length of the shed, splitting each block in half.

Operationally, there are five godowns each designated for different purpose and activities as follows:

- Loading of export cargoes
- Unloading of import cargoes
- Unpacking of import cargoes
- Packing of export cargoes.

There are also specific areas of the shed allocated for: the storage of dangerous cargoes, bonded and secure locker for high value goods, storage of damaged packages or inadequately packaged cargo, storage of goods requiring customs examination.

[13] A godown is a name used in same relation to that of the warehouse.(Godown = Warehouse)

Safety features required by the shed include: adequate lighting, clearly marked pedestrian walkways throughout the storage area. Fire extinguishers and sand buckets are kept at the entrances to the warehouses.

2.5 Equipment in Use[14]

The following equipment is presently used for CFS activities:

- 40 Tonne Kalmar 40 Tons 01 no
- 3 tonne capacity forklift trucks 04 no's
- 5 tonne capacity forklift trucks 01 no
- 8 tonne capacity forklift trucks 01 no
- 12 Tonne Skard (Hydra)
- Tractor-trailer sets
- Packing and securing materials (pallets, dunnage, wire and webbing, wood, etc.)
- Hand and power tools.

[15]**Figure 2.5.1: 40 Tons SWL Kalmar**

Figure 2.5.2: 12 Tons Hydra

[14] Information obtained from actual observation at the CFS.

[15] The photographs were taken on obtaining permission from the CFS Manager Mr. E. Krishna Murthy.

Figure 2.5.3: Forklift in Operation

Figure 2.5.4: 5 Tons Forklift

Chapter 3 RADIO FREQUENCY IDENTIFICATION (RFID)

3.1 Introduction

Radio frequency (RF) refers to electromagnetic waves that have a wavelength suited for use in radio communication. Radio waves are classified by their frequencies, which are expressed in kilohertz, megahertz, or gigahertz. Radio frequencies range from very low frequency (VLF), which has a range of 10 to 30 kHz, to extremely high frequency (EHF), which has a range of 30 to 300 GHz. RFID is a flexible technology that is convenient, easy to use, and well suited for automatic operation. It combines advantages not available with other identification technologies. RFID can be supplied as read-only or read / write, does not require contact or line-of-sight to operate, can function under a variety of environmental conditions, and provides a high level of data integrity. In addition, because the technology is difficult to counterfeit, RFID provides a high level of security.

RFID is similar in concept to bar coding. Bar code systems use a reader and coded labels that are attached to an item, whereas RFID uses a reader and special RFID devices that are attached to an item. Bar code uses optical signals to transfer information from the label to the reader; RFID uses RF signals to transfer information from the RFID device to the reader. Radio waves transfer data between an item to which an RFID device is attached and an RFID reader. The device can contain data about the item, such as what the item is, what time the device travelled through a certain zone, perhaps even a parameter such as temperature. RFID devices, such as a tag or label, can be attached to virtually anything – from a vehicle to a pallet of merchandise. RFID technology uses frequencies within the range of 50 kHz to 2.5 GHz.

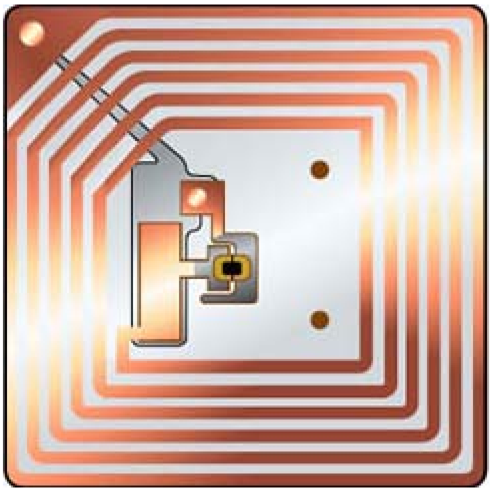


Figure 3.1.1: RFID
Source: Downloaded from internet website: www.micromata.com, 2004 Micromata Objects GmbH.

An RFID system typically includes the following components:

- An RFID device (transponder or tag) that contains data about an item
- An antenna used to transmit the RF signals between the reader and the RFID device
- An RF transceiver that generates the RF signals
- A reader that receives RF transmissions from an RFID device and passes the data to a host system for processing. In addition to this basic RFID equipment, an RFID system includes application-specific software.

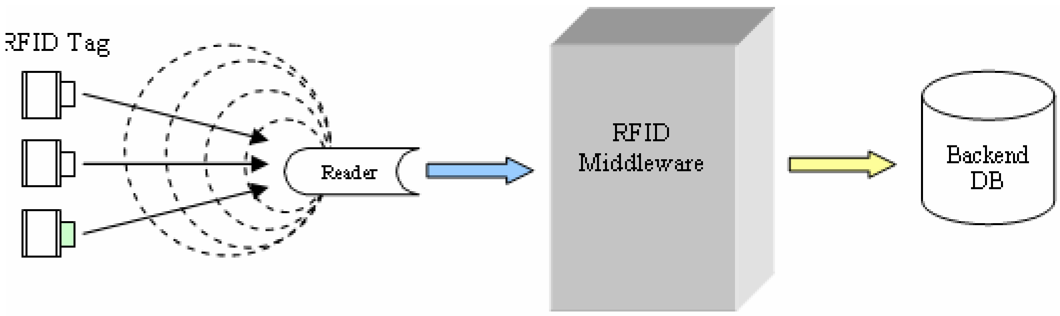


Figure 3.1.2: Typical RFID System Components
Source: Figure obtained from internet sources

RFID has a long history. It is only now becoming a major force in industry, with associated standards bodies and technology advancements.

The basic components[16] of any RFID system include:

[16] Information collected from various sources on internet and from books and Author after making a study on the RIFD working system, has written specifically required for the topic of the paper. References and List of Books as mentioned in the end chapter of List of References.

Tags

Also called *transponders*, these can be either active with their own means of sending a signal, or passive, relying upon the tag reader to provide the power necessary to generate the response signal. The signal could be a simple identification number stored in a read-only tag or a complex data stream that includes additional data stored within the tag's memory. These more complex tags could contain such data items as manufacture date, lot number, serial number, or even built-in sensors to track average storage temperatures or other data. Components of Tag

- ➢ Microchip
- ➢ Antenna

There are two types of tags

1. Passive tags
2. Active tags

Passive Tags

- No power
- Activated in presence of the reader's radio waves.
- No moving parts – long life
- Can survive Harsh Environment
- Smaller in size
- Cheaper

Active Tags

- Onboard Power Supply: battery
- Other items – processors, i/o
- Ports
- Larger in size
- Comparatively Expensive

Antenna

Each RFID system includes at least one antenna to transmit and receive the RF signals. In some systems, a single antenna transmits and receives the signals; in other systems, one antenna transmits and one antenna receives the signals. The quantity and type of antennas used depend on the application.

Readers

Also called interrogators, come in various configurations depending on the location, environment, and scanning area coverage required. A reader is used to identify all tags within its reception coverage area. Readers require some intelligence for aggregating and smoothing the tag data.

Components of Reader

- Transmitter & Receiver
- Microprocessor
- Memory
- IO Channels
- Communication Interface
- Power

The RFID reader directs the RF transceiver to transmit RF signals, receives the encoded signal from the tag through the RF transceiver, decodes the tag's identification, and transmits the identification with any other data from the tag to the host computer.

3.2 RFID Technology Overview

RFID technologies range from Very Short Range Passive RFID, Short Range Passive RFID, Active Beacon, Two-way Active, and Real-time Locating Systems (RTLS). Low-frequency (30 KHz to 500 KHz) systems have short reading range and are commonly used in asset tracking and security access implementations. High frequency (850 MHz to 950 MHz and 2.4 GHz to 2.5 GHz) systems, offer long read ranges (greater than 90 feet) and high reading speeds. The range of frequencies and their general distance ranges are noted below. An RFID tag (transponder) comprises a tiny integrated circuit (IC) microchip, no larger than a grain of sand attached to an antenna that is typically printed or etched n a plastic sheet known as an insert. Data is stored on the microchip and transmitted via the antenna. RFID chip is either passive (No battery) or active (battery powered) and data transmission speed and range depending on the radio frequency, antenna size, power output, and level of any local radio frequency interference.

Tags can be read only, read write, or a combination of both where some memory provides permanent data storage (e.g. a product serial number) while later memory is available for updating later during tracking and identification operations. Information is sent to and read from RFID tags using Radio Frequency signals. With passive tags, a reader (also known as interrogators as it is capable of both read and write operations) wakes up the tag by transmitting radio waves that provide the power to enable the tag to transmit or store new data. In an active tag, the battery powers the microchip and boosts the RF signal to increase the effective operating range to 30 meters or more. Some active tags also transmit signal periodically so that readers distributed throughout the facility can capture data. Special data transmission protocols and encryption algorithms are used to ensure integrity and security of the data transmitted between the tag and the reader.

RFID readers can be integrated into handheld terminals or located at fixed strategic positions such as entrances, dock doors, or at different points on an assembly line.

3.3 Reading RFID tags in a warehouse

The readers include a processor for reading the signals from the tags and an antenna for transmitting and receiving signals. The reader then transfers the collected data via wired or wireless Local Area Network (LAN) to the host computer systems.

RFID tags can be read through packaging, shipping containers and most materials except metals. Unlike barcodes[17], a single reader can read tens of RFID tags in milliseconds. This, coupled with ability to read and write tags through packaging materials, makes RFID highly suitable for unattended identification and tracking of the contents of the pallets, transit containers and the items inside them also. RFID device that actively transmits to a reader is termed an “active” tag; an RFID device that only reflects or backscatters transmission from a reader is termed “passive.” The tags are programmed with data that identifies the item to which the tag is attached. Tags can be either read -only, volatile read/write, or write one/read many (WORM) and can be either active or passive. In general, active tags use batteries to power the tag transmitter (radio) and receiver. These tags usually contain a greater number of components than do passive tags. Therefore, active tags are usually larger in size and are more expensive than passive tags. In addition, the life of an active tag is directly related to battery life.

Passive tags can be either battery or non-battery operated, as determined by the intended applications. Passive tags reflect the RF signal transmitted to them from a reader or

[17] Barcodes technology system is widely used in the Supply Chain Management. RFID tags can be read at greater distances; an RFID reader can pull information from a tag at distances up to 300 feet. The range to read a barcode is much less, typically no more than fifteen feet. Barcodes have no read/write capability.

transceiver and add information by modulating the reflected signal. A passive tag does not use a battery to boost the energy of the reflected signal. A passive tag may use a battery to maintain memory in the tag or power the electronics that enable the tag to modulate the reflected signal.

3.4 RFID Implementation in the CFS

To make the CFS RFID enabled, the RFID system will have to be installed which would include RFID readers, antennas, tags, processors, a wireless tag locator and a computer network system. All cargo/containers will be tagged with advanced RF enabled sensors (Tag) when they enter the Gate of the Container Freight Station.

The CFS boundary is implanted with RF based radio beckons (Location Antenna), which can read/write to the container tags, to uniquely locate their position in two dimensional plane. Hence, a portable metal-detector can pinpoint the location of the cargo/container in a two dimensional plane.

To map a plan[18] with RFID technology in the CFS, the author has used the following:

Tag, Antenna, Communicator card and Processor.

Figure 3.4.1: RFID PLAN

Source: Figures obtained from internet sources

Apart from the above, we need a wireless mobile Tag locator, and a handheld wireless computer to read/write to the tags.

[18] Figures obtained from sources on internet.

Figure 3.4.2: Handled Device

Figure 3.4.3: Mobile Locator

Mobile locator Handheld All containers are ***tagged*** with advanced RF enabled sensors (Tag) when they enter the Container Freight Station. The CFS boundary is implanted with RF based radio beckons (Location Antenna), which can read/write to the container tags, to uniquely locate their position in two-dimensional plane.

In mapping a RFID system in the Container Freight Station, there were two factors that I kept in mind. First, the system should automatically account for the pool of containers in the container yard. A secondary consideration was the reduction of the total pool of assets as a result of the new visibility and a reduction of labor associated with the automatic management of the container pool.

An analysis of the return on investment (ROI) was made to assess the financial and strategic impact of implementing RFID.

As described earlier, there are a variety of Tags available in the market depending on the purpose of each. For implementing RFID in the yard, the author chooses the semi-active RFID Tag because the tags could be automatically activated at the entry\exit points. The

battery-powered semi-active tags provide highly reliable tag reads off the metal container surface.
A network based reader infrastructure is to be installed with a enterprise application tracking software. This will enable the end user to integrate the data seamlessly with the inventory accounting system. This is designed to manage multiple container locations, enabling access from multiple sites.

The case includes around 1000 containers a month in the CFS facility with one entry/exit point. The average container (replacement) cost is $2,500 each. The system design includes two RFID network connected receivers and two "on demand" tag activation equipment installations at entry/exit point and in the yard for trucks. The software package automatically logs all the containers coming and going and delivers the data to the enterprise application. As a standalone, it provides time (or dwell) measurements, map-based location illustrations, alerting, and customer designed reports as needed.

The pricing of the system includes a total infrastructure cost of [19]Rs 24, 000, 00. Individual metal mount capable RFID asset tags are priced at Rs 950 each. The total capital cost of the entire system including installation and software on a per tag basis came to Rs 1200 each.

This overall measure pinpoints the total cost of ownership and was useful in normalizing competing architectures to the average total cost per tag including all aspects of the system. The highly conservative base case analysis showed a positive financial return (or ROI) for the capital purchase of a system capable of delivering (dynamically) an automatic asset inventory, facility location determination, and full asset management. The only savings assumption made in the base case was in the reduction of lost or missing containers by 1% (or 10) in total per year.

These containers are typically lost through leakage to other companies, sub-pooled out and not retrievable. Often times they remain at a customer location for an extended period. Typically, industry statistics for asset shrinkage are 2% of the total base per year. While the system can also automatically track-back damaged containers to the customer, no cash recovery was assumed in the analysis.

[19] 1 USD=40 INR

Also, although the system automatically calculates the time the customer has possession of the container (dwell), no late fees or monthly rental is included in the analysis. No labor savings are included in the base case. No assumptions are made for accurately tracking containers for mandated inspections. Finally, no assumption was made for reducing the total asset pool based upon the new asset visibility. Prior to the RFID implementation, no visibility existed.

The analysis returned an internal rate of return (IRR) for the savings, a 30 month payback for the system, and over Rs 704000 in net present value savings. Therefore, for a closed loop re-usable container management solution, a semi-active RFID system for automatically inventorying, locating, and managing containers proved to be financially viable.

The conclusion is that there is an immediate ROI and solid business case for using semi-active RFID for automatically counting, locating, and managing a pool of container assets. The new found visibility will also open up the opportunity to recover monies for damaged containers. The other new opportunity provided by RFID was the potential to charge customers late fees for overdue containers and even charge rent for containers in use.

Background

The CFS facility here is in the business of delivering export\import goods through containers throughout region. Containers travel to the customer's location and sit until emptied and then until picked up when the next order arrives. Without automated tracking, no visibility into the container pool existed. Frequently, containers would be returned late or not at all. And, damaged containers could not be traced to a customer. No easy way existed to identify containers needing periodic inspection to satisfy regulations. The multi-ton metal flow bin containers cost an average of $2,500 each and with a total of 13000 containers per year; the business issue warranted finding a solution for tracking and tracing.

The concept is to tag the containers and automatically identify them as they leave and enter the facility. The basic expectation is to improve the visibility with the dynamic location visibility and dwell calculations available from the software, late or missing containers could be addressed. The portfolio of published cases[20] to date were RFID solutions delivered

[20] Cases include:

savings for a stock of assets shows a range of from 2% to 44%. The savings in the cases consistently considered the elimination of shrinkage and the reduction in the pool of assets based on improved visibility and efficiency.

System Considerations

The size, content, working environment and logistics of the containers demand battery powered RFID tags. Passive tags placed on metal containers are unreliable, their transmit range too short (only a few feet at best), and the typical passive portal reader infrastructure required at vehicle gates are obtrusive and prone to frequent damage. Active-only tags which transmit on a beacon or regular basis are unacceptable for gate control, and waste their signal and therefore battery life while constantly transmitting. A semi-active operation was chosen because tags could be awakened only upon exit and entry using activator electronics. The semi-active tags are to be affixed to the metal containers and operated successfully. And, the rugged semi-active tags are known to be durable enough to withstand heavy heat, dust and cleaning for regular re-use.

The System Design

The system design includes two receivers placed at the truck entry/exit gate and in the yard. Tag activators with road loop antennas should be placed at the entry/exit points to awaken or interrogate the tags as they approach the gate and every time the information is needed. Each tag is enrolled in the system and its ID linked in the database to each unique container. Each tag activates and transmits its unique ID to the receiver. Tag data is sent over the IP network and collected in the online software database.

Software

1. The ROI for Automatic Container Tracking Using RFID: a Case Study analysis based on Re-usable Intermediate Bulk Containers. “www.axcessinc.com.”
2. Simplification of Real-time Location Systems Using the Radio Frequency Identification Integration Platform “http://www.lrni.com”
3. Hsu, C. -I. et al., Applying RFID to reduce delay in import cargo ..., Computers & Industrial Engineering (2008), doi:10.1016/j.cie.2008.02.003

There are different types of Software available and each is slightly different depending on the manufacturer. But essentially each one of it is a browser-based, enterprise software application which uses a powerful middleware engine to process the tag reads based on pre-defined user rules.

Tags are enrolled in the software which can include unique historical data and schedules for inspections. Tag data is collected and presented as read on a screen when logged. The software is easily interfaced to direct tag reads to the enterprise inventory system at the database level, thereby improving the utility of the enterprise system.

The software is also available to users at multiple sites and able to track containers at multiple sites. Tag reads are also filtered against the pre-defined rule base for alarming. Alarms or exception reporting can include emails or wireless messages to address a particular condition such as a scheduled inspection, a late arrival, or a damaged container. Queries are supported by location and by tag ID. Dwell times are available by tag ID. Automatic and dynamic inventory counts are managed and optionally available for display on the user configurable browser dashboard.

Any given tag ID can be drilled down on for data on the container, its location, and its history. Aggregate reports are available on-demand for containers (by type) and locations. Location queries include desk top visual map identification with optional tracing of previous locations for tagged containers. Also available in the system is an integrated digital video storage capability automatically linked to each tag read. By clicking the tag transaction, stored digital video of the tag event such as the container's entry or exit is displayed. This is particularly useful for recording evidence of damaged containers.

Chapter 4 QUALITATIVE ANALYSIS FOR RFID IMPLEMENTATION

4.1 Introduction[21]

The Qualitative Analysis made by the author illustrates the Time Allocation methods for various operations involved in the CFS Hyderabad.

It is important to have CFS operations carried out quickly and accurately since poor operating practices can result in problems of access to consignments, delays in identifying cargo, slow handling rates, storage congestion and damage to goods. Handling and movement of containers in the CFS has been sub contracted[22] to Lirin Roadways, Mumbai on competitive bids.

The activities are as categorized as follows:

1. Import Operations
2. Export Operations
3. Empty Container Handling Operations
4. Custom Bonded Operations

The Qualitative Analysis made by the author reflects the various aspects of time necessary for these operations and the advantages and shows the reduction of time upon successful implementation of the RFID system.

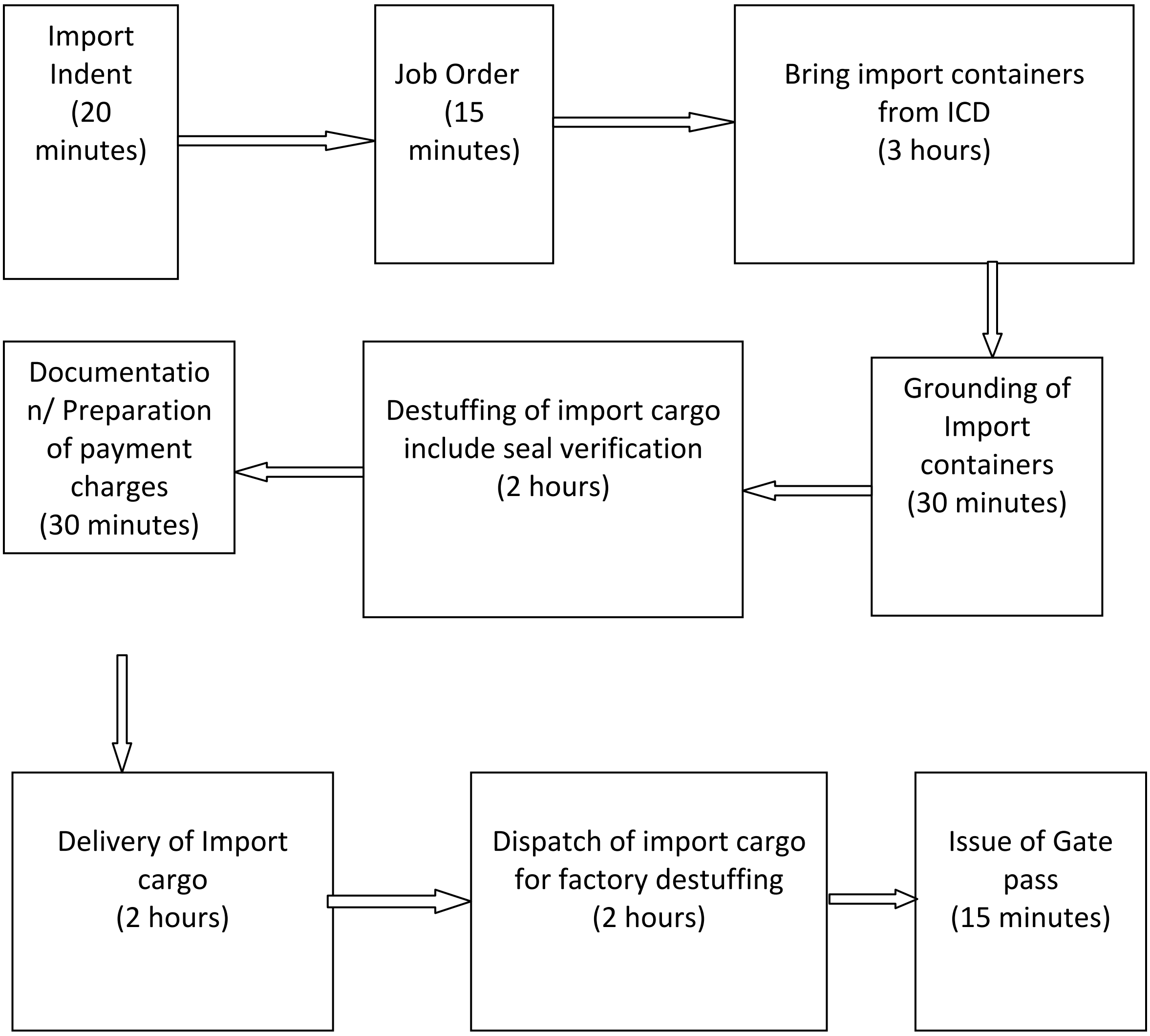
The detail of the RFID implementation and the operating is further explained after the initial study of the present time allocation methods for various operations.

[21] The Qualitative Analysis described by the author is based on actual study and information obtained directly from the Hyderabad CFS internal sources and additional information obtained by observation from author's friends at the CFS.

[22] Information obtained from internal sources of Hyderabad CFS.

4.2 Import Operations

Figure 4.2.1: Flow Chart of the Present Time Allocation for Import Operations



Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

There are a number of steps that are involved in the handling of inbound cargoes. These include the following steps.

1. Preliminary and planning processes
2. Receipt of loaded container from the container yard
3. Unpacking and storage of cargo packages in the CFS
4. Return of the empty container to the container yard
5. Collection procedures for discharge of inbound cargo to road vehicles

1. Preliminary and Planning Processes

The CFS usually is notified of the need to unpack containers before the delivery of the containers to the container yard, usually by the multimodal transport operator or its agent by way of an LCL list. This provides an indication of the likely workload, subject to any last minute changes. Finally, the multimodal transport operator sends a formal “request to unpack” by a particular date and this request lists information for each container including: the container ID code; the door seal number; the name of the vessel bringing the container; details to the unpacking (full or partial); and any special handling instructions. A container packing list for each listed container comes together with the request to unpack. Once this information is received by the CFS, an import consignment record is created for each cargo consignment listed. This process allows the CFS planners to use the storage plan to allocate the storage space and subsequently assign the appropriate bay for unloading. In addition, staff and equipment resources can also be allocated at this stage, albeit on a provisional basis only.

2. Receipt of Loaded Container from the Container Yard

The next stage of the process begins with a service request sent by the CHA through the CFS to the container terminal. The purpose of this request is to direct the ICD to move the container from yard storage to the CFS. The terminal schedules the move and then forwards the schedule to the CFS office. The CFS planners then are in a position to confirm their conditional allocations of bays, resources and storage locations.

Next, the CFS office staff updates the inbound register and prepares work orders for the gangs to unpack the containers and tally lists for the tally clerks checking the work. The documents provide details as to the unpacking operation as well as the details of the consignment for checking purposes. Next, the control room organizes the delivery of the container to the CFS. The associated work orders are given to the HTC foremen and labor is organized with the appropriate gear, equipment and materials. Tally lists are issued to the appropriate tally clerks. Once the container is landed safely at the appropriate unloading bay, the CFS supervisor checks the container for signs of damage and the door seal is inspected to ensure a match and that no tampering has been attempted. Finally, the door seal is removed and the doors of the container are opened. This step must be carried out carefully to prevent injury to personnel and/or damage to cargo that may have worked loose. Also, ventilation may be required for containers shipped under fumigation or containing solid carbon dioxide. Once the doors are open, the bracing materials are removed, and if necessary, the customs officer makes an initial content inspection. The supervisor also notes any signs of damage or defects. In the case of damage, the multimodal transport operator is notified and unpacking may be held up until a cargo surveyor can be present to survey and check the packages as they are discharged. When the container is ready to be unloaded, the suitable ramp or bridge is affixed to the container for equipment access to the box for unpacking.

3. Unpacking and Storage of Cargo Packages in the CFS

The unpacking method must be systematic to avoid any errors. Each item is lifted from the container and the tally clerk checks it carefully for quantity and condition. The tally list is ticked to indicate removal of the package or group of packages in that item. Also, any package defects, shortfalls, or discrepancies are noted on the tally list. The tally clerk also sorts the packages into consignments. Once a consignment has been fully collected, the packages are taken to the assigned storage locations and noted on the tally list. Any damaged packages are taken to a damaged cargo locker for security and separate treatment. Once the consignment is stored, the clerk identifies it by attaching a handwritten label known as a stack card to ensure identification of the consignment. The stack card number is added to the tally list as an additional identification marker.

Once the container has been unpacked, the tally clerk confirms the information on the tally list is correct, then signs the list and passes it to the HTC foreman. The foreman organizes the cleanup operation including the sweeping out of the container, the clearing up of the unpacking area and the return of the equipment, gear and materials to their storage positions. Once the cleanup is completed, the foreman then closes the container door and signs the work order to indicate job completion. The documents are all returned to the office and arrangements for the removal of the empty container are initiated. The office staff then updates the consignment records and storage plan with the storage locations. The office staff also prepares an outturn report, to be sent to the multimodal transport operator, containing such details as the bill of lading number, the shipper’s name or mark, a description of goods, the number of packages that should have been unpacked and the actual number, and any relevant remarks. Special cargoes are also handled by the CFS with appropriate measures – high value cargoes are taken to security lockers; bulky, awkward or dirty goods are stored in the open area storage; dangerous cargoes are segregated and handled according to specifications.

4. Return of the Empty Container to the Container Yard

The next step in the unpacking process is the return of the empty container to the ICD container yard. The container is not returned until it is clean and dry. Once the foreman indicates that the container is ready to be returned, the control room will order the collection of the empty as soon as it is convenient.

5. Collection Procedures for the Discharge of Import Consignments

In the planning, organizing and control of collection, the CFS must always be aware of four things, as it will bear the liability for any losses incurred.

a. That the release of each consignment is confirmed only to the rightful cargo owner.
b. That release occurs only once all freight, terminal and CFS charges have been paid.
c. That release occurs only once all customs taxes and duties have been paid and customs clearance has been given.
d. That cargoes do not remain in storage for excessive periods of time, i.e., that they are collected as quickly as possible.

There are a number of steps that need to be taken outside the CFS to arrange delivery. The multimodal transport operator needs to contact the consignee who in turn must process the necessary documents and complete administrative formalities for cargo release such as payment for goods, transport, handling charges, taxes and duties; and filing of necessary import and customs documents for clearance. Customs officers may need to examine the goods and the CFS is then requested to move the cargo to an examination area. Once these formalities have been completed, the holds on the goods are cleared and the multimodal transport operator issues a collection order to the consignee. This document is then presented to the CFS as authorization of collection. Once the consignee receives the collection order, transport is arranged.

The physical sequence of events for cargo collection from the CFS is as follows:

• The hauler contacts the CFS to arrange a time for collection if a vehicle appointment scheme is in place.

• On arrival at the gate, the road vehicle passes through a security check and the driver is instructed to park and report to CFS office. The collection order is presented, as is driver identification.

• The clerk then issues a document called a shed instruction or internal delivery order which provides the details of the collection request and routing instructions – the haulage company and vehicle, the date and time of collection, the consignment details, the loading bay, the driver's name, and authorization spaces for signatures .

Next, the clerk informs the supervisor that the vehicle has arrived and an appropriate work order is prepared and issued to a gang foreman and a tally list is prepared and issued to the tally clerk. The gang and tally clerk arrive at the storage location and the tally clerk confirms the consignment details. The vehicle arrives at the loading bay and is placed into position with vehicle brakes on and doors opened and the driver hands over the shed instruction as authorization for collection. The packages are then moved from storage to the loading area. Any defects or damage are recorded on the shed instruction and tally list. The goods are packed securely into the vehicle under direction of the driver.

Once loading has been completed, the foreman checks that the driver is satisfied that the cargo packages have been correctly, safely and securely loaded and the vehicle's doors are closed. The truck driver and foreman sign the shed instruction to acknowledge the receipt of the goods by the driver. One copy to given to the driver and the CFS keeps the other copy. The driver exits through the final security check at the gate, while the loading gang clears up the tools, material and any debris from the loading bay, and the foreman returns the documents to the CFS office. Finally, the clerk updates the register and record to note the number of the collecting vehicle and any other data needed for record, accounting and performance measuring purposes. The final step is the amendment of the storage inventory

- **Equipment Interchange Receipt**

The equipment interchange receipt (EIR) is central to the receipt/delivery operation. It is used to recognize the completion of a transfer of responsibility for a container between the multimodal transport operator and the container depot. The document can be issued by any number of parties including, the multimodal transport operator, the agent, or by the ICD. The EIR form contains basic information about the container, the vehicle and chassis delivering/collecting it to/from the terminal, and about the condition of the container and chassis on entry/exit. The condition information is noted upon entry/exit through the gate. The EIR acts as a receipt of transfer of the container.

For outbound boxes the CFS "receives" the box and for inbound boxes the consignee representative – the transport driver – "receives" the box.

Table 4.2.1: Time Comparison Table for Import Operations

Import Operations	**Present Condition**	**RFID implementation**
Import Indent	20 minutes	20 minutes

Job Order	15 Minutes	00 minutes
Bring import containers from ICD	03 Hours	02 hours
Grounding of Import containers	30 Minutes	00 minutes
Destuffing of import cargo include seal verification	02 Hours	01 hour
Documentation/Preparation of payment charges	30 Minutes	00 minutes
Delivery of Import cargo	02 Hours	01 hour
Dispatch of Import Cargo for factory destuffing	02 Hours	01 hour
Issue of gate pass	15 Minutes	00 minutes
total time	11 hrs	5 hours 35 minutes

Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

4.2.1 RFID Operating Plan

The time for the import indent is 20 minutes. Once the import indent is made, using the RFID information systems the job order can be created immediately thus saving a period of 15 minutes which is required for the job order operation.

To bring the import containers from the ICD presently takes about 3 hours. The time of 3 hours is required for locating the container which requires manual labor operation. If RFID system is used, the information of location of the container can be well known before in hand and saves a considerable period of time. The author estimated as the time saving to be 1 hours. Thus the total period to bring the container from ICD is taken as 2 hours instead of 3 hours.

Grounding of import containers is thus not necessary as the information is already available at the CFS by making using of the RFID system. Thus saves a period of 30 minutes.

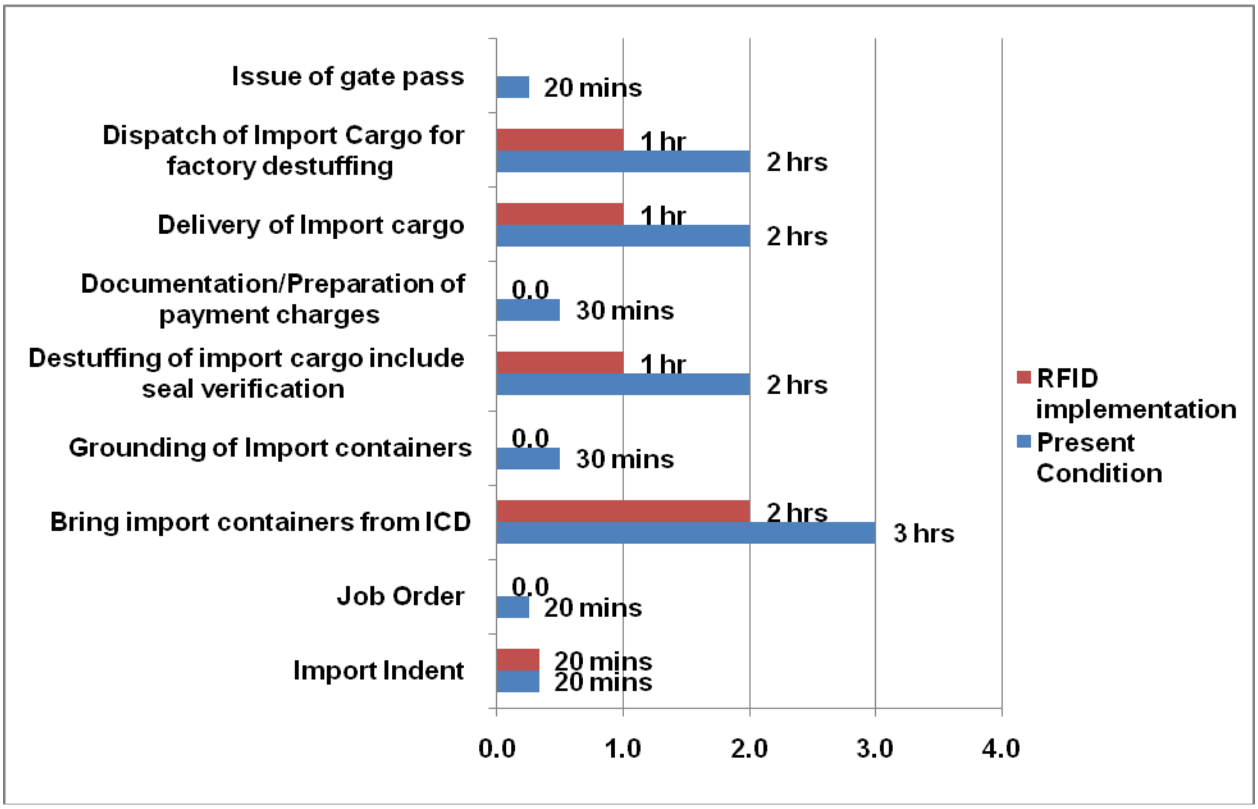
Destuffing of import cargo which includes the seal verification now takes a considerable period of about 2 hours. This is due to the information has to be manually sent to the tally clerk who then checks for the seal number and thus takes a considerable period of time. If RFID is used, it helps to transmit the seal number and the contents of the container well before in hand and the tally clerk has all the information required. He can thus spend only a little time in dealing with the seal verification and destuffing operation. The author estimated time saving as 1 hour. So the total period utilized for the destuffing of import cargo including seal verification is estimated to be 1 hour.

The documentation and preparation of payment charges can be done electronically and the custom broker can thus save a period of 30 minutes which is presently being used at the CFS. Delivery of import cargo time can be reduced using the RFID technology as the manual operation time being used in locating is reduced. The author estimated the time reduction as 1 hour.

Dispatch of import cargo for factory destuffing presently utilizes a period of 2 hours. Upon RFID implementation all the information regarding the contents, storage and the location methods are transmitted in real time and helps in considerable reduction in the time consumption required for this operation when the documents are sent by mail.

The time required for the issue of gate pass now takes a time of 15 minutes. Upon implementation of RFID, the information can be transmitted well before and the Exit gate authority can prepare the gate pass well in advance and thus issue the gate pass as soon as the container is about to leave the premises of the CFS.
In conclusion the author estimated the total time as 5 hours and 35 minutes upon RFID implementation compared to the total time presently required is 11 hours. Thus RFID technology implementation in the Import operations saves 50% of the time. In short RFID improves the accuracy of incoming data and enhances the transfer of data from point to point helping in reduction in time allocation.

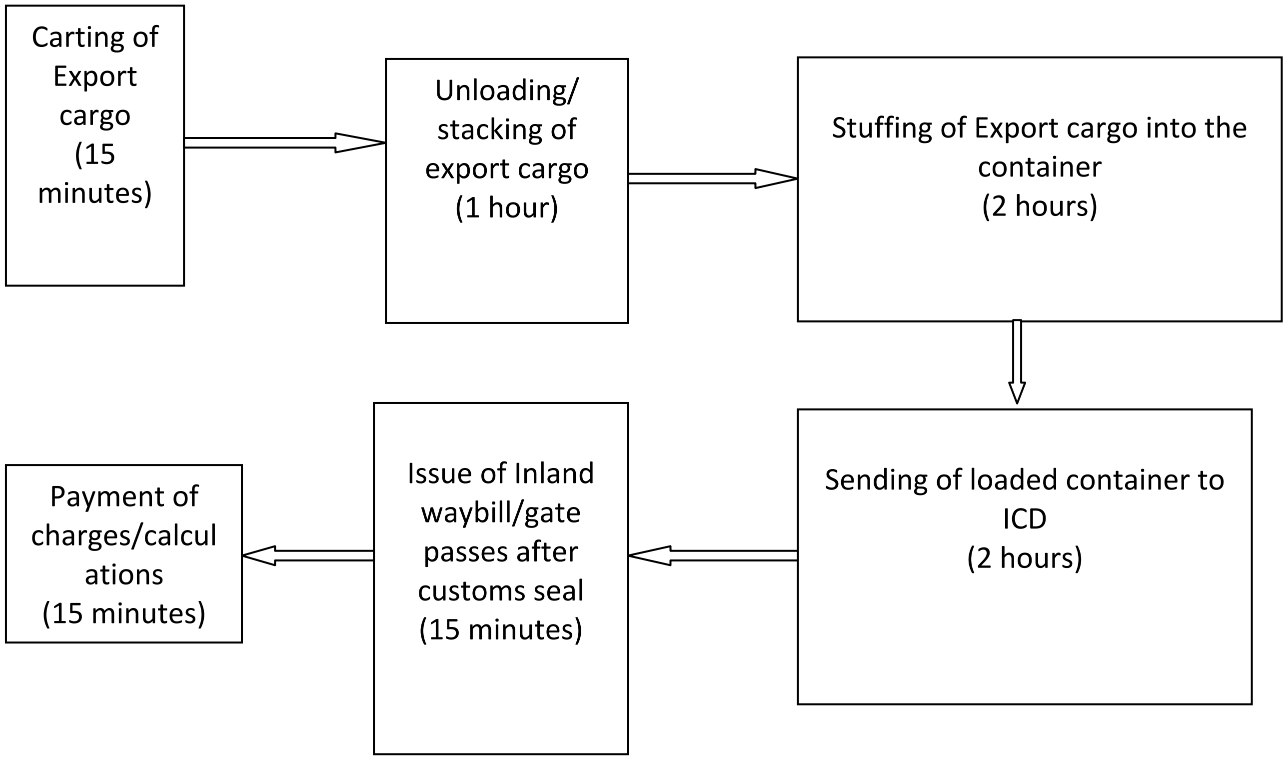
Figure 4.2.2: Graphical analysis of Import Operations



Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

4.3 Export Operations

Figure 4.3.1: Flow Chart of the Present Time Allocation for Export Operations



Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

The Logic structure that is involved in the handling of outbound cargoes included the following steps.

1. Receipt of Outbound Cargoes by Road Vehicle
2. Planning Processes for Packing Containers
3. Receipt of Empty Container from the Container Yard
4. Container Packing
5. Return of Packed Container to the Container Yard

1. Receipt of Outbound Cargoes by Road Vehicle

Prior to the physical receipt of the export cargoes at the CFS, the shipper must make booking arrangements for the cargoes to be shipped whereby the consignor is made aware of the acceptance period. The consignor must then prepare all the necessary outbound documents and arrange for transport of the break-bulk goods to the CFS. The multimodal transport operators will forward a CFS booking list to the CFS to advise them of the cargoes to be delivered to the CFS for packing. This information is used for preliminary planning purposes and to create a consignment record for each consignment. The booking list is followed up with a container loading list which specifies which cargoes are to be packed in which container. Work orders and tally lists are then prepared by the CFS.

When the time comes, the driver collects the goods and shipping note from the consignor which details the packages in that consignment and acts as authorization for the driver to deliver the goods to the CFS. Upon arrival, the driver parks the vehicle and offers the shipping note to office where the details are compared to the consignment record. The arrival must coincide with the agreed acceptance period, or else the goods may be rejected. At this point, missing data in the consignment record is filled in.

The clerk will then supply the driver with a shed instruction, which outlines the routing instructions and the unloading bay, acts as authorization to deliver the goods, and acts as a gate pass for leaving the CFS. As the driver leaves to deliver the goods, the work order is issued to the foreman of the unloading gang. The work order indicates the details of the operation as well as the resources allocated to the job. The tally list is also issued to the tally clerk. The foreman, gang and equipment move to the unloading bay.

Once the vehicle has arrived at the unloading bay, the foreman checks that the vehicle is safely parked with brakes on and engine off. The vehicle is inspected for any signs of damage, which are noted on the shed instruction. The driver unlocks and opens the doors. The foreman makes a quick inspection of the packages for any obvious signs of damage or defects.

If all is in order, the gang starts to unload. Unloading occurs in a systematic way so that packages are unloaded in sequence after which the tally clerk ticks off each item. Large packages and palletized cargoes are moved directly to the planned storage location while loose packages are stacked on CFS pallets before being moved to storage. Separate consignments are carefully sorted and stored. Special cargoes – high value goods, dangerous cargoes, – are stored accordingly. The tally clerk checks on the storage locations, attaching stack cards to each consignment and updating the tally list with the stack card numbers.

Once the vehicle is empty, both the driver and tally clerk make a final check that everything has been delivered and then they both sign the shed instruction. The driver shuts the vehicle doors and drives to the gate showing a copy of the shed instruction as proof of authorization to leave. Meanwhile, the tally list, work order and shed instruction are returned to the CFS office and the register is updated. Customs receives a copy of the shipping note, customs clears the goods and then returns the endorsed shipping note so that the CFS packs the container and transfers it to the yard storage.

As with inbound cargoes, special steps are taken when the goods being handled are dangerous cargoes, refrigerated cargoes, high value cargoes or awkward loads.

2. Planning Processes for Packing Containers

The detailed planning of the packing of each consignment takes place once the cargo has been received, checked and stored. The supervisor examines the goods and designs a loading plan for each container. This outlines how the items will be packed including which packages are to be placed in which position, what dunnage and separation is needed, and what securing materials and systems are required. The tally list and work order are also made up at this time.

3. Receipt of Empty Container from the Container Yard

Next, the multimodal transport operator issues a service request to the ICD. It specifies the empty container to be moved to the CFS and the date and time by which it is needed. The movement of the empty container is scheduled by the ICD and the CFS is alerted to the time of arrival. The CFS then schedules the packing operation into its work plan for the appropriate shift. Once the empty has arrived at the appropriate packing bay, the work order and tally list are distributed and the foreman, tally clerk, packing gang and equipment moves to the bay. The container is checked for safe positioning, the doors are opened. A quick inspection ensures that the container is in good condition to receive the goods.

4. Container Packing

The next step is for the packing to begin. The packing process is carried out to follow the specifications of the loading plan as closely as possible while still adhering to the principles of good packing.

During packing, the tally clerk ticks off the tally list and collect the stack card off of each item as it is placed into the container. To ensure a tight and secure stow, securing devices and dunnage are fitted during packing. Once packing is finished a series of events occurs: the ramp (if used) is removed, the face of the stack is secured, a final check of the cargo is made by the foreman, and the door is then closed. A customs officer typically arrives just before the doors are secured to apply the seal to the door. Appropriate IMDG labels are fixed to the outside of the container when dangerous goods are present in the container.

Finally, the packing gang clears the packing area to make ready for the next packing operation, the tally clerk records the seal number on the tally list, signs the list and passes it to the foreman. The work order is signed by the foreman who then returns the documents to the office to be updated in the register. Unusual loads may also require special arrangements:

- Heavy lifting equipment may be required to lift overweight cargoes.
- Shipwrights and carpenters may be needed to construct cradles and bracing arrangements for special cargoes to ensure that they are firmly secured to the containers during the journey.
- The transport operator commonly provides detailed instructions and drawings for securing loads, which must be followed carefully in packing.

In the case of dangerous goods, the requirements are as follows:

- Dangerous goods must be packed exactly according to a detailed loading plan to ensure correct segregation from other cargoes. All IMDG recommendations must be followed.
- The packages must be handled with exceptional care due to the risks to packers.
- The packing gang must be equipped with the appropriate protective clothing and equipment and necessary precautions must be taken.

After packing is complete, the CFS supervisor ensures that the appropriate dangerous goods labels are affixed to the outside of the container in the correct locations.

In the CFS, four areas where good operating practices can be instituted with positive results on operations are:

- **General Rules for Storage and Stacking**

There is a limit to the efficiency of stacking heights. In the CFS, high stacking can lead to various problems. One such problem is that high stacking would most likely mean the mixing of consignments since consignments in LCL containers tend to be small. Sorting would be required, slowing down operations. Another problem comes in the area of packaging. It may not be sufficiently strong to handle high stacking and damage to goods could result. A related problem is that incompatible cargoes may be stacked together, causing damage. Finally, a consignment may contain different types of packages, which cannot be stacked due to size and shape. Therefore, planning storage becomes a compromise between the desire for a compact stack and the needs for accessibility and safety of cargoes. To this end, rules have been devised by the CFS to address stacking height, segregation and operational requirements.

Table 3.3.1: Time Comparison Table for Export Operations

Export Operations	**Present Condition**	**RFID implementation**
Carting of Export cargo	15 Minutes	15 Minutes
Unloading/stacking of export cargo in warehouse	01 Hours	30 minutes
Stuffing of Export cargo into the container	02 Hours	1 Hours
Payment of charges/calculations	15 Minutes	00 Minutes
Issue of Inland waybill/gate pass after customs seal	15 Minutes	00 Minutes
Sending of loaded container to ICD	02 Hours	01 Hours
total time	**5 hr 45 min**	**3 hr 45 min**

Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

4.3.1 RFID Operating Plan

Once the carting of export cargo is done which take s a time of 15 minutes, the unloading and the stacking of the export in the warehouse takes place. The process consumes a time period of 1 hour at present. If the RFID technology is implemented successfully, it becomes easy for locating and the inventory procedures by making use of the RFID system, the visibility into the processing so goods can be identified anywhere in the warehouse and also making the changes without interrupting the other goods. The author estimated the time saving in this process as 50%.

Payment of charges and other calculations will no longer require for the person to do it manually, as RFID helps to do the process electronically. In this process the time of entire 15 minutes can thus be saved.

Also the issue of inland waybill and the gate pass can be done electronically.

Sending of loaded container to ICD makes the process easy and simple because the location and the position of the container where it has to be placed is already planned in advance using the

RFID system, thus it helps in reduction in the waiting time and helps in the reduction of time of about 50%.

Thus the total time for the export operation by making use of RFID is estimated to be 3 hrs and 45 minutes where as using the present traditional system its takes about 5 hrs 45 minutes.

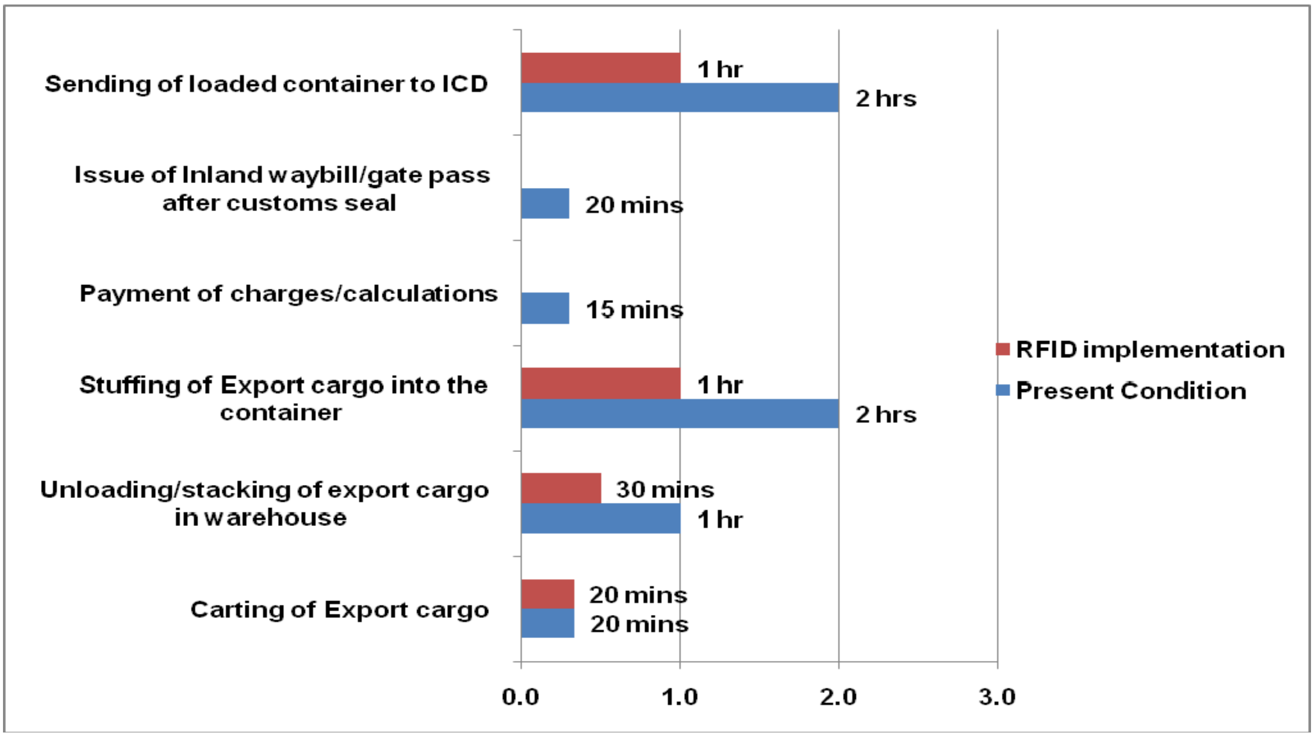
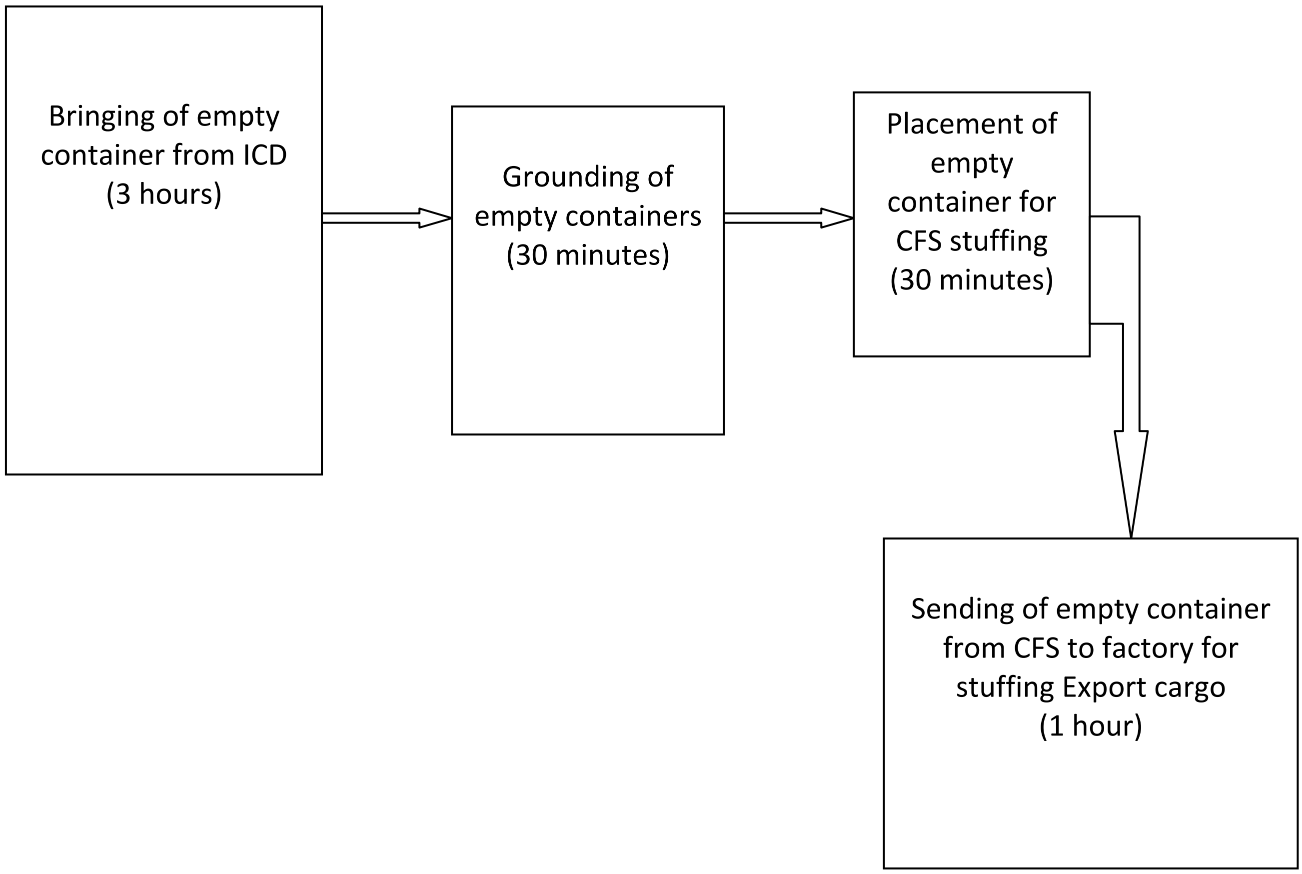


Figure 4.3.2.: Graphical analysis of export operation

Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

4.4 Empty Container Handling Operations

Figure 4.4.1: Flow Chart of the Present Time Allocation for Empty Container Handling Operations



Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

Receipt of Empty Container from the Container Yard

The multimodal transport operator issues a service request to the ICD. It specifies the empty container to be moved to the CFS and the date and time by which it is needed. The movement of the empty container is scheduled by the ICD and the CFS is alerted to the time of arrival. The CFS then schedules the packing operation into its work plan for the appropriate shift. Once the empty has arrived at the appropriate packing bay, the work order and tally list are distributed and the foreman, tally clerk, packing gang and equipment moves to the bay. The container is checked for safe positioning, the doors are opened. A quick inspection ensures that the container is in good condition to receive the goods.

The process of the empty container handling operations involves the process to be integrated with the working of the necessary formalities and the integration of various factors of the warehouse operational factors.

Table 4.4.1: Time Comparison Table for empty Container Handing Operations

Empty container handling operations	**Present Condition**	**RFID implementation**
Bringing of empty container from ICD	03 Hours	02 Hours
Grounding of empty containers	30 Minutes	30 Minutes
Placement of empty container for CFS stuffing	30 Minutes	30 Minutes
Sending of empty container from CFS to factory for stuffing Export cargo	1Hour	1Hour
total time	5 hours	4 hours

Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

4.4.1 RFID Operating Plan

RFID implementation in the CFS helps in locating the container at the ICD is a faster way when compared the traditional methods presently being adopted and thus helps in reducing the time needed for this purpose. The time reduction is estimated to be 1 hour in this case.

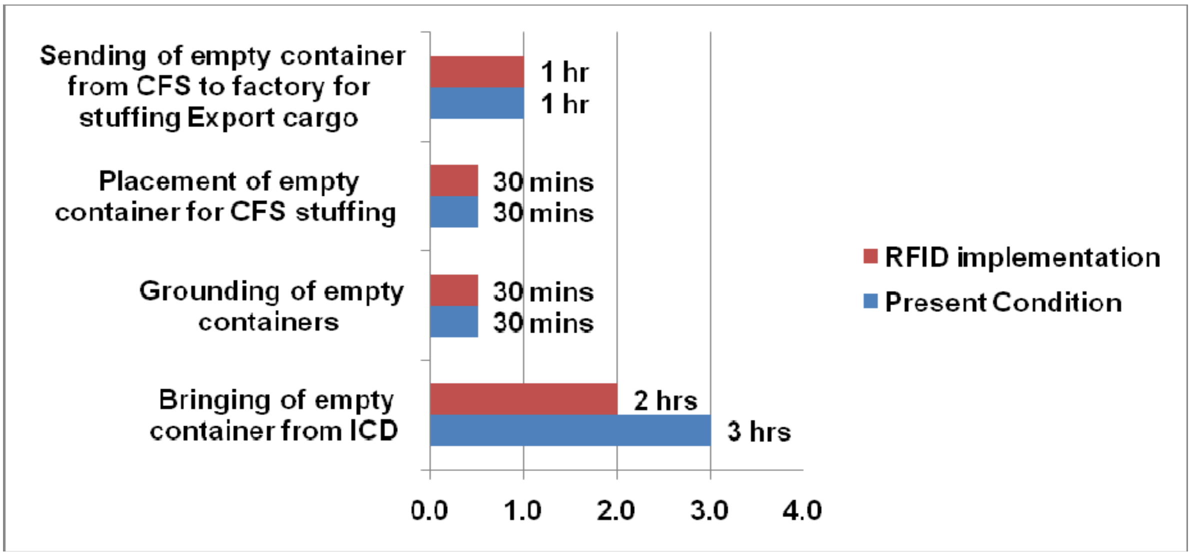
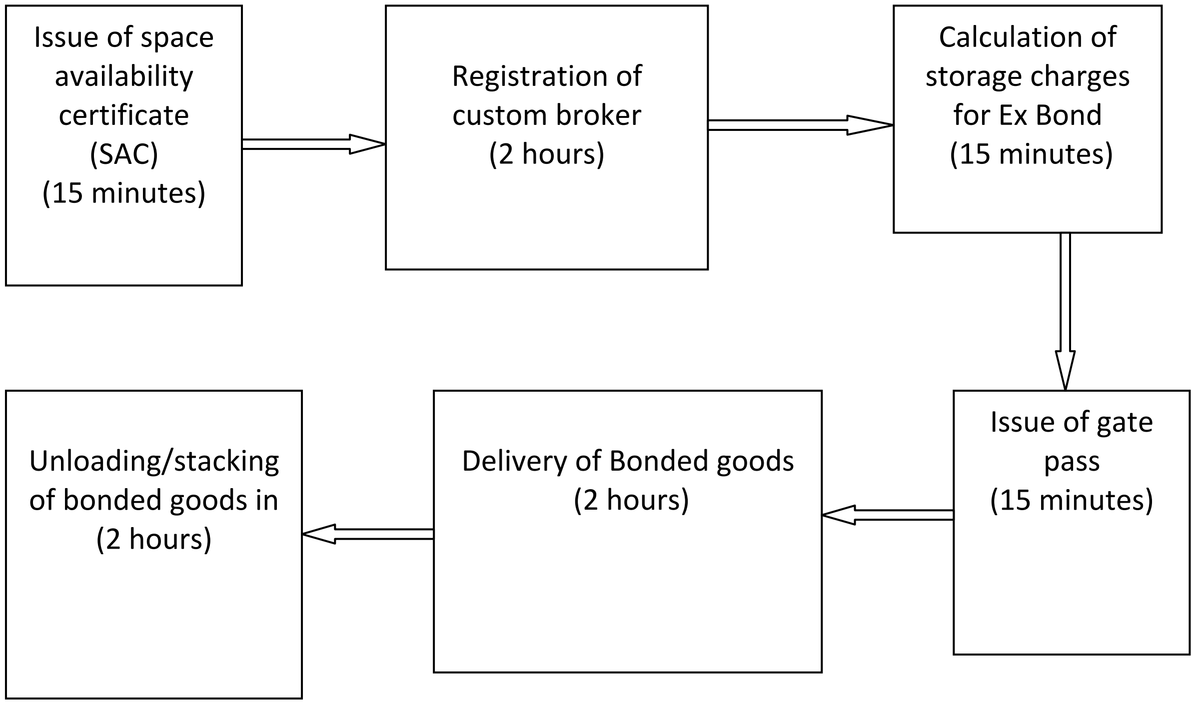


Figure 4.4.2: Graphical analysis of Empty Container Handling Operations
Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

4.5 Custom Bonded Operations

Figure 4.5.1: Flow Chart of the Present Time Allocation for Custom Bonded Operations



Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

The Present Procedure of Clearance of Goods at CFS

The main function of CFS is receipt, dispatch and clearance of Containerized Cargo, up-to-date inventory control and tracking system to locate containers/cargo. The goods received at ports are brought to CFS and stacked in CFS after verification of the seal by Customs Officers. In respect of import consignment, the Steamer Agents/liners/Importers desiring to take the consignment to CFS file Import General Manifests in the port.

After obtaining the permission from the AC/DC, the Container moves to CFS under Customs escort or under bond and bank guarantee. The CFS allows de-stuffing of the goods. The CHA /importer files the Bill of Entry at Customs House and then Customs formalities of assessment, examination and payment of duty are completed. Thereafter, Customs gives "Out of Charge" and the Custodian releases the goods from CFS by issuing a Gate-Pass.

In respect of exports, the goods are brought directly to CFS under a Shipping Bill. The export cargo in Less than Container Load (LCL)/ Full container Load (FCL) is received by the Custodian of CFS for safe custody. After stuffing of the goods, Container/ Customs The Custom Officer seals bonded Truck (CBT) and the same is removed from CFS for export through the desired Port.

The Procedure at Gateway Port in Respect of Import Containers to Hyderabad

Transshipment of containers from the gateway port to Hyderabad is allowed in accordance with the imported goods (containers of transshipment) regulators 1984. Only such containers are allowed transshipment as are specifically shown in the relevant import general manifest for transshipment. In case containers are to be transshipped, the steamer agent files a sub manifest in quadruplicate covering these containers meant for the CFS Kukatpally Hyderabad. The sub manifest in quadruplicate is filed along with the main IGM. The steamer agent shall also execute a bond in the prescribed form to the satisfaction of the commissioner of customs at the gateway port to re-export the containers within the period allowed by the customs authorities at the gateway port.

The import cargo containers with seals intact to the satisfaction of the preventive Officers of Customs at the gateway port is transported by rail or by road directly from the gateway ports to the ICD and only by road directly from the gateway port to the CFS Kukatpally, Hyderabad. The responsibility of the movement of the containers from gateway ports to the CFS Kukatpally is that of CWC who arranges motor vehicles as are necessary for the purpose of such road movement. The CWC executes a general bond (with guarantee) as required by the Commissioner of Customs at the gateway port in respect of the goods to be transshipped. The customs authorities at gateway port maintain a record of each consignment transshipped under the cover of the general bond.

The sealed containers to be transshipped shall normally not be opened. However, if there are reasons to believe that the container have goods other than those declared in the IGM, the custom at gateway port may open the containers and subject them to such examination as may be deemed necessary. The containers whose seals are found to be broken shall be subjected to such examination as deemed necessary.

After the above formalities have been completed and the commissioner of Customs at the gateway port has executed the bond executed by the CWC, the containers to be transshipped to CFS Kukatpally is removed from the port premises for being loaded in the motor vehicles under the supervision of the preventive officers of the gateway ports. The fact of such loading of the containers is endorsed by the preventive officer on all copies of the sub manifest and is put in a sealed cover and handed over by the preventive officer to the representative of the CWC at the gateway Port. The CWC will hand over the sealed cover to the customs authorities at the CFS Kukatpally, Hyderabad.

Table 4.5.1: Custom Bonded Operations Time Comparison

Custom Bonded Operations	Present Condition	RFID implementation
Issue of space availability certificate (SAC)	15 Minutes	15 Minutes
Registration of custom broker	02 hours	00 minutes
Calculation of storage charges for Ex Bond	15 Minutes	00 minutes
Unloading/stacking of bonded goods in Warehouse	02 Hours	02 Hours
Delivery of Bonded goods	02 Hours	02 Hours
Issue of gate pass	15 Minutes	00 minutes
total time	6 hrs 45 min	4 hours

Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

4.5.1 RFID Operating Plan

Presently the registration of the custom broker takes place in a traditional way. The procedure includes but not limited to handing of various documents after obtaining permission from various authorities. The total time required for this procedure is about 2 hours. But using the information on-line the custom broker can save this time without personally present at the site. The use of RFID in this case helps the information to be transmitted on-line and all the paper work is done electronically without interference of human work flow. Thus the RFID implementation will help in reduction of this total time of 2 hours which is presently required for the custom registration purpose.

Calculation of Storage charges for Ex bond will require a time of 15 minutes presently but using the RFID system, this calculations can be done electronically and thus helps in reducing time as well as labor usage.

The time required for the issue of gate pass now takes a time of 15 minutes. Upon implementation of RFID, the information can be transmitted well before and the Exit gate authority can prepare the gate pass well in advance and thus issue the gate pass as soon as the container is about to leave the premises of the CFS.

Thus the total time can be reduced to 4 hours instead of 6 hours and 45 minutes.

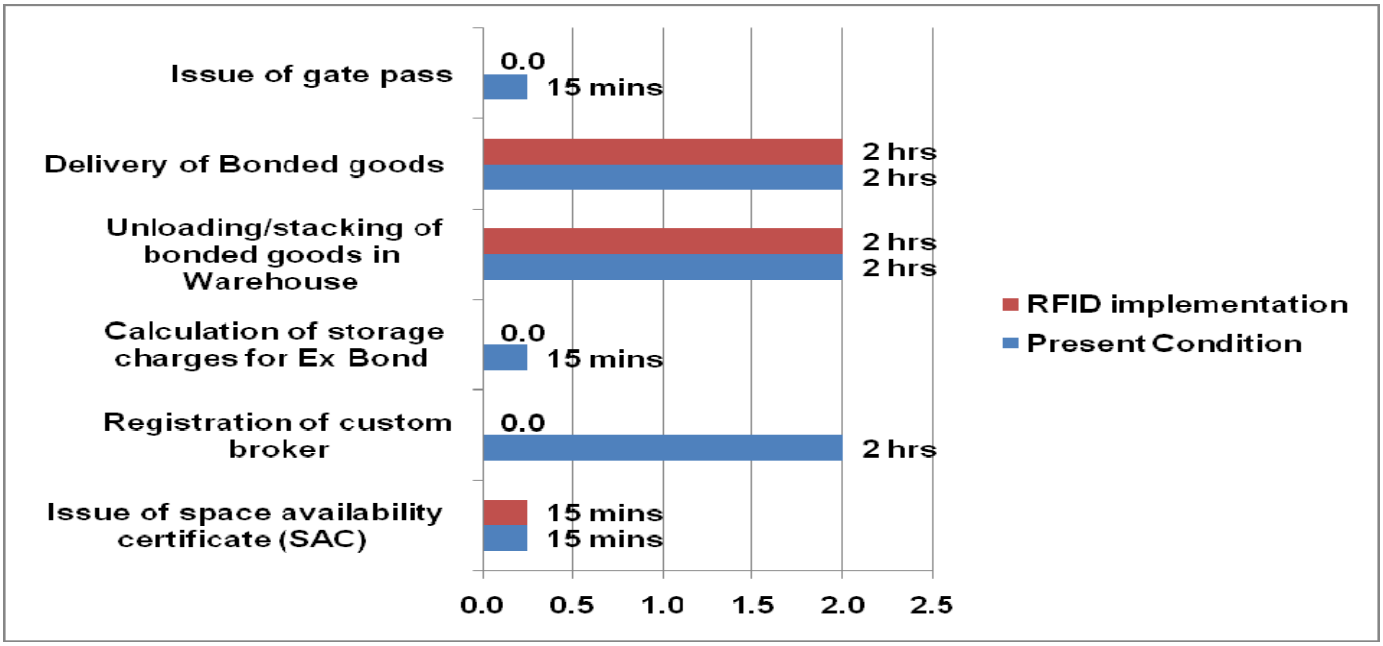


Figure 4.5.2: Graphical Analysis of Custom Bonded Operations
Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

4.6 Summary of Operations

This Qualitative Analysis for the RFID implementation in the Hyderabad CFS provides a feasible project and describes the advantages in adopting and thus saving a considerable period of time.

The following Table and the Graph briefly illustrates the summary of the Qualitative Analysis and can be concluded that RFID implementation in the Hyderabad CFS can create a way for moving the information and the operational workflow at a faster speed when compared to the present situation.

Table 4.6.1: Summary of Operations

	Present Condition	RFID implementation
Import Operations	**11**	**6**
Export Operations	**6**	**5**
Empty container handling operations	**5**	**4**
Custom Bonded Operations	**14**	**4**
TOTAL TIME	**22**	**15**

Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

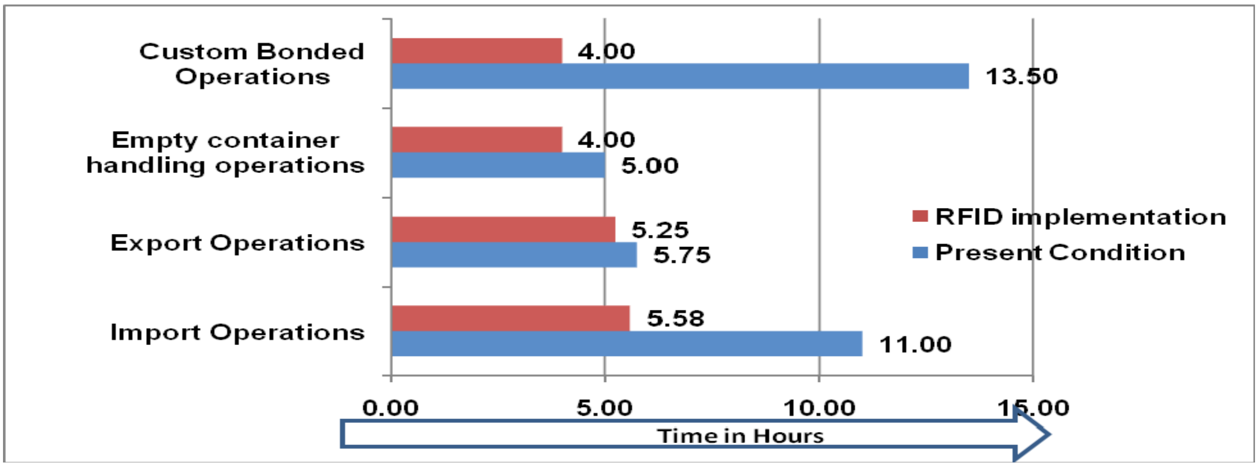


Figure 4.6.1: Graphical Analysis of Summary of Operations

Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

Chapter 5 QUANTITATIVE ANALYSIS FOR RFID IMPLEMENTATION

5.1 Introduction

For determining the financial capability of the Hyderabad CFS, the author estimated the Average loss of containers per year to be between 5 and 10[23]. The key intangible and variable savings item for the model was the reduction of the number of containers based the addition of visibility and management of the pool of containers. The assumption includes protection from loss of containers. It reflects a simple reduction in the overall pool based on improved visibility (such as the efficiency of containers being returned on time).

For a closed loop re-usable container management solution, a semi-active RFID system for automatically inventorying, locating, and managing containers proves to be financially viable. In the analysis, the author has used the figure of 5-10 containers being lost/ misplaced in a year. Using a figure of $ 2500 value per container being lost, gave a payback time of 30 months when 10 containers taken into account. Considering around 13,000 containers are worked/ handled in the CFS every year, this figure may appear to be on the lesser side when 1% is the global average figure[24] used for such losses. That would mean around 130 containers being lost. However the CFS Hyderabad being a relatively smaller enterprise, such losses hardly exist.

The analysis returned a dramatic 30% internal rate of return (IRR) for the savings, a 30 month payback for the system, Rs 700,000 in net present value savings (assuming a 12% discount rate or cost of capital). Therefore, for a closed loop re-usable container management solution, a semi-active RFID system for automatically inventorying, locating, and managing containers proves to be financially viable. In the above analysis, the author has used the

[23] Information obtained from the Yard Manager of CFS, Hyderabad (used for analysis purpose only)
[24] Information obtained from " Containerisation International Yearbook "

figure of 10 containers being lost/ misplaced in a year. Using a figure of $ 2500 value per container being lost, gave a payback time of 30 months.

5.2 Monte Carlo Simulation

The analysis is done by making use of the "Monte Carlo" simulation method[25].

The Monte Carlo method is just one of many methods for analyzing **uncertainty propagation**, where the goal is to determine how random variation, lack of knowledge, or error affects the sensitivity, performance, or reliability of the system that is being modeled. Monte Carlo simulation is categorized as a **sampling method** because the inputs are randomly generated from probability distributions to simulate the process of sampling from an actual population. The data generated from the simulation is represented as probability distributions (or histograms).

Analysis covers 4 years of operation corresponding to the average expected "field" battery life of an Active Tag.

The interest rate (floating rate) is assumed as 7.5% (with a variation of 1%).
The simulation is performed for 500 Iterations taking into account the interest rate and the cumulative cash flow.

All figures in INR (1 USD = 40 Indian National Rupees)

Table 5.2.1: CFS Kukatpally Profile

Interest rate (floating rate)	**7.73%**	""Normal Value (7.5%, 1%)""				
Number of containers lost per year	5	6	7	8	9	10
Average value	500000	600000	700000	800000	900000	1000000

CFS Kukatpally Profile

KEY DATA	

[25] In the fields of finance and mathematical finance, **Monte Carlo methods** are used to value and analyze basic financial models through to complex instruments, portfolios and investments by simulating the various sources of uncertainty affecting their value, and then determining their average value over the range of resultant outcomes.

Number of containers handled in 2007	13000
Estimated value of one container	100,000
Total number of Employees	14
Exit/Control Points	1
Readers	2

Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008) by real observations at the Hyderabad CFS.

Table 5.2.2: Equipment Costs

Equipments costs			
	quantity	Price Each	Total Price
readers	2	47520	95040
antenna	30	33240	997200
tags	1000	950	950000
software	1	60000	60000
Prof. Services	3	30000	90000
Installation	1	200000	200000
sub total			2392240
Subtotal minus installation costs			2192240

Source: Information obtained from internet sources

Table 5.2.3: Estimation for Loss of 5 containers per year

Estimation for loss of 5 containers per year						
Purchase	**year 1**	**year 2**	**year 3**	**year 4**	**year 5**	year 6
Savings costs	500000	500000	500000	500000	900000	900000
Costs	2392240	90000	90000	90000	90000	90000
Cash flow	-1892240	410000	410000	410000	810000	810000
Discount Factor	1	1	1	1	1	1
cumulative cash flows	**-1892240**	**-1513917**	**-1164823**	**-842701**	**-255481**	286370

Table 5.2.4: Simulation Show Case

Percentile Distribution	
Percentile	Value
0%	-550241
5%	-522591
10%	-515385
15%	-507473

Histogram Data	
Bin	Frequency
-542000	1
-534000	5
-526000	7
-518000	23

Interval Probability Data	
Value	Probability
-542000	0.20%
-534000	1.00%
-526000	1.40%
-518000	4.60%

20%	-501706
25%	-497554
30%	-493245
35%	-490337
40%	-486617
45%	-483283
50%	-479357
55%	-474983
60%	-472166
65%	-468761
70%	-465666
75%	-463438
80%	-459592
85%	-454515
90%	-448014
95%	-438446
100%	-393647

-510000	28
-502000	33
-494000	43
-486000	63
-478000	54
-470000	64
-462000	65
-454000	40
-446000	31
-438000	19
-430000	9
-422000	5
-414000	3
-406000	2
-398000	3
-390000	1
-382000	0

-510000	5.60%
-502000	6.60%
-494000	8.60%
-486000	12.60%
-478000	10.80%
-470000	12.80%
-462000	13.00%
-454000	8.00%
-446000	6.20%
-438000	3.80%
-430000	1.80%
-422000	1.00%
-414000	0.60%
-406000	0.40%
-398000	0.60%
-390000	0.20%
-382000	0.00%

Table 5.2.5: Results Summary

Results Summary	
Mean	-479763.84
Number of Trials	500
Standard error	1160.68
Minimum	-550240.73
Maximum	-393646.60
Median	-479357.36
Range	156594.14
Standard Deviation	25979.54
Variance	674936630.23
Skewness	0.14
Kurtosis	3.10

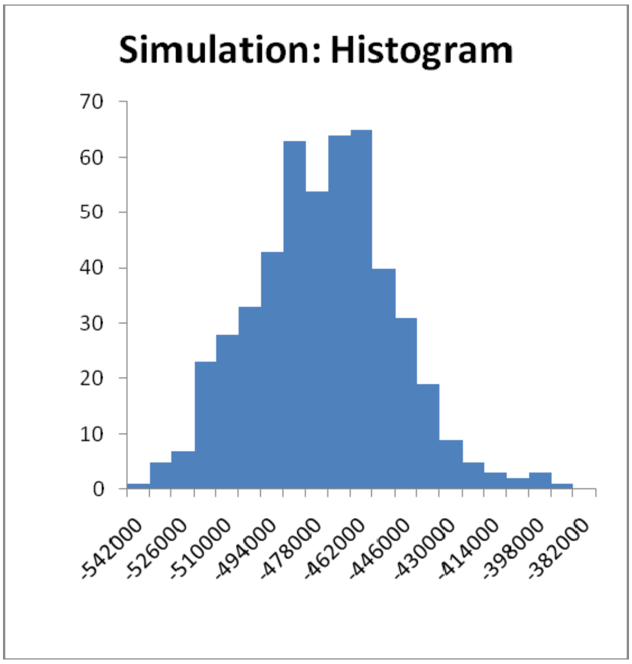


Figure 5.2.1: Estimation for the loss of 5 containers/ year

Table 5.2.6: Estimation for Loss of 10 Containers per year

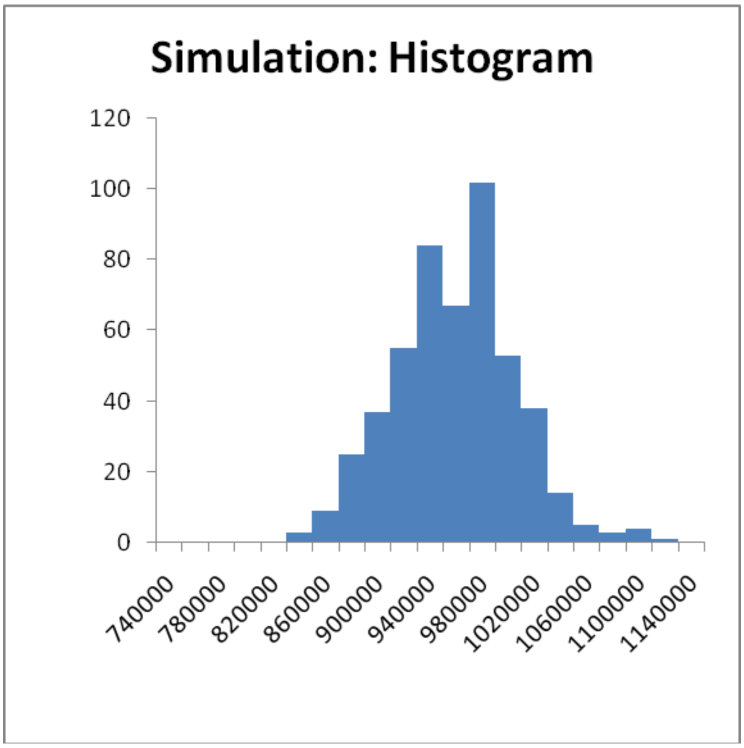
Estimation for loss of 10 containers per year				
Purchase	**year 1**	**year 2**	year 3	year 4
Savings costs	1000000	1000000	1000000	1000000
Costs	2392240	90000	90000	90000
Cash flow	-1392240	910000	910000	910000
Discount Factor	1	1	1	1
cumulative cash flows	-1392240	-536138	269259	1026953
	-1392240	**-550310**	228722	949629

Table 5.2.7: Simulation Show Case

Percentile Distribution		Histogram Data		Interval Probability Data	
Percentile	Value	Bin	Frequency	Value	Probability
0%	823876.3	740000	0	740000	0.00%
5%	873211.5	760000	0	760000	0.00%
10%	886069.4	780000	0	780000	0.00%
15%	900188	800000	0	800000	0.00%
20%	910477.6	820000	0	820000	0.00%
25%	917885.7	840000	3	840000	0.60%
30%	925573.8	860000	9	860000	1.80%
35%	930763.5	880000	25	880000	5.00%
40%	937401.9	900000	37	900000	7.40%
45%	943350.2	920000	55	920000	11.00%
50%	950354.5	940000	84	940000	16.80%
55%	958159.7	960000	67	960000	13.40%
60%	963185.5	980000	102	980000	20.40%
65%	969261.5	1000000	53	1000000	10.60%
70%	974784.2	1020000	38	1020000	7.60%
75%	978758.9	1040000	14	1040000	2.80%
80%	985621.5	1060000	5	1060000	1.00%
85%	994680.8	1080000	3	1080000	0.60%
90%	1006281	1100000	4	1100000	0.80%
95%	1023353	1120000	1	1120000	0.20%
100%	1103289	1140000	0	1140000	0.00%

Table 5.2.8: Results Summary

Results Summary	
Mean	949629.22
Number of Trials	500



Standard error	2071.01
Minimum	823876.34
Maximum	1103289.41
Median	950354.52
Range	279413.07
Standard Deviation	46309.28
Variance	2148846687.80
Skewness	0.14
Kurtosis	3.10

Figure 5.2.2: - Estimation for Loss of 10 containers / year

5.3 Results of Simulation

The following are the results of the simulations:

1. For the estimated loss of 5 containers per year, the payback period is 66 months when interest rate is considered to be 7.73%.
2. For the estimated loss of 10 containers per year, the payback period is 30 months at an interest rate of 7.7.3%.

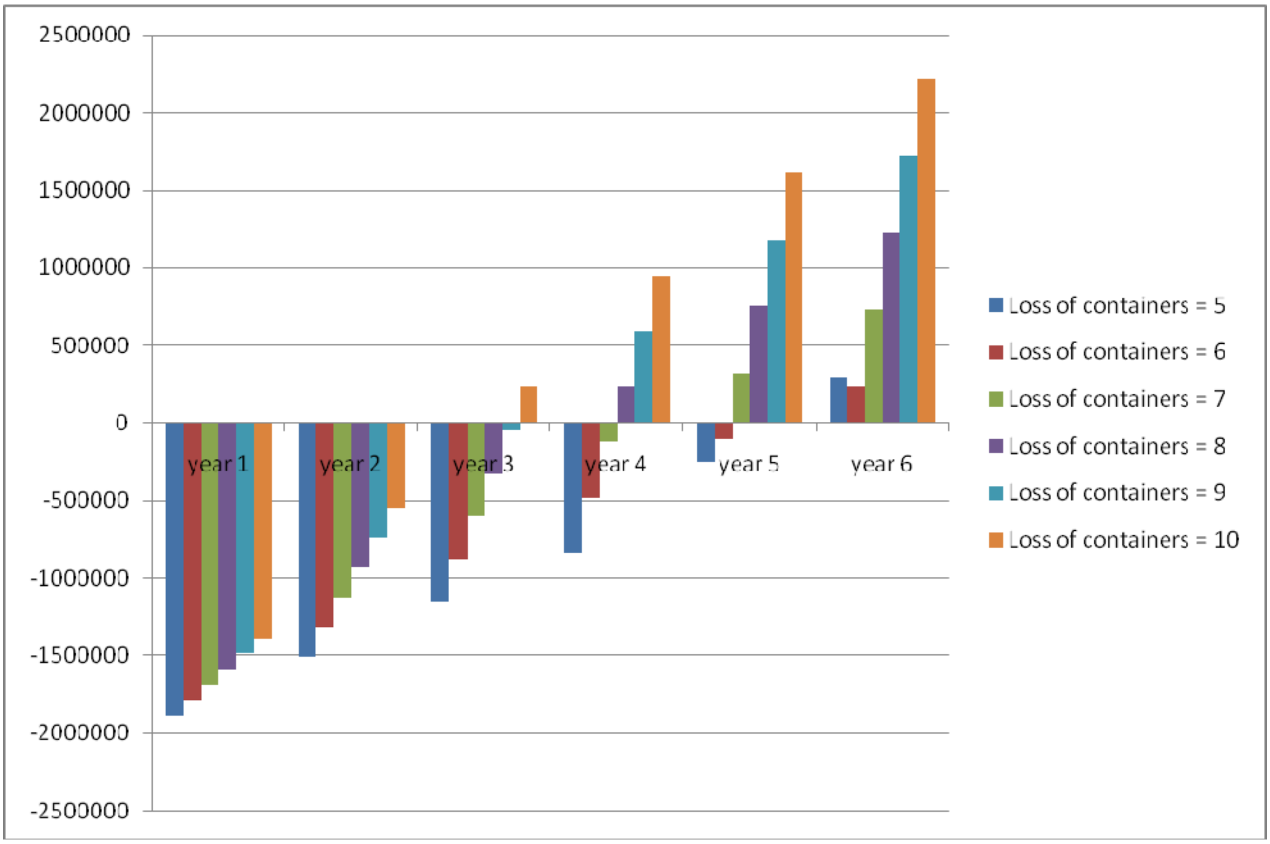
For a CFS like the Hyderabad which is directly under the control of CWC being a Government organization the interest rate of 7.73% is above the normal interest rate of lending. So the author concludes that even if the Capital is burrowed from a bank, the investment in RFID makes a successful venture for the Hyderabad CFS in order to sustain in this ever growing container shipping business and to have a better customer satisfaction by making use of the new technological methods.

Table 5.3.1: Summary of the Simulation Results

Summary						
Loss	year 1	year 2	year 3	year 4	year 5	year 6
Loss of containers = 5	-1892240	-1513507	-1163617	-840338	-250168	295241
Loss of containers = 6	-1792240	-1321133	-885905	-483776	-112188	231218
Loss of containers = 7	-1692240	-1128759	-608192	-127214	317234	727975
Loss of containers = 8	-1592240	-936386	-330479	229347	746655	1224729
Loss of containers = 9	-1492240	-744012	-52766	585909	1176077	1721485
Loss of containers = 10	-1392240	-551638	224947	942470	1605499	2218242

Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008)

Figure 5.3.1: Summary for Loss of Containers from 5-10 per year and Payback returns.



Source: Drawn by author: ©Copyright K.N.C.MOHAN, WMU-ITL Shanghai, 2008)

Chapter 6 Conclusion

This Dissertation "The Research on Container Operations at Container Freight Station, and RFID Implementation Hyderabad" studies the operations and procedures at CFS Kukatpally Hyderabad and evaluates the use of RFID technology at the CFS. The study has been successful in identifying the areas of improvement and suggests recommendations to improve the working and services at the CFS. Also, there is a lot of scope for further study in RFID implementation, Product standards, and regulatory approvals and working procedures.

RFID implementation cannot be considered as just an experiment. Once the costs and benefits are better understood, and a strong case for action is developed and accepted by senior management, it must be well translated into a marketing plan, with the applications defined and timetables for execution established — so benefits can be achieved and a reasonable return on investment can finally be generated. RFID can improve the accuracy of incoming data and enhance the transfer of data from point to point. The CFS should consider the need for making use of latest technological methods for improvement of service and in this regard the RFID plays a vital role.

After the study and upon the evaluation of analysis the author wishes to submit the following recommendations to CWC to improve the services at CFS.

1. Computerization of all activities in the CFS
2. Install video camera CCTV within the yard, warehouses, and gate. This is not very costly but will improve the visibility of operations.
3. Presently no provision for handling Refrigerated containers. The CFS should consider enabling facility for the same.
4. Establishment of Customs message exchange with ports, airports, CONCOR, banks and DGFT.

5. Extension of payment of charges through more banks via e-banking to enable importers pay warehouse charges through internet and clear goods quickly. This facility is available for paying the customs duties. The number of banks with such agreement can be extended. This would enhance transparent functioning, expeditious payment of Customs duty and overall reduction of dwell time in clearance of imported goods.
6. In line with international practice, the system of checking samples from each consignment should be substituted with checking a few sample consignments while allowing the bulk of consignments to move without physical examination.
7. A Risk management system to be implemented which would provide for selective screening of high risk cargoes while expediting clearances of low risk cargoes.
8. A Risk based Accredited Clients Programme (ACP) should be implemented. This ACP coupled with the self-assessment and examination waiver, on the basis of risk evaluation would result in clearances without assessment and examination by the Customs Officers. This would result in a steep reduction in the Customs component of Dwell Time. The two main customs components of dwell time of cargo are assessment and examination of goods. Implementation of RMS will bring about significant reduction in these components. For the accredited clients under the Risk Management System, who will be accorded assured facilitation, the time taken for assessment and examination will be virtually eliminated. As far as dwell time is concerned, the introduction of Risk Management System (RMS) with the benefit of green channel being extended to a large number of accredited clients (ACP) would considerably reduce the time taken for clearance of imported cargo.
9. Out of three main components of dwell time i.e.:
    a. Assessment to payment of duty,
    b. Examination of goods, and
    c. Registration of goods for issue of out of charge from customs, no time will be taken for assessment and for the examination of goods under the RMS and ACP program. To this extent, there would be considerable reduction in the dwell time.
10. The RMS would also benefit in terms of increased accountability, transparency, uniformity and expeditious clearance of goods on the basis of focused, consistent, structured and scientific risk analysis.

11. The objective of the Risk Management System (RMS) with the "Accredited Client's Programme" (ACP) is to grant assured facilitation to importers who have demonstrated capacity and willingness to comply with the laws.
12. The dwell time attributable to Customs and other aspects should be measured and monitored and find scope of improvement.
13. Staffing at CFS on 24x7 basis with attendant facilities from Customs and other agencies Ports, Banks. In view of increased volume of cargo, it would be wise to explore the possibility of round the clock Customs functioning at some identified ports. CWC should identify number of posts at each level which would be required for 24X7 operations. It is important that functional staff of other agencies like Customs, banking, security, customs house agents, and shipping agents should also be made available for a successful 24X7 operation.
14. Use of EDI system for purposes of monitoring of time taken for Custom assessment, examination and other aspects before the container/load is finally cleared from the yard.
15. RFID for franchise containers, import/ export containers in the yard. RFID tags on pellets in the warehouses should be installed.
16. Development of software to implement standardized measurement of dwell time for import and export of goods for continuous evaluation.
17. Increasing the use of E-filing. Customs House Agents Importers Exporters filing to move more than a minimum stipulated say 5 documents per working day to file the documents only through e-filing system. This is a progressive move towards automated on line filing of customs.
18. Traffic restrictions during the day time hours are a serious impediment in the growth of the CFS and in improving services of the CFS. Customers within the city limits have to wait till 10 PM in the night for shipping the container. Comprehensive measures have to be adopted to overcome the traffic problems.

List of References

Anthony (Buzz) (2000) Cerino, William P. Walsh, “Research And Application of Radio Frequency Identification (Rfid) Technology to Enhance Aviation Security”, Basic Commerce and Industries.

Anupindi, R., S. Chopra, S. D. Deshmukh, J. A. Van Mieghem, E. Zemel. (2006) “Managing Business Process Flows” Principles of Operations Management, Second Edition, 2006 (2).

BALLIS, A. GOLIAS, J. Towards the improvement of a combined transport chain performance. European Journal of Operational Research. Elsevier, 2004, Vol 152, Issue 2, p. 420–436.

Beresford, A.K.C. and Dubey, R.C. (1990). Handbook on the management and operation of dry ports. Geneva, UNCTAD.

Browse LXE’s company’s official Web site, “www.lxe.com”

The CONCOR official website: “http://www.concorindia.com

The book on “Containerization International Yearbook 2007”.

Free materials used for reference from Web Added Value Resource Centre at “http://www.jrosspub.com.”

Hsu, C. -I. et al., Applying RFID to reduce delay in import cargo ..., Computers & Industrial Engineering (2008), doi:10.1016/j.cie.2008.02.003

Hyderabad Customs Official website: http://hyderabadcustoms.ap.nic.in/customs/asp/cwc.asp

Indian Ports Association Official website: http://www.ipa.nic.in/oper.htm
In-loc project report – Strategies for development of ports into logistics centers function. Centre for Maritime Studies, University of Turku, Finland, 2005. 24 p

International Labor Organization (ILO, 1995). Container freight station operations (Unit C.1.6). Geneva, Switzerland.

Jones, Clarke-Hill, Shears, Comfort and Hiller. (2004). “Radio Frequency Identification in the UK: Opportunities and Challenges”, International Journal of Retail and Distribution Management, Volume 32, Number 3, pp 164-171, http://www.ingentaconnect.com.

Limao, N. Venables A.J (2000) Infrastructure, Geography Disadvantage, Transport cost and Trade. http://econ.lse.ac.uk/staff/ajv/nltv.pdf.

Muller, G., (1999): Intermodal freight transportation (4th Ed.). Washington, DC: Eno Transportation Foundation.

NOTTEBOOM (2002), T.E. Consolidation and Contestability in the European container handling industry. Maritime Policy and Management. Taylor & Francis, 2002, Vol 29, p. 257–270.

OECD (2000). Land Access to Sea Ports. European Conference of Ministers of Transport, Round table 113, Paris, 10th-11th December 1998.

PALŠAITIS, R.BAZARAS, D. Analysis of the perspectives of intermodal transport and logistics centers in Lithuania. Transport, 2004, Vol XIX, No 3, p. 119–123

PAROLA, F.; SCIOMACHEN, A. Intermodal container flows in a port system network: analysis of possible growths via simulation models. International Journal of Production Economics. Elsevier, 2005, Vol 97, Issue 1, p. 75–88

Raman, A, N. DeHoratius, Z. Ton. 2001 "Execution: The missing link in retail operations" California Management Review, Volume 43, No. 3, Spring.
RFID Alliance Lab (2000) "UHF EPC Tag Performance Evaluation", http:// ww.rfidjournal.com /article/ article view/1610.

RFID essentials course 1 from RFID Essentials. Further information from obtained from "www.rfidrevolution.com "

RFID Strategic Implementation and ROI: A Practical Roadmap to Success by POIRIER Charles C, MCCOLLUM Duncan

Robert H. Clarke, Diana Twede, Jeffrey R.Tazelaar and Kenneth K. Boyer, "Radio Frequency Identification (RFID) Performance: The Effect of Tag Orientation and Package Contents", Packaging Technology and Science, 2005

RUTTEN, B. C. M. The design of a terminal network for intermodal transport. Transport Logistics, 1998, No 1, p. 279–298

Sandip Lahiri, "RFID sourcebook", Upper Saddle River, N.J. IBM , 2006

Simplification of Real-time Location Systems Using the Radio Frequency Identification Integration Platform "http://www.lrni.com"

SLACK, B. Satellite terminals: a local solution to hub congestion? Journal of Transport Geography. Elsevier, 1999, Vol 7, Issue 2, p. 241–246.

The ROI for Automatic Container Tracking Using RFID: a Case Study analysis based on Re-usable Intermediate Bulk Containers. "www.axcessinc.com."

The State of RFID Applications in Libraries." By Mr. Jay Singh, Information Technology & Libraries no.1(Mar.2006) pp.24–32

Thomas, B.J.(1985) Operations Planning in Port UNCTAD monogram on port management http://www.unctad.org/en/docs/ship4944_en.pdf

Zaragoza,S. (2005) "Tandy using RFID on Wal-Mart shipments", Dallas Business Journal February 11, http://www.bizjournals.com.