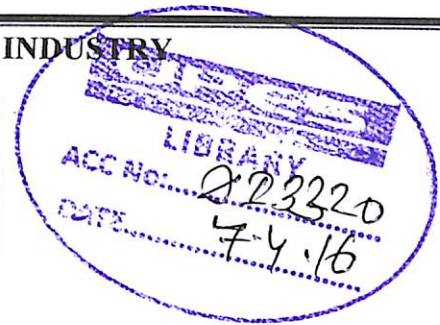
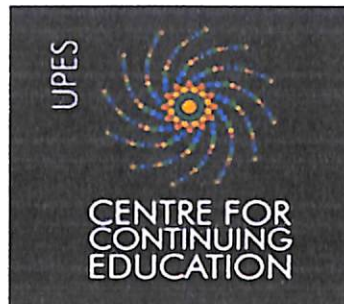


**ROLE OF AIR CARGO HANDLING IN AN AVIATION INDUSTRY**



By

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**A DISSERTATION REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE  
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EXECUTIVE BACHELOR OF BUSINESSADMINISTRATION IN AVIATION OPERATION  
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**UNIVERSITY OF PETROLEUM & ENERGY STUDIES, INDIA**

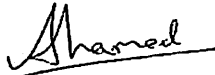
**CENTRE FOR CONTINUING EDUCATION  
UNIVERSITY OF PETROLEUM & ENERGY STUDIES, DEHRADUN**

# **ROLE OF AIR CARGO HANDLING IN AN AVIATION INDUSTRY**

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## Declaration by the Guide

This is to certify that Mr. AHAMEDKUTTY.PS a student of BBA (AO), Roll No 500028395 of UPES has successfully completed this dissertation report on "ROLE OF AIR CARGO HANDLING IN AN AVIATION INDUSTRY" under my supervision.

Further, I certify that the work is based on the investigation made, data collected and analyzed by him and it has not been submitted in any other university or institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of MBA/ M Phil/ PGDFM/ BBA.

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## Executive summary

Air cargo plays a crucial role in today's world. Whether it's through express shipments providing expedited service, cargo carried in the holds of passenger aircraft linking together businesses across the globe, freighters delivering cargo on high volume trade lanes, or chartered flights providing needed supplies on special service schedules, the air cargo industry serves as a key engine of economic growth and development. It supports trade and investment, promotes connectivity, and improves efficiency and competitiveness.

Air cargo represents a relatively small percentage by volume of world trade (less than 10%) - but its significance leaps by value, where it accounts for more than 30% of international trade. In other words, air cargo is oriented towards high value or time sensitive products. For example, the express industry has enabled the widespread adoption of just-in-time practices by many businesses, which saving countless dollars in inventory and logistical costs. That said, air cargo continues to expand its clientele and now serves a diverse range of businesses and consumers. It is interwoven into the fabric of everyday life - business and personal - in many corners of the globe.

With time-definite international transactions, production flexibility and speed characterizing much of the new economy, it is nearly certain that air cargo will play an increasingly vital role in the global economy. No other means of transportation is better equipped to meet the economic realities of the new era where global sourcing and selling, and just-in-time logistics, require that producers receive and ship smaller quantities more frequently, quickly and reliably over long distances.

Air services help to improve the competitiveness of almost all aspects of companies' operations, including sales, logistics and inventory management, production and customer support. By expanding the size of the market that can be served, aviation acts as a spur to innovation, increases sales and profits, allows more scope to exploit economies of scale and enhances competition.

Business in sectors such as technology, financial services, pharmaceuticals or business services increasingly require high speed delivery services to ensure they can respond to customers' needs.

Around 60 per cent of air freight travels in the hold of passenger planes, so it travels at the same time as passenger flights do. The remainder is carried on specialist freight services, which includes express carriers. These often need to leave at specific times of day to make international connections.... Freight services are often pushed to more unsociable hours due to the demand for passenger flights at more traveller friendly times. Express services need to operate at such times to fit with customer need - e.g. end of business day collections, delivery by start of day



## CHAPTER 1

### INTRODUCTION

The cargo handling simulator has been developed in order to give a valid mean in the training of tanker's cargo officers. This system allows dramatically reducing training time and providing accelerated and intensive loading/unloading/management experience in a safe and controlled environment. It is possible to simulate loading, unloading and emergency procedures in a controlled and risk-free environment. Cargo is goods or produce transported, generally for commercial gain, by ship or aircraft, although the term is now extended to intermodal train, van or truck. In modern times, containers are used in most long-haul cargo transport. In case of cold chain goods, especially those with limited shelf life, since they are always in transit, such goods are colloquially also referred to as cargo even when in storage such as school stores, perishable cargo storing centers or other temperature controlled storage structures.





## 1.1 HISTORY

### Early years

The first cargo flight took place on the 7 November 1910 in the USA, between Dayton and Columbus, Ohio. Philip Orin Parmelee piloted a Wright Model Baero plane 65 miles (105 km) carrying a package of 200 pounds of silk for the opening of a store. Newspaper clippings quoted the Wright brothers as stating he covered the distance in 66 minutes, but the flight was officially recorded at 57 minutes, a world speed record at the time. It was the first “cargo only” flight solely for the transport of goods; the first flight commissioned by a client, and the first example of multimodal air transport, since the pieces of silk were transported by car from Columbus aerodrome to the store.

The world's first official airmail flight took place on 18 February 1911, at a large exhibition in the United Provinces of Agra and Oudh, British India. The organizer of the aviation display, Sir Walter George Windham, was able to secure permission from the postmaster general in India to operate an airmail service in order to generate publicity for the exhibition and to raise money for charity. This first airmail flight was piloted by Henri Pequot, who flew 6,500 letters a distance of 13 km (8.1 mi), from Allahabad to Naini - the nearest station on the Bombay-Calcutta line to the exhibition. The aircraft used was a Humber - Sommer biplane with about fifty horsepower (37 kW), and it made the journey in thirteen minutes. The world's first scheduled airmail post service took place in the United Kingdom between the London suburb of Hendon, and the Postmaster General's office in Windsor, Berkshire, on September 9, 1911. It was part of the celebrations for King George V's coronation and at the suggestion of Sir Windham, who based his proposal on the successful experiment he had overseen in India. The service ran for just under a month, transporting 35 bags of mail in 16 flights.

In the early 20s, air cargo developed rapidly because numerous entrepreneurs realized aircraft could move high value and low volume consignments much faster than the railroads and

shipping companies. The first scheduled flight from London to Paris in 1919 had only one passenger but carried leather for a shoe manufacturer and grouse for a restaurant. Cinema films were also a frequent consignment: original news bulletins were first carried to a central laboratory to make copies, and then distributed by air throughout Europe for their release in cinemas.



### Post-war years

Although there were a few attempts to organize air freight airlines from the 1920s on, the first commercial airlines that were all-cargo did not emerge until after World War II. In 1945, at a conference in Havana, 57 airlines formed the International Air Transport Association.

In 1948 Berlin was jointly controlled by the Allies and Russians, although the Russians held the area surrounding the city and thus land access. As this access was closed, in the so-called Berlin blockade, an airlift remained the only option to get increasingly urgent deliveries of food, coal, and other supplies to West Berlin. Over 330 days to 12 May 1949 a total of 2.26 million tons of cargo were airlifted to Berlin, an average of 6,800 tons a day, 80% by the US and 20% by the UK.

Although freight traffic developed modestly, reaching only 800,000 tones worldwide by the mid-1950s, the world economy was hitting its post-war stride. Germany and Japan were emerging from their period of purgatory and were poised to take the world of business by storm, the United States was approaching the height of its economic dominance, and Western Europe had recovered from the war. In 1968, Boeing launched the four engines 747, the first wide-body aircraft. The 747 was the first aircraft capable of transporting full pallets in the cargo hold, revolutionizing the air cargo industry.



### Modern air cargo

Despite widespread hopes for a vibrant industry, for decades the air freight did not grow as expected and remained a very small part of total air traffic. For much of the first five post-war decades most carriers saw it as a secondary activity, although there had always been specialized cargo airlines. Some passenger airlines have found the practice of carrying "belly cargo" a highly lucrative enterprise (in fact, it is estimated that 50% of all air freight is moved in this way), to the point where it has lessened the demand for dedicated large cargo aircraft.

Cargo emerged as a solid pillar of the industry in 1990s. The catalysts for the renewed growth in the sector were the express parcel carriers, typified by FedEx, DHL, TNT and UPS, and changes in practices in the manufacturing sector. In 1992, FedEx sent software on computer disks to thousands of customers, allowing them to track shipments from their own workstations.

The rise of internet during in the years that followed contributed to increase the reliability and accessibility to the air cargo industry. Most airlines now offer to their customers' real-time flight status and the booking and tracking options. In addition, the industry is adopting electronic procedures, such as the electronic air waybill, to reduce the amount of paper documentation accompanying each shipment and increasing the security and safety of the transportation. An industry expert estimates that 15-20 tones of air car.



## 1.2 INTERNATIONAL AIR CARGO

The most efficient way to send your items across the globe from one country to other way is the International Air Cargo service. Be it a vehicle or a small gift, the better way to send them would be is through the air cargo. Unlike other transportation methods, the complexity and time included in air cargo is much less relatively compared to other modes .A lot of procedure is available on the online media about the International Air Cargo, but still there are many queries about the actual process involved. To solve this and create awareness, many organizations are planning and are conducting several symposiums on International Air Cargo. Many delegates, and representatives across the countries will be invited .cargo forums and cargo industry people will also be a part of this consortium. The quality of the cargo handling depends on several factors .the aviation protection and security measure must be improved to handle a large number of cargos per day. Apart from the internal security system there must also be security guards monitoring the mobility of cargos in and around the airport. Some International Air Cargo centers would deploy certain sensory equipment's over the place where the actual loading takes place. This is to ensure that access to these cargos is restricted only to certain restricted employees. This protects the cargo from unforeseen damages and problems. By this security measure, the customer is ensured of a very good and a safe transportation of the cargo.

One of the main reasons in booking a good air cargo company is that they automatically takes care the clearance procedure with the customs department. Many countries impose a very strict procedure of handling cargos inside their countries .many items are being banned to be imported from external affairs. This is because of the tight security measure that is being ensemble by both customs and the government organization. But the customer need not worry about this as the International Air Cargo service provider takes necessary measures to safeguard the cargo. Talking about the fares of the air cargo, it's clear that the rates are competitive among the providers of International Air Cargo. The goods can be basically classified into corporate goods, commercial goods and personal goods. Each cargo has its own delivery capacity and hence the rates and duties to be imposed differ. Normally personal cargo is much cheaper than a commercial or a corporate cargo. After packing all the goods and items for air cargo, ensure that markings and labels are placed correctly or there may be any discrepancy during the delivery. A report on the International Air Cargo to be sent is taken by both the cargo company and the customer to ensure that there is no theft or problem occurs during the travel. There may be delays occurring during the cargo process due to some unavoidable circumstances such as bad weather,

air equipment failure, strike etc... An inspection on these strategies must be made thoroughly and then the air cargo is to be booked. Altogether, it is a mutual responsibility of the customer and the company to the air cargo travel to begin and end safely.

### 1.3 CATEGORIES OF AIR CARGO

Dangerous goods are materials or items with hazardous properties which, if not properly controlled, present a potential hazard to human health and safety, infrastructure and/ or their means of transport. The transportation of dangerous goods is controlled and governed by a variety of different regulatory regimes, operating at both the national and international levels. Prominent regulatory frameworks for the transportation of dangerous goods include the United Nations Recommendations on the Transport of Dangerous Goods, ICAO's Technical Instructions, IATA's Dangerous Goods Regulations and the IMO's International Maritime Dangerous Goods Code. Collectively, these regulatory regimes mandate the means by which dangerous goods are to be handled, packaged, labeled and transported.

#### Dangerous in Use

Many products which we encounter on a daily basis can be hazardous to our health if we come into contact with them too often or for too long. The packaging of substances such as household cleaning fluids and gardening products will often carry what are known as Risk and Safety phrases together with one or more small square orange symbols which describe the nature of the hazard and the actions that should be taken if the substance is accidentally spilled or swallowed. The Chemicals (Hazard Information and Packaging for Supply) Regulations, known as CHIP, require suppliers to provide this information to their customers.

Symbols which might be applied to retail packaging are:



These symbols only relate to the hazards in use of the product and do not automatically mean that it is dangerous in transport. However, it must not be assumed that all substances which

are packed in small or retail packaging are not subject to the transport regulations, since the classification criteria are different.

### **Dangerous in Transport**

Substances and materials which are dangerous for transport range from those which present obvious risks, such as explosives and fuming acids, through to more frequently encountered products such as paints, solvents and pesticides.

The transport of dangerous goods is regulated in order to prevent, as far as possible, accidents involving people or property, damage to the environment, to the means of transport employed or to other goods being transported. Each mode of transport, (air, sea, road, rail and inland waterway) has its own regulations but they are now largely harmonized with the Model Regulations, published by United Nations Economic and Social Council's Committee of Experts on the Transport of Dangerous Goods. The UN Model Regulations use a classification system in which each dangerous substance or article is assigned to a CLASS, depending on the nature of the danger it presents. There are 9 Classes, some of which are sub-divided:

#### **Class 1 - Explosives**



#### **Class 2 - Gases**

Division 2.1 Flammable gas



Division 2.2 Non-flammable non toxic gas



Division 2.3 Toxic gas



**Class 3 - Flammable liquids**



**Class 4 - Other flammables**

Division 4.1 Flammable solids

Division 4.2 Substances liable to spontaneous combustion

Division 4.3 Substances which, in contact with water, emit flammable gases



**Class 5**

Division 5.1 Oxidizing agents

Division 5.2 Organic peroxides





**Class 6**

Division 6.1 Toxic substances

Division 6.2 Infectious substances



**Class 7 - Radioactive materials**

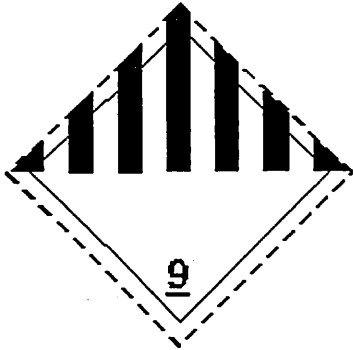


**Class 8 - Corrosives**



### **Class 9 - Miscellaneous**

Class 9 includes items such as asbestos, automotive airbags, lithium batteries and environmentally hazardous substances which don't fit into any of the other 8 classes.



Whilst the CLASS defines the type of danger which a substance presents, a second classification, called the PACKING GROUP (PG) defines just how dangerous it is. There are three Packing Groups; PG I is the most dangerous, PG II represents a moderate danger and PG III is the least dangerous. Packing Groups are always written in Roman numerals to differentiate them from the Class numbers.

It is possible for a substance to appear in more than one Packing Group, depending on its concentration. For example, concentrated sulphuric acid is Class 8, PG II. A mild solution of the same acid, which might be marketed as a domestic drain cleaner, is still allocated to Class 8, but because of its lesser corrosivity could be PG III.

### **1.4 RESEARCH HYPOTHESIS**

- To ensure that product and services are aligned with customer need.
- A major issue in the layout of airports is the extent to which cargo handling activities take place on the airport versus outside the airport boundaries.
- To ensure a certain level of quality in a product or services.

To eliminate or minimize waste improvement targets should include the partial or redundancy of unnecessary transportation, delay and inspection steps, etc, and redesign the inefficient layout, process sequences and flows.

## CHAPTER 2

### LITERATURE REVIEW

#### **2.1 AIR CARGO OPERATIONS**

Cargo handling operations at airports involve the preparation of cargo shipments, the loading and unloading of the aircraft, and the transfer of cargo between the storage facilities and land transport. For outbound cargo, the preparation includes consolidation of cargo, building up of the air cargo pallets and containers, inspection and documentation. For inbound cargo, the preparation includes customs and other regulatory procedures, as well as deconsolidation. For transshipment cargo, the operation is generally limited to unloading, reconsolidating, and reloading the cargo but can be as simple as a direct transfer between aircraft (sometimes known as tail-to-tail transfer). Although air cargo ideally remains in the airport for a relatively short time, it is necessary to provide storage facilities. Bonded facilities are required for imports and international transshipment cargo. For perishable cargoes, it is necessary to provide cold rooms. For outbound cargo, it is necessary to provide X-ray scanners to inspect the cargo. Since most air cargo is low density, most of the cargo is stored on racks, preferably in large open warehouses with high ceilings (more than eight meters). The storage areas must be equipped with loading docks on the landside to allow for rapid movement of goods to and from trucks. Most airports also provide offices near the warehouses for the airlines and forwarders to receive/deliver cargo and prepare shipping documents, and for customs to clear import and export cargo. A major issue in the layout of airports is the extent to which cargo-handling activities take place on the airport versus outside the airport boundaries. The airlines receive and dispatch cargo on the airport. Inspection is generally done on the airport including scanning, which generally implies that the pallets are built up on the airport. Beyond that, exporters, importers and forwarders generally prefer to locate their activities outside the airport to avoid space limitations and reduce operating costs. Where possible, they also prefer to build their own pallets and ULD containers prior to delivery to airlines, especially where they have to maintain a cool/cold chain for temperature-sensitive perishables. However, this requires that pallets/containers be accepted "as is" without having to be broken down for inspection and then rebuilt. In order to do this, the airlines and security officials must certify the forwarder's warehouse as well as the forwarder or shipper. Alternatively, if there is sufficient cargo volume, more expensive full pallet scanners can

be introduced. On-airport cargo terminals are usually multi-tenant. These may be common-user spaces managed by an authorized cargo handler, but, as traffic levels increase, carriers and integrators often want to have their own space. Initially this may be space rented on a long-term basis but eventually they need their own facilities. Similarly, forwarders/customs agents may occupy a designated storage area or merely place their customers' consignments in a common area. In order to accommodate different carriers and consolidators, various airports have established cargo villages. These are sites with multiple cargo terminals. They usually evolve from the existing warehouse facilities, but in some cases are constructed on a new site. The village is designed to allow better coordination of operations and improved traffic flow. It also allows for provision of a common office building to simplify the interaction between the carriers, forwarders and shippers. An alternative is to construct a larger, multi-story warehouse and lease space to the various parties. In the case of Dubai, both strategies have been applied with the introduction of a Mega Cargo Terminal within the Cargo village. Customs has an important role in the use of an airport for import cargo and more particularly for transshipment cargo. Because of the high value and time sensitivity of air cargo, it is important to minimize the time required for clearance of import cargo and to simplify the procedure involved in cargo transshipped through the airport. Many countries have developed a dual track for clearing goods. Expedited services are provided for express package services allowing them to meet tight delivery schedules, while large shipments are cleared more slowly. Most major airports in developing countries can clear cargo in a few hours to one day. While this is quite rapid relative to cargo shipped on other modes, anything over six hours must be considered inefficient and a reasonable target would be two hours. This is possible because of the level of computerization of airfreight documentation, which allows submission of the IGM (Inward General Manifest) at the time of departure from the previous airport. Slow clearance times are usually associated with the failure of customs and shippers to adopt modern information and communications technology. These systems are also important for tracking shipments and for ensuring efficient use of warehousing space.



## 2.2 HANDLING OF DANGEROUS GOODS AND HAZARDEOUS CARGO MATERIALS

Dangerous goods are solids, liquids, or gases that can harm people, other living organisms, property, or the environment. They are often subject to chemical regulations. In the United States and sometimes in Canada, dangerous goods are more commonly known as hazardous materials. "HazMat teams" are personnel specially trained to handle dangerous goods. Dangerous goods include materials that are radioactive, flammable, explosive, corrosive, oxidizing, asphyxiating, biohazardous, toxic, pathogenic, or allergenic. Also included are physical conditions such as compressed gases and liquids or hot materials, including all goods containing such materials or chemicals, or may have other characteristics that render them hazardous in specific circumstances. In the United States, dangerous goods are often indicated by diamond-shaped signage on the item its container, and/or the building where it is stored. The color of each diamond in a way has reference to its hazard, i.e.: Flammable is indicated with red, because fire and heat are generally of red color, Explosive is indicated with orange, because mixing red (flammable) with yellow (oxidizing agent) creates orange. Non-flammable/Non-toxic Gas is indicated with green, due to all compressed air vessels being this color in France after World War II, and France being where the diamond system of HazMat identification originated. Mitigating the risks associated with hazardous materials may require the application of safety precautions during their transport, use, storage and disposal. Most countries regulate hazardous materials by law, and they are subject to several international treaties as well. Even so, different countries may use different class diamonds for the same

product. For example, in Australia, Anhydrous Ammonia UN 1005 is classified as 2.3 (Toxic Gas) with sub risk 8 (Corrosive), whereas in the U.S. it is only classified as 2.2 (Non Flammable Gas). People who handle dangerous goods will often wear protective equipment, and metropolitan fire departments often have a response team specifically trained to deal with accidents and spills. Persons who may come into contact with dangerous goods as part of their work are also often subject to monitoring or health surveillance to ensure that their exposure does not exceed occupational exposure limits. Laws and regulations on the use and handling of hazardous materials may differ depending on the activity and status of the material. For example, one set of requirements may apply to their use in the workplace while a different set of requirements may apply to spill response, sale for consumer use, or transportation. Most countries regulate some aspect of hazardous materials.



## 2.3 EFFICIENCY OF CARGO HANDLING

### Material-Handling Equipment

Material-handling equipment is equipment that relate to the movement, storage, control and protection of materials, goods and products throughout the process of manufacturing, distribution, consumption and disposal. Material handling equipment is the mechanical equipment involved in the complete system. Material handling equipment is generally separated into four main categories: storage and handling equipment, engineered systems, industrial trucks, and bulk material handling. Material handling equipment is used to increase output, control costs, and maximize productivity. There are several ways to determine if the material-handling

equipment is achieving peak efficiency. These include capturing all relevant data related to the warehouse's operation, measuring how many times an item is "touched" from the time it is ordered until it leaves the building, making sure you are using the proper picking technology, and keeping system downtime to a minimum. A special analytical data-set known as Stock-keeping units (SKUs) has been devised to aid analysis of materials handling, which is obviously less efficient when a material asset is handled any more than a minimally necessary number of times.

### **Storage and Handling Equipment**

Storage and handling equipment is a category within the material-handling industry. The equipment that falls under this description is usually non-automated storage equipment. Products such as pallet racking, shelving, casters and carts, among others, belong to storage and handling. Many of these products are often referred to as "catalog" items because they generally have globally accepted standards and are often sold as stock materials out of Material handling catalogs.

### **Engineered Systems**

Engineered systems are typically custom engineered material-handling systems. Conveyors, Handling Robots, AS/RS, AGV and most other automated material-handling systems fall into this category. Engineered systems are often a combination of products integrated to one system. Many distribution centers will optimize storage and picking by utilizing engineered systems such as pick modules and sortation systems.

Equipment and utensils used for processing or otherwise handling edible product or ingredients must be of such material and construction to facilitate thorough cleaning and to ensure that their use will not cause the adulteration of product during processing, handling, or storage. Equipment and utensils must be maintained in sanitary condition so as not to adulterate or contaminate product.

### **Industrial Trucks**

Industrial trucks usually refer to operator driven motorized warehouse vehicles, powered manually, by gasoline, propane or electrically. Industrial trucks assist the material-handling system with versatility; they can go where engineered systems cannot. Forklift trucks are the most common example of industrial trucks but certainly aren't the extent of the category. Tow tractors and stock chasers are additional examples of industrial trucks. Their greatest advantage lies in the wide range of attachments available; these increase the truck ability to handle various types and shapes of material.





## CHAPTER 3

### RESEARCH DESIGN AND METHODOLOGY

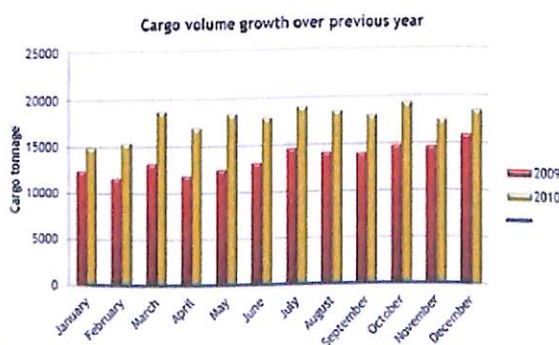
#### **3.1 AIR CARGO GROWTH IN INDIA**

The Air Transport industry is undoubtedly an important element of national and global economies so there exists abundance of literature on various aspects of airports and airline market such as prediction of air transport demand from regional airports, air transport demand and economic growth, importance and role of yield management for airlines, air transport accessibility and economic performance & air transport passenger analysis with neural modeling, air transport liberalization and sustainability. A rich body of literature is found on forecasting air traffic flows by Shaw, Matsumoto, Grubb and Mason, Jorge-Calderon, Abed et al. There are few papers available on Indian air transport sector but as far as air cargo industry is concerned, limited research has been done. In today's economy, air cargo sector has become indispensable to facilitate global trade, logistics and supply chain management. So there exists strong demand for predicting air cargo growth. Jiang et al, forecasted China's air cargo demand till 2020 by using econometric and extrapolation methods. As economic growth is considered the prime driver for air cargo demand, the forecast of China's air cargo is projected based on the relationship between air cargo demand and economic development (GDP) through econometric methodology which is used to determine the GDP and air cargo relationship and GDP projections are obtained by trend analysis. Kasarda and Green had shown the same empirical relationship between air cargo and economic indicators such as trade and GDP and considered air cargo as lead factor for economic development. Chang and Chang had shown empirical relationship along with long run equilibrium and bi-directional relationship between air cargo expansion and economic development. Heng et al, has established support vector machine (SVM) model for air cargo demand forecasting taking historical data of cargo volume as forecasting specimen and prediction model was compared with Brown's cubic exponential smoothing based on fitting effect and forecasting accuracy. The forecast report generated by

Boeing reflects that world air cargo traffic will triple over the next twenty years compared to

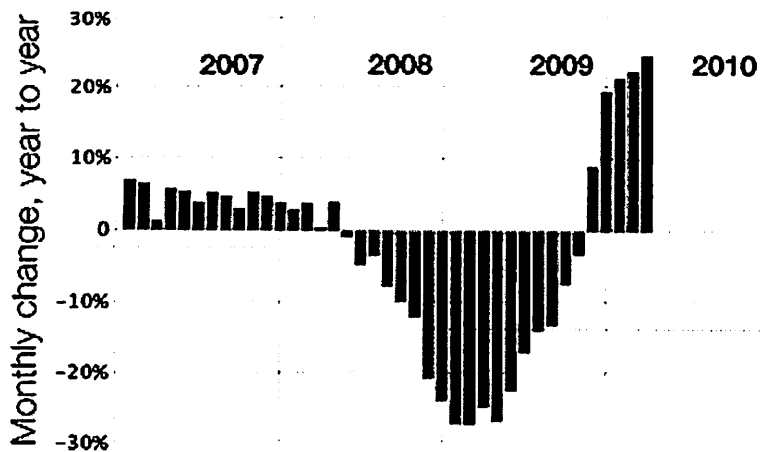
2009 levels with an average annual growth rate (AAGR) 5.9% in spite of global economic downturn such as rising jet fuel price, weak economic growth, turmoil in financial markets etc. GDP growth not only drives international trade but also stimulates air freight which will grow at nearly double the GDP growth rate. To tamane et al, proposed a multi producer/consumer solution for predicting cargo demand through weighted majority learning algorithm of a specific airline in a given route and cargo load factor for its flight schedule. To handle the variety and complexity of managerial forecasting problems multiple forecasting techniques have been developed. These methodologies such as econometric modeling, judgmental analysis, trend analysis and potential analysis are considered useful to provide forecast. Econometric modeling helps to determine the overall importance of underlying economic factors like GDP, trade, fuel price etc. and enables forecasts to be linked to expectations for those factors. This method is useful for medium and long range forecasts in regional markets. Judgmental modifications often account for expected changes in non-econometric growth factors like trade quotas, air service agreements etc. A simple trend analysis is often used to evaluate changes in economic factors. This approach is useful in evaluating general changes in the marketplace that can be attributed to the combined effects of a number of factors. Potential analysis is useful, particularly for forecasting markets in their early stages of development. Each methodology has its special application according to the situation; therefore special care must be taken to select one or multiple techniques. From the above literature review it is evident that there exists good scope of doing research particularly in the field of Indian Air cargo industry when Asian market is booming. Previous researchers have forecasted air cargo demand by establishing the relation between air cargo, GDP and trade. Although economic activity is having strong influence on air cargo growth, other factors must be considered. In this study fuel price is also considered having significant impact on air cargo growth along with GDP and trade. This research focuses on examining the impact of economic factors (GDP, trade, fuel price) on air cargo growth then generating the forecast

India using multiple and finally predictive been assessed based on forecast accuracy measurement.



of air cargo demand in forecasting techniques ability of the model has fitting effect and through error

## World air cargo growth



Sources: U.S. Department of Commerce, AAPA, AEA, ATA and the Boeing World Air Cargo Forecast

### 3.2 AAI: CARGO INFRASTRUCTURE

The Airports Authority of India (AAI) under the Ministry of Civil Aviation is responsible for creating, upgrading, maintaining and managing civil aviation infrastructure in India. It provides Air traffic management (ATM) services over Indian airspace and adjoining oceanic areas. It also manages a total of 125 Airports, including 11 International Airports, 8 Customs Airports, 81 Domestic Airports and 25 civil enclaves at Military Airfields. AAI also has ground installations at all airports and 25 other locations to ensure safety of aircraft operations. AAI covers all major air-routes over Indian landmass via 29 Radarinstallations at 11 locations along with 89 VOR/DVOR installations co-located with Distance Measuring Equipment (DME). 52 runways are provided with Instrument landing system (ILS) installations with Night Landing Facilities at most of these airports and Automatic Message Switching System at 15 Airports. AAI's implementation of Automatic Dependence Surveillance System (ADSS), using indigenous technology, at Kolkata and Chennai Air Traffic Control Centre's, made India the first country to use this technology in the South East Asian region thus enabling Air Traffic Control over oceanic areas using satellite mode of communication. Performance Based Navigation (PBN)

procedures have already been implemented at Mumbai, Delhi and Ahmadabad Airports and are likely to be implemented at other Airports in a phased manner. AAI is implementing the GAGAN project in technological collaboration with the Indian Space Research Organization (ISRO), where the satellite based system will be used for navigation. The navigation signals thus received from the GPS will be augmented to achieve the navigational requirement of aircraft. First phase of technology demonstration system was completed in February 2008.

AAI has four training establishments viz. The Civil Aviation Training College (CATC) at Allahabad, National Institute of Aviation Management and Research (NIAMAR) at Delhi and Fire Training Centre's (FTC) at Delhi & Kolkata. An Aerodrome Visual Simulator (AVS) has been provided at CATC and non-radar procedural ATC simulator equipment is being supplied to CATC Allahabad and Hyderabad Airport. AAI has a dedicated Flight Inspection Unit (FIU) with a fleet of three aircraft fitted with flight inspection system to inspect Instrument Landing Systems up to Cat-III, VORs, DMEs, NDBs, VGSI (PAPI, VASI) and RADAR (ASR/MSSR). In addition to in-house flight calibration of its navigational aids, AAI undertakes flight calibration of navigational aids for the Indian Air Force, Indian Navy, Indian Coast Guard and other private airfields in the country. AAI has entered into Joint Ventures at Mumbai, Kolkata, Delhi, Hyderabad, Bangalore and Nagpur Airports to upgrade these airports. The air freight sector in India has been growing at a Compounded Annual Growth rate of 11.36% from 2006-2011, and it is expected to maintain a further growth rate of 10% yearly by 2014. During the last five years, the cargo handled at Indian airports witnessed Compounded Annual Growth Rate (CAGR) of 10.9% with international cargo accounting for two-thirds of the total cargo handled mainly at Mumbai, Delhi, Hyderabad, Bangalore and Chennai. The fact that the international cargo traffic to India mainly concentrates on Mumbai, Delhi and Chennai has been considered to be an anomaly so far as the Qatar Airways is concerned. The carrier operates daily wide body capacity into Chennai and Mumbai and twice daily wide body capacity into Delhi thereby offering substantial cargo capacity in these markets. Chennai will continue to be the cargo hub of the carrier with 6 weekly freighter services with a combination of A300-600F and 777 freighters. "Currently, on an average our cargo load factor to and from India is about 85-90 per cent." Paul Rajaratnam, Regional Cargo Manager – ISC, Qatar Airways. Similarly, according to KekuGazder, Regional Director Cargo - Indian Sub Continent,

Saudia Cargo, the combined export load factor is in the region of apex 90 per cent while the inbound load factor averages 75 per cent, currently. However, in accordance with FICCI -KPMG report, the average weight load factor of air cargo in the last five years was about 62 per cent, which means there is lot of unused capacity. Accordingly, the total air cargo volume handled by all Indian airports together could be just about touching the 2.75-million-tonne mark this fiscal year, which is less than what is handled by airports such as Hong Kong, Shanghai and Paris. The varying factors, as indicated above, currently prevalent in the Indian air cargo sector highlighted the need to form a promotion board to improve this sector. With a view to understand the potentials, expectation, bottlenecks and to provide a support mechanism for inclusive growth of air cargo, a Working Group was formed by the Ministry of Civil Aviation with representation from all stakeholders of the Air Cargo Industry such as Ministries, PSU, Air Terminals and cargo related Associations. The Working Group, after extensive deliberations spread over a year and about a dozen meetings, come out with a report titled Air Cargo Logistics in India, recommending various measures to support the sector. One of the major recommendations of this report was the formation of Air Cargo Logistics Promotion Board to be constituted with representation from various Ministries involved in or with air cargo. The Board, which has since been constituted, is expected to establish fast track mechanism for improving the air cargo industry in India. Transshipment has been covered extensively in the report. Owing to India's geographic location, it can become an international cargo hub. The report recommended the creation of four air cargo hubs in the country in the next twenty years. Taking into consideration the facts that India needs to transship cargo from neighboring countries, connect them to Europe and America and many do not have direct flights to these destinations, the Board should take it forward and resolve outstanding issues to facilitate evolution of cargo hubs in the country. Infrastructure for transshipment remains a key hurdle. It is said that the logistics infrastructure when planned should be 20 years ahead of requirement and when executed it should be 10 years ahead of requirement. However, due to long bureaucratic delays between planning and execution, in India, the infrastructure is 10 years behind the requirement where the road rail, ports, airport infrastructure is used at 110-120%. The dedicated freight corridor that will allow speedy transfer of containers at a rail speed of 100km per hour has been delayed, thereby congesting the roads. The study undertaken by the Transport Corporation of India reveals that though India's road freight volumes are increasing at a compounded annual growth rate (CAGR)

of 9.8% and the population of vehicles, inclusive of all type, is increasing at a CAGR of 10.76%. However, on the contrary, the road length is increasing at a CAGR of only 4.1%, proving to be grossly inadequate to cater to the growing demand. Adding on to the delay in transit is the dwell time at airports. Owing to inadequate capacity and efficiency, the airports are increasing dwell time with effect on costs. "Unlike foreign airports like Singapore, Schiphol, Paris, Hong Kong, Frankfurt and Dubai, the custom processing activities for international cargo happens at the Indian Airports due to which the dwell time is higher at Indian Airports," commented Radharaman Panicker, CEO of Cargo Service Centre. Whilst the dwell time for export cargo, in India, is generally two days as against 8 to 9 hours in foreign airports, dwell time for import cargo is 4 to 5 days as against 6 hrs in foreign airports. According to Mr. Panicker, the terminal operators in India restrict their work as custom custodians of cargo. Therefore, the import cargo is directly delivered to custodian and is not in the hands of handlers of the airline. "This has severe limitation. The airline's responsibility for import cargo ceases once it is delivered to the custodian unlike abroad where the cargo remains in airline custody until delivered to consignee," explained Panicker.

A warehouse is constructed based on the long term concession awarded to the cargo handler by the airport. "You have to create a warehouse keeping in mind the long term demand requirement for capacity set by the airport which may match or not match in future with actual demand. So you are stuck with investment which may not yield good results," cited Panicker. Taking cue from the success of Container Freight Station for sea cargo, there can be more Air Freight stations for air cargo. CSC and CONCOR jointly started an Air Freight Station at Mulund. CONCOR plans to open more AFS at its IDS in India.

It is a fact that warehouse capacity at the Indian airports have not kept pace with the demand. It is inadequately planned to cater to the future demand during the next 10 to 15 years. "However airports like Delhi are creating capacity well ahead of demand," says Panicker. As per the DGCA, Ministry of Civil Aviation, report though the air cargo volume in India in next twenty years will be more than 15.44 million MT, the capacity presently exists can cater to only 6 million MT leaving behind a shortfall of nearly 10 million MT of capacity.

The airlines are cribbing over low rates, high taxes and high ATF. The 49% FDI in Indian Aviation still has no takers so far. Etihad Airways welcomed the FDI decision and there was speculation about its talks with Jet Airways but nothing has been in public yet. Its subsidiary Etihad Cargo has appointed a new cargo sales team in India, AVS Cargo Management Services to strengthen its operations in Mumbai, Bengaluru, Chennai and Delhi.

Even though South Asia's aviation growth has been pegged at 8.4% by Boeing world forecast up to 2031, which is higher than the world aviation growth forecast of 5%, the infrastructure lag may not allow India to realize its potential fully. The root causes of all this is the bureaucratic red tape in India those delays infrastructure projects. The implementation of Goods and Service tax is long pending; the congested Mumbai International airport which is expected to share the traffic with Navy Mumbai International airport is not getting any sign of relief. Moreover the billion cores up gradation at Mumbai International Airport Limited (MIAL) which is scheduled for completion by 2014 will provide capacity to handle one MMT of cargo and it handled 656,369 tons of cargo during FY 2011-12.

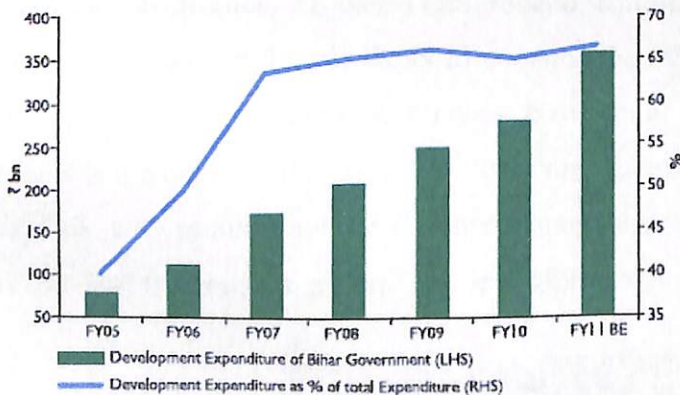
The Indian pharmaceutical industry is growing at an annual rate of 8-9%. According to McKinsey, the Pharmaceutical Market is ranked 14th in the world and 3rd in terms of manufacturing by volumes. By 2015 it is expected to reach top 10 markets in the world. Hyderabad is India's pharmaceutical capital where the Genome Valley has more than 100 operational pharmacy companies. The demand to carry the pharmaceuticals generated in this region has increased and the pharmacy zone at the Hyderabad international airport is facilitating this with the apt environment to operate. Lufthansa Cargo that specializes in carrying temperature sensitive pharmacy equipments operates freighter service four times a week on Mumbai- Hyderabad- Sharjah- Frankfurt route. While Thai Airways recently began operating B747-400F service on Bangkok-Hyderabad-Frankfurt routes, with more airlines expressing keenness to connect to Hyderabad International Airport.

The Greenfield airport at Bangalore where GVK has 29% stake, also holds huge potential for clothing, IT products, etc. Mr. Rajaratnam from Qatar Airways points out that with the



development of supporting infrastructure in the new Greenfield airports such as Bangalore and Hyderabad, it will also experience larger and more frequent capacity additions. Amongst the Airport Authority of India operated airports, the Ahmadabad airport recorded a massive 84.1 per cent rise in freight traffic in July 2012 as compared to the same period last year. Moreover the youth in India are spending more on high end products and clothes. Huge amount of telecom equipments, engineering goods, pharmacy, perishables are exported by air from India. "The Indian market is in a better position with exports, at par with last year and better positioned compared to the rest of Asia. It is difficult to predict trends as market dynamics are so uncertain – be it market capacity, volatility of rates, spiraling cost of operations, exchange rates, tax policies etc. " said Keki Patel Emirates Cargo Manager India & Nepal " We have healthy cargo load factors almost full cargo payload utilization on most of our 185 weekly flights and freighter services." he added. It is said that the Middle Eastern carriers are growing rapidly in India, and have deployed freighters with good frequency. The Indian national carrier which ended freighter aircraft operations in early 2012 is expecting to make huge profits with the addition of B787 into its fleet. A good handling of the national carriers' operations, often prescribed by analysts and observers to overcome the shortfalls, is yet to be heeded. With upgradation plans and the formation of air cargo promotion board, a steady growth is anticipated. The spirit of the common man to grow and consume is seen in the high level of growth in the middle class. The springing up of multinational companies, high consumption levels and demand are leading India towards faster growth with only deterrent being infrastructure which is the catalyst.

**Chart 3.8: Increased focus on development**



Source: Economic Survey of Bihar

- Focus on infrastructure development can be gauged from the four-fold increase in development expenditure of Bihar during FY05-FY10.
- While we expect this focus on development to continue, the key to rapid increase in growth would be implementation of the proposed development activities.

### 3.3 Air Cargo / Express Cargo

Air cargo operations generates additional revenue for airports and provides better utilization of the airport facilities as majority of these services are undertaken during the non-peak hours. While the amount of cargo freighted via air is growing steadily, the infrastructure related to air cargo handling and evacuation is not. The Government has acknowledged the need for development of cargo related facilities and is taking the necessary steps to address the situation with consistent and coherent application of policies. For a country like India, with its natural challenges in terrestrial transportation, a well networked air cargo system will go a long way in addressing the problem of networking the remote areas and creating a proper international market access to them. Air cargo remains a vital mode of transport for India's international trade especially for products with high value or value addition. The five major airports (Mumbai, Delhi, Kolkata, Chennai and Bangalore) account for around 88% of the total air cargo handled in India. Growth in cargo / freight volumes is an outcome of macro-economic factors such as domestic consumption, exports and imports. The infrastructure needed to cater to the growth remains a major challenge. However, the international and domestic cargo volumes have shown a steady growth despite inadequate capacity and infrastructure. Government's plans for developing MIHAN (The Multimodal International Hub Airport at Nagpur) as the first cargo hub in India are in progress. Some of the cargo service providers include Blue Dart, FedEx, Air India, Crescent Air Cargo, Gati etc. The major commodities being air freighted out of India are garments, machinery components, pharmaceuticals, dyes, chemicals and perishables such as fruits, vegetables, flowers, fish and meat. Due to the high time sensitivity clientele demand, there has also been a steady patronage of air cargo services across industries including telecom, gems and jewellery, electronics, IT and ITES related equipment etc. The increased usage of IT applications in cargo handling is likely to enhance the efficiency of movement of cargo traffic. With the opening of the economy, buoyant trade, new low cost carriers, upgradation of the airports across the country, the cargo handled by air is expected to grow more rapidly in the next decade. This will require not only better connecting transportation infrastructure, but also quality, standard warehouses, and speedy operations through automation.

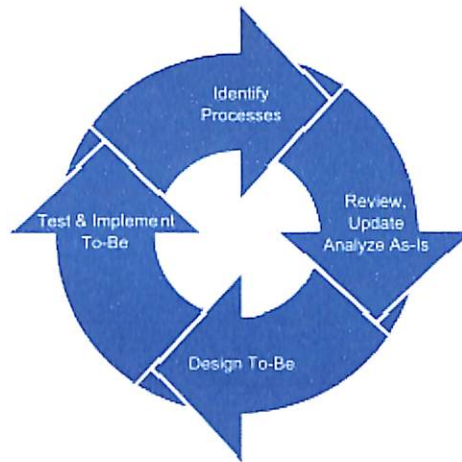


**CHAPTER 4**  
**FINDINGS AND ANALYSIS**

**4.1 BPR OF AN AIR CARGO HANDLING PROCESS**

Business Process Reengineering (BPR) is one of the most recent innovations in industrial engineering and management science which represents the rapid and radical redesign of strategic, value-added processes and the system, policies and organizational structures that support them to optimize the work flows and productivity of an organization. This paper presents a BPR effort and program of an air cargo handling process at an international airport. The objective of this work is to demonstrate the performance breakthrough of a BPR technique to achieve dramatic improvements in critical measures of contemporary performance with respect to quality service and speed in the airlines cargo handling process. Field data on service dimensions of the process have been collected choosing time as metric. Process-flow diagrams, process analysis worksheets and data summary charts are prepared as effective tools to get a thorough understanding of the existing process with a view to focus on the possible areas of improvements. A fact-based defensible and quantifiable "Before-after chart" of BPR has been presented for documenting the expected gains. BPR has proved to be a modern innovative useful industrial engineering and management technique to achieve dramatic improvement in operational efficiencies for quality services of the airlines cargo handling processes. Business process re-engineering is a business management strategy, originally pioneered in the early 1990s, focusing on the analysis and design of work flows and business processes within an organization. BPR aimed to help organizations fundamentally rethink how they do their work in order to dramatically improve customer service, cut operational costs, and become world-class competitors. In the mid-1990s, as many as 60% of the Fortune 500 companies claimed to either have initiated reengineering efforts, or to have plans to do so. BPR seeks to help companies radically restructure their organizations by focusing on the ground-up design of their business processes. According to Davenport (1990) a business process is a set of logically related

tasks performed to achieve a defined business outcome. Re-engineering emphasized a holistic focus on business objectives and how processes related to them, encouraging full-scale recreation of processes rather than iterative optimization of sub processes. Business process re-engineering is also known as business process redesign, business transformation, or business process change management.

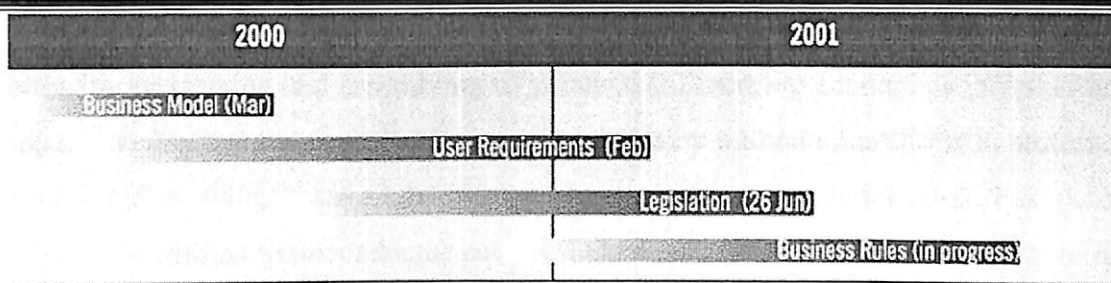


Business Process Reengineering Cycle

Customs is re-engineering its cargo management systems to deliver new import and export processes, increase cargo management efficiency for industry and deliver improved targeting of high-risk cargo. Cargo management re-engineering (CMR) contributes mainly to outputs 1 and 4.

Significant progress was made on the systems redevelopment phase of the re-engineering. As shown in figure, IT system user requirements for a new Integrated Cargo System were developed. This was done in consultation with internal and external stakeholders and outlines what the new system must do to meet the needs of users. The business rules that form the basis for the design of the new system are now being defined. Work processes and structures are also being reviewed to make the best use of the new system.

### **Progress of cargo management re-engineering during 2000 and 2001**



The major benefits to the trading community of this new system will be more open and easy access to the functions of the system and streamlined business processes associated with the reporting and movement of cargo. This includes an enhancement that promotes a single window to government agencies involved in the movement of goods into and out of Australia.

Government and industry will benefit through:

- Early identification of high-risk cargo and, as a consequence, facilitated flow of low-risk cargo
- Tailored arrangements for low-risk importers and exporters under the Accredited Client Program.

The Integrated Cargo System will be introduced through a series of releases to manage the many changes involved. This phased approach allows Customs and industry time to work together to ensure a smooth introduction.

Customs expects to trial Release 1 of the Integrated Cargo System with industry in April 2002. Release 1 primarily relates to air cargo reporting by express carriers. It also affects a range of Customs activities including compliance assurance and targeting and analysis of document consignments. Release 1 will provide most of the IT infrastructure required for subsequent releases.

#### 4.2 THE EVOLVING CHARACTERISTICS OF AIR CARGO TRANSPORT

Since the 1980s, with the reduction of tariffs and other trade barriers, there has been a marked trend towards international integration of economic activity. This has resulted in large volumes of products, raw materials and components flowing across international borders as part of global supply chains. Advanced manufacturing requires a complex international network of

assembly and production sites, shipping parts from one location to the other, and often back to its origin following processing and assembling of products.<sup>2</sup> Emerging economies in Asia-Pacific, in particular, have been at the centre of location strategies by multinational firms in sectors such as electronics and clothing to take advantage of lower labor and material costs. For example, through the 1990s Philips Semiconductor and Dell Computer benefited significantly in terms of cost and shipping time reduction by locating sourcing operations respectively in Thailand and Malaysia (Kasardaet *al.*, 2004). Underlying these developments is also the emergence of a new commercial environment in which time is playing an increasingly important role for competitive success. A prominent advance in production, distribution and inventory control methods is commonly known as “just-in-time”, under which all elements in the value chain are synchronized to decrease production and delivery cycles and reduce inventories. The logic behind just-in-time operations is that inventory costs have become prohibitively high in the production and distribution of many manufacturing products in the new global economy. Early delivery can increase warehousing and inventory expenses, while late delivery can result in costly interruptions of production and foregone sales. Product life spans are also shortening in several industries, such as electronics, pharmaceuticals and designer clothes (Nordåset *al.*, 2006).

<sup>2</sup> It should be noted that exports of manufactured products, particularly in industries characterized by international production sharing, contain a considerable amount of imports. In 2001, for example, the import content represented 32% of export value in the electronics sector in China, 65% in Thailand and 72% in the Philippines (Nordåset *al.*, 2006) and the share is considered to be higher in the Asia-Pacific region. Advanced manufacturing firms are also increasingly locating at sites near air cargo hubs to optimize their location strategies. In many Asian economies, these developments have contributed to foster investment in aviation infrastructure. Airports from Kuala Lumpur, Singapore and Thailand’s new Bangkok International Airport are setting world standards for security and efficiency, operating round the clock. China has made remarkable infrastructure investments in its busiest airports, with major expansions in Beijing, Guangzhou and Shanghai (Senguttuvan, 2006).

Air cargo shipping is a complex Endeavour that involves a wide range of firms and requires on-going coordination between them, both with respect to the physical movement of products and the management and exchange of information. The industry has typically distinguished providers in three core functions, physical carriage, forwarding and integration:

➤ ***Air Carriers:***

Predominantly move cargo from airport to airport and largely rely on freight forwarders to deal directly with customers. So-called *combination* carriers either use only the belly holds of their passenger aircraft and consider cargo as a marginal source of income (e.g. United Airlines); or both dedicated freighter aircraft and the belly holds in passenger aircraft (e.g. Korean Airlines). All cargo airlines operate only freighters on scheduled and non-scheduled operations (e.g. Nippon Cargo Airlines in Japan). In light of the seasonal nature of part of air cargo, charters play a non-negligible role. The bulk of the world's air cargo is carried by combination carriers in scheduled and non-scheduled operations.

➤ ***Freight forwarders:***

Act as intermediaries between airlines and the end customer (e.g. U-Freight and Nippon Express). They contract with airlines for the carriage of goods and buy block space on their flights, consolidate shipments for carriers, and deliver the goods to consignees through contracting with ground transportation services. In addition, by leasing and sometimes operating aircraft, forwarders are also acting as virtual air carriers.

➤ ***Integrated express carriers:***

Constitute a particularly dynamic segment, which first developed in the US facilitated by the 1977 Air Cargo Deregulation Act. Express carriers (e.g. FedEx and UPS) provide as one entity the different components of door-to-door services. To achieve higher speed and reliability, they use dedicated multimodal transport networks, owning and operating their own aircraft of different sizes, surface transportation equipment such as trucks, and automated handling and storage facilities. At times, integrators operate similarly to forwarders, relying on charters and other third party capacity to provide the actual transport services.

In recent years, the traditionally fragmented nature of air cargo firms has undergone profound change. Just-in-time manufacturing and decreasing product life spans, coupled with technology advances (e.g. real-time booking and tracking), have led to a reorganization of the

industry towards more integrated, ground-linked structures. The most prominent challenge to the traditional air cargo system has resulted from the rapid expansion of integrated service providers. Until recently, a single shipment was handled by several airlines, multiple forwarders, as well as customs brokers, warehouse operators, and trucking firms. Express companies have thrived by reducing some of this complexity through the integration of air and ground functions performed by airlines, forwarders, and ancillary service providers (Bowen and Leinbach, 2002). As a result, integrated express operators such as FedEx and UPS now rank among the largest cargo airlines in the world.

Meanwhile, some large international freight forwarders are operating their own trucking fleet to handle goods on the way to and from the airports and are expanding into value-added services for comprehensive supply chain management. So-called third-party logistics (e.g. US-based Geologistics) handle warehousing, order fulfillment, inventory analysis and other logistics functions for multinational clients (Schwarz, 2005). Similarly, airlines are giving a higher profile to their cargo divisions, sometimes making them separate entities. For example, Cathay Pacific has expanded into the express industry with its Wholesale Courier and Cargo Express services (Dodwell and Zhang, 2000). These companies increasingly provide express services similar to those of the express operators. Airlines have also attempted to compete with integrators by forming partnerships with freighter and shipping companies.

Another important development in the airline industry has been the creation of cargo alliances, partly intended to meet the challenges posed by regulation in the sector and by the growth of integrators. Like for passenger services, air cargo carriers have started to cooperate through common service options, sales and compatible information systems in order to build global networks. Air cargo alliances first emerged in 2000 with the establishment of the WOW Alliance (initially named New Global Cargo) and of Sky Team Cargo. Several cargo carriers from APEC economies are members to these alliances. Singapore Airlines Cargo and as of 2004 Japan Airlines are part of the WOW Alliance, while Sky Team Cargo includes Delta Airlines, Korean Airlines and Aeroméxico Cargo. Traditionally, air cargo specialized in high value-to-weight products, perishable goods or urgent items (e.g. medicines). In the late 1990s, the range of air transported products has widened, reflecting an increasingly liberal and dynamic trading environment. The industry has grown with rising value-per-weight of many goods but has also been able to move down the value-to-weight ladder. Electronics and garment account for a



significant share of international air cargo flows. As noted, these industries have combined low-cost labor (particularly in Asia) with air transport in complex, labor-intensive production processes and international supply chains. Other important commodities carried by air include food (e.g. live animals), pharmaceuticals and machine parts (Kasardaet *al.*, 2006). Most cargo airlines are also involved in the transportation of mail.

While for obvious reasons air passenger and cargo transport share many features, there are a number of characteristics which are specific to air freight. For starters, air cargo flows are “unidirectional” since, unlike passengers, goods move in one direction. This imbalance is apparent in the cargo flows between Asia and North America. Secondly, the routing of goods (e.g. whether they fly direct to destinations) is not very important as long as time requirements for delivery are met. Air cargo firms, particularly integrated express operators, also rely considerably on overnight transport in order to make best use of the time between close of business, when a company hands over its shipment, to delivery early the following day (reducing the lead-time of cargo on the ground). Furthermore, air freight is often combined with other modes of transport, which allows the use of more remote and less congested airports.

The air cargo industry has grown at a rapid pace over the past several decades. World air cargo volumes grew at 7.7% per year between 1980 and 2000, more than twice as fast as the growth of GDP (ICAO, 2001). Air cargo growth has subsequently slowed in light of major external events. Work by the WTO Secretariat shows an average growth rate of around 6% between 2000 and 2005; growth was uneven during the period ranging from double-digit growth to actual declines (WTO, 2007). More recently, with the slowdown in world trade caused by the global financial crisis, international air cargo traffic fell considerably (IATA, 2009). Industry specialists also suggest that even though the air cargo industry has often achieved high rates of traffic growth, air cargo revenues have been declining in recent years. IATA estimates that around 50% of air freight is carried in the belly holds of passenger aircraft (quoted in Aviation Week and Space Technology, 7 May 2007), although all cargo airlines and particularly integrated express operators are growing rapidly.

The air cargo traffic pattern in different regions of the world is varied (see e.g. Boeing, 2007; and WTO, 2007). The Asia Pacific region has experienced dynamic growth and currently

accounts for almost 40% of world traffic, while growth has been modest in North America and Europe; the other two largest air cargo markets. According to Boeing, the Asia Pacific region will continue to lead the world air cargo industry in average annual growth rates in the next 15 years. All Asia-related traffic is expected to expand, with the fastest-growth rates forecasted for the intra-Asia market at 8.6% growth per year. China will be the fastest-growing air cargo market in the world with an estimated average 10.8% growth per year (Boeing, 2007).

Among the top 25 airlines in the world in terms of cargo traffic, 11 are from Asia and a total of 19 are from APEC economies (see Table 1). The pattern of air cargo development is different between Asia and the US. Although several Asian airlines have dedicated cargo fleets, air cargo remains for the most part carried in the belly compartments of passenger aircraft, which are typically wide-bodied. As such, passenger airlines compete head-on for the general air cargo business. In the US, most passenger carriers use narrow-bodied aircraft, which significantly limits their capacity to carry cargo. This is one of the factors contributing to the rise in the share of US cargo carried by integrated express operators by around 60% in the last 30 years (Zhang and Zhang, 2002). As indicated in Figure 1, Fed-Ex is now the largest cargo airline in the world and UPS ranks third.

### ***WORLDS LEADING CARGO AIRLINES***

The first tier of the 2007 Top 50 Cargo Airlines worldwide looks a lot like the 2006 ranking with FedEx Express, UPS, Korean Air and Lufthansa retaining their No. 1 through No. 4 positions. Yet there has been movement. With a 17.4 percent growth last year, Cathay Pacific, and its subsidiary Dragon air, bumped Singapore Airlines from the No. 6 slot, while China Airlines moved up a notch to No. 7, with Air France close behind at No. 8. FedEx and UPS retained their vaulted positions despite punishing high fuel costs, a faltering economy and a noticeable decline in domestic air cargo. Significant quarterly losses in early 2008 showed how even the integrated express carriers continue to get pounded financially. FedEx lost \$241 million in the three months ending May 31 compared with a profit of \$610 million for the same quarter in 2007, while UPS saw its net profit fall 21 percent in its second quarter. Korean Air, which slowed its growth engine significantly last year in the face of declining yields and migration of traffic to ocean vessels, retained its No. 3 overall position and the airline remains the world's

largest international freight airline with 9.5 million freight tones kilometers flown. Air France's elevation to the No. 8 spot and its partner KLM Cargo's jump to the No. 12 position from No. 14 can be attributed to a rejuvenation of its fleet and tight cost controls, which has seen a significant bump in profits. The fastest growing carrier last year among the Top 50 airlines was Shanghai Airlines, which jumped from No. 57 to No. 42 and expanded its business 60.8 percent. Following close behind was No. 33 Qatar Airways, which posted a 50.6 percent growth from 2006 to 2007. The long-term growth of the industry remains in parts of Asia and the Middle East, where Emirates moved up to the No. 9 spot from No. 12 despite slowing from 19.9 percent growth the year before. Air China, the world's fifth largest domestic cargo carrier, grew 12.3 percent last year and moved up to No. 16 from No. 18. Not all Asia and Middle East carriers showed traffic gains in 2007. Nippon Cargo Airlines, which slipped to No. 28 from No. 26, showed a 17.2 percent decline in traffic last year over 2006. Gulf Air's growth dropped 26.5 percent in 2007, the second straight annual decline.

A number of combination carriers posted modest gains or losses in air freight traffic. Yet United Airlines, at No. 18, showed 15.6 percent traffic growth last year. American Airlines retained its No. 20 position, increasing traffic 4 percent in 2007. Northwest Airlines, which left Chapter 11 bankruptcy in 2007 and is awaiting regulatory approval to merge with Delta Air Lines, posted a 9.4 percent decline in traffic in 2007, dropping to No. 19 from No. 17. The top 50 list is based on freight traffic, measured in freight tones kilometers flown, reported by the International Air Transport Association and on figures provided by airlines. In a change from previous years, we have sought to include only carriers in scheduled service rather than "wet lease" carriers. That means that carriers such as Atlas Air, Evergreen International Airlines, Air Atlanta Icelandic and the defunct Gemini Air Cargo are not included. U.S. carrier ABX Air operates largely on an ACMI basis is included mostly as a proxy for DHL in the United States. Our goal remains to show the relative scale of all carriers that fly cargo. Carriers that have ceased operations are not listed in this year's top 50. Where available, we have included revenue figures and notable orders for aircraft, particularly freighters.

**CHAPTER 5**  
**INTERPRETATION OF RESULTS**

**5.1 THE IMPACT OF AIR CARGO ON THE GLOBAL ECONOMY**

The global air cargo industry represents almost 100 billion revenue ton-miles of Transportation, an estimated \$52 billion in direct revenue in 2005 and substantially more revenues in related trucking and logistics services. In this paper, we combine data from many sources with new analysis of systematic data to characterize the nature of the air cargo industry and examine its impact on the global economy.

Our analysis indicates that the air cargo industry is responsible for transporting

Approximately 29.9 percent of all international trade (by some estimates, substantially more) and 34.6 percent of non-land-based trade with an annual value of \$2.7 trillion in 2004. With time-definite international transactions, production flexibility and speed characterizing much of the new economy, it is nearly certain that air cargo will play an increasingly vital role in the global economy. No other means of transportation is better equipped to meet the economic realities of the new era where global sourcing and selling, and just-in-time logistics, require that producers receive and ship smaller quantities more frequently, quickly and reliably over long distances. Global exports (by volume and value) have outpaced production (by volume) which has, in turn, outpaced economic growth indicating a substantial restructuring of production and distribution. Air cargo has outpaced all, increasing by approximately 80 percent, over the last decade despite recessions and other setbacks to air transport. Scheduled air cargo service providing an estimated 4,396,353 tons of weekly air cargo capacity is available at over 3,400 airports in 220 countries. Charter and integrated express companies provide additional capacity. With McKinsey estimating that the 20 percent of manufactured goods that are traded internationally today will rise to 80 percent by 2020, the air cargo industry is poised for continuing rapid growth at an expected rate of 5.9 percent annually for the next 20 years (according to recent estimates by Airbus) and at 6.2 percent (according to analyses by Boeing). Our focus here is how operational

reforms in the air transport industry, combined with air rights liberalization and continued improvements in supply and distribution practices, will allow air cargo to expand its geographic spread – primarily to the southern hemisphere – and deepen its product mix, thereby further accelerating economic development and the diffusion of prosperity.



**CHAPTER 6**  
**CONCLUSION AND SCOPE FOR FUTURE**

Cargo is goods or produce transported, generally for commercial gain, by ship or aircraft, although the term is now extended to intermodal train, van or truck. In modern times, containers are used in most long-haul cargo transport. In case of cold chain goods, especially those with limited shelf life, since they are always in transit, such goods are colloquially also referred to as cargo even when in storage such as school stores, perishable cargo storing centers or other temperature controlled storage structures. The cargo handling simulator has been developed in order to give a valid mean in the training of tanker's cargo officers. This system allows dramatically reducing training time and providing accelerated and intensive loading/unloading/management experience in a safe and controlled environment. It is possible to simulate loading, unloading and emergency procedures in a controlled and risk-free environment. Air cargo operations generates additional revenue for airports and provides better utilization of the airport facilities as majority of these services are undertaken during the non-peak hours. While the amount of cargo freighted via air is growing steadily, the infrastructure related to air cargo handling and evacuation is not. The Government has acknowledged the need for development of cargo related facilities and is taking the necessary steps to address the situation with consistent and coherent application of policies. For a country like India, with its natural challenges in terrestrial transportation, a well networked air cargo system will go a long way in addressing the problem of networking the remote areas and creating a proper international market access to them. Air cargo remains a vital mode of transport for India's international trade especially for products with high value or value addition. The five major airports (Mumbai, Delhi, Kolkata, Chennai and Bangalore) account for around 88% of the total air cargo handled in India. Growth in cargo / freight volumes is an outcome of macro-economic factors such as domestic consumption, exports and imports. The infrastructure needed to cater to the growth remains a major challenge. However, the international and domestic cargo volumes have shown a steady growth despite inadequate capacity and infrastructure. Government's plans for

developing MIHAN (The Multimodal International Hub Airport at Nagpur) as the first cargo hub in India are in progress. Some of the cargo service providers include Blue Dart, FedEx, Air India, Crescent Air Cargo, Gati etc. The major commodities being air freighted out of India are garments, machinery components, pharmaceuticals, dyes, chemicals and perishables such as fruits, vegetables, flowers, fish and meat. Due to the high time sensitivity clientele demand, there has also been a steady patronage of air cargo services across industries including telecom, gems and jewellery, electronics, IT and ITES related equipment etc. Cargo handling operations at airports involve the preparation of cargo shipments, the loading and unloading of the aircraft, and the transfer of cargo between the storage facilities and land transport. For outbound cargo, the preparation includes consolidation of cargo, building up of the air cargo pallets and containers, inspection and documentation. For inbound cargo, the preparation includes customs and other regulatory procedures, as well as deconsolidation. For transshipment cargo, the operation is generally limited to unloading, reconsolidating, and reloading the cargo but can be as simple as a direct transfer between aircraft (sometimes known as tail-to-tail transfer). Although air cargo ideally remains in the airport for a relatively short time, it is necessary to provide storage facilities. Bonded facilities are required for imports and international transshipment cargo. For perishable cargoes, it is necessary to provide cold rooms. For outbound cargo, it is necessary to provide X-ray scanners to inspect the cargo. Since most air cargo is low density, most of the cargo is stored on racks, preferably in large open warehouses with high ceilings (more than eight meters). The storage areas must be equipped with loading docks on the landside to allow for rapid movement of goods to and from trucks. Most airports also provide offices near the warehouses for the airlines and forwarders to receive/deliver cargo and prepare shipping documents, and for customs to clear import and export cargo. A major issue in the layout of airports is the extent to which cargo-handling activities take place on the airport versus outside the airport boundaries. The airlines receive and dispatch cargo on the airport. Inspection is generally done on the airport including scanning, which generally implies that the pallets are built up on the airport. Beyond that, exporters, importers and forwarders generally prefer to locate their activities outside the airport to avoid space limitations and reduce operating costs. Where possible, they also prefer to build their own pallets and ULD containers prior to delivery to airlines, especially where they have to maintain a cool/cold chain for temperature-sensitive perishables. However, this requires that pallets/containers be accepted "as is" without having to

be broken down for inspection and then rebuilt. In order to do this, the airlines and security officials must certify the forwarder's warehouse as well as the forwarder or shipper. Alternatively, if there is sufficient cargo volume, more expensive full pallet scanners can be introduced. On-airport cargo terminals are usually multi-tenant. These may be common-user spaces managed by an authorized cargo handler, but, as traffic levels increase, carriers and integrators often want to have their own space. Initially this may be space rented on a long-term basis but eventually they need their own facilities. Similarly, forwarders/customs agents may occupy a designated storage area or merely place their customers' consignments in a common area. In order to accommodate different carriers and consolidators, various airports have established cargo villages. These are sites with multiple cargo terminals. They usually evolve from the existing warehouse facilities, but in some cases are constructed on a new site. The village is designed to allow better coordination of operations and improved traffic flow. It also allows for provision of a common office building to simplify the interaction between the carriers, forwarders and shippers. An alternative is to construct a larger, multi-story warehouse and lease space to the various parties. In the case of Dubai, both strategies have been applied with the introduction of a Mega Cargo Terminal within the Cargo village. Customs has an important role in the use of an airport for import cargo and more particularly for transshipment cargo. Because of the high value and time sensitivity of air cargo, it is important to minimize the time required for clearance of import cargo and to simplify the procedure involved in cargo transshipped through the airport. Many countries have developed a dual track for clearing goods. Expedited services are provided for express package services allowing them to meet tight delivery schedules, while large shipments are cleared more slowly. Most major airports in developing countries can clear cargo in a few hours to one day. While this is quite rapid relative to cargo shipped on other modes, anything over six hours must be considered inefficient and a reasonable target would be two hours. This is possible because of the level of computerization of airfreight documentation, which allows submission of the IGM (Inward General Manifest) at the time of departure from the previous airport. Slow clearance times are usually associated with the failure of customs and shippers to adopt modern information and communications technology. These systems are also important for tracking shipments and for ensuring efficient use of warehousing space.



### **Airport Infrastructure**

During the year 2007-08, the Civil Aviation Ministry has put infrastructure development on priority with a number of projects identified. The government has planned to take up projects worth Rs. 41,000 crore during the 11th five year plan (2007-2012) out of which Government will fund Rs. 12,000 crore. Rest of the funds will be arranged by PPP mode.

### **Security Services**

- CCTV and microwave sensors
- Smart Cards and Biometrics systems
- Weapon, Explosive, Drug detection in air cargo shipments
- Baggage systems (color X-ray and RFID baggage systems)
- Encrypted communication
- Fire and safety systems

### **Aircraft and Airline**

- On-board flight safety systems
- Flight Deck Avionics
- Flight Operations Support
- Maintenance Ops Support
- Precision Navigation



### **Airport**

- Airfield lighting systems
- Vehicle navigation systems
- Car parking management:
- GPS systems
- Self service kiosks

- Standby power systems
- Video monitoring
- Baggage handling systems:
- Access controls -Smart cards, biometric passenger checks
- Visitor management system
- Retail business management:
- Data management systems

### **Air Traffic Management**

- Precision landing system
- Radar video surveillance (RVS)
- Global navigation satellite system (GNSS)
- Instrument Landing Systems (CAT II / CAT III)
- Satellite communication (SATCOM)
- Automatic dependence surveillance (ADS)
- Communication, Navigation surveillance (CNS)
- Air Traffic Network (ATN)
- Controller-Pilot Data Link Communication (CPDLC)
- Flight data processing system (FDPS)
- Advanced Surface Movement Guidance and Control Systems (A-SMGCS)
- Docking systems
- GPS Aided GEOS Augmented Navigation (GAGAN)



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## **OTHER SOURCES**

Air Cargo Handling Sectors

## **APPENDIX:**

### **Abbreviations**

AAI	Airport Authority of India
AAGR	Average Annual Growth Rate
ADSS	Automatic Dependence Surveillance System
A-SMGCS	Advanced Surface Movement Guidance and Control Systems
ATM	Air Traffic Management
ATN	Air Traffic Network
AVS	Aerodrome Visual Simulator

## ROLE OF AIR CARGO HANDLING IN AN AVIATION INDUSTRY

CNS	Communication, Navigation surveillance
CATC	Civil Aviation Training College
CPDLC	Controller-Pilot Data Link Communication
DME	Distance Measuring Equipment
FDPS	Flight data processing system
FTC	Fire Training Centre's
GAGAN	GPS Aided GEOS Augmented Navigation
GNSS	Global Navigation Satellite System
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
NIAMAR	National Institute of Aviation Management and Research
PBN	Performance Based Navigation
PG	Packing Group
RVS	Radar Video Surveillance
SATCOM	Satellite communication
SKUs	Stock Keeping Units
SVM	Sector Vector Machine
ULD	Unit Load Device