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OPEN UNIVERSITY**

BBA(AT)

**BACHELOR OF BUSINESS ADMINISTRATION
(AIR TRAVEL MANAGEMENT)**



BBAATR-305

AIRPORT OPERATION & MANAGEMENT

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**DR. BABASAHEB AMBEDKAR OPEN UNIVERSITY
AHMEDABAD**

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ISBN 978-93-91071-24-0

Edition : 2022

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ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self- instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is

particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self- instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included many tables and examples for easy understanding.

We sincerely hope this book will help you in every way you expect. All the best for your studies from our team!

AIRPORT OPERATION & MANAGEMENT

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Airport Operation & Management

BLOCK 1 : AIRPORT LAYOUT

UNIT1 : BASIC CONCEPTS OF PLANNING AND DESIGN OF AIRPORTS

UNIT 2 : THE UNIQUE 20TH CENTURY AIRPORT BUILDING TYPE

UNIT 3 : MASTER PLANNING OF AIRPORTS

AIRPORT LAYOUT

Block Introduction :

The construction of an airport is one of the most complex multidisciplinary projects. As a student of aviation you shall be acquainted to some of the basic aspects pertaining to the design planning process of constructing an airport. Airports being points of connectivity and gateways to places or even countries are blend of architectural and technological finesse. The development of an airport not only depends on engineering fundamentals but also encompass a lot of elements that are embedded in the social, cultural, political and environmental ecosystem. You shall be learning about some of the architectural styles and patterns that are hallmark of some of the airports of the world. Planning is the key word in construction of an airport and a master plan is the basic blue print of an airport's vision. The development of the master plan requires meticulous planning involving all the stake holders and involves every aspect of the airport plan for a time span. You shall also learn in this block about how a master plan for an airport is drafted and how it contributes to the development of an airport.

Block Objectives :

- To list the planning steps and describe the issues and challenges undertaken in an airport planning process.
- To enumerate on the operational aspects pertaining to the airside of an airport that are important elements of airport planning.
- To list the essential features, key objectives and stages of preparation of a master plan in the design process of building an airport.
- To list and enumerate airport architectural features, design, meaning, form and its relevance to sustainability of an airport design feature.

Block Structure :

Unit 1 : Basic Concepts of Planning and Design of Airports

Unit 2 : The Unique 20th Century Airport Building Type

Unit 3 : Master Planning of Airports

UNIT STRUCTURE

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1.0 LEARNING OBJECTIVES :

- To list the planning steps undertaken in an airport planning process.
- To describe the issues and challenges encountered in an airport planning process.
- To enumerate on the operational aspects pertaining to the airside of an airport that are important elements of airport planning.

1.1 INTRODUCTION :

The construction of airport is multi disciplinary project and involves the pooling of various engineering disciplines, agencies, experts, contractors, executives and the end users. Before entering into the real insight of

construction of runways and application of supply chain management technique it is essential to built up the concepts and the general idea about the about airport planning and construction.

1.2 AIRPORT PLANNING AND DESIGN :

The airport is a point of connectivity in the transportation system. At the end of a trip the airport provides for the change of mode from a ground to air mode or vice versa. The airport is often analyzed with the airport's airside consisting of approach airspace, landing aids, runways, taxiways, and aprons, all leading to the gate where the passenger (or cargo) passes through; and the airport's landside consisting of the areas where the passenger (or cargo) is processed for further movement on land: the arrival and departure concourses, baggage handling, curbsides, and access to parking lots, roads, and various forms of transit. Most design aspects of the airport must reflect the composite understanding of several interrelated factors. Factors include aircraft performance and size, air traffic management, demand for safe and effective operation, the effects of noise on communities, and obstacles on the airways. Various disciplines of engineering are called into use in airport planning and design.

1.2.1 Airport Master Plan :

An airport master plan is a concept of the ultimate development of an airport. This plan is not simply the physical form of the airport development but a description of stage development of the entire airport area, both for aviation and non aviation demand and land use adjacent to the airport, while involving both financial implications and physical studies. The components of a typical airport system are shown below as a table. The major components of the system are air side and land side. The terminal building is the major interface between the two components. You shall be studying about Airport Master plans and it's role in detail in subsequent unit under the block. The objectives of an airport master plan are

- Ensuring optimal land use in the vicinity.
- Planning for the development of physical facilities.
- Establishment of a plan and schedule for development of the airport in phases.
- Establishment of a plan for improvements within the existing infrastructure.
- Undertaking feasibility analysis based on aspects of technicality and finance.
- Establishment of a study for the impact of environment in respect to airport operations.
- Documentation of policies in relation to aeronautical demand for the future, land use control, debt incurrence and other crucial aspects.

The ICAO guidelines for the development of a master plan for an airport are based on certain steps that are taken into consideration. They are

Basic Concepts of Planning and Design of Airports

PLANNING STEP	DESCRIPTION
Preplanning Aspects	Coordination between stake holders Planning procedure and organization Formulation of Goals and policy objectives
Forecasting for Planning	Pre requisites for forecasting Principles on which forecasting shall be undertaken Presentation of forecasts
Financial Arrangement	Capital Costs involved Sources of funds, domestic and foreign financing Operational Costs
Site Evaluation and Selection	Requirement of Land Location of potential sites Factors that are constraints to location Site inspection and study SWOT analysis and evaluation
Runways and Taxiways	Dimensions and strength Aircraft characteristics for the airport Length of Runways Airfield size and runway configurations
Aprons	Layout of aprons Hangar Aprons Parking Service and Holding bays Apron capacity Security Services
Air and Ground Traffic Navigation and control	Visual aids Radio navigation aids Control tower building Demarcation of critical areas Communication control system

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Passenger Terminals	Principles involving supply and demand Scale of services Airport traffic and management Security
Cargo Facilities	Building design Facility requirement Access Parking and control measures Security
Internal Vehicle Circulation, Parking and Control	Types of vehicles and permissions Curbside road planning and parking
Airport Operation and Support	Administration and maintenance Emergency Services Vehicle fuel stations Medical facility Meteorological services Air crew building Aircraft maintenance facility
Security	Air Side Security Land Side Security Emergency responses

1.2.2 Airport Planning Issues :

Almost every airport has some deficiency that the airport board or the community or some other airport stakeholder would like to see addressed. These issues can be multiple and of different nature. The study is undertaken by

- first identifying and gathering the issues obtained by examining prior studies and reports
- Through in–depth discussions with the all concerned agencies of airport management, the air traffic controller, the airlines, and others involved in the airport use.
- Collection of data on the airport, the airspace infrastructure, and the non aviation areas of airport land use. Data collection on various aspects helps the authorities to undertake decisions and correlate the decisions based on the vision of the airport.
- The data consists of an inventory of the existing physical plant, including an assessment of its condition and useful life, and other

relevant items, such as land use surrounding the airport, financial data on the airport operation, community social and demographic data (to aid in forecasting), operational data on the airport, meteorological data, environmental data, ground access data, and air traffic management data.

1.2.3 Forecasting Air Traffic :

Airport investment is based on traffic and its accurate projection over the years. A very elaborate forecast may lead to very high investments and higher operating costs. A very conservative approach will lead to delays, congestions and revenues being lost. The factors taken into consideration during a projection are

- Demographic factors that may lead to minimal use of airport.
- Geographic factors that may be detrimental for a large number of aircrafts.
- Projected change in disposable income.
- Airports in the vicinity and their operational structures.
- Impact of other airports on the new airport.
- Plans for airport and its usage. The same is planned with airlines and their opinion about the usage of a new airport and how do they plan to optimize usage.
- Impact of an airport amongst the community in which it is located.
- Impact of airport on the city. An airport may lead to increased business and faster movement of goods.
- Impact of airport on different industries and the potential growth of number of more visitors to the city in which the airport is being built.

☐ Check Your Progress – 1 :

1. Passenger handling at an airport happens from
 - a. Safeside
 - b. Curbside
 - c. Airside
 - d. Landside
2. Airport master plan is a
 - a. One time plan
 - b. Runway plan
 - c. Developmental plan in stages
 - d. Financial plan
3. The characteristic of a runway at an airport depends on
 - a. Type of city
 - b. Type of aircraft for the airport
 - c. Type of Airline company
 - d. All the above
4. Air traffic forecast at an airport is undertaken based on
 - a. Demographic factors
 - b. Geographical factors
 - c. Economic factors of location
 - d. All the options

1.2.4 Capacity and Delay :

Once the demand forecasts and having developed an inventory of the airport and reviewed its condition, the planning proceeds to determine the capability of the airport to accommodate the forecast demand.

- The first aspect is the determination of the capacity of the airport relative to the demand, with special attention to the delay that will be incurred at peak times.
- Capacity is used to denote the processing capability of a facility to serve its users over some period of time. For a facility to reach its maximum capacity there must be a continuous demand for service. At most facilities such a demand would result in large delays for the user and eventually become intolerable.
- To develop a facility where there was virtually no delay would require facilities that could not be economically justified.
- The second key aspect in the requirements analysis is to assess the capability of the airport to provide the traffic controls during poor weather flying conditions (IFR) as well as during good weather conditions (VFR). Electronic and visual approach capabilities are both judged.

1.3 CONSIDERATIONS ON AIRPORT SITE DETERMINATION :

The success of any airport is dependent on the site where the airport is located and the areas surrounding the airport. Many factors that are part of an airport like the airspace, runways, ground tracks etc are associated with the site of the airport. A site determines

- Safe landing of an aircraft with favourable wind conditions for majority of the period.
- No obstacles within the flight path of an airline.
- Acceptable impact of sound levels of the airport in the vicinity.
- Acceptable land use in event of an emergency that may control any loss.
- Soil conditions for the development of infrastructure of the airport.
- Access connections to the airport.

1.3.1 Airside Layout and Design :

The design of an airport is dependent on the aircraft that the airport shall host. The design elements of an airport start with the analysis of the physical characteristics of the aircrafts that shall use the airport. The approach speed or the landing speed of an aircraft defines an aircraft category as A, B, C or D. The designation of aircraft size is based on grouping aircrafts according to the size of the wing spans also known as aircraft design group (ADG).

Group	Wingspan
1	Up to 49 feet (15 metres)
2	From 49 feet (15 metres) to 79 feet (24 metres)
3	From 79 feet (24 metres) to 118 feet (36 metres)
4	From 118 feet (36 metres) to 171 feet (52 metres)
5	From 171 feet (52 metres) to 214 feet (65 metres)
6	From 214 feet (65 metres) to 262 feet (80 metres)

The important characteristics of an aircraft that affect airport design are

- Maximum take off weight
- Wingspan
- Length of the Aircraft
- Tail height of the aircraft
- Wheel Base
- Nose to centreline of the main gear
- Under carriage width
- Main gear track
- Line of sight or obstacle free zone at the nose of the aircraft.

1.3.2 Runway Length :

The length of the runway is determined by

- The aircraft, maximum takeoff weights.
- Engine capability of the aircraft.
- Landing and braking capabilities of the aircraft.
- Flap settings, and required safety factors as required by the aircraft.
- The runway length for landing must be capable of permitting safe braking if touchdown occur one third the length of the runway past the threshold.
- The runway must also be long enough to meet the obstacle-free capability to permit each aircraft to take off with one engine out.
- The stopping zone must include ample stopping distance in case the pilot chooses to abort takeoff just before rotating to become airborne (called stopway).
- The runway safety areas are a must for airport control.
- The altitude of the airport and the temperature also has a significant impact on the airport runway length, because lift capability is proportional to the air density, which diminishes as the altitude and temperature increase. The requirement for longer runways increases significantly as the altitude of the site above sea level increases.

At an average temperature of 65 degrees Fahrenheit, the increase is from 4900 feet at sea level to 8660 feet at an altitude of 8000 feet, or about 370 feet of additional runway for each 1000 feet increase in altitude.

1.3.3 Runway Gradients :

There are standard dimensions that have been established by different agencies that determine runway width and separation between runways, taxiways, safety areas between runways and taxiways.

➤ Longitudinal Gradients :

The desire at any airport site is to have the runways and taxiways as level as possible, allowing for drainage with the design of the transverse grade. In many locations the grading for a perfectly level site would be too expensive when most aircraft can easily accept 1% grade.

➤ Line of Sight :

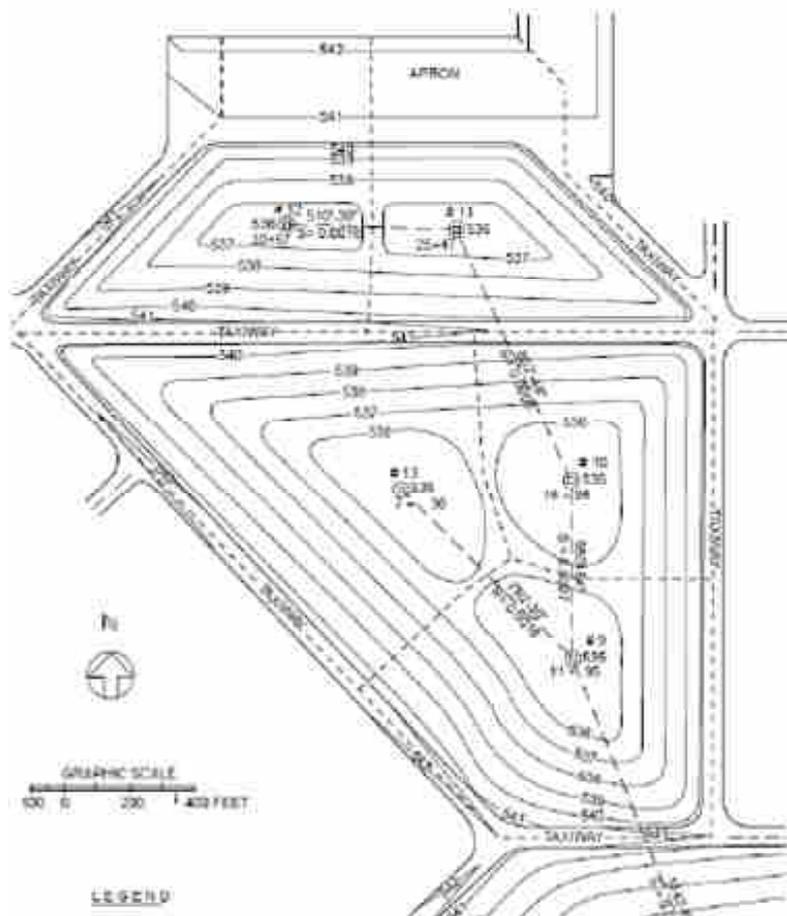
The line-of-sight requirements also determine the acceptable profile of the runway. Any two points 5 feet above the runway centreline must be mutually visible for the entire runway or if on a parallel runway or taxiway for one half of the runway. Likewise, there needs to be a clear line of sight at the intersection of two runways, two taxiways, and taxiways that cross an active runway. Most line-of-sight requirements are within 800 to 1350 feet of the intersection, depending on the configuration.

➤ Transverse Gradients :

The transverse gradients are important to ensure adequate drainage from the runways and the taxiways. The chief concern is drainage and the line of sight to adjacent runways or taxiways.

1.3.4 Drainage :

Drainage on the airport surface is a prime requisite for operational safety and pavement durability. The drainage design is handled like most drainage for streets and highways. Avoidance of water collection and erosion of slopes that would weaken pavement foundations is critical for design. Because of the need for quick and total water removal over the vast, relatively flat airport surface, an integrated drainage system is a must. Runoff is removed from the airport by means of surface gradients, ditches, inlets, an underground system of pipes, and retention ponds. The large area and aprons are critical and must have an adequate sewer system. Runoff water treatment is required when there are fuel spills or during the winter, when a de-icing chemical is used.



Schematic representation of drainage design for a portion of airport

1.4 AIRPORT LIGHTING AND SIGNAGE :

Lighting and signing of the runway are very important aspects at the airport as it

- Provides the pilot visual cues to ensure alignment with the runway, lateral displacement, and distance along the runway.
- Runway edge lights standing no more than 30 inches and no more than 10 feet from the runway edge are 200 feet or less apart and are white, except for the last 2000 feet of runway, when they show yellow.
- Centreline lights are white and set 2 feet off the centreline of the runway, except for the last 3000 feet. In this area they are alternating red and white for 2000 feet, and they are red 1000 feet from the runway end.
- When aircraft are approaching the runway to land, the pilot determines the threshold because it is marked by a bar of green lights. However, those lights show red when aircraft approach the end of the runway from the other direction.
- Exits, particularly high-speed exits, are clearly marked by signs placed at a distance of 1200 to 1500 feet before the exit.

1.4.1 Airfield Signs :

The airfield is marked with a variety of signs delineating the taxiways, stoplines, holding areas, and the like.

- Blue lights indicate taxiway edges.
- Stop bars before crossing or entering an active runway are yellow. There have been a number of accidents and near accidents on the ground, especially when the visibility is low.
- The controller controls the lights. When the bar is lit there are now centre lights ahead, creating a black hole effect. Once the aircraft is permitted on the runway, the light bar is extinguished and the taxiway/runway lights are illuminated to guide the pilot onto the runway for takeoff].
- Typical airfield markings give the pilot directions to the ramp, parking areas, fuel, gates, and areas for itinerant aircraft, ramps for military aircraft, cargo terminals, international terminals, and other airside functions.
- Visual cues also aid the pilot in docking the aircraft at the gate. Generally there is also an airline ground employee with handheld signal lights to direct the pilot as the aircraft pulls into the gate.
- The approach lighting system (ALS) dictates the navigation and approach capability. Light bars may extend as much as 3000 feet from the threshold along the aircraft's desired glide path.
- Lighting systems are available to provide runway glide slope cues indicating whether the pilot is above, below, right, or left of the hypothetical wire representing the proper descent trajectory.
- The visual approach slope indicator systems (VASIS) provide at the side of the runway red and white light bars. The precision approach path indicator (PAPI) system provides upper and lower lights of red and white that in various combinations indicates whether the pilot is too low or too high.
- Positioning along the glide path is accomplished by the use of light bars extending from the runway along the flight path.
- There are several different approach lighting systems, for precision approaches (category I, II, or III) ILS, the high-intensity approach lighting system with sequenced flashing lights (ALSF) is employed.
- The ALS consists of light bars 3000 ft from the threshold. From 3000 to 1000 ft the lights are a sequenced flasher that gives the appearance of a rolling ball leading to the runway centreline. From 1000 ft (inner marker) to the threshold there are white light bars in the centre and bars of red lights on either side of the centreline spaced 100 ft apart. An extra light bar is placed at 500 ft to provide an added visual cue.

1.4.2 Runway Pavement Design :

Pavement design methods are based on the gross weight of the aircraft. Since it is impracticable to develop design curves for each type of aircraft, composite aircraft are determined and loads are converted from the actual aircraft to the design aircraft, the design aircraft being the one that requires the greatest thickness of pavement. The traffic forecast, which includes the mix of aircraft anticipated, is converted to a traffic forecast of equivalent annual departures.

1.5 AIRPORT PLAN :

Upon completion of the inventory, forecasting, requirements analysis, and site evaluation, the master planning proceeds to the synthesis of airside and landside concepts and plans. These include an airport layout plan and an approach and clear zone plan. Other plans could include the site plan, the access plan, and the environmental plan. The airport layout plan is a graphic representation to scale of the existing and the future airport. All dimensional data pertinent to the plan are put in the graphic representations. The other plans that are also drawn are the Terminal Area Plan and Noise Compatibility plan. The Terminal Area Plan is a conceptual drawing indicating the plan of the terminals and their possible expansions. Using future airport traffic, noise contours should be generated to identify future impacts of noise in the community. The Noise compatibility plan would include alternative takeoff tracks and operational constraints. It would also identify buildings and other facilities that might potentially need to be moved or soundproofed.

☐ Check Your Progress – 2 :

1. The capacity of an airport denotes
 - a. Processing capability of a facility to serve its users
 - b. Number of passengers that can be accommodated at an airport
 - c. The inflow and outflow of aircrafts from the airport
 - d. None of the above
2. Site determination for an airport considers
 - a. Obstacles in flight path
 - b. No obstacles in flight path
 - c. High rise buildings on flight path
 - d. All the options
3. Grouping of aircrafts are undertaken based on
 - a. Fuselage
 - b. Manufacturing Company
 - c. Wing Span
 - d. Radar

4. Line of Sight requirement at an airport is between _____ feet of intersection
- | | |
|---------------------|---------------------|
| a. 700 to 1500 feet | b. 750 to 1450 feet |
| c. 800 to 1500 feet | d. 800 to 1350 feet |

1.6 LET US SUM UP :

The concept of planning and design of an airport is a highly complex discipline pertaining to higher levels of Engineering and different other fields of study. It is important for you as a student of aviation to have a generic idea about basic planning and designing concepts involved in building and constructing an airport. The most important part in construction of an airport is the involvement of all the stakeholders in the planning process. There are a lot of macro and micro level environmental factors that impact the construction of an airport or may do in the long run. The planning of an airport begins with the drafting of a master plan that considers the developmental stages of an airport to be built over a period of time taking the factors of land use, facility development, phase development, environmental impact and finances into consideration. There are a lot of challenges that the planners, executors and stake holders undergo in building an airport and the dynamic process of resolution and overcoming of challenges and reorientation of the plan. A design or size of an airport is based on major factors like air traffic forecasts, the facilities to be planned to meet the capacity and demand, site determination and planning of important airside and landside features play a major role in the airport design process.

1.7 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

- | | | | |
|------|------|------|------|
| 1. d | 2. c | 3. b | 4. d |
|------|------|------|------|

Check Your Progress – 2 :

- | | | | |
|------|------|------|------|
| 1. a | 2. b | 3. c | 4. d |
|------|------|------|------|

1.8 GLOSSARY :

Runway : Long piece of ground with a hard surface where aircraft take off and land at an airport.

Taxiway : A route along which an aircraft can taxi when moving to or from a runway.

Apron : An airplane's parking area in an airport located off the airport runway and taxiway.

Landside : The side of an airport terminal to which people have unrestricted access.

Airside : The side of the airport terminal that is beyond passport and customs control and has restricted access.

IFR : Instrument Flight Rules are rules which allow properly equipped aircraft to be flown under instrument meteorological conditions.

VFR : Visual Flight Rules. These are set of regulations under which a pilot operates an aircraft in weather conditions that are clear.

Tail : Structure at the rear of an aircraft that provides stability during flight.

Wingspan : The distance between one wing tip to another wing tip.

Stopway : Area beyond the takeoff runway to support an airline in event of an aborted takeoff without causing any structural damage to the aircraft.

1.9 ASSIGNMENT :

Refer to Plan and Design of Indira Gandhi International Airport as a model and work on the following as mentioned.

- a. The graphical representation and design of the airport.
- b. The number of Terminals and their size and passenger holding capacity.
- c. The facilities that the airport provides on the Airside for aircrafts.
- d. The Landside facilities offered by the airport.

1.10 ACTIVITIES :

Take references of 3 airports that are located on islands. Enumerate special design considerations taken into account during the planning process.

1.11 CASE STUDY :

The X airport constructed at India has put into the latest design trends and an emergent eco–design project. The airport has taken the social considerations into its construction by building it a zone free from impacts of noise pollution. To strengthen the communication facility, travel time and accessibility the roads connecting to the city have been simultaneously enhanced into 6 lanes. The sustainability of the airport has been developed keeping the economic boom in the region, the need for global connectivity and introduction of features that do not impact the environment negatively. The features of energy efficiency, water recycling, minimum waste generation and its recycling, reduced emissions and social acceptance have been prioritized in its Master Plan. The structural material used is recyclable and the airport also plans to get world class certifications like Leeds or Breeam rating for the airport.

1. How can accessibility to an airport become a challenge for the airport ?
2. List ways how accessibility to an airport can be incorporated as a part of the master plan ?

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Management**

3. List some green measures that airports are introducing and how can these measures lead to sustainability of the airport ?

1.12 FURTHER READING :

1. Airport Engineering by Norman J Ashford, Saleh A Mumayiz and Paul Wright
2. Planning and Design of Airports by Robert Horonjeff
3. Airport Design by Christian Schoenwetter

The unique 20th Century Airport Building Type

UNIT STRUCTURE

2.0 Learning Objectives

2.1 Introduction

2.2 Airport Architecture

2.3 The Role of Meaning, Function and Form in Defining The Architecture of Terminals

2.4 Sustainable Development of an Airport

2.5 Aircraft Types and Airport Terminal Design

2.6 Relation of Airport Design and Passengers

2.7 Let Us Sum Up

2.8 Answers to Check Your Progress

2.9 Glossary

2.10 Assignment

2.11 Activities

2.12 Case Study

2.13 Further Reading

2.0 LEARNING OBJECTIVES :

- To list the different airport architectural features as a part of modern design concept.
- To enumerate on meaning and form of defining architecture of modern airport terminals.
- To list the importance of sustainability of airport designs.

2.1 INTRODUCTION :

The airport is the one unique building type of the latter half of the twentieth century. Like the golf course – its landscape equivalent in terms of modern origins – the airport has no direct parallels in function, scale or form. Though similar to the railway terminal in some respects, the modern airport has a size and intensity all its own. From the airport one ventures into the sky, and in a few hours to distant continents. The airport, with its runways and terminal buildings, has a huge scale, dwarfing most other urban structures. Large international airports, such as London's Heathrow, handle in a year almost the same numbers as those who live in the country. With over more than 80 million passengers using Heathrow each year and growing, the airport is a great cosmopolitan centre. As the third busiest airport in the world, Heathrow is a self-contained urban

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entity, with its buildings, roads and business parks serving a remarkable variety of functions. Heathrow employs more people than the city of Oxford, and has an economic impact as great as that of London Docklands. Trade alone at Heathrow amounts to millions per year, with thousands of direct jobs and indirect ones provided as a consequence of the airport's presence. It is clearly more than just an airport; it is a city in its own right, with the terminal buildings its public landmarks. These buildings, plus the hotels, car parks, conference centres and business parks, add up to a fresh kind of twentieth-century city. Culturally, economically and socially the modern airport is a new point of exchange between people, companies and nations. The airport in modern terms is now considered a placeless city.



Heathrow Airport London

2.2 AIRPORT ARCHITECTURE :

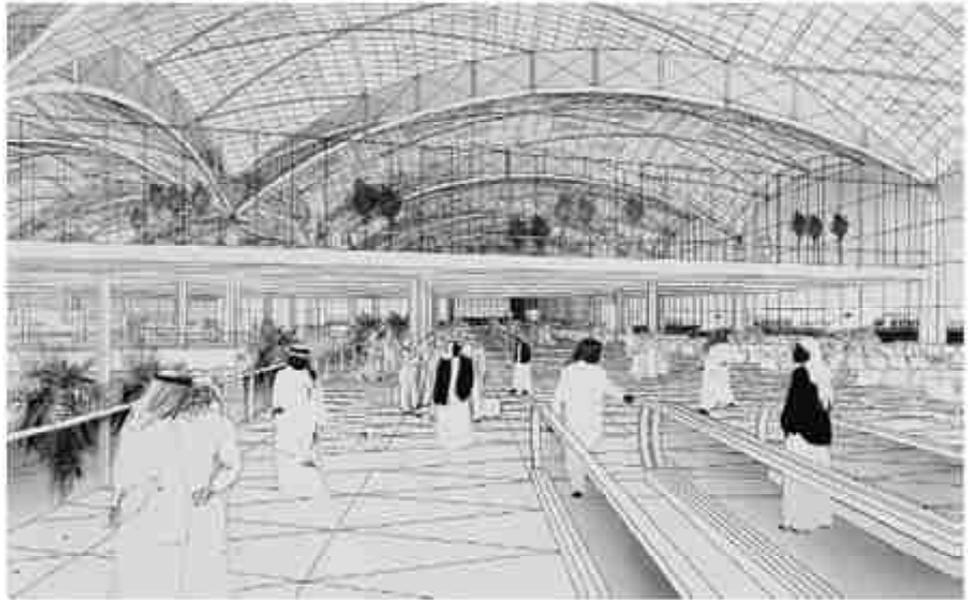
The architecture of airports reflects the international flavour of modern air travel.

- There is a sense of technological development balanced by national pride in airport design. Countries like to express a modern efficient image through the national airports in general and the terminal buildings in particular.
- While the aircraft are the same, whether in Asia, Europe or North America, the individual terminals often retain something of local cultural identity.
- The internationalism of air transportation is invariably tempered by regional characteristics in the design of terminals themselves. This is occasionally the result of climate, and sometimes of the traditions

of building in a particular area, but often of the sense that airports are great national gateways, where cultural differences have to be expressed.

- The comparison between London Heathrow and Paris Charles de Gaulle shows how far national characteristics can infuse airport design. While the first is a collection of disjointed terminal buildings set within an apparently haphazard master plan, the latter is grandly conceived, beautifully executed and infused with Gallic pomp.
- Different philosophies apply with regard to the nature of airports in different parts of the world. In Europe the airport is a complex interchange and a leisure destination, while in the USA the airport journey is rather akin to catching a bus. At Chicago O'Hare Airport, for instance, the typical airline passenger arrives by car, parking in a huge open car park, travels by courtesy coach to the airline terminal (not the airport), and boards the plane with generally no passport or customs check. Direct gate ticketing allows the passenger to proceed through the terminal without hindrance or delay. Shops, bars and duty-free facilities barely exist: the airport is a linear functional system, with the terminal – dedicated to a specific airline company – merely an enclosed space through which the passenger hurries en route to the plane.
- In Europe, leisure activities and retail sales dominate the architecture of terminals. Airports such as Gatwick, with its separate retail floor at North Terminal sandwiched between the arrival and departure levels, and the burger-bar-dominated 'Village' in South Terminal, look and feel more like shopping malls than traditional terminals.
- In the Middle East and Africa the airport is normally a loss-making, though architecturally distinguished, statement of nationhood. Riyadh Airport in Saudi Arabia is typical of the rather Olympian ideal behind many airports in the Gulf States. Here retail and tourism pressures are kept to the periphery of terminals; the passenger experiences instead a grand processional sequence of public spaces – lofty, well lit and unencumbered. The terminal mirrors the aspirations, wealth and prestige of the country, not the free play of market forces (as in the UK) or ruthless airline efficiency (as in the hub airports of the USA).

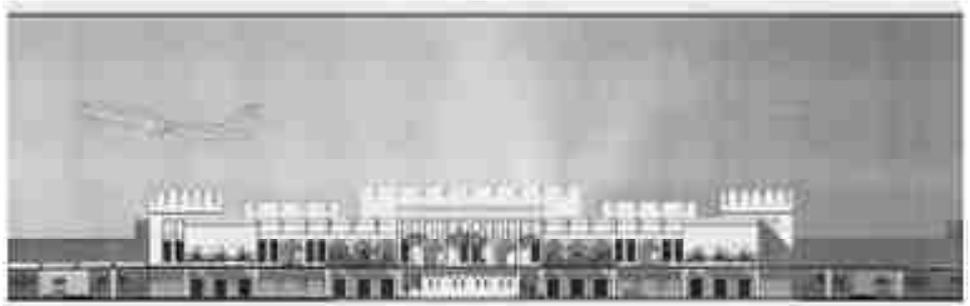
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*King Abdul Aziz Airport Jeddah, KSA, is more of a Confluence of
People and Meeting than Retail Outlets*



Munich Airport Terminal, Germany



*A Sense of National Image at
New Doha International Airport, Qatar*

☐ **Check Your Progress – 1 :**

1. The airport at Paris is known as
 - a. Heathrow
 - b. Schipol
 - c. Brussels
 - d. Charles de Gaulle
2. King Abdul Aziz airport Is located at
 - a. Bahrain
 - b. Qatar
 - c. Saudi Arabia
 - d. Iran
3. The aspirations of national culture are infused in airport buildings majorly
 - a. True
 - b. False
 - c. May be True
 - d. May not be true
4. Gatwick airport is located at
 - a. London
 - b. Paris
 - c. Munich
 - d. Brussels

2.3 THE ROLE OF MEANING, FUNCTION AND FORM IN DEFINING THE ARCHITECTURE OF TERMINALS :

In understanding the airport terminal as a distinctive typology, it is important to grasp three main formal elements that give it shape: the plan, the design of surfaces, and the handling of light.

- The plan – the geometry of space, as it is sometimes described – establishes the spatial and hierarchical composition.
- The medium of plan and section begins the process of defining the airport as a distinctive building type. However, the design of the masses and their surfaces also plays an important part. How the materials are used, and whether the surfaces reflect the functional and socially infused meaning of the airport, are also key factors.
- Finally, light and the play of light in an optical sense help to distinguish the airport terminal from other related building types such as railway stations.
- In defining the architectural factors that give the airport terminal its typological identity – the compositional components of plan, mass and light are of fundamental importance. These combine to give the function appropriate form and meaning, which allow the terminal to be understood by its users, and which permit the terminal to be recognized as a distinctive type of building by those who have yet to enter into it.
- This argument also allows function, meaning and form to have social value rather than purely aesthetic value.
- The term 'airport' or 'airport terminal' is exclusively a twentieth-century one; before the modern age no conception of the airport existed, and hence no preconception of the design of the terminal building had occurred in the mind of architects. By giving the airport

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a name one constructs a functional narrative, which allows designers to conjure up appropriate forms.

- The earliest terminal buildings, such as Eero Saarinen's TWA Terminal at New York and his Dulles Terminal at Washington (both designed around 1956), or the more Miesian terminals at O'Hare, Chicago designed at the same time by Naess and Murphy, were important beginnings in helping to define the modern airport in architectural and typological terms.
- In the 1950s and 1960s America was the centre for airport development: here new layouts and airport patterns (such as hub airports) were developed, and the typology of the terminal was established.
- It was in the USA that the standard two-level departures and arrivals terminal was evolved, each level having its own deck of vehicle access.
- By the 1970s, however, the focus of attention had shifted to Europe, which began to develop airports integrated with other modes of transportation.
- Deregulation in the 1980s opened up terminals to greater commercial pressure, and it was the United Kingdom that refined the notion of the passenger terminal as a huge open retail mall.
- In the 1980s also the Middle East and parts of the Far East explored the relationship between airports and nationhood, which found expression in grand civic terminals. The relatively straightforward precedent of airports represented by New York's JFK became by the early 1990s a diverse canvas of different design and management approaches.
- The extremes are represented by the expressive Kansai Terminal, on its man-made island in the Pacific, the neutral and refined Stansted Airport in the English countryside north of London, and the tented roof structure of Denver Terminal, evoking images of North American Indian tepees.
- In each case, though the buildings are undeniably airports, their functional meaning has been enriched by cultural differences.
- As the airport has matured into a recognizably distinctive twentieth-century building type, it has also diversified into a range of formal types, whose taxonomy responds directly to different airport management systems. These inevitably reflect the values of the peoples served.
- Emerging nations have a different view of airports from mature nations, and where the culture of free enterprise is common; the airport is undeniably a means of making money.
- What is not always recognized is the role of airports in facilitating knowledge and technology transfer between nations and within

The Unique 20th Century Airport Building Type

countries. New airports in undeveloped parts of the world, designed by global firms and constructed by international contractors, allow new skills and management approaches to be learned. The particular place that airports have in technology transfer and training is pertinent in Africa and China, which looks set to be the arena for airport development in the next century.

- The flow of ideas about the nature and design of airports has moved from the New World to the Old and from the developed parts of the Old to more distant lands. In the process of disseminating wisdom and approaches, the orthodoxy evolved at countless American airports has increasingly been challenged by different geographical and cultural factors.
- In Australia, Japan and China a new generation of airports is developing, based upon the airport as an element of integrated transportation. Here the role of the airport as a growth centre is recognized not resisted, within a network of regional airports established (like Shenzhen in China) as a spur to economic, technological and social regeneration.
- In Australia and parts of Africa the airport is seen as part of sustainable development, bringing in eco-tourists to help preserve endangered landscapes.
- The environmental battles that accompanied airport expansion in the USA, Europe and Japan have been replaced in the less developed world by greater accommodation with environmental protection.
- Recent airports too are likely to be designed using local materials and respecting indigenous building traditions. The specifics of place, culture and climate are beginning to balance the universal standards and ideologies of IATA manuals which remain the blueprint for airport development throughout the world.



The Geometry of Shape and Articulation at An Airport



Tectonic Construction Feature at An Airport



Design of a Modern Airport

2.4 SUSTAINABLE DEVELOPMENT OF AN AIRPORT :

The sustainable development of an airport is very essential aspect in the modern design aspect. Airports impact the environment through a considerable of land waste contamination, pollution related to air, water, noise and carbon dioxide emissions. The carbon dioxide emission is around 8% to and from airports. Airports can undertake sustainable measures through different ways. Some of the measures are

- Harness and farm renewable energy like solar and wind.
- Designing building patterns that reduces dependant on fossil fuels and maximizes recycling.
- Introduce techniques that work towards resource conservation.

- Introduce technology that helps in reduction of consumption of energy and other resources.
- Combination of infrastructure development coupled with green space management leading to land use strategy for sustainability.
- Effective planning and development of peripheral growth.
- Partnering with bodies that work towards reduction of impact and help develop sustainable measures.
- Increasing economic value of a region that benefits communities.
- Supporting social infrastructure in communities settled within the vicinity of the airport.
- Integration of the aesthetic and geometric dimensions to reduce the negative impacts and increase sustainability.
- Usage of materials that is sustainable and less impactful negatively.
- Easing out community conflict through physical and environmental planning. The structuring of any growth outside the airport perimeter also needs to be ensured.

2.5 AIRCRAFT TYPES AND AIRPORT TERMINAL DESIGN :

The terminal design of different airports across the globe is dependent on the type of aircrafts that operate from the airport. The different scales of air transport spanning across the continents and within the region are served by distinct type and category of aircraft. Each type of aircraft has its own need at an airport related to various aspects that may be related to apron, servicing and other terminal design needs. The need and demand of air travel has led to an increase in the volume of aircrafts and an increased demand for space at airports. There is a demand for modern terminals today with greater technological advances to fulfil the needs of the modern aircrafts operating. A lot of airside modifications have been introduced pertaining to instruments, runways and other aspects at majority of the airports across the globe to accommodate modern aircrafts. Flexibility, expandibility and functional adaptability are the new design philosophies for airports globally. The modern design is adherent to lesser consumption payload of energy and impact to the environment. The Payload efficiency is the operational efficiency for any operational airline company. Payload indicates the carrying capacity of an aircraft for its passenger and freight. The payload capacity determines the type of aircraft to be used in operation. Payloads are one of the key element for companies and increased payload leads to increased number of passengers and usage of bigger flights that directly impact all aspects of an airport both at the air and the land side.

2.6 RELATION OF AIRPORT DESIGN AND PASSENGERS :

Airports are one of the most complex facilities engineered by humans but the underlying fundamental of an airport is that the passenger

experience at an airport must be simple and easy going. A well designed airport should be one where routes to different facilities should be simple and easy to use. The image and the design of an airport should carry an aesthetic sense in the mind of a passenger. The efficient use of spaces is also a key to airport design. Airports are engineering marvels to save energy and impact environment sustainability. The airport designer has 2 distinct and parallel perceptions to satisfy; the airport authority and the passenger. The modern airport needs to operate smoothly and be viable from both short and long term perspective. To fulfil the physical and psychological needs of passenger's airport design need to take a holistic approach. The key elements include

- Optimization of design specifications leading to improved design and cost effectiveness.
- Apportion of risk efficiently and improvement in productivity.
- Reduction in waste in the design phase itself through the use of prototypes for common design management process and involvement of customer opinions in the design development at an early stage.

❑ Check Your Progress – 2 :

1. The spatial composition of an airport can be referred to as
 - a. Geometry of Space
 - b. Geometry of algorithms
 - c. Geometry of Design
 - d. None of the options
2. Mass and light are of fundamental importance at an airport to provide
 - a. Physiological identity
 - b. Typological identity
 - c. Topographical identity
 - d. Geometrical identity
3. The terminal designed in 1956 at Washington DC, USA was
 - a. TWA
 - b. O'Hare
 - c. Dulles
 - d. Naess
4. Reduced dependency on fossil fuels at airports increase
 - a. Geometric identity
 - b. Physiological identity
 - c. Susceptibility
 - d. Sustainability

2.7 LET US SUM UP :

The airport is one of the most complex engineering marvels designed with variety of functions to cater. The airport is the gateway to a city and often to a nation, often depicting the heritage and culture of the place. The airport provides a first impression about the place in the mind of a traveller. The architecture of an airport reflects technological development with regional needs and traditions. The design of an airport is largely dependent on a lot of factors that form a part of the master plan for design. The geometry of space decides the spatial and hierarchical composition. The term airport constructs a functional narrative which allows designers to conjure appropriate forms. The airport reflects the

values of the people served. A lot of recent airports are designed using local materials and respecting indigenous building traditions. Sustainability is the key to design of an airport and different methods are incorporated in the planning phase to manage and endure the same for a better future.

2.8 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. c 3. c 4. a

Check Your Progress – 2 :

1. a 2. b 3. c 4. c

2.9 GLOSSARY :

Tectonic : Structural feature as a whole

Harness : Controlling energy to produce power/Occupational Surrounding

Tepee : Portable Conical tent.

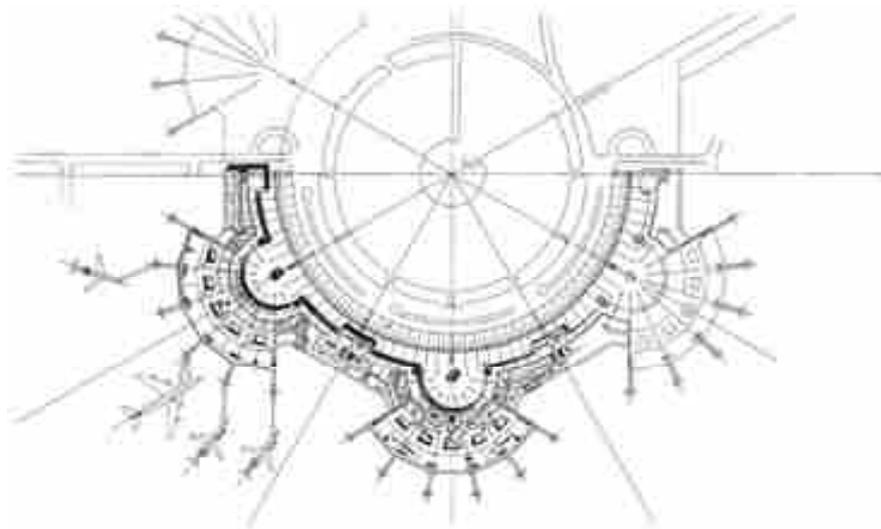
Geometry : The study of lines, shapes, curves etc.

Aesthetic : The study concerned with beauty and art.

Linear : Moving from one thing to another in a single series of stages.

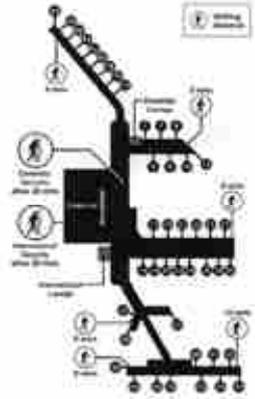
Conjure : To affect or influence.

2.10 ASSIGNMENT :



From the diagram above point out the spatial and the structural advantages that have been taken into consideration during planning.

2.11 ACTIVITIES :



List the challenges that a passenger will encounter at the airport according to the diagram as provided.

2.12 CASE STUDY :

The Y airport at a particular city was designed considerably smaller keeping in context the population and the economic growth of the city. It was a feeder airport for smaller aircrafts operating between fixed destinations. The airport was a simple design with a small single runway and an apron space for two aircrafts. Eventually with time the city progressed economically and became one of the hubs for industrial development. With growth in industries the city was frequented by people from different destinations. The nearest airport that was international and connected to different parts of the globe was 5hours away from the city. Soon restructuring programs were put into place and the managing body could accommodate up to 14 flights in a day from different destinations. With high demand of these flights the fares too were higher than other parts of the country. The demand has led to administration planning to shift the airport to a new location with a bigger infrastructure. The location as earmarked by the administration is around 30 km from the city on a highway. Being a smaller city the distance of the airport is considered to be very long for commuters.

- a. What are the factors that the administration should encompass in its design element for the new airport to ease the acceptance factors ?
- b. How can the airport at the new location achieve sustainability over a period of time ?

2.13 FURTHER READING :

1. Airport Architecture by Chris Van Ufelene
2. Planning and Design of Airports by Robert Horonjeff
3. The Modern Airport Terminal by Brian Edwards

UNIT STRUCTURE

- 3.0 Learning Objectives**
- 3.1 Introduction**
- 3.2 The Working of the Master Plan**
 - 3.2.1 Key Objectives for Planning of Master Plan**
 - 3.2.2 Intermediate Plans**
 - 3.2.3 Forecasting**
 - 3.2.4 Participation in Master Plan**
 - 3.2.5 Master Plan Checklist**
- 3.3 Compilation of the Master Plan**
- 3.4 Data Requirements for An Airport Master Plan**
- 3.5 Essential Elements of An Airport Master Plan**
- 3.6 The Planning Process for Preparation of An Airport Master Plan**
- 3.7 Let Us Sum Up**
- 3.8 Answers to Check Your Progress**
- 3.9 Glossary**
- 3.10 Assignment**
- 3.11 Activities**
- 3.12 Case Study**
- 3.13 Further Reading**

3.0 LEARNING OBJECTIVES :

- To list the essential features of a master plan in the design process of building an airport.
- To enumerate on the key objectives of a master plan.
- To discuss on aspects pertaining to participation and checklists of a master plan.
- To list the steps and stages in preparation of a master plan for an airport.

3.1 INTRODUCTION :

In Unit 1 you have studied about the basic concept of a master plan for an airport and its importance in the development of an airport. A master plan of an airport deals with economic and financial activities, airport system, infrastructural needs, a physical framework, political and environmental concerns and all planning consents that are required. In

an industry of rapid change and growth, master planning has a vital role in anticipating land, financial and infrastructural needs and is a crucial element of airport management. Airport master plans are usually spatial diagrams of future development options. They necessarily deal with strategic matters, leaving questions of detailed design until engineers and architects are appointed for specific projects. Master-plans need to be flexible in outlook and operation. Changes in aircraft technology, ever-stricter environmental controls, and the altering pattern of the airline industry – all have profound effects upon the airport master plan. Hence the plan needs to offer an element of tactical flexibility within a graphic framework.

3.2 THE WORKING OF THE MASTER PLAN :

The Master plan serves a lot of purpose for the present and the future. The essential features that help a master plan work are

- Master plans should prescribe solutions within varying time horizons. Decisions for short-term capital improvements as well as long-term visions (say, up to 15 years ahead) are both required.
- Master Plans need to address different audiences; the public has a right to know of an airport's plans, but so too do the state regulators, the local planning authority, and the financial institutions who may be asked to invest in it. The role of the master plan is to keep everybody informed, to seek a consensus for the shape and scope of future expansion, and to be flexible enough to meet reasonable objections.
- With transfer of majority of the airports being a private entity and with rapid deregulation, the recognition of the importance of the physical master plan in realizing the land assets at airports has gained importance.
- Management of modern airports are working on utilizing peripheral land as means of raising cash and bringing in improvements in the core areas of the airport.
- The master plan helps in realizing the capital tied up in the land itself by identifying surplus land and by creating the right balance of adjoining land uses and infrastructure to maximize its value. It is a technical statement of potential and a means of raising expectations and worth, which helps in increasing the valuation of land assets. BAA's use of master planning around Glasgow Airport is a notable example of planning-led land utilization and asset enhancement.
- The master plan needs to be convincing, candid in its analysis of problems, and clear in its forward vision.
- Airport master plans are documents that are monitored and updated every year so that the same is in sync with changes happening in the environment.

- The master plan should be financially feasible. The phasing of the plan's capital projects should be aligned with identified need and the ability to secure available funding.
- The plan should be balanced between airport development needs and community impacts and should also consider environmental impact aspects in detail.

3.2.1 Key Objectives for Planning of Master Plan :

The purpose and objectives of a master plan designed will vary according to the location of the airport and various circumstances prevalent. The master planning in common to all airports have some definite on airport and off airport objectives that it fulfils. To enumerate the same the key objectives of the master plan revolve around

- Facilitation of the ability of the airport to grow and expand in response to the demand.
- Promotion of the role of the airport from the socio economic aspect and its significance as a community asset.
- Planning the aspects that lead to the growth of revenue for the airport including non aviation revenues.
- Provide a graphic representation of the development of the airport with plans of land use adjacent to the airport.
- Formulating and sustaining the long term plans for an airport.
- Implementation of compliances and regulations at global levels and evolve to make the airport sustainable and better.
- Management of environmental conditions and regulations.
- Management of aspects that affect the community and the surroundings of the airport like noise impact, wildlife, public safety, navigational restrictions etc.
- Management of off-airport issues like ground transport arrangements serving the airport and other important aspects.
- Planning of sources of data collection for effective decision making.

3.2.2 Intermediate Plans :

The master plan is a framework for development for a longer period spanning between 20 or 25 years. To implement the master plan the same is compartmentalized into short term intermediate plans based upon five-yearly increments. Major development (such as runway expansion, enlargement of a terminal or ground transport provision) should correspond with these intermediate plans, thereby allowing financial and facilities planning to proceed smoothly. The aim is to produce a long-term vision that can be implemented on the basis of well-specified incremental growth.

These intermediate plans provide both the framework for airport expansion and the means to monitor and modify the full airport scheme.

Over the plan period the assumptions upon which the master plan was based will have changed. There may, for instance, be a different pattern of passenger use, a new generation of aircraft design, and changes in government policy to air transportation. Hence the staged provision of airport facilities may need modification. The role of the master plan and its intermediate plans is to ensure that the totality of the airport design is sufficiently flexible to cater for the unexpected.

□ Check Your Progress – 1 :

1. Airport master plan also encompass _____ development at the airport
 - a. Present
 - b. Future
 - c. Specific
 - d. Present and Future
2. Master plans help in
 - a. Identifying surplus land
 - b. Realizing capital tied to land
 - c. Optimizing land use
 - d. All the options
3. A Master plan is a _____ plan
 - a. Short term
 - b. Long term
 - c. Mid term
 - d. None of the options
4. An intermediate plan is a _____ of master plan
 - a. Subset
 - b. Super Set
 - c. Under set
 - d. Same as

3.2.3 Forecasting :

Airport master plans are developed on the basis of forecasts. From forecasts, the relationships between demand and the capacity of an airport's various facilities can be established and airport requirements can be determined. Short-, intermediate-, and long-range (approximately 5-year, 10-year, and 20-year) forecasts are made to enable the planner to establish a schedule of development for improvements proposed in the master plan. The forecasting methods involved are either qualitative or quantitative.

Qualitative forecasting methods are based on the judgement, ability, experience and expertise of the planners. The forecasting is undertaken through foresight of the current and the potential future environment. The techniques of qualitative forecasting also require some amount of quantitative data to back up decisions. The common methods and techniques used are Sales force composite method, consumer market survey, Delphi technique etc. Quantitative forecasting methods are those that use numerical data and mathematical models to derive numerical forecasts. In contrast to qualitative methods, quantitative methods are strictly objective. Because only numerical data are used, quantitative methods do not directly consider any judgment on the part of the forecaster. Quantitative methods are either used as stand-alone forecasting methods, or used to support forecasts made under qualitative methods. Some of the quantitative forecasting methods include time series, trend analysis models, causal model, regression analysis etc.

3.2.4 Participation in Master Plan :

There are a lot of stake holders involved during the development process of an airport. The preparation of the master plan involves the following levels of involvement for smooth design, execution and implementation of the plan. The stakeholders involved are

Planning Groups that intend to augment an existing facility or build a new facility. These groups may be a company or a conglomerate or the government. These groups are the main stake holders for creation and implementation of the plan. The groups work in close consultation regarding different aspects pertaining to the development of the airport facility and work towards areas that might be a problem in design of the plan and possible ways to overcome the same during the planning process.

- Consultant groups that are hired by the company or the primary stake holders for design and development of the airport.
- Airline operating companies operating both on a domestic as well as international scale.
- Airport regulating authorities.
- Team of engineers.
- Team of financial consultants and bodies.
- Environmental groups.
- Members of the community or bodies that represent the community.

3.2.5 Master plan Checklist :

A checklist is a basic outer structural pointer for to do elements and is prepared for the areas that need to be a component of the same. The checklist leads to individual detailing of each component that is integral to the plan. The master plan basic checklist consists of

- Organization and study groups
- Inventory of existing facilities
- Forecast of future aeronautical demand
- Capacity and Delay Analysis of any existing facility
- Facility requirement and concept development
- Airport site selection
- Environmental procedure analysis
- Airport Plans
- Implementation process

3.3 COMPILATION OF THE MASTER PLAN :

A master plan is needed for existing and new airports. Both are subject to the same pressures, and will need to follow similar procedures in the master planning exercise. Generally speaking there are six stages in airport master planning. They are

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- Appointment of a core team to establish the parameters of the plan.
- Review aviation forecasts through data collected.
- Survey the facilities for the airport plan and identification of the issues pertaining to the facility.
- Evolve and test concepts against environmental, financial and regulatory constraints.
- Formulation of a draft plan and testing of the plan through a simulated environment.
- Modify and adopt plan after testing.

The master plan needs to be concluded with a policy based upon a thorough analysis of existing conditions and forecasts.

3.4 DATA REQUIREMENTS FOR AN AIRPORT MASTER PLAN :

The collection and validation of data is one of the most crucial stages in developing a master plan. The data is analyzed for future forecasts and assumptions are drawn for preparation of the master plan after validation. The process of collection and analysis of data to predict the elements to be considered is a time consuming process. The master plan drafting exercise incorporates the under mentioned data requirements for study.

- Passenger movement data spread across and bifurcated on an annually, monthly and hourly basis. The data collected is for a minimum period of 5 to 10 years. Peak Day data on hourly basis is segregated from non peak day hourly data.
- Aircraft movement from the region for a period span of 5 to 10 years on annual, monthly and hourly basis.
- Airline estimate of potential growth in the region in the next 5 years or more.
- Airline estimate of fleet mix to the destination in the next 10 to 15 years.
- ICAO estimates of the development of the destination and its projection of passenger and aircraft movements.
- The scheduled pattern of operating airlines in the region.
- The influence of military aircraft movement in the region.
- Socio economic data encompassing projected growth rate of the locality in the region of the airport.
- Socio economic data related to population, average income, sources of income, employment, tourism potential of the area, income from tourism, growth rate of tourism sites in the region, retail sales, industrial output of the region, income distribution and many other relevant data.

- Environmental data related to development plans around the airport and its surroundings.
- Existing land use and status of development.
- Transportation plans at the local level.
- Noise pollution regulations implementation at local levels and national policy regarding the same.
- Meteorological data indicating rainfall, snow, low visibility periods, wind records.
- Detailed topographical data related to the airport and its surroundings.
- Data related to architectural details of existing buildings, terminals, various facilities with designated usage.
- Detailed structural details of existing runways, taxiways, aprons , major buildings and other facilities.
- Data on existing sewerage and drainage facilities.
- Data on the present lighting, navigation and telecommunication system.
- Data on hazards that have happened at the airport and potential areas for hazards.
- Fire fighting capacity and services data.
- Other general data that may be relevant in the drafting the plan.
- Aeronautical data that shall encompass minute details.
- Detailed financial data that encompasses revenues, debts, expenditures, assets, liabilities etc

3.5 ESSENTIAL ELEMENTS OF AN AIRPORT MASTER PLAN :

The most crucial elements that encompass a master plan for an airport and are most essential to be incorporated by the stake holders for the airport is

- A Pre–planning process that is clear on what are the needs related to the project and the master plan. Once the needs are determined it is very important to develop the study design for the project, identify and finalize consultants, preparation of contracts and finalize sources for funding.
- An involvement program with all the stake holders and the consultants to identify issues pertaining to the development of a master plan is essential. Different stake holders have challenges from various aspects and resolving them before designing the project is very essential.
- The environmental requirements and the aspects pertaining to the legal considerations need to be worked out for a long period.
- Data collection of the present inventory and the aspects already mentioned above need to be executed to initiate decisive functions.

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- The aeronautical forecasts related based on time frames need to be worked out.
- Estimation of facility and the need for development of facilities in the pre-decided time frames in relation to the extent and augmentation of the demand need to be finalized.
- Alternative component development plan in relation to the primary plan need to be prepared for all aspects to be taken into consideration. Secondary planning supporting the primary plan is an essential aspect of the master plan.
- The financial feasibility, estimation, sponsorship of the project, the terms and conditions of sponsorship and its implementation need to be an essential element of a master plan.

3.6 THE PLANNING PROCESS FOR PREPARATION OF AN AIRPORT MASTER PLAN :

There is no standard methodology for preparation of a master plan. The execution takes place taking into account the circumstances pertaining at each airport. The data collection that you studied in 3.4 may happen simultaneously with the planning process. The planning process involves a number of stages and they are as

➤ **Stage 1 – Situation Analysis :**

The first stage involves a study of the existing situation. The study is often conducted by professional consulting bodies that submit a transparent report on different aspects that help the airports planners to make decisions. The major aspects taken into consideration are

- i. the regional context where the airport is located.
- ii. the socio economic context of the region.
- iii. the role and existence of the airport; the assessment of the need for the airport and its importance in context to the region.
- iv. the weather conditions, surrounding land, its usage and topography.
- v. the existing activities pertaining to aviation and non-aviation.
- vi. the adequacy of the existing facilities.
- vii. the previous plans of the airport and its governance.
- viii. the stake holders of the airport involved in the governance and the regulatory policies followed by the airport.
- ix. Constraints pertaining to environment and heritage.
- x. Assessment of competition with other airports in the region.
- xi. Economic impact analysis
- xii. Preliminary air quality impact analysis
- xiii. Facilities planning for the airport.
- xiv. Airspace and runway capacity analysis.

- xv. Preliminary engineering feasibility and evaluation.
- xvi. Preliminary financial assessment.

The situation analysis stage involves a lot of data that is analyzed and mapped. The analysis phase involves SWOT analysis that is undertaken that helps in understanding the existing situation of the airport and decision making for the subsequent stages. Risk assessments too are undertaken at this stage that may affect the airport and are incorporated in the master plan to be addressed.

➤ **Stage 2 – Providing a Direction for Future :**

Once the existing situation is analysed and is clear to all the stake holders it is very important to take into consideration the future planning and its direction. The stage involves a lot of decisive questions that are answered by the stake holders and the airport planners that provides direction to the airport for the future and the achievements that need to be undertaken for the same. It also encompasses the study of the regulatory policies of the government and the opportunities that the airport shall incorporate for the future growth and development. A master plan indicates how developments are linked to Air traffic and demand, economic and environmental factors, investment requirements, the financial implications and strategies.

➤ **Stage 3 : Implementation :**

The implementation phase is the most crucial phase of a master plan. There are many agencies that are involved with the planners from design aspect to land use to facilities to finance and stages of implementation play a crucial role to the whole project. The phase involves lot of legal formalities, permissions, interventions, contracts, movement of resources. It is the most critical and toughest of the phase and requires

- Combination of need driven as well as a design driven process. A design driven process often happens at the planning stage but there may be a lot of challenges that emanate only when the process is implemented. Implementation of a master plan often involves bypassing the design driven process and re-look at the criticality of the aspect that acts as a challenge and undertake a need driven action.
- Change in design and processes are part of the implementation phase,. The team working for the project in coordination with various sub teams should always embrace change with flexibility and alter course of action for execution of the project.
- Implementation of the master plan shall always be holistic and integrated keeping the long term perspective and the vision for the master plan in sight.
- Expertise shall always be brought in during the implementation phase. An involvement of experts during actual implementation is more important than their involvement in the planning phase. Experts

can indicate anomalies in the projects and processes and can save a lot of money for the project in the long run.

- Stake holder involvement in the execution is very important during the implementation phase. There should be no ambiguity after a structure of the project is built on its technical aspects and stake holder engagement.
- Implementation involves continuous review process and monitoring as circumstances pertaining to external and internal environment may change.

The extent of a master plan extends beyond the physical boundaries. Master plans for airports may encompass development only in the area earmarked for an airport or may go beyond into the adjoining areas as an integrated development proposal. Modern airport developments are incorporating the latter as a developmental aspect of the airport as the same is beneficial from civic as well as business perspectives for the place where the airport is located.

☐ Check Your Progress – 2 :

1. In the formulation of a master plan the following groups are involved
 - a. Airport regulating authorities
 - b. Airline companies
 - c. Financial consultants
 - d. All the options
2. Regression Analysis is a statistical tool that may be used in analysis for
 - a. Graphical design
 - b. Spatial design
 - c. Forecasting
 - d. None of the options
3. A Pre planning process is _____ element of a master plan
 - a. alternate
 - b. crucial
 - c. Non essential
 - d. Expensive
4. Situational analysis is _____ stage in planning of a master plan
 - a. 1st
 - b. 2nd
 - c. 3rd
 - d. 4th

3.7 LET US SUM UP :

A master plan for an airport is one of the most important tool that every airport needs to prepare during its planning phase of construction. The plan deals with strategic matters of an airport pertaining to infrastructural, financial, physical framework, political, environmental and other detailed aspects that shall determine the present and the future course of action for an airport. The master plan not only serves for the present and the future but also prescribe solutions within varying time horizons. It is an integrated solution for a short term capital improvements of a long term vision. The role of the master plan is proper utilization of resources for a long term, keeping all the stake holders involved. The

challenges to the building of an airport, if any, are part of the master plan with a clarity in solutions to overcome them, not only for the moment but for the future also. The plan incorporates the role of an airport from socio-economic perspective, financial objective, environmental obligations, sustainability and continuous development. There are intermediate plans at every stage that are designed as a part of the process to support the master plan. Data collection, analysis, decision making and forecasting are key elements that continuously move in a dynamic cycle during the preparation phase of the plan. Though a master plan is compiled and framed by a group of technical persons with lot of expertise, but it also involves a lot of stakeholders who are associated with an airport and their perspectives for a final outcome and implementation.

3.8 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. b 2. d 3. b 4. a

Check Your Progress – 2 :

1. d 2. c 3. b 4. a

3.9 GLOSSARY :

Quantitativ : Measurement related to amount or number/ numeric variables.

Qualitative : Measurement related to types and represented by a name, symbol or a code.

Checklist : List of things that can be checked and completed. Job aid.

Inventory : A detailed list of items.

Augment : Make greater by adding to it.

Deregulation : The act or process of removing restrictions.

Peripheral : Connected with the outer edge of a particular area.

Ambiguity : Unclear; Capable of being understood in two or more ways.

3.10 ASSIGNMENT :

The X airport has been planned to be newly constructed in the city as a part of rapid economic growth of the city and need for air transport to be connected from different cities to augment and support the economic boom. The land identified for the development of the new airport was 30 km away from the city. The terrain was rugged and climatic conditions of desert prevailed. The highway was the only life line that connected the city to the identified spot. List the importance of the under mentioned aspects that would play a major role as part of the master plan for the airport and how ?

Airport Operation & Management

- Communication Network from the city to the proposed site.
- Road and rail network connecting the airport.
- Energy sources and its harness and regeneration.
- Water sources and conservation techniques.
- Managing greenery.
- Building of Cargo Hub.
- Development of area around the airport as part of land use.
- Study of weather conditions and precautions.

3.11 ACTIVITIES :

Collect master plans of 2 airports and compare the different aspects related to the plan.

3.12 CASE STUDY :

The airport master plan of "Airport Y" indicated development of a satellite township and commercial activity as a part of land use of the airport built. The stakeholders approved the above plan and started designing commercial establishments on the Eastern side of the airport and residential projects on the Southern side. The airport authorities urged the municipality to connect the Eastern and Southern flanks of the airport periphery with major arterial roads for easy movement of cargo and vehicles to and from the airport. Initially the municipality had approved of the project but later objections raised by the forest department for a stretch of land that was under the purview of the green zone, where the arterial connecting roads were to be built, led to bureaucratic issues. The road was not built as the issue was in the court for a decision. The airport stake holders had developed cargo facilities by then but the same could not be brought under operation due to the challenge.

1. What went wrong in the planning stage between the stakeholders of the project ?
2. How could have the things be different at the planning stage of the project ?
3. Write some possible solutions that can end the deadlock ?

3.13 FURTHER READING :

1. Aerodrome Masterplanning and Design by Rajesh Jethwani
2. Strategic Airport Planning by Mike Brown
3. Airport Planning by Mc Graw Hill

BLOCK SUMMARY

The Units in the above block provided an insight for you about the design elements that are important in construction of an airport. Apart from the fundamentals of planning for construction of an airport that you have come across in the blocks you have learnt about spatial geometrical designs at different airports of the world and their role in development of an airport. You have also learnt about the various factors that contribute towards building of an airport. The master plan that is one of the most important document drawn for a longer time frame is the vision document for an airport considering the involvement of all the stake holders. You in this block have studied the objectives, components, stages and checklists required to build a master plan and the importance of the document in relevance to building an airport.

BLOCK ASSIGNMENT

1. List the stages in planning process of a master plan
2. What are the planning issues encountered during the planning phase of an airport ?
3. List some ways how airport planning can be sustainable ?
4. What are the essential elements of a master plan for an airport ?
5. What is forecasting ? How does forecasting contribute to a master plan ?
6. What are the elements that contribute to airport architecture ?

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❖ Enrolment No. :

1. How many hours did you need for studying the units ?

Unit No.	1	2	3
No. of Hrs.			

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____

3. Any other Comments

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AIRPORT OPERATION & MANAGEMENT



**DR. BABASAHEB AMBEDKAR OPEN UNIVERSITY
AHMEDABAD**

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ISBN 978-93-91071-24-0

Edition : 2022

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ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self- instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is

particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self- instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included many tables and examples for easy understanding.

We sincerely hope this book will help you in every way you expect. All the best for your studies from our team!

AIRPORT OPERATION & MANAGEMENT

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Unit 2 Airport Maintenance Operations

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Unit 3 Airport Passenger Services

Introduction, Services and Facilities, Minimum Connect Time (MCT), Low Cost Carriers, Modern Concepts on Airports, Technology at Airports, Challenges for Airport Operators for Delivering Service

Unit 4 Airport Baggage Handling Operations

Introduction, Baggage Handling Process, Baggage Drop, Hold Baggage Screening, Bag Storage, Aircraft Loading, Arrivals Reclaim, Equipment System and Technology



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BBAATR-305

Airport Operation & Management

BLOCK 2 : AIRPORT OPERATIONS

UNIT 1 : AIRPORT SECURITY OPERATIONS

UNIT 2 : AIRPORT MAINTENANCE OPERATIONS

UNIT 3 : AIRPORT PASSENGER OPERATIONS

UNIT 4 : AIRPORT BAGGAGE HANDLING OPERATIONS

AIRPORT OPERATIONS

Block Introduction :

In the airline industry airports and airline companies work together for a seamless operation creating experiences for travellers. The entire travel experience as encountered by the passenger shall be optimally efficient, cost effective, safe and friendly. To implement the same, airports play a major role on their part integrating technology and human interaction at different touch points. The entire operations of an airport have numerous subparts that are integrated and each part functions individually in imparting the vision and the goals of the airport. In this block you shall be acquainted to some of the critical operational aspects of an airport that contribute towards its efficiency and customer satisfaction. Many a times you might have visited an airport that has beautiful infrastructure around but you wait for a long period of time at the baggage belt for your baggage. Though you created a beautiful picture of the airport in the first instance, the delay in baggage processing slowly turns down your expectations. You shall study some of these aspects that might build and affect perceptions of passengers. Maintenance is a critical aspect of any airport and is a planned activity. The unit shall provide detailed information on the necessity and the process of undertaking maintenances.

Block Objectives :

- To list and describe security models and screening procedures at airports.
- To describe the security regulations based on international standards at airports.
- To evaluate various points for control within and outside the airport premises.
- To list the objectives, categories and components pertaining to maintenance at an airport
- To enumerate on procedures and principles of reactive and preventive maintenance.
- To list the various areas in an airport those are part of maintenance schedules.

Block Structure :

Unit 1 : Airport Security Operations

Unit 2 : Airport Maintenance Operations

Unit 3 : Airport Passenger Operations

Unit 4 : Airport Baggage Handling Operations

UNIT STRUCTURE

- 1.0 Learning Objectives
- 1.1 Introduction
- 1.2 International Framework Based on ICAO Framework
 - 1.2.1 SARPs of ICAO Council– Annexure 17
 - 1.2.2 The Security Planning Cycle
- 1.3 Airport Security Programs
 - 1.3.1 Security Models
- 1.4 Security Screening Procedures
- 1.5 Baggage Search and Screening Procedures
- 1.6 Access Control Within Airport Premises and in Different Areas of Airport
 - 1.6.1 Perimeter Control and Fencing
- 1.7 Let Us Sum Up
- 1.8 Answers to Check Your Progress
- 1.9 Glossary
- 1.10 Assignment
- 1.11 Activities
- 1.12 Case Study
- 1.13 Further Reading

1.0 LEARNING OBJECTIVES :

- To list and describe security models and screening procedures at airports.
- To describe the security regulations based on international standards at airports.
- To evaluate various points for control within and outside the airport premises.

1.1 INTRODUCTION :

Airports since its existence have often been the centre of conventional crimes like theft, breaking, and vandalism and against persons. As a public facility it is a common occurrence and the same can be controlled easily. Lately there have been incidents of terrorist attacks on aircrafts, at airports, attacks with firearms and missiles at airports, hijacking of aircrafts and use of hijacked aircrafts to sabotage buildings. The immense loss of life

and property that happened on 9/11 has changed world perspective of security at airports and the aviation industry globally. Nationally and internationally, there is considerable concern to provide continuous protection against the possibility of attacks on civil aviation; airports stand in the last line of defence. The occurrence of a severe security incident is as unpredictable and as unlikely as the probability of an aircraft accident, but both have the serious potential for loss of life and injury or damage to property.

1.2 INTERNATIONAL REGULATIONS BASED ON ICAO FRAMEWORK :

The convention on International Civil Aviation also known as Chicago convention 1944 superseded the Paris Convention and introduced the need for security to manage peace. The 1960's and 1970's was a period that saw a lot of hijackings of aircrafts. The conventions that took place during this period incorporated airline security as a key issue and excerpts from some of the conventions are as

- The Tokyo Convention 1963 on Offenses and Certain Other Acts Committed on Board Aircraft was concerned with the whole subject of crime on aircraft and in particular with the safety of the aircraft and its passengers.
- The Hague Convention 1970 for the Suppression of Unlawful Seizure of Aircraft deals with hijacking, specifically recommending that it be made an extraditable offense.
- The Montreal Convention 1971 on the Suppression of Unlawful Acts against Civil Aviation—enlarges the Hague Convention and adding the offense of sabotage; Safeguarding International Civil Aviation against Acts of Unlawful Interference. The annexure 17 to the Chicago Convention of 1944, dated 1974 (ICAO 1974)—established 40 international aviation standards and 17 recommended practices.
- The Montreal Protocol for the Suppression of Unlawful Acts of Violence at Airports Serving International Civil Aviation, 1988 is a supplement to the Montreal Convention intended to cover acts of violence against civil aviation that occur at airports and ticket offices, which were overlooked in 1971.
- The Mexico Convention 1991, produced regulations for the marking of plastic explosives for the purposes of detection of their sources.
- The ICAO Document 8973: Security: Safeguarding International Civil Aviation against Acts of Unlawful Interference was first published in 1971 and frequently updated, these manual documents, in detail, procedures for preventing acts of violence against aviation.

1.2.1 SARPs of ICAO Council – Annexure 17 :

Annexure 17 sets out a number of standards and recommended practices (SARPs) for securing civil aviation. These include standards involving the setting up of a national organization with

- overall responsibility for aviation security
- the requirement that each airport should run an airport security program
- a responsible authority at each airport
- an airport security committee at each airport and
- the design requirements for airport security are adhered to.

These standards are, respectively :

Standard 2.1.2 : "Each Contracting State shall establish an organization and develop and implement regulations, practices and procedures to safeguard civil aviation against acts of unlawful interference taking into account the safety, regularity, and efficiency of flights."

Standard 3.2.1 : "Each Contracting State shall require each airport serving civil aviation to establish, implement, and maintain a written airport security programme appropriate to meet the requirements of the national civil aviation security programme."

Standard 3.2.2 : "Each Contracting State shall ensure that an authority at each airport serving civil aviation is responsible for coordinating the implementation of security control."

Standard 3.2.3 : "Each Contracting State shall ensure that an airport security committee at each airport serving civil aviation is established to assist the authority mentioned under 3.2.2 in its role of coordinating the implementation of security controls and procedures as specified in the airport security programme."

Standard 3.2.4 : "Each Contracting State shall ensure that airport design requirements, including architectural and infrastructure-related requirements necessary for the implementation of the security measures in the national civil aviation security programme, are integrated into the design and construction of new facilities and alterations to existing facilities at airports" (ICAO 1974).

1.2.2 The Security Planning Cycle :

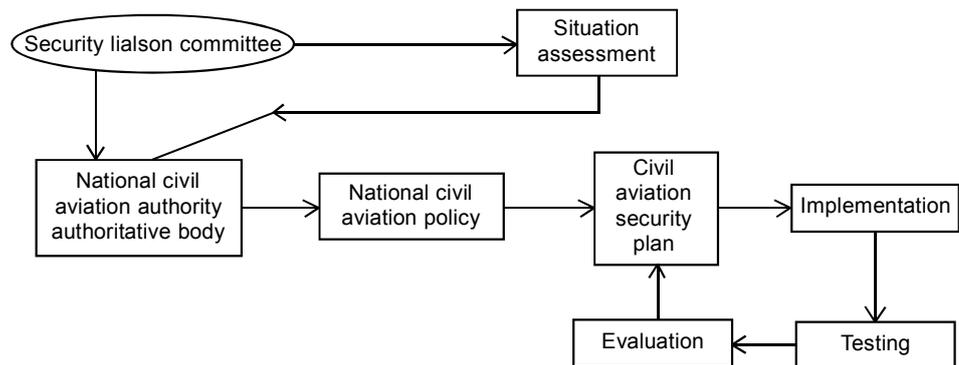
The planning for security at an airport and facilities that incorporate airlines is very critical globally. The planning for the same is undertaken by experts at the National level of a country as a policy and some of the aspects include:

- Internationally, ICAO requires that each Member State initiate a national aviation security program that can be developed by a national aviation security committee formed from representatives of these organizations.
- There should be a clear National policy on the operational aspects implemented at each airport.
- The National policy is translated to the National Security Aviation Plan adhered by all the airline companies and the airport. The national plan is implemented by the provision of staff, equipment,

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and training at airports and other sensitive aviation areas. System-wide and at individual facilities, security operations are tested, evaluated, and modified to ensure adequate performance standards.

- The evaluation and reviews is carried out by qualified security officers and operations personnel, and assessments should include information on the severity of any deficiency and how it relates to airport security as a whole. All existent system related and human problems need to be identified and plugged during the evaluation process. An analytical approach to judge the strengths and weakness of the system is to be undertaken.
- A continuous threat assessment and readiness against the threat perception needs to be built up at the facilities to prevent any threat from occurring.
- Planning to meet the needs of security emergencies and to ensure deterrence of unlawful acts against civil aviation requires the involvement of a number of organizations, such as the airport administration, the operating airlines, the national civil organization, the national security service, the police, armed forces, medical services, customs, government departments and many other concerned departments.



Security Planning Council

❑ Check Your Progress – 1 :

1. The subject of crime on aircraft and safety of passengers was a concern presented in
 - a. Chicago Convention
 - b. Paris Convention
 - c. Tokyo Convention
 - d. Hague Convention
2. Suppression of unlawful seizure of aircraft deals with crime related to
 - a. Sabotage
 - b. Hijacking
 - c. Robbery
 - d. Theft
3. The discussion on plastic explosives and its regulations were part of
 - a. Chicago Convention
 - b. Paris Convention
 - c. Tokyo Convention
 - d. Mexico Convention

4. The acronym SARPs stands for
 - a. Standard and Recommended Practices
 - b. Standard and Recommended Procedures
 - c. Straight Recommended Practices
 - d. None of the options

1.3 AIRPORT SECURITY PROGRAMS :

Majority of the countries are signatories and part of ICAO. The aviation security programs are planned and designed by ICAO and countries have a similar structure of security programs that are implemented. The differences in the program lie in the degree of involvement of the government of the country in the programs. The overall structure of the programs contain the following elements

- Legislations related to security of airports.
- Airport Security Committee.
- Security Measures and Controls
- Communication and structure of communication.
- Security Equipments
- Response in event of unlawful interference
- Security training
- Monitoring and quality control.

1.3.1 Security Models :

- The United States suffered one of the most tragic incidents related to breach of airline security on 9/11. The responsibility for security at airports in United States prior to the tragic incident of 2001 was with the respective airline companies and screening procedures with private security firms.
- After 2001, the responsibility of security at the airports was transferred to Department of Homeland Security (DHS) and Transportation Security Administration (TSA).
- Title 49 of "Transportation" of the code of Federal regulations guide security at airports in the United States mentions that each airport should mandatorily have a security program in place.
- The security program is undertaken by the Federal agency and incorporates the role of the Security coordinator for each airport and operating procedures in detail.
- The Federal agency monitors the implementation and readiness of the protocols applicable to various areas and ensures the personnel involved in managing security are continuously trained.

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- The United Kingdom and a lot of European countries follow the bottom up approach. A multiagency threat and risk assessment is conducted for each airport by a group that constitutes of different agencies involved in the security of the country.
- The report submitted by the group decides the plan that is to be executed and implemented for each airport.
- A Security Executive Group (SEG) is established that comprises of the airport operator, local police authority and the airline company to ensure that protocols and standards are adhered.
- All stake holders are part of implementing the security program.
- In India the Ministry of Civil Aviation directly formulates the protocols for security at the airports. A team comprising of defence experts and the security agencies work on designing a uniform security protocol for the airports.
- Security for all domestic and international civil airports in India is handled by the air wing of the Central Industrial Security Force (CISF).

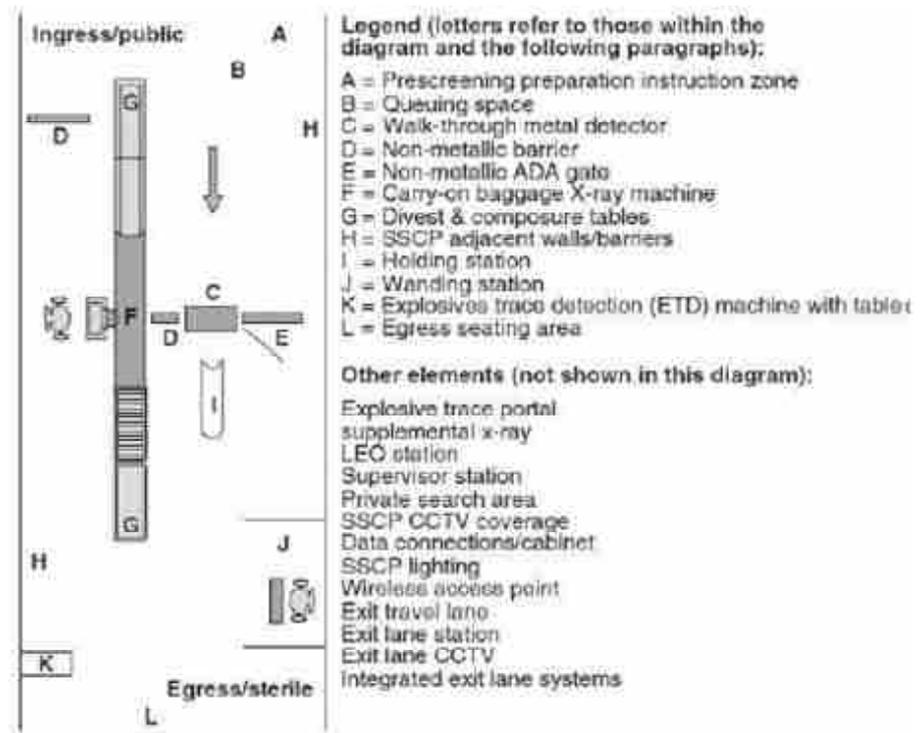
1.4 SECURITY SCREENING PROCEDURES :

The security processes for any airport start from a defined perimeter of the airport. Perimeters are allocated and security is planned accordingly. At Indian civil airports the perimeter of the airport is monitored by both the Central Industrial Security Force and the local police. The process of security cover is in the following stages

- The first checkpoint for security is done for vehicular traffic entering the airport by the CISF personnel. The check point may or may not ask about the details of the passengers in a car, but a vigilant observation is undertaken for all cars entering the airport perimeter.
- Once the passenger gets down from the vehicle at the terminal, the outside perimeter of the terminal is managed by armed security personnel of the CISF. Continuous rounds of the outside perimeter of the terminal along with the car parking areas are undertaken by CISF personnel.
- A standby Quick Reaction Team and armoured vehicle is also deployed by the CISF to meet any emergencies. Security bunkers and strategic watch towers with armed personnel are also there to keep a watch on the activities at the airport terminal.
- The first level of check happens when the passenger enters the terminal building. Passengers are required to show necessary travel documents and ID proof and are then allowed to enter the premise. Staff and other personnel working at the airport use a different gate for entry and have ID cards endorsed by the airport authority that are supposed to be always visible.

- There is baggage screening for passengers facilitated by different airline companies upon entry at many airports. Once the procedure for Check In is handled by the airline, the passenger proceeds for a security check.
- At the security check area passengers are supposed to keep hand baggage and all belongings including mobile phones and belts in totes. Even Jackets and shoes with high heels are supposed to be kept in totes and passed through scanning machines.
- The scanning of goods is done by X Ray machines and passengers undergo a physical screening. The first level is through a walk through metal detecting machine and the second is the screening with a hand held metal detector.
- Any suspicious goods or goods not permitted to be carried in a hand baggage are physically checked and retained.
- Goods under suspicion but are not banned as per law are made to be entered in a register before being allowed to be carried.
- The entire terminal perimeter is managed by the CISF forces and rounds are continuously carried by teams.
- The gates for boarding are also managed by the security forces and facilitated by the respective airline.
- During boarding of a flight, the security is managed by the respective airline according to their standard procedures.
- The CISF also manages the airside through installation of watch towers at strategic points and continuous rounds.
- Communication between units at different areas is undertaken through radio sets.
- The efficacy of security systems at various airports depend a lot on the technology being implemented. Many airports have ETD (Explosive Trace Detection) machines. Passengers may carry components separately that may finally be assembled into an explosive. These machines detect the compound of any powdery substance being carried by a passenger.
- Many airports have face recognition software that continually check images and do a match with the database they have related to prohibited passengers or passengers with criminal records.

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A Security Screening Check Point Layout of An Airport



A Security Check Point Area



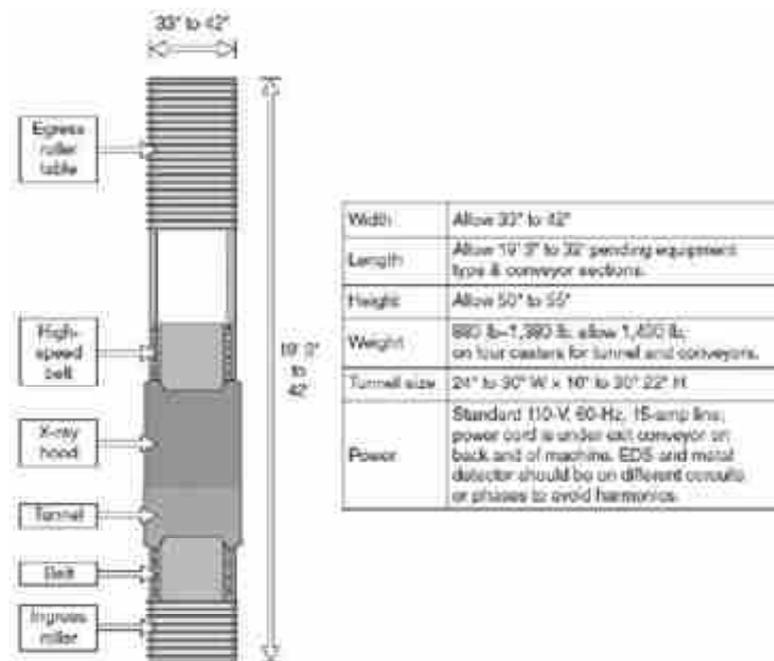
Explosive Trace Detector Machine (ETD)

- Explosive trace portal (ETP) is machines used to provide the capability of detecting explosive traces on the body of a potential passenger. These devices, which are constructed in the form of a walk-through portal, have the ability to determine the presence of explosive that could evade detection at the Walk through Metal Detector (WTMD) stage of search. Unlike in the WTMD, the passenger is required to pause briefly in the ETP portal. ETP technology is capable of detecting a range of explosives, liquids, and narcotics. In size and aspect, the ETP is very similar to the ordinary WTMD.
- Supplemental x-ray equipment is required at larger checkpoints to examine shoes and other items scanned in the secondary screening process. A private search area should be provided for passengers requesting a discreet search.
- Around 2010, larger airports both in the United States and elsewhere, particularly in Britain and the Netherlands, introduced whole-body scanners. These come in two types that depend on very different technologies: Backscatter x-ray scanners Terahertz scanners
- Backscatter x-ray scanners (also called soft x-ray scanners) operate on the use of a very low ionizing radiation dose. This dosage is stated to be equivalent to one additional hour of background radiation and is much lower than the exposure received when flying for one hour at 35,000 feet.



Whole Body Scanner : X Ray Back Scatter

- Terahertz scanners use extremely high-frequency radio waves that are capable of penetrating clothing. Because they do not use x-rays, there is no radiation dose to which it can be considered to be equivalent.

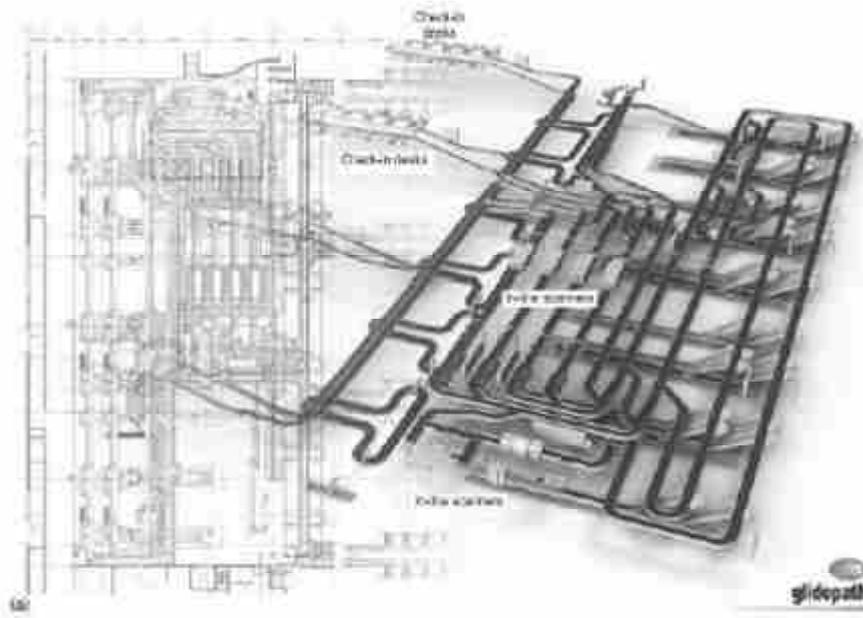


Carry on Baggage X Ray Machine

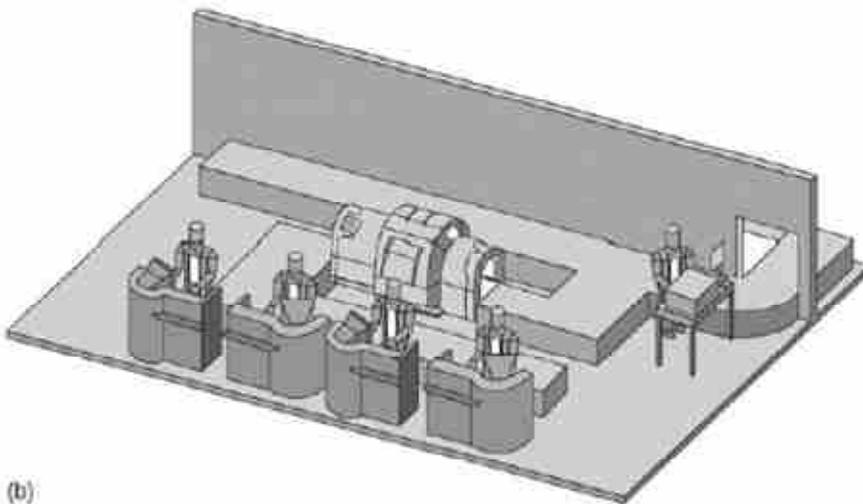
1.5 BAGGAGE SEARCH AND SCREENING PROCEDURES :

There had been incidents worldwide where checked baggage have created mishaps and disasters that had cost a lot of lives.

- All checked baggage at airports is subject to X ray scans and baggage of passengers who do not board the flight but have checked in baggage are offloaded.
- Most airports now operate an in-line baggage-examination system. In Europe, bags are subject to a three-level examination. Level 1 is an x-ray scan, which, if passed, allows the bag to go to loading. Bags that are rejected at Level 1 are subject to more detailed scrutiny of the x-ray image at Level 2. Those which pass are allowed to go on to loading. Bags that fail Level 2 are passed to a detailed search at Level 3. Only when the Level 3 search is satisfactory is the bag allowed to progress.
- Advanced technology has been incorporated at baggage scans at a lot of airports and the same detect articles that are not permitted to be carried in an aircraft.
- Airports with lesser amount of baggage holding space still carry out mandatory baggage checks either at the Check In counter or within the terminal at a space allocated. The screening can either be done on behalf of the airport or on by the airline carrier.
- The screening of freight and cargo carried in ULDs is done through X Ray machines. These machines have colour displays of container contents and are capable of detecting contraband such as concealed weapons, explosives, narcotics, and currency.



Inline Baggage Carrying X Ray System



(b)

Near Check in Baggage Scanning System



Freight X Ray Machine

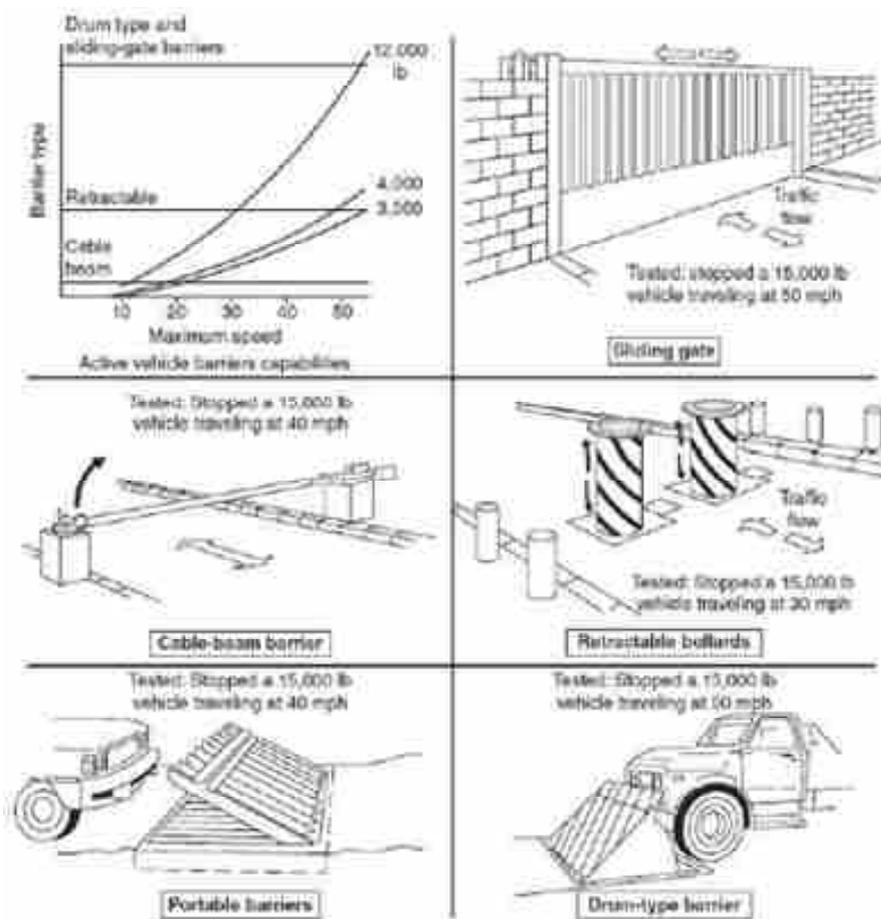
**1.6 ACCESS CONTROL WITHIN AIRPORT PREMISES AND IN
DIFFERENT AREAS OF AIRPORT :**

- Access to airports other than passengers is restricted to only personnel who are working at the airport and are identified through an access control mechanism.
- All airport workers, ground staff, crew, security personnel use a tamper proof badge or identity card with photograph and details also known as Security Identification Area Pass.
- Countries like United States conduct a thorough background check for any criminal records before issuing passes.
- Issuing of passes is a strict procedure at all airports in every country and passes need to be submitted compulsorily on leaving a job.
- There are many controlled and restricted areas within an airport that need additional security input apart from passes depending on the airport and the technology used.
- A lot of airports use biometrics within the airport terminals at a lot of access controlled areas.
- Similarly, airside access should be granted only to vehicles that must be airside to perform their functions. Access can be restricted by the issue of individual vehicular passes, the control of which is maintained by the central airport security authority.
- The passes issued are for a fixed term and are subject to immediate cancellation when no longer required.

1.6.1 Perimeter Control and Fencing :

- It is essential in a properly secured airport that the secured areas are positively separated from those which are unsecured. The two basic elements of perimeter control are fencing and controlled-access gates.
- The airside must have an adequate security fence that serves the multiple functions of clearly defining the protected area, providing a deterrent to an intruder, delaying and possibly inhibiting unlawful entry, and providing controlled access points at gates.
- Care must be taken to secure all conduits, sewers, and other ducts and pipes that pass under the fence to ensure that entry to the airside is not possible.
- Controlled access gates must be provided to the movement area and other parts of the airside. These should be kept to a minimum, and where access is other than by key or automatic control, the gates must be manned, illuminated, and provided with alarms. The access gates are normally equipped with barrier systems with retractable devices that will disable and severely damage a vehicle attempting to force entry.

- Perimeter security measures include Security Lighting Systems, Patrols, Closed Circuit Televisions, Electronic Sensors, Intruder Alarm systems, Motion Detectors and Infrared microwave sensors.
- An airport should designate an isolated aircraft parking position that can be used for parking an aircraft when sabotage is suspected or when an aircraft appears to have been seized unlawfully. This position should be at least 325 feet (100 m) from any other aircraft parking position, building public area, or utility (IACO 2010). Furthermore, a disposal area should be designated on the airport for disposal or exploding of any device found in the course of sabotage or unlawful seizure. The disposal area also should be clear of all other used areas, including the isolated parking position, by at least 325 feet (100 m). An airport might need several designated isolated positions to be used for different kinds of incidents. Some positions should be amenable to surreptitious approach.



Vehicle Barrier Systems at Access Controlled Areas

☐ Check Your Progress – 2 :

1. The acronym ETD stands for
 - a. Explosive Tracking Device
 - b. Explosive Tracking Detection
 - c. Explosion Detection device
 - d. Explosive Trace Detection

Airport Operation & Management

2. The acronym QRT stands for
 - a. Quick Reaction Time
 - b. Quick Response Time
 - c. Quick Reaction Team
 - d. None of the Above
3. _____ scanners are used for body checking at airports and do not use X rays and do not emit any radiation dose
 - a. Megahertz
 - b. Tetra Hertz
 - c. Terra Hertz
 - d. Poly Hertz
4. Vehicle Barrier systems are installed at _____ areas at an airport
 - a. Access Controlled areas
 - b. Runways
 - c. Landside areas
 - d. Airside areas

1.7 LET US SUM UP :

Security at any airport is a crucial task and the same makes airline one of the world's most safe and efficient medium to travel. There is a huge movement of people and goods at the airport and it has to be ensured that nothing that can endanger lives board an airplane. Airports incorporate maximum usage of technology to detect any potential risks and operate through an efficient system to prevent any mishap from occurring. The unit acquaints you in depth with the procedures that are followed at any airport pertaining to security aspects related to passengers, goods, staff members, vehicles and cargo. The unit also acquaints you with

1.8 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. b 2. b 3. d 4. a

Check Your Progress – 2 :

1. d 2. c 3. b 4. a

1.9 GLOSSARY :

Hijack : To take control of an aircraft by force due to some reasons.

Seizure : The act of taking possession of something.

Unlawful : Not allowed by the law

Sabotage : To damage or destroy on purpose.

Suppression : To keep something from happening.

Protocol : System of fixed rules and formal behaviour.

Narcotics : Psychoactive compound with numbing quality.

Conduit : Person, Organization or country used in transferring things, information etc.

1.10 ASSIGNMENT :

A courier company wants to send medicine from India to Dubai which has a prescription and is a liquid.

- a. Is it permitted to be carried by the courier company ?
- b. If the carriage of medicine is permitted what are the security procedures that need to be undertaken ?

1.11 ACTIVITIES :

List 5 airports around the globe and make a comparative study on their security procedures regarding Visa, immigration and customs.

1.12 CASE STUDY :

Airport C was located near the wild life sanctuary. There were occasional challenges of wild animals roaming on the air side of the runway. It was dusk and the flight was on the runway ready for take off. As the engines took the thrust for power, the pilot spotted a herd of fox running on the runway. The emergency brakes were applied and the aircraft came to a halt in the midst of the runway. One or two passengers suffered nervous break downs, however, there was no major mishap. The aircraft too was not damaged and it taxied back to the apron. The entire aircraft was re-inspected, the officials met every passenger and the aircraft took off after 2 hours.

1. What are the steps that should be taken in an airport where the menace of wild life is frequent ?
2. How can airports prevent bird menace which is common at many airports of the world ?
3. In this situation how could the minor mishap that occurred been averted ?

1.13 FURTHER READING :

1. www.icao.int
2. Airport operations by Norman Ashford
3. General Aviation Security by Daniel D. Benny

UNIT STRUCTURE

- 2.0 Learning Objectives**
- 2.1 Introduction**
- 2.2 Objectives of Maintenance**
- 2.3 Components of Maintenance**
- 2.4 Importance of Maintenance**
- 2.5 Categories of Managing Maintenance**
 - 2.5.1 Reactive or Corrective Maintenance**
 - 2.5.2 Usage of Reactive Maintenance**
 - 2.5.3 Proactive Maintenance**
 - 2.5.4 Benefits of Proactive Maintenance**
 - 2.5.5 Challenges in Proactive Maintenance**
- 2.6 Airport Maintenance**
- 2.7 Principles of Preventive Maintenance Program**
- 2.8 Let Us Sum Up**
- 2.9 Answers to Check Your Progress**
- 2.10 Glossary**
- 2.11 Assignment**
- 2.12 Activities**
- 2.13 Case Study**
- 2.14 Further Reading**

2.0 LEARNING OBJECTIVES :

- To list the objectives, categories and components pertaining to maintenance at an airport
- To enumerate on procedures and principles of reactive and preventive maintenance.
- To list the various areas in an airport those are part of maintenance schedules.

2.1 INTRODUCTION :

Maintenance is an integral part of any operations. It is essential to keep equipments, machines, work–environment safe and performing. The reliability of equipments used to determine smooth and complex operations to be undertaken with utmost ease increase with regular maintenance. Maintenance is a set of combined activities undertaken to

restore a component or machine to a state where it can continue to perform its designated functions. Aviation industry uses a lot of equipments and integrated technology to keep the sky safe. It is an integral part of the infrastructure and essential maintenance activities scheduled ensures safer operations. Maintenance at airports is planned activities that adhere to desired levels of safety standards, legislations, operational ease and stringent definite measures for evaluation. The activities involve both technical as well as administrative action towards a focussed intent. The process is accomplished in an order and involves all the functions of management to optimize the resources and achieve the desired objective.

2.2 OBJECTIVES OF MAINTENANCE :

Managing maintenance has definite objectives and it is similar in all organizations. The efficacy of managing maintenance services determines the efficiency of the organization. Some of the objectives of managing maintenance are

- Minimizing failure of any assets and downtime.
- Extending the life of an asset.
- Initiating a planned way of undertaking maintenance work.
- Optimizing all resources available to execute tasks.
- Controlling of costs and budgeting.
- Developing policies, procedures and standards for imparting maintenance tasks.
- Complying with all regulations.
- Ensuring safety and well being all especially personnel involved in the activity.

2.3 COMPONENTS OF MAINTENANCE :

There are a lot key functions that are undertaken as a part of managing maintenances. Each of these function are independent and need to be efficiently managed to improve the entire process of maintenance. The components that build the entire function are

➤ **Work Orders :**

These are primary channels of communication for any maintenance work in an organization. The effective handling of the work orders are important as the processing of the same determines the standards and accuracy of maintenance tasks that are being handled. Work orders decide a lot of other aspects like prioritization, standards, scheduling, assignment, distribution, execution, documentation and closure of tasks.

➤ **Asset Management :**

Asset Management policies are important components in the maintenance process as it is one of the aspects of asset management. Maintenance helps extend an asset's useable life by coordinating the

resources needed to keep it in operating condition. The maintenance strategies of an asset help an organization to determine whether further usage of an asset is feasible or replacement.

➤ **Facility Management :**

Facility management encompasses a range of functions and activities within an organization and managing maintenances are a part of the same. Facility management is the coordination between the physical facility, people and support services. Maintenance in facility management resolves unexpected issues and planned work of different maintenance issues related to different areas.

➤ **Inventory Management :**

Inventory Management is an important component in the maintenance function that manages inventory for daily repair and operations. It involves procurement, storage and replenishment of necessary tools and other items used for managing maintenance. The main tasks of inventory management incorporate Identification of items required for maintenance functions by an organization, Procurement, Storage and Control.

➤ **Maintenance Planning and Scheduling :**

Planning and Scheduling of maintenance activities is the key to effective management of maintenance activities in an organization. It involves prioritizing and organizing maintenance work. The activities involve manpower requirements, tool requirements, mobility, coordination, funds and many other detailed aspects.

➤ **Reporting :**

Reporting is an important management function and are used to collect key data and track performance indicators about the level of activities that are undertaken. Reports help in forecasting schedules, preparation of budgets and decision making.

2.4 IMPORTANCE OF MAINTENANCE :

Managing maintenances is a strategic function of the management in any organization as there are multiple factors involved. Organizations employ various approaches to streamline all maintenance related activities to augment operational efficiency. The importance of maintenance activities in an organization leads to

- Managing of resources in a proper condition.
- Controlling of operational time without loss of time due to breakdowns.
- Maximizing efficiency of a designed operational process.
- Cost control.
- Inducing organization to deliver quality leading to long term success.
- Execution of processes effectively and delivery of desired standards.

- Enhancing safety of people and operations and creating a secure environment.
- Protecting environment optimally.

☐ Check Your Progress – 1 :

1. Effective Maintenance leads to
 - a. Increasing the life of an asset
 - b. Budgeting
 - c. Complying with regulations
 - d. All the options
2. The channel of communication used for any maintenance work is known as
 - a. Work Permit
 - b. Asset Management
 - c. Work Order
 - d. Work Note
3. The coordination between physical facility, people and support services is known as
 - a. Asset Management
 - b. Facility Management
 - c. Work Note
 - d. None of the options
4. The function of maintenance involving collection of data and managing the same is called
 - a. Reporting
 - b. Facility Management
 - c. Work Order
 - d. Asset Management

2.5 CATEGORIES OF MANAGING MAINTENANCE :

Managing maintenances employ one of the two strategies; Reactive maintenance or Proactive Maintenance. Both of the strategies are acceptable processes and are often used in combination with one another. There are vivid differences too in both the approaches and each organization works towards its own strategy to adopt any of the approaches.

2.5.1 Reactive or Corrective Maintenance :

Reactive maintenance includes identification of a fault in the system after the occurrence of the fault and subsequent rectification of the fault so that the system can be restored to an operational condition as per the standards of the operation. The reactive maintenance can be categorized under 2 heads

➤ **Planned Reactive Maintenance :**

- The type of maintenance though is undertaken after a breakdown but organizations can still plan these maintenances.
- The approach is for equipments and assets that are non–critical and can be repaired at a low cost with the available resources around; a maintenance intervention post failure can be administered.

- Planned reactive maintenance can be embedded as a part of preventive maintenance and often the same can be more effective in detection of problems before a total failure occurs.

Unplanned Reactive Maintenance indicates a situation when a breakdown happens between two scheduled maintenances. The sudden breakdown of any asset leads to a reactive maintenance.

2.5.2 Usage of Reactive Maintenance :

Reactive maintenance can improve asset health and performance in situations when

- Potential faults are detected during proactive maintenance that may induce asset failure if not corrected.
- Non critical assets are allowed to function till failure as the same can be easily repaired.
- The failures of assets do not jeopardize any safety situations within the organization.
- The system allows the asset to function properly inspite of failure of a part.

2.5.3 Proactive Maintenance :

Proactive maintenance is a set of regular and routine maintenance of equipments and assets in an organization that leads to efficient system of operations and prevent unexpected failures. Preventive maintenances detect problems before it can actually happen and saves a lot of money. It includes safety and critical checks that leads to increased asset lifespan and an environment that incorporates no loss to life or property. The maintenance of records in a proactive maintenance schedule and inspections acts as a base for decision making on equipments and appraises the organization about the condition of the equipments. Modern organizations with huge inventory of equipments and complex infrastructures are moving towards digitized interventions to keep a track on a real time basis and act accordingly.

The objectives of proactive maintenance is taken into account and planned to develop and execute a proactive maintenance program that integrates with the objectives, mission and plans of an organization. Preventive maintenances can be Time based, wherein assets are serviced at regular intervals according to calendar schedules. The steps involved in a time based maintenance system are

- Identification of the assets
- Analysing maintenance records and manuals related to the asset.
- Set time based maintenance intervals
- Notification on set intervals for maintenance
- Performing necessary inspections
- Record inspections performed

Proactive maintenances are not only time bound but also undertaken in assets based on meter readings. Meter based assets often have indicators that inform in advance of maintenance requirements.

2.5.4 Benefits of Proactive Maintenance :

The benefits of undertaking proactive maintenance programs in organizations are

- Reliability on performance of equipments gets enhanced.
- Extension of asset lifespan.
- Better planning and resource utilization.
- Decrease unplanned maintenance and inspections.
- Increased productivity and output in organizations.
- Reduction in usage of energy leading to cost saving.
- Better audits and adherence to legal compliances.

2.5.5 Challenges in Proactive Maintenance :

The challenges associated with proactive maintenance in an organization are

- The best optimal time frame to periodically maintain an asset is not a rule of thumb.
- For busy operations a shut down may be difficult to undertake for maintenance activity.

2.6 AIRPORT MAINTENANCE :

Maintenance activities at airports are complex tasks because of multi level activities taking place at the same time. To keep the operations smooth and efficient a lot of coordinated effort coupled with optimal manpower, tools and technology is required to ensure error free operations. Every airport is different from another in comparison to size, equipment, machinery, operations, technology and number of aircrafts handled. The basic component of maintenance at an airport involves inspection, servicing, overhaul and repair. The fundamental components of maintenance in an airport may involve

- Plans for preventive maintenance and Standard operating procedures.
- Service Level agreements and contracts for different maintenances
- Procurement and managing inventory for machinery required for maintenance activities.
- Planning of different types of maintenance personnel requirement based on tasks.
- Managing of vehicles required for facilitating maintenance process.

Maintenances at airports can be operational, reactive, preventive as well as predictive. The infrastructural aspect of an airport can be bifurcated into 2 components

Airport Operation & Management

➤ **Airside :**

Airside accommodates the movement of aircrafts around the airport and includes parking aprons, taxiways, airfield lights and signs, navigational aids, visual aids and runways.

➤ **Landside :**

Landside includes the area for movement of ground based vehicles and passenger. Landside includes access roads and parking lots, aviation and non aviation support buildings and terminal buildings.

Airport infrastructure systems on the airside that require a proactive maintenance and contribute to the efficient management of the airport are

➤ **Airfield Electrical Vaults :**

The airfield electrical vault powers electrical components in the airport that are critical to aircraft operations. They may include runway lights, taxiway lights, visual systems and many other equipment. These are often separate building structures located at different places at the airport. These structures may air conditioned or heated to stabilize internal temperatures depending on weather conditions at different places. Periodic electrical equipment maintenance, checks, observations, readings and routine maintenances as per schedule is important as the same might affect aircraft operations.

➤ **Airfield Lighting :**

Lighting systems are important for flights to operate during night time and is an essential feature of an airport. Lights are demarcated according to international protocols and different colour of lights designates different purpose. The different colours also bifurcates boundaries between runways and taxiways at an airfield. Scheduled maintenance activity is essential and includes replacement of bulbs, cleaning of glass domes, cleaning of grass and weed as the same may be an obstruction for lights installed on the ground and testing of cables feeding the lights.

➤ **Airfield Signs :**

Airfield signs help to locate pilots their location at an airport and is an indication that provides direction. The different colours of sign panels provide different meanings. Planned maintenance activities include cleaning of area around the signage, cleaning of faces of the signage, bulb replacements, testing of cables supplying power.

➤ **Airfield Visual and Navigational Aids :**

The visual and navigational aids include beacons, rotating beacon approach lighting systems, runway identifier lights, visual glide path indicators, precision approach path indicators and many other important types of equipment. These critical equipments aid pilots to find an airport and locate runways easily and make a safe approach. Maintenance of these equipments include high grass and weed clearance, bulb replacements,

testing and maintenance of wiring, lens cleaning, painting of metal structures and calibration of systems.

➤ **Airfield Pavements :**

The pavements in an airfield are either made of asphalt or concrete and include runways, taxiways, taxi lanes, parking aprons and other designated areas. These areas need to be in a good condition always as they can be detrimental to the safety of an aircraft. The load of an aircraft leads to continuous maintenance of these areas. Maintenance of these areas include periodic sweeping, sealing of cracks, surface sealing, overlaying of new pavements and many other activities.

➤ **Airfield Markings :**

Airfield markings are painted lines, signs and designations that appear on pavements all through the airport. The markings must be visible during daytime as well as during night and is vital to safe navigation, distance awareness and enhanced safety. The general markings at airports are in white colour and taxiway markings are in yellow colour. The surface painted holding position signs are painted on taxiways and at entrance to runway. These are white numbers on red backgrounds. Normally waterborne paint and glass is used for markings and same depends on weather conditions at the airport. Maintenance ensures that the markings are visible at all times and the same includes periodic assessments, cleaning, repainting and other activities as required.

➤ **Hangars :**

Hangars are storage areas for aircrafts protecting them from environmental hazards and providing additional safety. Hangars are also used for aircraft maintenance. The maintenance of hangars includes structural integrity of the building, maintenance of doors (electric or hydraulic). Larger hangars may have heating or air-conditioning systems that need to be maintained. Hangars are a source of revenue and poorly managed hangars may lead to loss of revenue.

➤ **Maintenance and Storage Buildings :**

These vary in size depending on the intended use at various airports. Maintenance buildings may have different equipments like overhead cranes, forklifts, vehicle lifts or other specialized equipments that also needs periodic maintenance. The storage areas for hazardous or flammable materials require periodic monitoring.

➤ **Fuelling Facilities :**

Many airports have fuel tanks that may be build over or underground facilitating aircrafts to refuel. Maintenance of these fuel tanks is of utmost importance to prevent any hazard and includes inspection pipes, sumping of tanks for contaminants, replacement of fuel filters, inspection of all pressure equipments and nozzles and checking of all aspects as per legal compliances.

➤ **De-Icing Facilities :**

These facilities are available at airports where the temperature is sub zero. The pilots can get ice and snow removed from the aircraft prior to taxiing on the runway for take off. De icing facilities are connected to storm water drains and regular checks are to be undertaken for applicable discharges and disposal of de-icing fluids. Maintenance includes managing and maintaining pavements, storm water drainage lines and check of collection of fluids.

The landside facilities provide access to airports. The maintenance aspects often involve different municipalities as a partner in the maintenance schedules. However, the maintenances include

- Repair of Access roads.
- Electrical repair and maintenance. Managing substations.
- Check and repair of water storage tanks, borewells and pumps.
- Checking and repair of fibre optic cables for internet.
- Infrastructure checks and repair.
- Maintaining electrical and electronic equipments that aids passengers.
- Maintenance of electronic security systems and surveillance systems.
- Managing and cleaning of drainage systems and septic tanks.
- Managing of trees around the vicinity.
- Landscaping.

Airport fencing is a major area of maintenance as the same prevents human and wildlife trespassing within the airport. The perimeters of the airport are secured else the same can become a potential hazard. Maintenance of all equipments used for fencing and strengthening the same is an important task.

2.7 PRINCIPLES OF PREVENTIVE MAINTENANCE PROGRAM :

The basic principles used in airport maintenance are prevention of any untoward break down leading to operations getting affected. Airport maintenances work on the principles of

- Keeping airports as safe as possible.
- Increasing of systems and their longevity.
- Mitigating all negative environmental impacts.
- Integrating all maintenance objectives as a part of airport objectives.
- Establishment of standards for fulfilment of maintenance objectives.
- Allocation of appropriate resources like funds, equipments, personnel, time and material to meet objectives.

☐ **Check Your Progress – 2 :**

1. Identification of a fault after it has occurred and then repairing the same is a maintenance procedure that is
 - a. Proactive
 - b. Implied
 - c. Regular
 - d. Reactive
2. Planned reactive maintenance are undertaken for equipments that are
 - a. Obsolete
 - b. Critical
 - c. Non-critical
 - d. None of the options
3. Unexpected failure of equipment is prevented through maintenance that is
 - a. Reactive
 - b. Proactive
 - c. Non critical
 - d. Implied
4. Contracts undertaken for maintenance of equipments by third parties are called
 - a. Service Level Agreements
 - b. Agreements
 - c. Term Agreement
 - d. Repair order

2.8 LET US SUM UP :

Maintenance is a critical area of operation for any organization for its smooth and effective functioning. Airport operations incorporate a lot of electrical, electronic, technological equipments that are part of the operations and helps in keeping the sky safe and secure for the aircraft. The minimal failure of assets during operations and extending its lifespan can only be attained through regular and thorough maintenance schedules. Good maintenance programs implemented by organizations reduce the operational costs and ensure safety and well being of all stake holders involved in the business. Maintenance procedures at airports involve several components and the same are categorized under proactive and reactive maintenances. There are advantages and disadvantages of both the type of maintenance, however, pre-empting and planning maintenance schedules in a round the clock operations is a major task. Critical procedures are followed in ensuring that maintenances are undertaken in a timely manner and with precision. There are a lot of agencies that work hand in glove with the maintenance department at an airport. Some of these agencies work on contracts within the maintenance department. It is essential for the department that professionals are hired and correct levels of Service agreements are enforced for best results. Above all the entire maintenance department requires a cohesive team to manage the show properly as the areas under the gamut of maintenance are big.

2.9 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. c 3. b 4. a

Check Your Progress – 2 :

1. d 2. c 3. b 4. a

2.10 GLOSSARY :

1. **Asset** : Something / someone of value
2. **Inventory** : Accounting of items/ parts/raw material used in production or sales.
3. **Scheduling** : Process of arranging, controlling and optimizing work
4. **Proactive** : Doing things prior to control a situation
5. **Calibration** : Process of configuring an instrument before its use.

2.11 ASSIGNMENT :

Airport maintenances are a huge budget for airport managing authorities. List some of the cost control measures that can be adopted by the stake holders to manage any untoward or exorbitant costs for maintenance.

2.12 ACTIVITIES :

Make a list of machines that are required and should be available with the facility management team at the land side of an airport.

2.13 CASE STUDY :

A city where airport M is located receives a lot of rainfall coupled with tornados very frequently. There are unprecedented happenings due to the weather conditions at the city often without prior warnings. Two days back a sudden tornado swept the city. The roof of the airport that had partial acrylic coverings was broken leading to water logging. The main power transformer was affected leading to black out situation at different parts of the airport. Signage erected outside the airport was broken and there was a lot of water logging at the departure terminal of the airport. The response teams of different departments were put into work. The challenge faced by these teams was machines that were not present to deal with such situations and inadequate goods and equipments. The water logging in the city prevented goods or machines from arriving at the airport. The catastrophic situation at the airport could not be brought under control and restoration work could not be resumed for the next 6 hours.

1. List the things that went wrong in the above scenario from maintenance perspective ?
2. What should have been done to avoid such a situation ?
3. List the things that should be incorporated in the planning process for the maintenance of an airport ?

2.14 FURTHER READING :

**Airport Maintenance
Operations**

1. Airport Maintenance Management by Harry Kinnison
2. Airport Maintenance Worker by Jack Rudman
3. www.airportoperations.net
4. www.skybrary.aero

UNIT STRUCTURE

3.0 Learning Objectives

3.1 Introduction

3.2 Services and Facilities

3.3 Minimum Connect Time (MCT)

3.4 Low Cost Carriers

3.5 Modern Concepts on Airports

3.6 Technology at Airports

3.7 Challenges for Airport Operators for Delivering Service

3.8 Let Us Sum Up

3.9 Answers to Check Your Progress

3.10 Glossary

3.11 Assignment

3.12 Activities

3.13 Case Study

3.14 Further Reading

3.0 LEARNING OBJECTIVES :

- .To list the various services and facilities offered at different airports of the world.
- To enumerate on the role of Low Cost Carriers and plans of airports to cater to the segment.
- To elaborate some of the modern concepts adopted by different airports globally.
- To list service delivery challenges at airports.

3.1 INTRODUCTION :

Modern airports globally consider wide range of services and facilities to meet the demands of their passengers, airlines and other users. Greater competition within the airline industry combined with the more commercially focused airport industry has meant that many airport operators have abandoned their one-size-fits-all approach and instead are differentiating their offer to meet the varying requirements of their diverse users. In addition, there have been some major developments in the ways some key processes at airports are provided. This has been partly due to legal and regulatory changes, particularly in the area of security and border control, as the industry has had to adjust to new risks and threats

to the business. It has also been a result of technological innovations that have been applied to security and border control and to other areas, most notably check-in. All of this is having major impacts on airport operations and management in areas including space allocation, efficiency and the mix of aeronautical and non-aeronautical revenues.

3.2 SERVICES AND FACILITIES AT AIRPORTS :

Airport operators globally have reworked their business models and have facilitated more commercial outlook and orientation to offer a wide range of services and facilities. The need of customers is varied and airports continuously work on fulfilling needs of the customers. The facilities extended are connected either to the airfield or the terminal with ground handling services providing better linkage between passengers, their baggage, the cargo with airfield and terminals. Airports have considered different aspects to develop when the physical airport infrastructure and its technical capabilities are being assessed. This includes the number of runways, their length and configuration; ATC services; instrument landing, lighting and weather monitoring systems; ramp and apron space allocation, stand and gate provision; fire, rescue and policing/security services. The main areas in the airside (runways, apron, gates) will each have an overall capacity associated with them, and the airfield infrastructure will determine what type of airline is able to use the airport. Developing infrastructure of the airside would lead to more airlines being operational from an airport and more facilities incorporated. Terminals too have been planned with the required design for futuristic expansion and keeping the volume of traffic in the process. Service standards are designed for the planning process of the terminal. Space requirements for various activities are worked out prior to terminal execution.

Historically, most airports offered a fairly common set of services and facilities in trying to serve their airlines, passengers and other users, regardless of the specific needs of the different market segments within these customer groups. Very little segmentation took place at the airports, with product differentiation being limited to separate check-in for economy and business-class passengers, and remote stands rather than air bridges for passengers travelling on charter airlines. This level of segmentation was then increased, with business travellers having access to 'fast-track' systems that guide them swiftly through various processes, including immigration and customs. At the same time, airline lounges for premium class and frequent flyer passengers became more popular. In spite of these developments, the overall focus was still predominantly on a one-size-fits-all airport for all airport users. However, in recent years stronger competitive forces have led airports to pay far greater attention to differentiating their services and facilities in order to meet the requirements and expectations of different market segments. At the same time, the range of different airline models has become more varied (e.g. alliance member, LCC, cargo specialist).

Airport Operation & Management

Airports across the globe have started a new wave of transformation and are providing wide range of services and facilities. These include

- Better linkage and connectivity for passengers in terms of flight operations and connectivity. Airports are working continuously to utilize the facilities and create demand in the market by operating flights to different destinations. Airport teams have been working on incorporating more flights.
- Introducing efficient Baggage handling systems. Though airports have increased in size, baggage handling activity is planned scientifically so that there is minimum waiting time for the passenger at the airport. Baggage handling as an efficient function also facilitates transit passengers whose baggage need to reach the next aircraft before time so that there is no holding or congestion. The lesser the time taken, the faster airline operators can turn around with a connecting flight and more aircrafts can be accommodated at the airport.
- With airline companies forming alliances across the globe, passengers too have become aware of the facilities that partnering airlines provide and as a result alliance companies have stepped up their facilities so that passengers can get the same service quality with both the airline companies under alliance.
- Airline companies have stepped up better ground transport facilities. Airline companies that do not use an air bridge have good transport facilities to make passengers board the aircraft comfortably.
- Access to the airports were often challenging at many places. Working on stepping up infrastructure and creating better surface access links have been priority of the airports for their development in association with the regulatory authorities. Bigger terminals have provided inter terminal coaches for ease of passengers to be transferred from one terminal to the other. Metro rail services have been incorporated in many airports to augment the ease of travel for passengers.
- Parking infrastructure facilities were always a challenge for passengers travelling to busy airports. Modern airports have augmented parking facilities and have designed infrastructures for parking to facilitate passengers.
- Commercial facilities at airports have increased. Airports today are hub of retail activities. There are global brand of eateries, retail outlets of various products, beauty salons, entertainment facilities, technology related facilities. Many airports have hotels, conference facilities and offices within their infrastructure.
- Premium and Business class passengers of different airlines are being given privileges at all airports. The range of privileges depends from airport to airport. Many airports provide a premium waiting

lounge for high valued premium class passengers. They offer high end catering, refreshments, facilities for a business centre, technology support. Many airport premium lounges include secretarial services, personal assistants and valet services too.

- Premium passengers have the privilege offered by all airlines to have a faster hassle free check in. Passengers are not required to stand in the queue for a check in process and the same is undertaken through assisted service by the airline.
- Airports like Bahrain and Copenhagen have separate security check zones and immigration services for premium passengers. They have fast track zones that reduce or eliminate any unnecessary waiting time for the passenger.
- Airports like Doha have a separate terminal dedicated to premium passengers and at the Frankfurt airport in Germany there is a separate terminal for premium passengers of Lufthansa Airline.
- There are airports in the world that have been designed keeping only the premium passenger into consideration. The London City Airport is an airport that is used by charter flights and private jets. The passengers using the airport have a very high average income. Regular commercial flights are not permitted from the airport. British Airways though uses Heathrow airport but for its business class flights to New York the London City Airport is used.
- The airport provides chauffeur and valet services, personal airport concierge service and upmarket retail outlets catering to the needs of the passengers.
- Many airports across the globe have pay and use facilities for the passengers. There is Plaza premium lounge at airports like Kuala Lumpur, New Delhi, Hyderabad that offers a relaxed environment to passengers with many services like food, rest, workstations and shower.
- Amsterdam airport has a lounge for babies and children. They have cubicles and beds and seating for the family. The area has play area for the kids and bath e facilities.
- Airports at a lot of European countries have a facility of fast tracking check in procedure through payment of a fee. Many airline companies have also started the facility of fast tracking airline check in process by payment of fees.
- There are a lot of airlines that provide additional facilities to passengers who are part of a loyalty program. Even passengers who are members of VIP clubs with high membership fees and are affiliates of the airline get special privileges. At the Riga International airport

☐ **Check Your Progress – 1 :**

1. Good linkage in air transport at an airport
 - a. creates demand at the airport
 - b. leads to utilization of more facilities
 - c. operation of more flights
 - d. All the options
2. A lounge is a
 - a. Waiting area for passengers
 - b. Waiting area for the crew
 - c. separate privileged waiting area for passengers
 - d. None of the options
3. Fast track check in for economy class passengers at many European airports are undertaking levying
 - a. Taxes
 - b. Fee
 - c. Airport Pass
 - d. Random
4. The acronym MCT refers to
 - a. Minimum Connect Time
 - b. Maximum Connect Time
 - c. Measured Connect Time
 - d. Measured Correct Time

3.3 MINIMUM CONNECT TIME (MCT) :

Globally airline companies have been undertaking alliances with different airlines to establish a global footprint. Through code sharing and different alliances passengers today can travel to destinations where the airlines they have booked do not operate. The airline companies operate through connecting flights at various airports. Many airports function as hub airports for transfer. These alliance aircrafts work on a minimum time of transfer of passenger and baggage to board the connecting flight. This is known as Minimum Connect Time (MCT). Airports play a very important role in infrastructure and technology in minimizing the MCT. Improvements across the globe have been made through creation of transfer hubs. Copenhagen airport reduced transfer time from 40 minutes to 30 minutes and enabled 70 extra transfer flights. The transfer of passengers from domestic terminals to international terminals is still a challenge at many airports. The transfer time at Indian airports are around 90 minutes and airports like T3 at Indira Gandhi International Airport, New Delhi are continuously working on reducing the same. The measures taken by majority of the airports include

- Less walking time by passengers during the transfer process. Use of moving walkways, escalators, battery operated carts have reduced the time taken.
- Usage of display boards that indicate the way for transfer. Often passenger's get confused and take a lot of time in searching the right terminal and the gate for transfer.

- Dedicated personnel deployed by airlines and airports to facilitate the transfer process for passengers.
- Inclusion of special baggage transfer procedures for transfer flights that are easy and fast. Technology has been adapted at many airports that have made the task faster. At Rotterdam airport in Netherlands and Hong Kong airport robots have been introduced for luggage transportation. Robots like Anstar at Incheon airport and Josie Pepper at Munich airport undertake luggage transfers efficiently. British Airways in association with Bots and us are using artificial intelligence technology at Terminal 5 of Heathrow airport to enhance punctuality of passengers.
- Inclusion of easy transfer processes by using technology.

3.4 LOW COST CARRIERS (LCC) :

Low Cost Carriers have dominated the skies with their focus on efficiency of time, faster turnarounds and lower pricing. Low cost carriers do not need much area inside terminals to operate as they are involved in basic processes. The low cost model discourages passengers to carry too much luggage and many airlines charge for check in baggage also. The same leads to less baggage handling and less utilization of manpower and other resources. Airports include many different business models for low cost carriers. A simple table into the model of operations that includes service facility at the airport required will describe the needs of a low cost carrier

Service Facility at The Airport	Low Cost Carrier Need
Terminal Design	Simple and low in operating cost
Check in Baggage	Lower numbers
Airline Lounge	Not Required
Security	Efficient process. No delay to the aircraft
Transfer Facilities	Majorly not required
Air Bridge	Prefer steps for quicker boarding and disembarking.
Airfield bus	Prefer passengers walk to terminal building where permissible
Office area	Simple

As the quotient of business is high for a Low cost carrier airports too have adopted various models. Airports are sceptical about low cost carriers because many airports that restructured for facilitation of services have suffered business losses due to the volatile nature of the operation of these carriers. Malmo airport in Sweden lost its value due to the closure

of low cost carrier operations. Many airports across the globe are undertaking the following measures for low cost carrier operations

- Low cost carriers in many airports have occupied unused areas within the airports. The same have suited business model for low cost carriers and also faster turnaround of the aircrafts.
- Many airports like Budapest, Copenhagen, Helsinki serving both low cost carriers and full service flights have separate low cost terminals for the low cost carriers with lesser facilities. The same facilitates both the airport as well as the airline.
- John F Kennedy airport in USA has separate low cost terminal for JetBlue airlines.
- The low cost carrier separate terminal model is difficult to be implemented in Asia Pacific due to lack of secondary or regional airports. However, Singapore and Kuala Lumpur airports have separate budget terminals for Air Asia airline.
- Brussels airport developed facility for low cost carriers but could not open due to objection and legal challenges from full service operators.
- At Geneva airport the major airline connecting the city is Easy Jet. There were plans to connect the Old terminal to a new Low Cost terminal. There was objections by KLM airlines, Air France as lower passenger charge would have competitive advantage for Easy Jet.

3.5 MODERN CONCEPTS ON AIRPORTS :

Airports are becoming increasingly diverse in what they offer to users. The diversity extends not only in terms of passenger facilities and baggage handling but in other areas too. Some of the airports are looking forward to incorporate different dimensions. To elucidate some of the major developments they are

- The airports are working as hubs for connecting facilities of cargo operators and integrators. Liege Airport in the United Kingdom is working as a Flexport. The airport is offering a secure cargo connecting process. The airport has no curb on movement of heavy vehicles. It has easy motorway and approach for cargo vehicles. The airport also has a huge number of warehouses and a long runway for heavy cargo planes.
- A lot of airports undertake pre-clearance for customs and immigration at the point of boarding and the passenger is treated as a domestic passenger at the destination country. The passenger need not undergo any hassle at the destination location. It is done for the United States at some of the Canadian airports, Abudhabi, Bahamas, Oslo, London and many other places.
- Virtual airports have been built were passengers Check In, undertake shopping, pre order services and purchase customised services. The

same is done to reduce actual pressure on the main airport terminal. Before the departure of flight the passengers are transferred to the actual airport. Volaris International Airport, Mexico, Etihad airlines for Abu Dhabi airport have such facilities.

3.6 TECHNOLOGY AT AIRPORTS :

Diversity, Differentiation and Innovation are the 3 keys to any business and airports too have applied the fundamentals to bring a new experience for passengers. Technology plays a crucial role in various aspects of operation and passenger experience. Technological advancement and implementation of new perspectives are bringing revolution at many airports. To highlight some of the advancements in technology

- Delta Airlines through their Fly Delta app have installed parallel display screens for passengers at airport lounges. The app contains captivating entertainment options, full body wearable exoskeletons and artificial learning operations platform.
- Baggage handling being undertaken by unmanned robots using artificial intelligence.
- Aerial Unmanned vehicles (UAVs) are used in the test phase at airports for status checks and security purpose at Frankfurt airport.
- Drone delivery of food and drinks at airport terminal is under trial at Edmonton airport at Canada.
- Tele-presence is the experience of virtual reality and is being live tested at Japanese airport and is a project of Japanese airline ANA. The company is working on Tele-presence of passengers for 2020 football World cup.
- Sitalabs has developed a 3 dimensional 86 inch touch screen interface and installed it at United States East Coast airport known as the Digital Twins. The device improves operational decision making by providing a holistic view of the airport operations. The device has a playback facility that allows effective ways of investigation and managing disruption.
- Chat Bot applications that are artificial intelligence powered resolves passenger queries and assist in providing services. The chat bots are designed for continuous learning and enhancing passenger experiences. Air Asia Virtual All Star (AVA) , the chat bot for Air Asia has won an award for the Best Passenger Experience initiative.
- Airports are introducing 5 G technology. Many airports in the United States, China, United Kingdom, South Korea, Germany are working towards promoting 5G technology. Vodafone has installed a 5G enabled Blast pod at Manchester airport. Passengers can download movies and other content to test the speed.
- In-flight Virtual Reality experiences have been introduced by many airlines. A company named Renacen introduced 3 Dimensional

virtual reality seat maps that provided a 360 degree view of the cabin. The same has been used for seat up-selling by many airline companies like Emirates, Etihad, Austrian etc.

- Innovative autonomous wheel chair at Abu Dhabi airport and self driven electric wheel chairs at Narita International airports are installed with robotic elements and are self guided.
- Real time translation in 26 languages has been introduced by American Airlines for its passengers using club lounge facilities at Los Angeles airport.

In recent years there has been increased attention on the 'passenger experience' when considering service quality, passenger satisfaction and other related issues at airports. Some airports are using it as a key differentiator of their offer rather than relying on 'good' service provision as indicated with their service quality measures. In essence, as Boudreau et al. (2016) explained, "the airport experience is a net impression of all of the experiences a passenger has in an airport as judged by a passenger's individual standards, expectations and perceptions". Passenger experience at airports are essential because

- Passenger experiences have led to the growth of non aeronautical revenue considerably.
- A good experience leads to more spending by the passenger and they feel relaxed.
- As airports compete against each other a good experience of a passenger at a particular airport leads to repeat visits through that airport.
- Airports are the gateways for countries and carry the first impression of country. A great airport enhances reputation.
- The crux of customer focus leads to clear goals and objectives of the organization.
- Pride for an airport for the people working there brings better experiences and leads to all positive outcomes.
- Great passenger experiences leads to better media attention leading to more publicity.

The key activities focussed on customer channels in the right direction at an airport leads to a value proposition of the airport as a first interactive point of a traveller visiting a city.

3.7 CHALLENGES FOR AIRPORT OPERATORS FOR DELIVERING SERVICE :

There are a lot of challenges that are faced by stake holders operating the airports in delivering the right service. Some of the challenges are

- Diverse customers with diverse needs.

- There is an uneven spread of demand amongst passengers.
- Service is a combination of activities undertaken by different bodies working and each body has a different perception of service and goals to be achieved.
- Integration of automation and digitization between the airport service environment and the customer.
- The altering market need affects the preferences of customers leading to a gap of demand and supply.
- The Airline pricing policy system on food, seat, baggage has provided more responsibility to be carried by the airport in terms of passenger services.
- More funding of airports is required from the non-aeronautical revenues and Passenger facility charges. The same would involve expansion and diversification of facilities.
- Management of people during congestions and peak hours often lead to challenges in service delivery.
- There are lot of airports where transportation facilities, Inter modal connectivity issues and infrastructural facilities often lead to poor service delivery.

☐ Check Your Progress – 2 :

1. Robots for luggage transportation was introduced at _____ airport
 - a. Rotterdam
 - b. Indira Gandhi International
 - c. O'Hare
 - d. Heathrow
2. The acronym LCC refers to
 - a. Landing Carry Cost
 - b. Low Cost Carrier
 - c. Level Cost Carrier
 - d. Low Carry Cost
3. Separate budget airline terminal at Changi airport is in
 - a. Kuala Lumpur
 - b. Seoul
 - c. Singapore
 - d. Beijing
4. _____ airport at United Kingdom is also known as Flexport
 - a. Manchester
 - b. Heathrow
 - c. Incheon
 - d. Liege
5. The acronym UAV stands for
 - a. Aerial Unmanned Vehicle
 - b. Aerial Unidentified Vehicle
 - c. Aerial Unidentified volume
 - d. None of the Options

3.8 LET US SUM UP :

The need of customers travelling by air is varied as the diversity of the people and their confluence at an airport is huge. Airports need to be continuously work on satisfying the varied needs and acct as linkages between passengers, baggage, cargo, airfield and the terminal. Airports

across the globe have started new wave of transportation and providing wide range of services and facilities for passengers. The same includes modifications, addition and building new facilities at airports related to diverse aspects like baggage transfer, commercial facilities, parking, infrastructure, lounges, fast track zones, technology enabled services and many more. The unit also enumerates on different process and strategies adopted for low cost carriers at different airports of the world as they play a major role in air transportation. Technology is the key driver and airports have adopted various technologically advances systems to engage passengers and connect them to the airport. Being a diverse area of need fulfilment and different perceptive understanding of service delivery, a lot of challenges are faced with a dynamic outlook and ever evolving new ways of resolution.

3.9 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. c 3. b 4. a

Check Your Progress – 2 :

1. a 2. b 3. c 4. d 5. a

3.10 GLOSSARY :

Disembarking : Leaving an aircraft.

Alliance : An association of people, groups, or nations working together for a specific purpose.

Code Sharing : Business arrangement in the airline industry where two or more airlines market the same flight under their own airline designator and flight number.

Lounge : A public

Chat bot : A software that simulates human like conversations with users via text messages on chat.

Chauffeur : A person employed to drive a car.

Telepresence : Technology that enables a person to perform actions in a distant or virtual location as if physically present in that location.

3.11 ASSIGNMENT :

Compare and list the facilities that are provided to passengers at Indira Gandhi International Airport, New Delhi and Chatrapati Shivaji International airport, Mumbai.

3.12 ACTIVITIES :

Select 5 different International airports of your choice that provide lounge facilities. List the services that are provided at the lounge of these different airports.

3.13 CASE ANALYSIS :

A lady had a connecting flight from Terminal 1 of X airport. She landed at Terminal 4 of the X airport from a particular destination and was supposed to continue her journey on a code shared flight. There was a layover of 3 hours in between. The incoming flight was delayed by 1 hour and 15 minutes. As the lady was travelling for the first time she did not know where the next terminal was. After asking a lot of people she was guided to exit the terminal, board a coach and proceed to Terminal 4 which was 10 minutes away. In the hurry she forgot about the luggage and thought that it would be transferred on its own. However, the airline announced before deplaning that luggage needs to be taken from the belt for passengers travelling ahead and again checked in. With bare minimum time left for boarding of the next flight she managed to reach the gate and enquired about her luggage. There was no clue for the staff of the airline present and a hunt started for her luggage over the telephone. The boarding process started and she was made to board the flight. The flight departed and on arrival her luggage never showed up on the belt. She was directed to the airline counter where she was informed that her luggage was detected at Terminal 1 and was moved to the unclaimed section due to which it could not be transferred. The airline shall do the same in next two days.

1. What went wrong on the part of the passenger in the entire situation ?
2. What went wrong on the part of the airline in the entire situation ?
3. List the corrective steps that can be incorporated as a part of process or change so that mishaps like the above do not recur ?

3.14 FURTHER READING :

1. A Practical Guide to Airport Customer Service by Collin C Law
2. Airport Operations by Norman J Ashford
3. Managing Airports by Anne Graham

UNIT STRUCTURE

- 4.0 Learning Objectives**
- 4.1 Introduction**
- 4.2 Baggage Handling Process**
 - 4.2.1 Baggage Drop**
 - 4.2.2 Hold Baggage Screening**
 - 4.2.3 Bag Storage**
 - 4.2.4 Aircraft Loading**
 - 4.2.5 Arrivals Reclaim**
- 4.3 Equipment System and Technology**
- 4.4 Staffing**
- 4.5 Let Us Sum Up**
- 4.6 Answers to Check Your Progress**
- 4.7 Glossary**
- 4.8 Assignment**
- 4.9 Activities**
- 4.10 Case Study**
- 4.11 Further Reading**

4.0 LEARNING OBJECTIVES :

- To list efficient and standardized baggage handling process at airports.
- To enumerate on security measures in the baggage handling process for various stages at different areas of an airport.
- To list different machines, equipment and technology used for the baggage handling process.
- To elaborate on staffing related aspects in the baggage handling process.

4.1 INTRODUCTION :

Baggage handling is an essential element of airport operations, but as with other utility functions, it is often remarked on only when it goes wrong. The effects of failure can range from a few passengers not receiving their bags when they arrive at their destination to the widespread disruption of airport operations affecting both passengers and airlines. Baggage related issues accounted for one of the top complaints of passengers which have steadily declined. Complaints related to baggage that still persist are

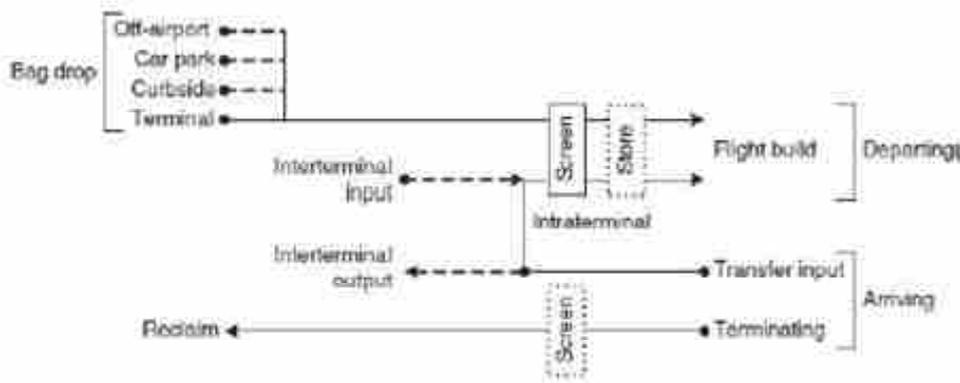
accountable majorly to airline operators and the third parties working with the concerned airlines for baggage handling. The role of the airport operators in the entire baggage related complaints that arise out of passengers is very small. This improvement has been the result of

- Industry-wide appreciation of the costs associated with poor baggage-handling performance,
- Investments in advanced, automated baggage systems around the world.
- Introduction of efficient processes for baggage handling.

Though baggage handling is a prerogative of an airline operator often passengers encountering the same problem at a particular airport, blame it on the airport rather than the airline. Passengers build the notion that at an X airport, the baggage is bound to be delayed. The scale and complexity of baggage handling have changed over the course of the last few decades, and this has led to a spectrum of baggage-handling solutions that range from the simple to the very sophisticated, based on the needs of the airline customers.

4.2 BAGGAGE HANDLING PROCESS :

A typical set of baggage processes will have check in, reclaim, and flight build facilities (also called makeup). Only hub airports will have any significant transfer-baggage facilities. Hub airports with multiple terminals also may have a significant inter-terminal transfer process connecting passengers and their bags arriving at one terminal with their departure flights in a different terminal.



Flight Baggage Process

- Bags entering the system via a bag drop generally will be screened in the terminal of departure.
- Once in the baggage system, optionally, they may be stored and then delivered to a flight build output. From there they are taken to the departing aircraft and loaded.
- Terminating bags arriving at a terminal will be delivered to reclaim for collection by passengers. In some circumstances and jurisdictions, terminating bags are screened for illicit items.

- Transfer bags arriving at a terminal will be input into the baggage system and routed to the terminal of departure. Once there, the process follows that for locally checked-in baggage.

4.2.1 Baggage Drop :

Baggage Drop by passengers can happen in many ways in different countries. The ways in which baggage drop facilities are undertaken are

- Passengers can drop their baggage at the Airport airline Check In counter. The baggage is weighed and a tag generated that is fixed to the baggage and a part of the tag is given to the customer as an acknowledgement. Many functions have been converted online to save time at the traditional methods of baggage check in. Boarding passes and baggage tags are pre generated by the online system during the Web Check in process and the same is carried by the passenger.
- Off Airport Check In counters facilitate baggage processing in advance and prevent crowding at the airport. The same can happen where an airline have the facility at their office like Emirates in Dubai. In Hong Kong and New Delhi, there are facilities to drop baggage at metro stations.
- Car-park and curbside check in are convenient ways to check in for a flight and to drop bags without having to take them through a crowded airport building. It is done through presenting a photo ID and ticket number to an agent. A baggage receipt is collected and the passenger can proceed for security. American Airways and Delta had introduced the facility at many airports at the United States.
- Self Service kiosks with baggage drop facilities saves time for the airline and are less space consuming. The passenger does all the processes himself on the screen. Many airlines have installed multiple self service kiosks. These kiosks are operationally more profitable for the airline.



Self Service Kiosk



Baggage Drop Facility Handled by Airline Staff

Self-service bag drops are places where passengers can deposit baggage without the need for a member of staff. Qantas is an early adopter of this approach for domestic traffic. In this arrangement, bag tags are printed and attached at a check in kiosk so that when the passenger reaches the bag drop, there is little more to do than put the bag onto the receiving conveyor. The average process time is in the range of 20 to 30 seconds per bag. This short process time has reduced waiting time for passengers to deposit bags.



Baggage Drop Facility Self Service

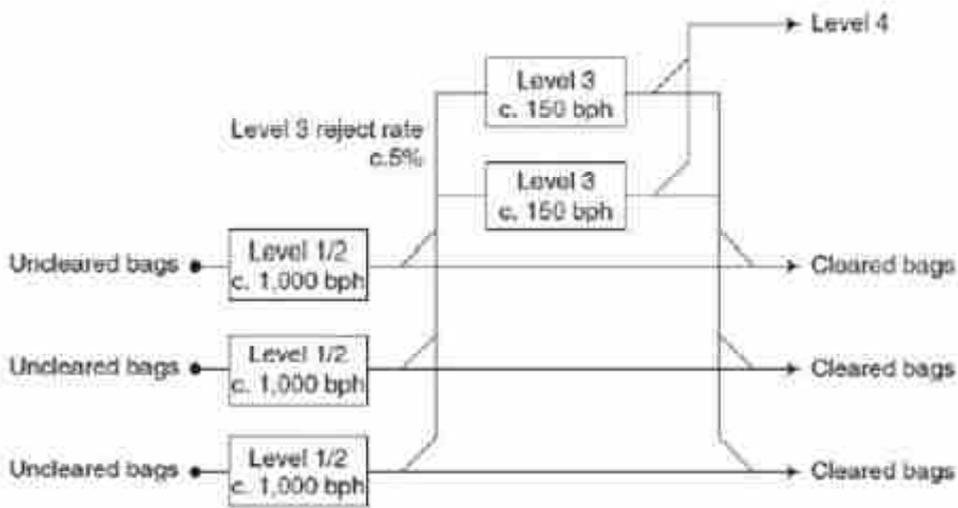
❑ **Check Your Progress – 1 :**

1. Poor baggage handling at an airport leads to
 - a. depreciation of cost
 - b. depreciation of resource
 - c. appreciation of cost
 - d. None of the options
2. Flight built baggage processes are known as
 - a. Reclaim
 - b. Check in
 - c. Check out
 - d. Make up
3. Baggage drop undertaken at place other than airport check in counter is known as
 - a. Off Airport Check in
 - b. On Airport Check in
 - c. Online Check in
 - d. Counter Check in
4. Self service baggage kiosks are operationally
 - a. Expensive
 - b. Profitable
 - c. Labour oriented
 - d. None of the options

4.2.2 Hold Baggage Screening :

Once bags have entered the baggage system, generally they will be screened using in-line x-ray machines [also known as explosive-detection systems (EDS)] to ensure that dangerous or prohibited items are not present.

- Un-cleared bags are examined by a level 1 hold-baggage-screening (HBS) machine. These machines typically can process bags at rate of more than 1,000 per hour. If the machine and its image-processing algorithm is able to determine that there is no threat present, the machine will clear the bag. For perhaps 30 percent of bags, the image-processing algorithm will not be able to clear the bag confidently, so the image will be passed to a human operator for a level 2 decision.
- In most cases at Level 2, the bags then will be cleared, but typically 5 percent of all incoming bags will still be unresolved and will require a more detailed examination. These bags will be sent to a level 3 HBS machine.
- Level 3 uses computed tomography to give a three-dimensional image, allowing a more thorough examination by an operator. Level 3 machines typically have a throughput of 150 bags per hour. In the vast majority of cases, no threat will be present, and the operator will clear the bag. In a very small fraction of cases, the images taken at level 3 still will be inconclusive, and the bags will be sent to level 4 scanning.
- At the Level 4 stage the physical examination of the bag is carried out.



Multilevel Systematic Screening

The above screening protocol is common in European countries. In the United States the protocol adopted is as

Level 1 screening is performed with EDS units. All bags that can physically fit in an EDS unit are directed to level 1 screening and scanned using an EDS. All bags that automatically alarm at level 1 are subject to level 2 screening.

During level 2 screening, Transportation Security Administration (TSA) personnel view alarm bag images captured during the level 1 EDS scan and clear any bags whose status can be resolved visually. All bags that cannot be resolved at level 2 and all bags that cannot be directed to level 1 because of size restrictions are sent to level 3 screening.

Level 3 screening is performed manually and involves opening the bag and the use of explosive-trace-detection (ETD) technology. Bags that do not pass level 3 screening (typically, a small percent age of total bags) are either resolved or disposed of by a local law enforcement officer.

4.2.3 Bag Storage :

Baggage Storage was not very popular aspect as the Baggage that were screened were moved to flight make up positions that were typically available for a particular airport 2 to 3 hours in advance. With more connecting flights flying out of an airport, the need for bag storage has increased. Baggage of passengers for transfer flights arrive way before the actual schedule of the departing flight. Many airline companies to ease out passenger stress have provided them with a bigger time window to deposit baggage not only in the conventional way but also through modern ways that incorporate places that are beyond the airport premises. The same has increased the flow of baggage often early and the need for baggage storage areas. Many airports are using mechanized systems and even robots at baggage store areas to segregate and store baggage efficiently.

4.2.4 Aircraft Loading :

- Baggage that have been processed and sorted ultimately are delivered to outputs where they are loaded either into ULDs or trailers. ULDs are containers into which bags and cargo can be loaded.
- The number of makeup positions allocated per flight will depend on the expected volume of baggage, the flight build time, and the number of segregations into which bags have to be sorted. This can vary from one or two positions for small aircraft to 10 or more for larger aircraft with complex terminating and transfer products.
- Smaller aircraft (e.g., B737s, B757s, and A319s) are not containerized, and bags for these types will be loaded into trailers. These trailers then are towed to the aircraft side, and the bags are loose loaded into the aircraft hold using a belt loader. Since this type of operation is relatively slow and labor-intensive, it becomes unsuitable for dealing with the number of bags carried by larger aircraft.
- Larger aircraft (e.g., A330s, A340s, B777s, B747s, and A380s) are equipped to carry ULDs. A ULD might be able to contain 30 to 50 bags depending on bag size and ULD type.



Unit Load Device (ULD)

The bags may be segregated during the loading process in the flight based on the following factors

- Premium Terminating
- Economy Terminating
- Crew Bags
- Short Connect Transfers
- Long Connect Transfers

- Inter terminal transfers
- Onward Transfers

Loading bags according to these types of segregation assists the speed and ease of handling at downstream stations, but at a price. The flight build operation becomes larger and more complex, and the filling efficiency of ULDs generally will be poorer because some ULDs will be only partially filled. Thus, build segregation policies depend on airline priorities and products, handling operations, and facilities at originating, terminating, and transfer airports.

Whatever process for loading an airline might adhere to, it is the responsibility of the airline to track every single piece of luggage loaded. Bingo Cards are a way of reconciliation that is done for smaller aircrafts and baggage tags can be reconciled against names of passengers. For larger flights, a typical reconciliation system will consist of a number of hand scanners for use by handlers that are connected to a database and message-handling system. The handler scans the bar code on the bag tag and waits for confirmation that the bag may be loaded. The scanned tag number is matched against records in the database, and if the security status is satisfactory, the reconciliation system will indicate, usually via the hand scanner, that the bag can be loaded.



Loading ULD's in An Aircraft

4.2.5 Arrivals Reclaim :

The function of reclaim is to reunite passengers and their baggage. Since the arrival processes for passengers and baggage are very different, the reclaim hall functions as a buffer space—for passengers to wait for bags and for bags to wait for passengers.

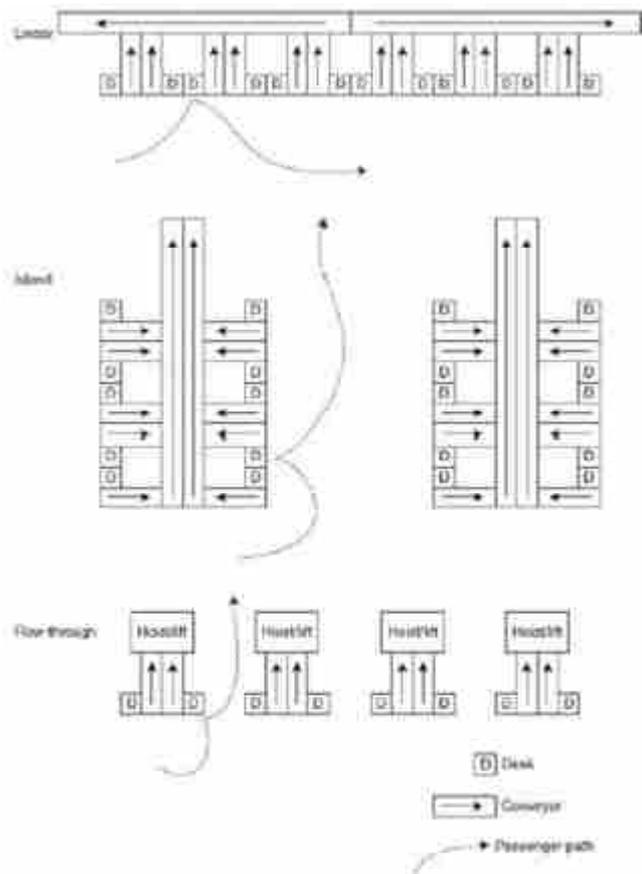
The aircraft operators ensure that the reclaim hall for baggage does not become too overcrowded. The following procedures are ensured

- Segregation of Premium baggage which is unloaded first. Little or no wait is ensured for premium class passengers for baggage.
- Gridlock is balanced to ensure neither the passenger arrives too early and wait for the baggage nor the baggage arrives early and there is no space on the conveyor belt to put all luggage.
- Transfer bags need to be processed and, if on a minimum connection time, processed rapidly. To enable this, bags should be loaded into segregated ULDs on the inbound aircraft at the outstation. These short-connect ULDs then can be unloaded as a priority from the aircraft and taken to transfer input locations. Bags then are removed from the ULDs and input into the baggage-handling system. These bags are then moved to a flight build location for holding.
- In certain emergency situations a bag may be unloaded from one flight and moved to another flight without screening in event of a connecting flight. It also depends on the protocols of the airport. This is known as Tail to Tail transfer.
- At multi terminal airports, transfers can occur between two different terminals. In this case, baggage typically is put into the automated baggage system of the inbound terminal, where it will be sorted to a vehicle loading dock for transport to the terminal of departure, where the bag will be processed and, ultimately, delivered to the connecting flight.

4.3 EQUIPMENT SYSTEM AND TECHNOLOGY :

System and process configurations of baggage handling depend a lot on the design of the airport

- Conventional airports like Chicago or Schipol have a central bag room in the main terminal building which may be either one or many but in a single location. A central bag room requires elaborate sorting techniques as the chances of mix up is very evident. However, utilization of manpower is optimal in these type of setups and staff can be utilized for different flight baggages.
- Decentralized facilities like Frankfurt airport have scattered bag rooms closely associated with a few gates. Sorting in these bag rooms are minimal, however, distance of one bag room from another do not lead to optimal use of the staff during a lean period.
- An airport such as Atlanta, where three-quarters of the traffic is transfer, there is considerable cross-apron activity. Remote bag rooms provide for the complex sorting necessary without transporting all baggage back to the main terminal.
- The traditional Check In and baggage drop desks can be arranged in a number of ways. They can be Linear, Island or a Flow Through.



Check In Desk Configurations

- Once a baggage enters a system it needs to be sorted. The sorting of bags are done differently at different airports and are majorly based on the factors of Space, Cost and the Required Capacity. Conveyor based merge units and divert units are chosen for low capacity operations. Higher capacities use vertical sorting techniques which allow faster sorting. Tilt tray sorters are used for very high capacities. These operate at around 400 ft/min (2 m/s) and typically have a tray size of about 4 feet (1.2 m), giving a tray rate of 6,000 per hour.



Tilt Tray Sorter

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- An alternative approach that reduces the risk of bag jams is to use a totes system. In such a system, bags are not carried directly on conveyors but are first placed in a carrier or tray. Baggage tracking and storage are also made easier with totes. A bag can be identified once and then is linked in the baggage system with a given tote.



Tote Based System

- Baggage screening is technology driven and lot of advancement has happened in the area. There are 3 types of X Ray technology that are been followed. They are Single View Technology, Multiview technology and Computed Tomographic Technology.



Baggage Screening Equipment

- Baggage Storage can be manual grouping in the most simplest of the operations or can be stored in totes vertically moving through conveyor belts. The checking, segregation, movement and the reconciliation of the Totes are undertaken by RFID systems inserted in the Totes.



Baggage Storage in Totes

- Baggage reclaim can be done at the airports through a Flatbed reclaim or an inclined reclaim. Flat bed carousels occupy more space but are convenient to passengers in picking up the luggage. An inclined carousel accommodates more baggage on the conveyor system. Baggage often gets trapped in a flatbed system which does not happen in an inclined system.



Flatbed Baggage Reclaim System



Inclined Baggage Reclaim System

4.4 STAFFING :

The growth of airline companies has led to growth in the number of baggage being handled by each airline.

- Baggage handling is a tedious task and airline companies have employed handling agents. These handling agents often are from another airline handling company or an independent company.
- There is increasing pressure for the establishment of competing companies to carry out ground handling, including baggage handling, based on the argument that such competition will result in lower costs to airlines together with improved efficiency.
- The largest group of personnel engaged in handling baggage consists of those who deal with it on the ramp, transporting baggage to and from the aircraft and loading and unloading the hold. Ramp personnel must be allocated by some system to individual flights, and this necessitates an oversight of ramp activity.
- The basic method of allocating staff to flights is tackled in a variety of ways. At low-activity stations, this is not a complicated procedure and merely requires the lead hand (head loader) personally to allocate staff based on personal experience.
- At higher-activity stations, where handling staff might number several hundred, it is usual to find specialist staff employed as allocators. Their task is not only to ensure the necessary number of staff for a particular flight but also to ensure a reasonably fair distribution of the workload.
- In order to satisfy these requirements, it is essential for staff allocators to have available up-to-the-minute details of flight arrivals and departures, as well as prior notice of the load on board an arrival or the load planned for a departure.
- There is less of a problem in this respect if an airline is doing its own handling, but information easily can be delayed or forgotten when it has to be passed to another organization. All too often this is manifested by the unannounced flight. The establishment of a direct link between staff allocators and air traffic control (ATC), where possible, should ensure that accurate, up-to-the-minute times are available.
- Increasingly, computerized resource-management systems are being used to manage handler task allocations. These involve a centralized management system linked to mobile data terminals in handlers' vehicles.
- The handlers respond to tasks that are presented to them in the vehicle cab-acknowledging the task, confirming that they are undertaking the task, and indicating when the task is finished so that a new task can be allocated.

- Well-defined performance metrics are an important part of the management of baggage-handling processes and systems. There are measures of the overall end-to-end performance of the baggage process, as well as subsidiary measures that focus on particular elements within the end-to-end process.

❑ **Check Your Progress – 2 :**

1. The acronym EDS refers to
 - a. Explosive Detection System
 - b. Explosion Detection System
 - c. Expense Detection System
 - d. Expanse Detection System
2. HBS machine refers to
 - a. Hand Baggage Screening
 - b. Hold Baggage Screening
 - c. Hard Baggage Screening
 - d. Hold Bag Screen
3. The 3D image of baggage is undertaken at Level 3 through computed
 - a. Topography
 - b. Terragraphy
 - c. Tomography
 - d. Trans Graph
4. ETD technology refers to
 - a. Explosion Trace Detection
 - b. Examine Track detect
 - c. Explode Track Detection
 - d. Explosive Trace Detection
5. ULD refers to
 - a. Unit Load Device
 - b. Unit Loading Device
 - c. Under Load Device
 - d. None of Options

4.5 LET US SUM UP :

Baggage handling is an essential aspect of airport operations and is a function that builds perceptive notions about an airport for passengers. Though the task of baggage handling is undertaken by airline companies, but it is often the airport that carries the bad repute. The process of baggage handling is ever evolving with the span of airports becoming big and more airlines operating from the same. Technology plays a major role in the process of baggage handling. There is a lot of security aspects involved in baggage processing and advanced machines are used to prevent any untoward incident and manage safety. Baggage processing is a labour intensive and tedious task and often leads to a lot of pressure on the airline companies. There are a lot of alternative and innovative solutions that have been worked out to ease the process and ensure hassle free travel for passengers. The unit provides an insight into the different processes that a baggage undergoes from Check in to loading in an aircraft and reclaim of the same at the arrival destination. The unit also details different equipments and their functions in the entire process. There are a lot of handling agents that are employed by airline companies coupled with technology, training and performance metrics for faster processing of baggage.

4.6 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. c 2. d 3. a 4. b

Check Your Progress – 2 :

1. a 2. b 3. c 4. d 5. a

4.7 GLOSSARY :

Prerogative : Exclusive right or privilege

Reclaim : Retrieve or recover.

Illicit : Forbidden by law or rules

Tomography : a technique for displaying a representation of a cross section through a human body or other solid object using X-rays or ultrasound.

RFID : Radio Frequency Identification Device

ULD : Unit Load Device

Tote : A box used for holding items.

Kiosk : A small open fronted cubicle

4.8 ASSIGNMENT :

List the cargo handling procedures from Check in to reclaim at a major airport that is used as a regional cargo hub for a country/city.

4.9 ACTIVITIES :

List 5 international airports that have high traffic volume. Study and compare the machines and technology used at these airports for handling of baggage.

4.10 CASE STUDY :

At the baggage belt a passenger upon lifting his suitcase found that the castor wheels of the suitcase were broken and the frame on which the wheels were mounted was also dislocated. The passenger approached the airline counter at the arrival lounge showing the condition of his suitcase but the staff members were reluctant to believe that the same could have happened en route. There was a lot of argument between the passenger and the airline staff without any concrete outcome. The passenger approached the airline through email and a telephonic call established by the airline company was also reluctant to take the blame and insisted upon the passenger flying without insurance. The matter had to be escalated to the consumer forum and after 6 months of pursuing the issue the court directed the airline company to pay the passenger on part of their negligence.

- a. What procedure should have been followed by the airline company during baggage check in at the counter ?
- b. How should the baggage been handled by the should have been under.

4.11 FURTHER READING :

1. Airport Operations by Norman J Ashford
2. www.wikipedia.org
3. www.internationalairportreview.com

BLOCK SUMMARY

The units in the block provide an insight on aspects of an airport that are critical for operations and focus related tasks are adhered in these areas to keep the operations smooth and easy for all the stake holders of the airport. The first unit lists and describes security models and screening procedures at airports and all the security regulations that are based on international standards. The unit also emphasizes on the control aspects that are crucial for security both within and outside the airport premises. Maintenance is key to efficient functioning of an airport as there are diverse elements involved in maintenance. From buildings to equipments to technological interfaces maintenance is involved in all stages of operation. The unit 2 highlights the objectives, categories and components pertaining to maintenance at an airport and also enumerates on procedures and principles of reactive and preventive maintenance with their relevance vis a vis airport operations. The unit also details on the various areas in an airport those are part of maintenance schedules. Airports are confluence of passengers from diverse backgrounds, culture and geographic locations. The diversity includes very different types of needs and fulfilment of needs are a priority of any airport through the diverse services that it offers. The unit 3 details on various services that airports globally are providing to customers and also gives an insight into the modern concepts with technological orientation and the key challenges encountered by airports in service delivery. Baggage handling is an important deciding parameter between a good and bad airport. Though the process is handled by airline companies the repute or the disrepute often is borne by the airport. The 4th unit lists efficient and standardized baggage handling process at airports and enumerates security measures in the baggage handling process for various stages at different areas. The unit also details on different machines, equipment and technology used for the baggage handling process.

BLOCK ASSIGNMENT

Short Questions : Explain the following terms

1. List the ICAO framework on airport security procedures.
2. List 5 machines and their use in airport security process.
3. What are the objectives of maintenance at an airport ?
4. Compare between Proactive and Reactive maintenance procedures.
5. List 10 services and facilities offered by airports to passengers.
6. Enumerate on the different machines and equipments used in baggage handling.
7. Role of airport in providing facilities to Low Cost Carriers.
8. Explain the Security planning cycle at an airport.

Descriptive Questions :

1. Explain the security procedures that are undertaken at airports according to international standards from the entry point at the airport to the exit ?
2. Describe the role of technology in the security process of an airport ?
3. Explain the various components, types and importance of maintenance at airports ?
4. Explain in detail the role of technology in enhancing service experiences at airports ?
5. Explain the stages of baggage handling process at an airport from baggage drop to reclaim ? List the importance of human work force in the baggage handling task ?

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❖ Enrolment No. :

1. How many hours did you need for studying the units ?

Unit No.	1	2	3	4
No. of Hrs.				

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____

3. Any other Comments

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AIRPORT OPERATION & MANAGEMENT



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ISBN 978-93-91071-24-0

Edition : 2022

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ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self- instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is

particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self- instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included many tables and examples for easy understanding.

We sincerely hope this book will help you in every way you expect. All the best for your studies from our team!

AIRPORT OPERATION & MANAGEMENT

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Dr. Babasaheb Ambedkar
Open University Ahmedabad

BBAATR-305

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BLOCK 3 : AIR TRAFFIC AND EMERGENCY MANAGEMENT

UNIT 1 : AERODROME TECHNICAL SERVICES

UNIT 2 : AIRPORT AIRCRAFT EMERGENCIES

UNIT 3 : MANAGING DISRUPTIONS

UNIT 4 : AIRPORT NOISE CONTROL

AIR TRAFFIC AND EMERGENCY MANAGEMENT

Block Introduction :

Air Traffic Control is the backbone of airline operations. It is imperative to manage safe operations and Air Traffic Control manages the same in a controlled air zone and on the ground at the airport. The block introduces you to the importance of the Air Traffic Control system and the services offered by the ATC. It also acquaints you with various technology used for the same. Emergencies are potential threats that may occur at an airport. The airport being a complex structure with equipments and machineries of high value and aircrafts that are worth millions need to also be prepared to identify potential threats for hazards and combat them. The unit discusses various emergencies and ways for combating the same at an airport. Disruption is a global phenomena encountered by airlines across the globe. The same can be due to internal as well as external causes. The unit gives an insight into the types and the scientific ways applied to manage disruptions. Noise pollution due to aircrafts at any airport is a global phenomenon. With stringent laws across nations, the apex body ICAO is focussing on reduction of noise impact at airports and its vicinity. The same involves various techniques and technological innovations pertaining to aircrafts and equipments. The unit provides you with some insight on the ways noise is being controlled and monitored at various airports of the world.

Block Objectives :

- To enumerate on Air Traffic Control system, its purpose and services.
- To explain flight rules and its categories, airspace classes, aeronautical communication and operational structure.
- To list the types of emergencies and the methods and management techniques applied to combat emergencies at an airport.
- To define disruption and discuss techniques to manage disruptions.
- To define aircraft noise, its impact and strategies implemented to control the same.

Block Structure :

Unit 1 : Aerodrome Technical Services

Unit 2 : Airport Aircraft Emergencies

Unit 3 : Managing Disruptions

Unit 4 : Airport Noise Control

UNIT STRUCTURE

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1.0 LEARNING OBJECTIVES :

- To enumerate on Air Traffic Control system, its purpose and services.
- To explain flight rules and its categories, airspace classes and operational structure.

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- To list services associated with aeronautical communication and meteorological services.
- To enumerate a generic overview on Air Traffic services in India.

1.1 INTRODUCTION :

There are many operational services in an airport that are concerned with the safety of aircraft operations in terms of control, navigation, communication and information. These services together can be termed as Technical Services. ICAO has passed 4 technical annexure in relation to technical services and they are

- Annexure 10– Air Traffic Services
- Aeronautical Telecommunications
- Meteorological services
- Aeronautical information services

In addition to the above services Emergency services also have to be provided to all the airports in order to provide fire fighting and rescue capabilities for any untoward event. Safety Management systems are integral part of airport operational planning. It is imperative for all airports to incorporate technical services as a part of Safety Management system. The ICAO Universal Safety Audit program is mandatory for all the airports and certification for the same ensures that an airport is adhering to global norms for safety and implementing a proper Safety Management system. Target Level of Security is fundamental to all the technical services at any airport. Compliances designed for different aspects that are part of the technical services are implemented by different guiding bodies and countries at airports. Risk assessments and matrix for acceptability and mitigations are continuously worked out to ensure smooth technical services being provided at airports. The Safety Management system is a process that should be implemented with rationale and logic in the technical services for safety of airport operations and works as a tool that ensures due diligence in its execution and implementation.

1.2 AIR TRAFFIC CONTROL SYSTEM :

1.2.1 History :

The Air Traffic system offers some basic forms of services. To list they are

- Navigation Aid and Landing
- Flight planning
- In flight advisory information
- Air Traffic Control

The Croydon airport at London was the first airport in the world to introduce Air Traffic Control in 1920. A wooden hut 15 feet high was

built with windows on all the four sides. The hut was used to provide basic traffic, weather and location information to the pilots. In the United States, Airmail Radio Stations (AMRs) were created after the World War I in 1922 to direct and track the movement of aircrafts. A system of beacons was set up along the airmail routes to guide pilots in the night and during conditions of poor visibility. The system started at one of the cities of United States and was soon replicated at other cities.

The ground beacons were replaced after 1930 and were replaced by 2 types of low frequency radio navigation aids: the non directional beacons and the 4 course radio range stations. These devices provided easy directional signals for pilots. In the 1950, the 4 course radio range station was phased out and was replaced by very high frequency Omni-range transmitters (VOR). VOR systems were unaffected by weather conditions, interferences of other radio devices and provided a cockpit display support that freed the pilot from listening to radio signals continuously. The VOR stations had a disadvantage of range and more stations had to be installed for coverage.

In 1960, the VOR system was replaced by Distance Measuring Equipment (DME) that permitted the movement of range and direction to a station. The DME collaborated with the VOR station through a Tactical Control Navigation System (TACAN) to create something known as VORTAC, which is still in use in the navigation system. VOR systems have challenges over oceans, low altitude and mountainous areas and often produce potential conflict at intersections where airways cross. Many navigational systems were further developed for military and civil purposes. These new systems were equipped with a technology called Area Navigation (RNA V) where the pilot can fly directly between any 2 points without restriction to a VOR airway.

1.2.2 Purpose of Air Traffic Control :

Air Traffic Control is a service provided by Ground based air controllers for flights on the ground at an airport and in a controlled airspace. Air Traffic control also provides advisory services in a non controlled airspace on various aspects like weather conditions, hazards etc. The purpose of Air Traffic Control can be enumerated as

- Expediting traffic flow at any airport.
- Management of traffic separation.
- Prevention of aircraft collision on the ground and in the air.
- Organizing of traffic for easy landing and takeoff.
- Providing information to pilots about the necessary rules and advisories.
- Helping in the monitoring of the activities on the ground and assisting in security functions.
- Continuous communication with pilots.

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- Locating and tracking flights continuously over voice sets and radars.
- Optimizing technology and providing services to civil, military (whichever country applicable) and private aircrafts operating within its airspace.
- Issuing and ensuring follow of mandatory instructions and advisories to pilots.
- Encouraging safe operation of an aircrafts through airspace.

1.2.3 Evolution of ATC Services :

The prime task of ATC service is separation under IFR conditions where it is difficult for the pilot to see another aircraft in the surrounding airspace. Assistance is required to maintain safe separation and reach the destination. The initial separation services began over radio and telephone communication. As the traffic was less, at expected points pilots would radio their time of arrival and altitude and the expected time of arrival at the next check point. The message would be communicated to the Air Traffic Control. At the control the message was written on blackboards and the flights tracked with a moving marker over a table top map. The system of paper strips marked with flight data posted in the order of their estimated arrival time at each reporting point was introduced and is still used as a backup system in event of equipment failures. With the increase of air traffic, the number of air ground stations had to be increased, for ATC to receive accurate information. The same was devised for improved safety, capacity and efficiency of the control process.

After World War II, radars were introduced. Surveillance radars were installed at major airports providing data of incoming and outgoing flights up to a certain range. Long range radars were later introduced that allowed continuous monitoring of actual flight progress and detection of potential conflict or hazard situations. Radar vectoring process was used by controllers to guide aircrafts away from thunderstorms and other hazards. The radars could not determine the altitude of aircrafts. Transponder systems were introduced that were fitted to the airline and provided reduced controller workload. The introduction of Discrete Address Beacon System (DABS) provided a two way digital data link that led to improved transmission of data between the ground and the aircraft.

In 1983, ICAO formed a special committee on Future Air Navigation System (FANS) leading to the development of very wide ranging operational concept of the ATC. The FANS report laid the basis for industry's future strategy for Air Traffic Management, through digital communication, navigation and surveillance using satellite and data links. Communication technology that was Voice only became Voice and Digital data based technology. Navigation technology involved integration of satellite based navigation systems. The FANS solutions introduced systems on aircrafts that monitored navigation error probability. The final report of FANS was released in 1991 and implementation plan was released in 1993.

☐ **Check Your Progress – 1 :**

1. The acronym AMR stands for
 - a. Airport Radio Service
 - b. Airport Radio Station
 - c. Airmail Radio System
 - d. Airmail Radio Station
2. The acronym DME stands for
 - a. Direction Measuring Equipment
 - b. Distance Meeting Equipment
 - c. Distance Measuring Equipment
 - d. None of the options
3. The acronym DABS stands for
 - a. Distance Address Beacon System
 - b. Discrete Address Beacon System
 - c. Dispute Address Beacon System
 - d. Direction Address Beacon System
4. The acronym FANS stands for
 - a. Future Air Navigation System
 - b. Familiar Air Navigation System
 - c. Future Air Neutral System
 - d. None of the Options

1.3 INTERNATIONAL ATC COLLABORATIONS :

Air Traffic Control is primarily a prerogative of the government and its appointed agencies in majority of the countries, however, in many countries the same has been partially privatized for different areas. Air Navigation Service Providers (ANSP) is a common term in many countries. ATC services globally have undergone a lot of change. To make services and quality of services better, ATC services have gone beyond the boundaries of nations. In Europe, EUROCONTROL was formed as an unit funded by national governments, based out of Brussels in Belgium, to address operational issues of aircraft control in restricted volume of airspace in certain European countries. EUROCONTROL is responsible to the European Commission. The funding helps the organization to establish research and development capability, operational capability, emerging service provision requirements and provides strategic evaluation of demand and airspace sector capacity for years ahead. The body also provides consultation services for routings, schedules, undertakes Air Traffic Management research programs and other activities for future development and implementation of better Air Traffic services. EUROCONTROL manages a program called SESARC (Single European Sky Airspace Research). Similar bodies like the EUROCONTROL are existent in different countries of the world undertaking Air Traffic Management programs. In the United States, the FAA, runs a Air Traffic Management

program known as NEXT GENERATION for better implementation of technology and ways in managing air traffic. Australian bodies manage a program known as ASTRA. Countries across the world aim at better air transportation services, higher levels of service quality, minimizing delays, less fuel burn and better air space capacity.

1.4 FLIGHT RULES :

Flight rules related to Air Traffic are on a common platform globally designed by ICAO. The Global Air Traffic Management Operational Concept (Doc 9854) provides a comprehensive understanding of the intent of, and delivery mechanisms for, the ATM (Air Traffic Management) system envisioned. The document

- Clearly defines performance expectations, sets a relevant performance framework, set achievable targets and implements change cost-effectively, based on capabilities at any particular time along the planning horizon.
- Aims to define high-level requirements supporting the OCD (Global ATM Operational concept), and is to be used in conjunction with the OCD from which the requirements were derived.
- Application in developing Standards and Recommended Practices (SARPs) to realize the concept.
- Planning and implementation regional groups (PIRGs) as well as countries to develop transition strategies and plans at regional and State levels.
- The ATM system requirements will generally be stable over time; that is, they represent the fundamental characteristics/attributes required of the ATM system.
- Continuous improvement in the process and capabilities of countries in relation to Air Traffic Management.

The Air flight rules are categorized under 3 sets and enumerated as

➤ **General Flight Rules :**

The General Flight Rules are observed by all aircrafts in any class of airspace. These rules guide the conduct of the flight and safeguards flights from collision on ground and in the air.

➤ **Visual Flight Rules (VFR) :**

These rules are observed by aircrafts flying in weather conditions equal to or above prescribed limits. The rules are applicable on flights at SEE and BE SEEN basis in relation to terrain and other aircrafts. Weather criteria for visual flight are intended to provide pilots opportunity to see other aircraft or obstructions in time to avoid collision. There are norms specified to ATC for VFR flights guided by the ICAO for different class of airspace and same is adhered. When conditions go below the VFR conditions it is known as Instrument Metrologic Condition (IMC).

➤ **Instrument Flight Rules (IFR) :**

When visibility is lower than VFR conditions an aircraft is guided through IFR. The ATC is notified of the flight details in advance for IFR conditions and the same is known as ATC Flight Plan. The aircraft conforms to the ATC plan and instructions. An IFR must be conducted at a minimum height of 1000 feet (300 metre) above the highest obstacle. The ATC adheres to all the guidelines of the ICAO in IFR under different class of airspace. The flight crew need to be trained for IFR flights.

1.4.1 Airspace Classes :

The density of traffic and constraints of weather play a major role in any airspace and are determining factors that lead to division of an airspace. ATC authorities often apply stringent control in some areas than others due to the above factors. There is always more control near the vicinity of a busy airspace and a varying level of provision of air traffic services. The geographic division of airspace is country specific and is known as Flight Information Regions (FIRs). ICAO notifies airspace from Class A to Class G totalling 7 classes based on IFR and VFR operations. The same is illustrated as a table below.

Class	Type of Flight	Separation Provided	Service Provided	Speed Limitation*	Radio Communication Requirement	Subject to an ATC Clearance
A	IFR only	All aircraft	Air traffic control service	Not applicable	Continuous two-way	Yes
	IFR	All aircraft	Air traffic control service	Not applicable	Continuous two-way	Yes
B	VFR	All aircraft	Air traffic control service	Not applicable	Continuous two-way	Yes
	IFR	IFR from IFR IFR from VFR	Air traffic control service	Not applicable	Continuous two-way	Yes
C	VFR	VFR from IFR	1) Air traffic control service for separation from IFR; 2) VFR/VFR traffic information (and traffic avoidance advice on request)	250 kt IAS below 3,050 m (10,000 ft) AMSL	Continuous two-way	Yes
	IFR	IFR from IFR	Air traffic control service, traffic information about VFR flights (and traffic avoidance advice on request)	250 kt IAS below 3,050 m (10,000 ft) AMSL	Continuous two-way	Yes
D	VFR	Nil	IFR/VFR and VFR/VFR traffic information (and traffic avoidance advice on request)	250 kt IAS below 3,050 m (10,000 ft) AMSL	Continuous two-way	Yes
	IFR	IFR from IFR	Air traffic control service and, as far as practical, traffic information about VFR flights	250 kt IAS below 3,050 m (10,000 ft) AMSL	Continuous two-way	Yes
E	VFR	Nil	Traffic information as far as practical	250 kt IAS below 3,050 m (10,000 ft) AMSL	No	No
	IFR	IFR from IFR as far as practical	Air traffic advisory service, flight information service	250 kt IAS below 3,050 m (10,000 ft) AMSL	Continuous two-way	No
F	VFR	Nil	Flight information service	250 kt IAS below 3,050 m (10,000 ft) AMSL	No	No
	IFR	Nil	Flight information service	250 kt IAS below 3,050 m (10,000 ft) AMSL	Continuous two-way	No
G	VFR	Nil	Flight information service	250 kt IAS below 3,050 m (10,000 ft) AMSL	No	No
	IFR	Nil	Flight information service	250 kt IAS below 3,050 m (10,000 ft) AMSL	No	No

ICAO Airspace Class Definitions

1.4.2 Separation Limits :

The criteria used by ATC to determine required spacing between aircrafts to achieve safety is known as SEPARATION MINIMA. These are specific criteria relating to vertical or horizontal distances or times established between aircrafts. There are several mathematical formulas for separation based on lateral, longitudinal and radars adopted and implemented by the ATC. The other factors of separation include weather, traffic, type of aircraft etc.

1.5 OPERATIONAL STRUCTURE :

ATC is a very operation as there is a lot of traffic at majority of the airports. There are complex system of navigation aids and communication facilities used in ATC. The Short Range ground based radio aids used include Non Directional Beacons (NDB), Omni Directional Radio Range Beacons (VOR), Distance Measuring Equipment (DME), Fan Markers (FM). For precision approach and landing guidance Instrument Landing System (ILS) is used. There was an improved technology in aircraft equipment that enhanced instrument flight capability in matching ILS installations on ground that aids landing even in fog. The Runway Visual Range (RVR) and Decision Height (DH) are used for precision approach on runways. When aircrafts approach and land in minimum weather conditions, the ATC requires, precise information on the position of all the aircrafts. The precise information is provided by Primary Surveillance Radars (PSR) and Secondary Surveillance Radars(SSR). The GPS tracking capability at ATC prevents aircrafts from runway incursion risk through computer based monitoring. Advanced Surface Movement Guidance Control Systems (ASMGCS) combines information from SSR, GPS and Surface movement radars (SMR) and provide conflict detection resolution to ATC staff. The main function of ASMGCS is

- Surveillance (locating position of aircrafts and surface vehicles)
- Control (Conflict detection and alert)
- Routing (Moving vehicles on most appropriate route)
- Guidance (giving pilots and drivers indication that enable them to follow assigned route)

1.5.1 Aerodrome Control :

Aerodrome control is the prime function of the ATC. The same is carried out from glass topped part of tower building that provides panoramic view of airport and surroundings. The higher tower structures at busy airports provide better sightline visibility. Often extension of terminals have led to higher ATCs. The remote TV cameras with display units are attached and act as visual control room

➤ Light Signals : Aerodrome Control

At airports with high volumes of traffic, it is necessary to divide airport control into ground and air. Ground control is responsible for all movement in the manoeuvring areas except the runways and approaches to the runways. At busy airports, ground control also will be responsible for implementing any departure flow-control regulations that might be in force. This usually is originated by a central control unit, which increasingly will address national airspace needs while also addressing simultaneously the intra-national implications of a clearance on airspace capacity utilization further afield. Light Signals play an important part in control. The below mentioned chart defines the implications of light signals for ATC.

Color and Type of Signal	On the Ground	In Flight
Steady green	Cleared for takeoff	Cleared to land
Flashing green	Cleared to taxi	Return for landing (to be followed by steady green at proper time)
Steady red	Stop	Give way to other aircraft and continue circling
Flashing red	Taxi clear of landing area (runway) in use	Airport unsafe—do not land
Flashing White	Return to starting point on airport	
Alternating red and green	General warning signal—exercise extreme caution	

Approach Control

Approach control has similar problems of coordination. It deals with IFR traffic approaching the airport and departing IFR traffic once it is handed over by aerodrome control, usually almost immediately after takeoff. It is common practice worldwide for approach control to also handle arriving and departing VFR traffic. The area of responsibility of approach control extends out typically to a distance of some 20 miles (32 km) from the airport. Traditionally, approach controllers have been situated in the same building as aerodrome control, but in a separate room, but increasingly it is being accepted that the best place for this function to be performed is in the ARTCC unit. This is especially true when approach control may be responsible for more than one airport. The use of radar, both primary and secondary, has proved an essential aid to dealing with the difficult conflicts of departing climbing traffic and arriving descending traffic. In this regard, the European practice is to employ compulsory IFRs in busy traffic areas around airports, even in VMCs. It is also a practice not to mix VFR and IFR traffic in the same air space for safe visual separation by pilots themselves is not so much prevailing weather in terms of visibility and distance from cloud but the pilots' ranges of vision from the flight deck.

At particularly busy airports, procedures also have been standardized for departing and arriving routes:

- Standard Instrument Departure (SID)
- Standard Instrument Arrival Route (STAR)

The use of SID and STAR reduces the load on radio frequencies as a result of shorthand descriptions used for complicated pattern of tracks and altitudes to be flown.

1.6 AERONAUTICAL TELECOMMUNICATIONS :

Telecommunications play a very important role in the ATC services. Telecommunication is a technical service that is standardized by the ICAO as per Annexure 10. International aeronautical telecommunications services are formally classified as

Airport Operation & Management

- Fixed Services
- Mobile Services
- Radio Navigation Services
- Broadcasting Services

1.6.1 Fixed Services :

Fixed-service communication fills the need for a rapid means of point-to-point ground communications between fixed points (either by cable or radio link) to pass messages relating to safety and the regular, efficient, and economical operation of air transport and general aviation. The basis of the worldwide service is the Aeronautical Fixed Telecommunications Network (AFTN). It is in effect a dedicated network confined to the following categories of messages:

- Distress Messages
- Distress Traffic
- Flight Safety related messages
- Meteorological
- Flight Regularity
- Reservations
- Notification to Airmen
- General aircraft operations

1.6.2 Mobile Services :

In the context of telecommunications, the term mobile refers to the service being provided for aircraft (moving vehicles), although the facilities provided by the individual government agencies are primarily fixed installations on the ground. Mobile service covers two vital aspects of aircraft movement:

- Communications
- Navigation

In event of a runway check by a team prior to landing of an aircraft, the communication between the inspection team and the ATC shall happen through radio sets and the same is known as a mobile service. Satellite communication is a part of mobile communication and is widely used for communication. At the level of individual airport facilities, the main concern is with the voice communications used by aerodrome and approach control, and for this purpose, very high frequencies (VHF) are used to avoid the risk of interference. The band of frequencies 118.0 to 136.0 MHz is used, and this provides up to 714 channels with 25-kHz spacing. An International airport has separate frequencies for the following

- Information Service
- Approach Control
- Aerodrome

- Ground Control
- Clearance Delivery
- Helicopters

1.6.3 Radio Navigation Services :

There are internationally agreed standards for radio navigation equipment laid down by ICAO. The technology used is not what ICAO specifies, but rather it is the minimum navigational performance specification (MNPS) of equipment used in certain applications. The services are helpful in the most remote of the areas of operations like oceans and deserts.

1.6.4 Satellite Navigation :

Satellite-based communication systems such as ADS-B and ACARS are predominant sources of the position (and vector) information sent through these systems is derived from satellite navigation sensors on the aircraft. It is the latter element that is regarded as constituting satellite navigation (SATNAV) system. Global Positioning System (GPS) emerged from a series of U.S. military satellite-navigation developments able to offer very precise position fixing.

1.6.5 Broadcast Services :

A great deal of information relating to air navigation is required by aircraft in flight or about to depart. Such information on weather and airport and radio aids serviceability is of particular importance. Since the requirement is universal, the telecommunications agency of each country makes available suitable broadcast facilities and is required by international agreement to publish details of the frequencies used and times of broadcasts. These channels are separate from those used for normal control purposes, and no acknowledgment is required from aircraft receiving the broadcasts. There is an increasing tendency for information to be pre-recorded or produced electronically using synthesized speech created from a database. Automatic Terminal Information Service (ATIS) has for many years been the most common type of broadcast concerned with airport operations.

1.7 METEOROLOGICAL CONTROL :

Aviation meteorological services are provided by governmental organizations in all ICAO Member States, and their services are organized to conform to ICAO Annex 3. Some countries employ their military to produce aviation-related weather products, but most use the civil meteorological organization. The World Area Forecast System was established by ICAO and the World Meteorological Organization (WMO) in 1982 with the purpose of providing worldwide aeronautical forecasts in a standardized form. Currently, there are two world area forecast centres (WAFCs), one in Washington (United States) and the other in London (United Kingdom). The main task of the WAFCs is to provide significant weather forecasts as well as upper-air forecasts (grid-point forecasts) in

digital form and on a global basis. These forecasts are disseminated by a satellite-based system. The two WAFCs are designed to back up each other and produce the same products for different areas. The products generated by the WAFCs are described below.

- Aviation Routine Weather Report (METAR)
- Aviation Selected Special Weather Report (SPECI)
- Local Routine MET Report (MET Report)
- Local Special MET Report(MET Report)

1.8 AIR TRAFFIC SERVICES IN INDIA :

AAI has drawn plans to upgrade Air Traffic Management infrastructure in the country both in terms of conditional provision of automation systems and up gradation of technology which also involves shifting from ground based navigation to satellite based navigation. The modernization of Air Traffic Services in different parts of the country are as

➤ **Mumbai and Delhi :**

Up gradation of automation systems to (Auto Track-III) with new Air Traffic Controller assistance features such as Arrival Manager, Departure Manager, is almost complete and is at various levels of testing prior to declaring operational.

Advanced Surface Movement Ground Control Systems (ASMGCS) added to improve efficient handling of Aerodrome Traffic.

Automatic dependent surveillance I CPDLC has enhanced the surveillance of suitably equipped aircraft over the entire Flight Information Region.

➤ **Hyderabad and Bangalore :**

Advanced integrated automation systems, that integrates state of the art Radars, flight data processors, air situation display Advanced Surface Movement Ground Radars, have been installed by SELEX Integreti for providing effective Air Traffic Management.

➤ **Chennai and Kolkata :**

ATS modernization project is underway for replacing old Radars, surveillance systems by the latest state of the art technology one par with Mumbai I Delhi to provide a common platform for integration of the entire systems over Indian Airspace, which will effectively increase Air Traffic capacity and bring synergy in ATS operations.

➤ **At Other Area Control Centres (Nagpur/ Varanasi/ Ahmedabad/ Trivandrum/ Mangalore) :**

Integration of Radar with flight data processors has been completed by ECIL in collaboration with AAI for providing indigenous automation solutions for effective Air Traffic Management within the designated airspace.

Initiatives to Enhance the Standards of ATC in India

The following are the initiatives for enhanced standards of the ATC

- Performance Based Navigation: (PBN), Standard Instrument Departures (SIDs) and STARs (Standard Terminal Arrival Routes) have been introduced at Delhi, Mumbai, Ahmedabad and Chennai order to reduce delays to aircraft.
- Established a number of ATS Connector routes in Mumbai and Chennai airspace to facilitate PBN operations.
- AAI has drawn the concept of future India Air Navigation (FIAN), and is on the threshold of introducing Air Traffic Flow Management over busy routes, dedicated helicopter routes, providing automation systems at 35 non metro control towers, and the use of space based augmentation system (GAGAN).

☐ Check Your Progress – 2 :

1. The program NEXT GENERATION is a Air Traffic Management run by _____
a. Australia b. India c. Canada d. USA
2. The acronym OCD stands for
a. Original Concept Development
b. Global Original Concept Development
c. Global ATM Operational Concept
d. None of the Options
3. The acronym VFR stands for
a. Very Fast Route b. Visual Flight Rules
c. Visual Flight Route d. Visual Fast Route
4. The acronym IFR stands for
a. Instrument Flight Rules b. Information Flight Route
c. Instrument Flight Route d. None of the options
5. ACARS is a
a. Satellite based TV
b. Satellite based communication system
c. Satellite
d. Aircraft

1.9 LET US SUM UP :

The technical services at an airport are the fulcrum for the entire aircraft operations and navigation. Air Traffic Services is the key to operational safety of aircraft on the ground and in the air. The ATC services are guided by ICAO and implemented by governments of different countries according to ICAO guidelines and regulations. The ATC services

started with basic equipments like beacons to guide mail aircrafts in dark to modern day advanced technological equipments for navigation, guidance and communication. The purpose of ATC services is to prevent collision on the ground and air, organizing of traffic for landing and takeoff, communication with pilots, providing regulatory and necessary information to pilots, locating and tracking flights and ensuring safe operation of aircrafts. The unit details on the technical aspects related to ATC services and also highlight the perspective of Airport Authority of India in management of ATC services.

1.10 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. c 3. b 4. a

Check Your Progress – 2 :

1. d 2. c 3. b 4. a 5. a

1.11 GLOSSARY :

Audit : An official examination of the present state of something

Compliance : It is the state of being in accordance with established guidelines and specifications or process.

Advisory : Giving advice without the power of making decisions.

Beacon : A light used as a signal

Tactical Control : The authority over forces that is limited to the detailed direction and control of movements within the operational area.

VOR Station : Very High Frequency Omni Directional Range is a type of navigation system for the aircraft.

Collision : An occasion when things collide; Crash.

Meteorology : The study of weather and climate.

1.12 ASSIGNMENT :

How does a GPS system function at an airport? What are the benefits of using a GPS system to any airline and airport.

1.13 ACTIVITIES :

Make a list of the equipments used in Air Traffic Control of a Class A airspace airport and indicate the function of each equipment.

1.14 CASE STUDY :

An aircraft was taxiing for takeoff and was at an intersectional point between taxiway and runway. A land vehicle of an airline was coming from the opposite side of the intersection. The driver saw the approaching aircraft but thought he could cross before the aircraft. As the car was at the intersection the aircraft too reached at the same time. The ATC

observing from the tower warned the pilot of the car. The driver of the car became so nervous seeing the approaching aircraft that he stopped his car at the middle of the intersection. The aircraft pilot applied its brakes but the front wheel of the aircraft hit the car. The aircraft had to be towed back for inspection and was delayed.

1. What should have been the ideal scenario in the above situation ?
2. List the mistakes of the ATC, Airline Company owning the car and other airport authorities ?
3. List the training interventions to be undertaken in the above scenario ?

1.15 FURTHER READING :

1. Airport Operations by Norman J Ashford
2. Managing Airports by Anne Graham

UNIT STRUCTURE

- 2.0 Learning Objectives**
- 2.1 Introduction**
- 2.2 Probability of An Aircraft Accident at An Aerodrome**
- 2.3 Types of Emergencies**
- 2.4 Levels of Protection**
 - 2.4.1 Water Supply and Emergency Access Roads**
 - 2.4.2 Communication and Alarm Requirements**
 - 2.4.3 Rescue and Fire Fighting Vehicles**
 - 2.4.4 Personnel Requirements**
- 2.5 Airport Emergency Plan**
- 2.6 The 3 C's of disaster planning**
- 2.7 Let Us Sum Up**
- 2.8 Answers to Check Your Progress**
- 2.9 Glossary**
- 2.10 Assignment**
- 2.11 Activities**
- 2.12 Case Study**
- 2.13 Further Reading**

2.0 LEARNING OBJECTIVES :

- To list the types of emergencies that may arise at an airport.
- To enumerate on the levels of protection at an airport and different methods applied to combat.
- To discuss on airport emergency plan and the 3 C's of disaster planning.

2.1 INTRODUCTION :

At any particular airport, a number of different types of emergencies might occur, including an aircraft emergency, a building fire, or other major disruptions, such as a major spillage of flammable or poisonous liquids or non-accidental emergencies caused by attacks, bomb scares, or other terrorist activities. This chapter gives you an insight on the first category, the aircraft emergency, which is peculiar to airports and aviation and could involve loss of life on a scale that is rightly termed disastrous. Air travel is not a particularly hazardous mode of transportation; indeed,

commercial air passenger transportation has a safety record that is bettered only by the railroads. Nevertheless, every airport operator must recognize the possibility that an aircraft accident on the airport or in its vicinity can take place. For airports serving air carriers, this imposes a special responsibility to plan for the saving of a large number of lives through the provision of competent fire fighting and rescue services, recognizing and even hoping that during the life of the airport they will never be employed to the limits of their capability.

2.2 PROBABILITY OF AN AIRCRAFT ACCIDENT AT AN AERODROME :

At airports aircraft accidents are very unlikely. A statistical study revealed by Boeing suggests that the probability of an accident for an aircraft at an airport is around 4 in 6 million departures. The figure varies from country to country and the performance standards adhered to by each country. The reliability of modern air transport aircraft has largely removed aircraft failure as a cause of accidents; more than 60 percent of air transport accidents are directly attributable to some form of human error. Even with low accident probabilities, aircraft disasters do occur at airports, often with a large loss of life. On March 27, 1977, at Norte Los Rodeos in Tenerife, a KLM B747 crashed while taking off, colliding with another B747 of Pan American back-taxiing on the runway. In all, 555 passengers and 25 crew members were killed, making this the worst air disaster in civil aviation history.

2.3 TYPES OF EMERGENCIES :

The International Civil Aviation Organization (ICAO) classifies aircraft emergencies for which rescue and fire fighting services might be required into three categories (ICAO, 1991):

➤ **Aircraft Accidents :**

When an aircraft accident has occurred either on or in the vicinity of an airport, air traffic control (ATC) at the airport will alert the airport rescue and fire fighting service (RFFS), giving details of the time and location of the accident and the type of aircraft involved. Other appropriate organizations, such as the local fire department, are notified in accordance with the airport emergency plan.

➤ **Full Emergency :**

When an aircraft approaching an airport either is or is suspected to be in danger of an accident, the rescue and fire fighting service is called to predetermined standby positions for the approach runway and is given details of the type of aircraft, number of occupants, type of trouble, runway to be used, estimated time of landing, and location and quantity of any dangerous goods on board. In accordance with the procedure laid down in the emergency plan, the local fire department and other organization are also alerted.

Airport Operation & Management

➤ **Local Standby :**

When an aircraft has or is suspected of having some defect, but the trouble is not serious to cause any difficulty in landing, the rescue and fire fighting service is alerted to its predetermined standby positions for the approach runway and is given all essential details by ATC. It has been seen that whereas aircraft accidents are a relatively rare occurrence, other forms of emergencies are much more frequent.

2.4 LEVELS OF PROTECTION :

- The level of rescue and fire fighting protection depends on the size of the largest aircraft using the airport and the frequency of operation.
- The aircraft rescue and fire fighting (ARFF) services are strongly recommended at all airports and are required to be present at all airports operating under FAR Part 139. For those airports not operating under FAR Part 139, an agreement with local municipal rescue and fire fighting agencies is necessary for safe operations.
- Ten different levels of protection are designated by ICAO (ICAO 1991); the category into which the airport is assigned is determined by the dimensions of the longest aircraft that uses the airport.
- The categorization of the airports and the minimum number of rescue and fire fighting vehicles required against each category of airport are mentioned as below.

Airport Category	Rescue and Fire-Fighting Vehicles
1	1
2	1
3	1
4	1
5	1
6	2
7	2
8	3
9	3
10	3

Airport Category vis a vis Minimum Vehicles

The minimum usable amounts of extinguishing agents at different airport categories are shown and are computed from the amount of liquid required to control an area adjacent to the aircraft fuselage (the so-called critical area) in order to maintain tolerable conditions for rescue of the occupants.

Airport Aircraft Emergencies

Airport Category	Foam Meeting Performance Level A		Foam Meeting Performance Level B		Complementary Agents		
	Water (L)	Discharge Rate Foam Solution/ Minute (L)	Water (L)	Discharge Rate Foam Solution/ Minute (L)	Dry Chemical Powders or (kg)	Halons or (kg)	CO ₂ (kg)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	350	350	230	230	45	45	90
2	1,000	800	670	550	90	90	180
3	1,800	1,300	1,200	900	135	135	270
4	3,600	2,600	2,400	1,800	135	135	270
5	8,100	4,500	5,400	3,000	180	180	360
6	11,800	6,000	7,900	4,000	225	225	450
7	18,200	7,900	12,100	5,300	225	225	450
8	27,300	10,800	18,200	7,200	450	450	900
9	36,400	13,500	24,300	9,000	450	450	900
10	48,200	16,600	32,300	11,200	450	450	900

The characteristics of aircraft fires are different from those of other structures and equipment because of the speed at which they develop and the intense heat they generate. Because of this, FAR Part 139 designates specific ARFF requirements based on the type of aircraft that typically use any given airport. The ARFF index of an airport is based on the length of the aircraft that use the airport and the average number of daily departures of the same size of aircraft that happens from the airport (Generally 5 departures for the longest aircraft operating from the airport is considered for ARFF index).

Index A	Aircraft less than 90 feet in length
Index B	Aircraft more than 90 feet but less than 126 feet in length
Index C	Aircraft more than 126 feet but less than 159 feet in length
Index D	Aircraft more than 159 feet but less than 200 feet in length
Index E	Aircraft greater than 200 feet in length

It is important to note that

- The index system is based on an area that must be secured to effect evacuation or protection of aircraft occupants should an accident involving fire occur.
- The protected area is equal to the length of the aircraft, multiplied by a 100-foot width, consisting of 40 feet on each side of the fuselage plus a 20-foot allowance for fuselage width.
- The indexing system was based on this critical area concept, expressed in aircraft length, to provide a more equitable protection to all aircraft using the airport.
- FAR Part 139.317 describes the required ARFF equipment and agents to be present at the airport, based on the airport's ARFF index.

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Airport Index	Carrying Capacity of Vehicle as per ARFF Index
A	500 pound of Sodium based dry chemical OR 450 pounds of potassium-based dry chemical and 100 pounds of water and AFFF for simultaneous water and foam application
B	One vehicle carrying at least 500 pounds of sodium-based dry chemical, and 1,500 gallons of water, and AFFF for foam production OR Two vehicles, with one vehicle carrying the agents required for Index A and one vehicle carrying enough water and AFFF so that the total quantity of water for foam production carried by both vehicles is at least 1,500 gallons
C	Three vehicles, with one vehicle carrying the agents required for Index A, and two vehicles carrying enough water and AFFF so that the total quantity of water for foam production carried by all three vehicles is at least 3,000 gallons OR Two vehicles, with one vehicle carrying the requirements for Index B, and one vehicle carrying enough water for foam production by both vehicles is 3,000 gallons
D	One vehicle carrying the agents required for Index A OR Two vehicles carrying enough water and AFFF so that the total quantity of water for foam production carried by all three vehicles is at least 4,000 gallons
E	One vehicle carrying the agents required for Index A OR Two vehicles carrying enough water and AFFF so that the total quantity of water for foam production carried by all three vehicles is at least 6,000 gallons

Extinguishing agents are of two major types: principal agents, which are used for the permanent control of fire, and complementary agents, which have a high capability to "knock down" a fire, but which provide no exposure or re flash protection. Modern principal extinguishing agents provide a fire-smothering blanket. ICAO recommends the use of

- The protein foam that creates a long lasting blanket over the fire. The foam is produced mechanically and has a lasting impact.
- Aqueous film-forming foam (AFFF). This is effective on spill fires, providing faster extinguishing than protein foams. However, the liquid film over the fuel surface is destroyed by high temperatures. AFFF foams are not suitable for fires involving large masses of hot metal.
- Fluoro protein foam has a fluoro carbon added to the protein base foam. The foam cuts on the pickup of fuel and is ideal for fires that have depth of fuel.

Complementary agents in addition to principal agents help in rapid fire suppression so that the fire does not get out of control. Some of the notable complementary fire control agents are

- Carbon Dioxide
- Dry Chemicals
- Halocarbons

It is important to maintain sufficient stock of principal and complimentary items so that any situation beyond control can be controlled. It is estimated that 200% of the items should be maintained at any airport for vehicle replenishment. A rescue and fire fighting service should have as its operational objective a response time of not more than three minutes, preferably not more than two minutes, to any part of the movement area in ideal visibility and surface conditions. Airport rescue and fire fighting teams have showed this exemplary feat in lot of situation where in 3 minutes fire was brought in control by rescue teams. Evacuation too is a time bound response and carried out skilfully by rescue teams. Often incidents involved with aircrafts require immediate evacuation rather than fire fighting services.

☐ Check Your Progress – 1 :

1. The acronym RFFS stands for
 - a. Rescue and Fire fighting syndicate
 - b. Random fire fighting services
 - c. Rescue and Fire fighting services
 - d. None of the options
2. If an airport category is 7, the number of rescue and fire fighting vehicles should be
 - a. 1
 - b. 2
 - c. 3
 - d. 4
3. The acronym AFFF stands for
 - a. Aqueous Film Forming Foam
 - b. Adhesive Film Forming Foam
 - c. Aqueous Film Forming Fire
 - d. Aqua Foam Fire Film

4. _____ is considered to be a complimentary fire control agent
 - a. Halocarbon
 - b. Helium
 - c. Oxygen
 - d. Carbon monoxide
5. The acronym ATC refers to
 - a. Air Tide Control
 - b. Air Time Control
 - c. Air Traffic Control
 - d. Air Traffic Care

2.4.1 Water Supply and Emergency Access Roads :

Water is a crucial element that is required for fire fighting and source of water is very important in an airport.

- Water for aircraft rescue and fire fighting purposes can come from either the airport water supply or natural water supplies within the airport area.
- Airport Water supply terminals should always be near to apron, service areas and in vicinity of administrative areas. It is desirable that the airport water supply is provided in apron and service areas and in the vicinity of administration areas.
- Fire fighting vehicles are more easily replenished if the supply is extended to hydrants spread about the movement area where this is economically feasible.
- Natural surface water from rivers, lakes, streams, and ponds can be used only if the fire fighting vehicles are adequately equipped to pick up and pump such supplies.
- The reduction in response time to an accident is undertaken through vehicles reaching the site on time. The provision of emergency access roads to different areas at the airport provides action being initiated rapidly.
- ICAO recommends particular attention to providing ready access to approach areas up to 3,300 feet (1,000 m) from the threshold point.

2.4.2 Communication and Alarm Requirements :

An aircraft emergency is an unplanned event, and accidents are very rare occurrences. Consequently, a reliable rescue and fire fighting operation can be achieved only with a defined chain of command linked with effective communications. Every airport has a different chain of communication systems devised; however, the structure of communication is as

- There is a direct communication between the emergency activation authority (usually ATC) and the airport fire station through a two way radio network.
- Presence of a direct telephone line that do not pass through the switchboard or operator. Exchange of all important and necessary

mobile phone numbers between the ATC and the fire control and rescue teams.

- Alarm and public address system to alert the crew members during emergency.
- Communication between rescue and fire fighting vehicles and both ATC and the airport fire station with presence of 2 way sets in the vehicles. It is essential that the vehicles and ATC have unbroken communications en route to the accident and on site.
- Communication with other departments is mandatory as per regulations and protocols. This involves Airport security, Airport Station Manager, Airport Management, Local fire department, Medical Services, Local police. The same is undertaken through conference circuits in Emergency communications system.

2.4.3 Rescue and Fire Fighting Vehicles :

- The carrying and discharge capabilities of the rescue and fire fighting vehicle fleet should be based on the needs over the short- and medium-term future during the economic life of the vehicles.
- The vehicles must be protected and maintained in a manner that permits immediate availability should an emergency arise.
- The rescue and fire fighting vehicle is designed to carry out the principal attack on an aircraft fire. Its design and construction should make it capable of carrying a full load at high speeds in all weather over difficult terrain.
- Power tools and latest technology shall be installed and updated in the vehicles to meet any emergency.



All Terrain Fire Fighting Vehicle

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	Rescue and Firefighting Vehicles up to 4,500 L	Rescue and Firefighting Vehicles over 4,500 L
Monitor	Optimal for categories 1 and 2.	Required
	Required for categories 3 to 10	
Design feature	High discharge capacity	High and low discharge capacity
Range	Appropriate to longest airplane	Appropriate to longest airplane
Hand lines	Required	Required
Undertruck nozzles	Optional	Required
Bumper turret	Optional	Optional
Acceleration	80 km/h within 25 s at the normal operating temperature	80 km/h within 40 s at the normal operating temperature
Top speed	At least 105 km/h	At least 100 km/h
All-wheel-drive capability	Yes	Required
Automatic or semiautomatic transmission	Yes	Required
Single-rear-wheel configuration	Preferable for categories 1 and 2	Required
	Required for categories 3 to 10	
Minimum angle of approach and departure	30°	30°
Minimum angle of tilt (static)	30°	30°

Characteristics of Fire Fighting Vehicles at Airport

Equipment for Rescue Operations	Airport Category			
	1-2	3-5	6-7	8-10
Adjustable wrench	1	1	1	1
Axe, rescue, large non-wedge type	—	1	1	1
Axe, rescue, small non-wedge or aircraft type	1	2	4	4
Cutter bolt, 61 cm	1	1	1	1
Crowbar, 95 cm	1	1	1	1
Crowbar, 1.65 m	—	—	1	1
Chisel, cold 2.5 cm	—	1	1	1
Flashlight/hand lamps	2	3	4	8
Hammer, 1.8 kg	—	1	1	1
Hook, grab or salving	1	1	2	3
Saw metal cutting or hacksaw, heavy duty, complete with spare blades	1	1	1	1
Blanket, fire resisting	1	1	2	3
Ladder, extending (of over-all length appropriate to the aircraft types in use)	1	1	2	3
Rope line, 15 m length	1	1	2	3
Rope line, 30 m length	—	—	2	3

Pliers, 17.8 cm, side cutting	1	1	1	1
Pliers, slip joint 25 cm	1	1	1	1
Screwdrivers, assorted (set)	1	1	1	1
Snippers, tin	1	1	1	1
Chocks, 15 cm high	—	—	1	1
Chocks, 10 cm high	1	1	—	—
Powered rescue saw complete with two blades; or—pneumatic rescue chisel complete—plus spare cylinder, chisel, and retaining spring	1	1	1	2
Seat belt/harness cutting tool	1	2	3	4
Gloves, flame resistant pairs (unless issued to individual crew members)	2	3	4	8
Breathing apparatus and spare cylinder	One set per fire fighter on duty			
Oxygen inhaler	—	1	1	1
Hydraulic or pneumatic forcing tool	—	1	1	1
Medical first aid kit	1	1	2	3
Tarpaulin	1	1	2	3
Fan for ventilation and cooling	—	1	2	3
Protective clothing	One set per fire fighter on duty			
Stretcher	1	2	2	2

List of Equipments used During Rescue Operations and Carried in Rescur Vehicle

2.4.4 Personnel Requirements :

The number of personnel required for rescue and fire fighting services are determined at an airport through the standard guidelines as defined by ICAO. They are

- The principal and the complimentary extinguishers can be deployed immediately in event of an emergency. The same must be done parallel and there must be adequate staff to undertake the task.
- There must be sufficient personnel to continue with the rescue and fire fighting operations till back up support arrives.
- Thorough training of personnel and their familiarity to equipments and their role should be clear.
- The personnel should be physically fit to discharge their duties as is required for fire fighting and rescue operations.

2.5 AIRPORT EMERGENCY PLAN :

Annexure 14 of the International convention on civil aviation requires that each airport establish an emergency plan in level with aircraft operations and other activities at the airport (ICAO 1991).

- Every country has their own regulations and legislations at par with the international requirements.
- The objective of the emergency plan is to reduce the impact of any type of emergency in respect to saving lives, maintenance of

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airport operations and a coordinated program between the airport and the surrounding community.

- The plan should include a section of instructions to ensure immediate response of rescue and fire fighting services, law enforcement, medical services, and other persons and agencies both on and off the airport.
- All plans should encompass a clear organizational authority, structure of responsibilities and testing of the plan before implementation.
- There should be an orderly and efficient transition from normal to emergency operations and delegation of airport emergency authority to key authorized personnel. The chain of command in an emergency situation should be unambiguous.
- ICAO recommends that an emergency plan be tested by full-scale emergency exercises using all facilities and associated agencies at intervals not exceeding two years, with partial exercises each year and tabletop exercises every six months.

The recommended guideline and standard operating procedures in event of different emergencies are laid down as a manual to be adhered by all personnel working in the organization. The standard operating procedures are normally drafted for incidents like

- Aircraft accident at the airport.
- Aircraft accident off the airport.
- Malfunction of aircraft in flight.
- Structural fires
- Sabotage including bomb threats
- Unlawful seizure of the aircraft
- Incident at the airport

The Standard operating procedures define the role and the responsibility of personnel who directly are to be involved during an uneventful situation.

2.6 THE 3 C's OF DISASTER PLANNING :

It has been emphasized in the management of uneventful situations that there are certain elements that play the most crucial role in saving lives and executing a fulfilling plan. The 3 C's are

- Command
- Communication and
- Coordination

➤ **Command :**

In event of an emergency at an airport command refers to the persons delegated to take decisions in that situation. There might be a chain of multidisciplinary units and services involved in the site of an emergency. The control of the situation lies with a single person followed by the chain of structured units with their own hierarchy. During an event where evacuation happens, areas are assigned for different category of passengers. There might be passengers who shall require immediate medical assistance, passengers who are minor, passengers requiring delayed care and also passengers who might have been deceased. The creation of zones helps the entire rescue operation to be executed smoothly. In some operations priority levels are also set in the zones that are demarcated and based on the priority levels assistance is provided. Even symbols are used to demarcate zones and it becomes easy for rescue workers to identify specific zones.

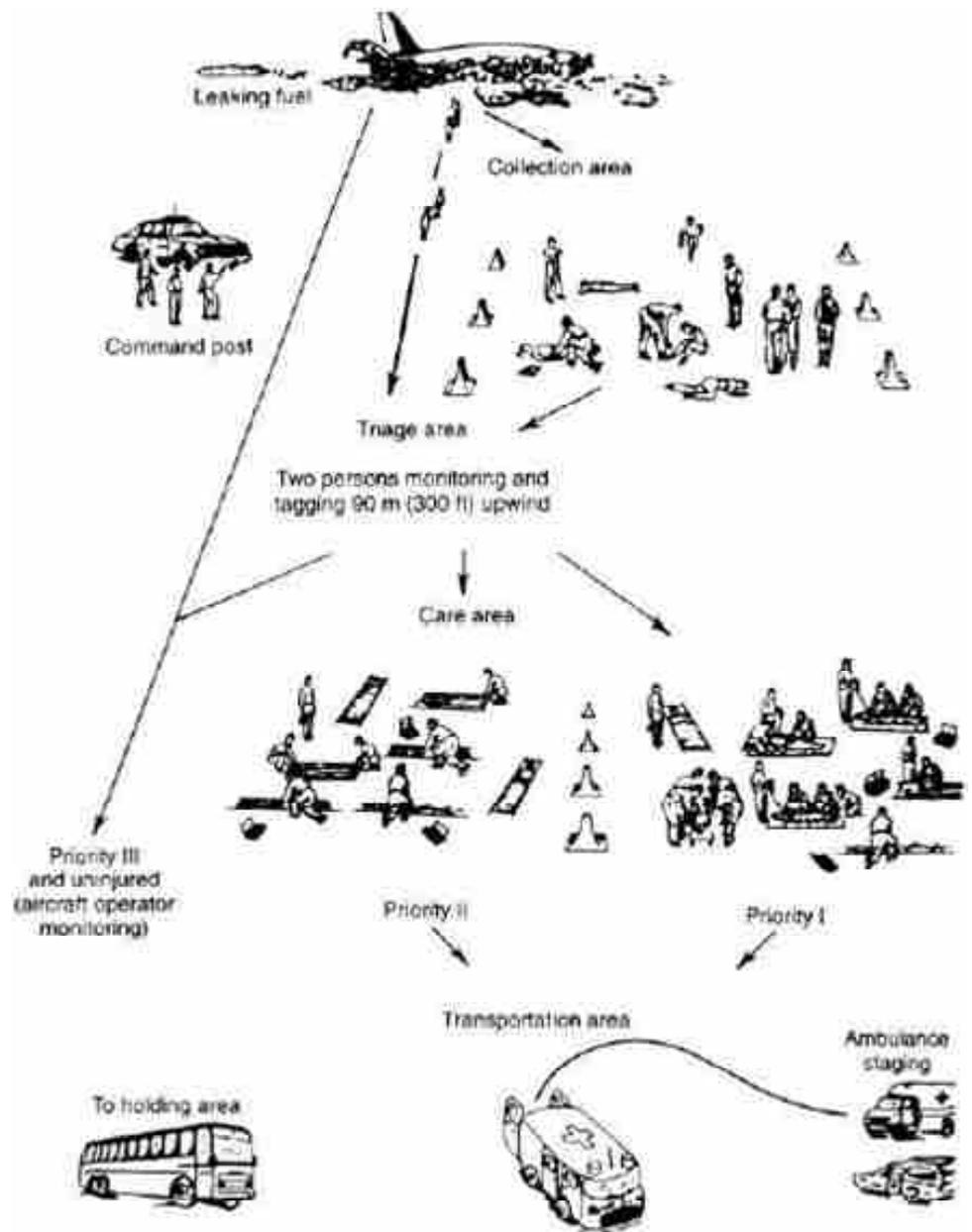
➤ **Communication :**

Communication is a very important tool used during rescue and evacuation process. Communication should be uninterrupted and between different departments working at the site. A communication centre is immediately set up after a fateful event and all coordination is directed through the centre. The person heading the operations is continuously updated on developments and the instructions from the person passed to all bodies working together. All communication mediums shall be in an active mode during any emergency.

➤ **Coordination :**

Coordination of the many agencies and individuals to be involved in the case of an emergency or an accident requires planning, patience, and teamwork. It is essential that everyone involved, on-and off-airport, know what his or her responsibilities are when an emergency is declared. Drills and trainings undertaken to handle exigencies help in managing the aspect of coordination better.

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Graphic Layout of An Accident Site (Courtesy ICAO)

☐ Check Your Progress – 2 :

1. The emergency plans for any airport has been made mandatory by ICAO under Article
 - a. 12
 - b. 13
 - c. 14
 - d. 15
2. Any rescue and fire fighting vehicle at an airport must be equipped with
 - a. Power tools
 - b. Hydraulic technology
 - c. All terrain features
 - d. All the options

3. Reduction in the response time by rescue vehicles can be undertaken by
 - a. Closed approach
 - b. Access to approach area
 - c. Fire station outside the airport premises
 - d. None of the options
4. One of the most crucial elements during fire fighting operations is the availability of
 - a. Water
 - b. Carbon Dioxide
 - c. Oxygen
 - d. Nitrogen
5. The 3 Cs of disaster planning are
 - a. Concise, Create, Communicate
 - b. Clarity, Command, Concise
 - c. Command, Communication, Coordination
 - d. None of the options

2.7 LET US SUM UP :

Airports must take into consideration different types of emergencies that may occur due to causes often beyond control leading to major disasters. Airports must always be prepared to avoid and combat any emergency situation. ICAO categorizes that rescue and fire fighting services at an airport is very crucial for 3 types of emergencies; aircraft accidents, full emergency and local stand by. Airport protection has been globally standardized and categorized under different levels. As aircraft fires are different from any other structural fire, there are specific ARFF requirements to combat aircraft fires. Airports are categorized under different ARFF indexes depending on the size of the aircrafts operating from each airport. Standard measures are devised for each airport index. Water being a crucial element needs to be available within an airport complex in a planned manner so that the response time can be reduced during an emergency. Accessibility too, plays an important role. Airports are equipped with modern communication technology, advanced rescue vehicles, trained personnel, equipment and a ready to execute emergency plan under any adverse situation. The 3 C's of disaster planning Communication, Command and Coordination form the basic infrastructure of a plan.

2.8 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. c 2. b 3. a 4. a 5. c

Check Your Progress – 2 :

1. c 2. d 3. b 4. a 5. c

2.9 GLOSSARY :

Fuselage : the main body of an airline.

Gallon : Unit of volume. 1 Gallon is equal to 3.78 litres.

Smothering : Extinguish by covering it.

Aqueous : Relating to or resembling water.

Fluoro Carbon : Organic compounds made of Carbon and Fluorine.

Halocarbon : Organic compounds that contain carbon and one or more halogens. Man made, used in lot of applications

2.10 ASSIGNMENT :

In event of an emergency landing of an aircraft at an airport in which the left engine has caught fire what is role of the following

- a. Air Traffic Control
- b. Airport Management
- c. Airline Company and Ground Staff
- d. Crew
- e. Fire Department
- f. Other Government Agencies

2.11 ACTIVITIES :

List 10 unique essential equipments used in rescue operations and emergencies at any airport of the world.

2.12 CASE STUDY :

An early morning small flight carrying 45 passengers from a level 1 airport located at a remote destination during take off was struck by a bird in its left engine The plane was out of control for some time mid air and soon the left engine caught fire. The passengers were in panic and the pilot relayed the ATC for an emergency landing. An emergency was sounded at the airport as the plane touched the runway. There was only one fire engine present at the airport which was immediately pressed into action. The nearest fire station was 30 km away and a message was immediately conveyed. The crew and the pilot showed immense courage and undertook an emergency evacuation procedure with very few ground staff from different departments. All the passengers were somehow rescued and the fire tender tried its best to douse the fire. The water in the fire tender soon got over and there was no reserve supply for the same. Fire tenders from the city were on the way. Small extinguishers were not effective. Suddenly there was a blast and the entire aircraft was engulfed in fire.. When 2 more fire tenders arrived the plane was completely damaged.

1. What are reasons that lead to an emergency situation going out of hand at the airport ?
2. What precautions should the airport authorities undertaken to prevent such a situation ?

2.13 FURTHER READING :

1. Managing Airports by Anne Graham
2. Airport Operations by Norman J Ashford
3. <https://www.icao.in>

UNIT STRUCTURE

3.0 Learning Objectives

3.1 Introduction

3.2 How Does Disruption Affect Airline Ecosystem

3.3 Services and Facilities

3.4 Minimum Connect Time (MCT)

3.5 Low Cost Carriers

3.6 Modern Concepts and Major Developments at Airports

3.7 Technological Changes and Customer Experience

3.7.1 Challenges for Airport Operators for Managing Disruptions

3.8 Let Us Sum Up

3.9 Answers to Check Your Progress

3.10 Glossary

3.11 Assignment

3.12 Activities

3.13 Case Study

3.14 Further Reading

3.0 LEARNING OBJECTIVES :

- To define disruption and discuss on how disruption affects airline operations.
- To enumerate on services and facilities that airports facilitate to reduce and manage disruptions.
- To discuss the role of Minimum Connect Time and Low Cost Carriers in reducing disruption.
- To list some of the modern airport concepts and technological innovations that manages disruptions.

3.1 INTRODUCTION :

Airline companies operate in a volatile environment and are today influenced by a variety of external factors that impact their business; either on the ground or in the air. Extreme weather conditions, natural disasters, mechanical problems, labour issues, industrial action, air traffic congestion, security alerts and other disruptions can not only damage an airline's brand value but also generate unexpected costs.



The Cost of Delay

Flight cancellations due to weather disruptions, technical issues and other reasons put tremendous pressure on the ground staff to accommodate passengers on next flights and generate their new PNRs. These irregular operations hugely impact the revenue of any airline.

To deal with such delays, airlines need the agility to restore normal services swiftly and cost-efficiently.

- Airline operations need to re-route aircrafts along with performing flight cancellations and delay decisions for various types of aircrafts with minimal disruption.
- Crew planners need to find efficient recovery solutions and coordinate with airline operations controllers to ensure that the considered operations decisions are feasible with respect to the crews.
- Customer service coordinators have to find efficient recovery solutions for passengers and coordinate with airline operations controllers to provide an assessment about the impact of possible operations decisions on passengers
- Air traffic control groups are required to collect and provide information, such as the likelihood of future ground delays, to airline operations controllers to improve future airline scheduling and planning.



Enabling Effective Disruption Management

An efficient disruption management process helps airlines and airports with

- Improved Visibility: Aggregation of real time flight data and crew schedules for proper mapping.
- Better Decision Making: helping in intelligent, cost-effective and crew friendly decisions
- Cost Savings for airlines.
- Efficiency Improvement: ensuring availability of the right crew, right aircraft both in terms of numbers and suitability, even during schedule changes
- Improved Passenger & Crew Satisfaction
- Enhanced Flexibility : based on the airline's requirements and multiple airline business models support
- Seamless Scalability : Based on the criticality of the situation

■ **Sources of Disruption :**

The sources of disruption can be categorized under two heads

➤ **Airline Resource Disruption :**

These types of a disruption are caused by factors that are internal to any airline. Mechanical failures, fuel shortage, crew members not reporting due to illness with no back up crew are some of the common factors that may cause a major disruption.

➤ **External Environment Disruption :**

These types of disruption are caused by factors that are external to the airline. Air travel depends a lot on weather and sometimes even minor weather conditions may lead to delays. The safety of passengers, crew and the aircraft is of prime importance and measures adopted by air traffic control according to stringent guidelines lead to disruptions that cannot be avoided. The closure of any airport for even a few hours disrupts the entire schedule of flights that were supposed to take off or land. The

capacity of the airport being limited once the airport re opens leads to tremendous pressure and challenges on the airport operations.

■ **Recovery Operations Undertaken for Disruption :**

Once a disruption leads to closure of the airport or partial closure of the airport, recovery is the key to normalize operations. Recovery is management of the state that has been caused by disruption and in the entire process the airline and airport work hand in glove to ease out the situations. The objectives include safety, priority of objectives and passenger management. The following operations are generally undertaken for recovery due to disruption

➤ **Delaying of Flights :**

The departure time of affected flights and related flights may be delayed. This helps in the minimum transit time of the aircraft and the crew members. The result of this operation is to mitigate the total delay and normalize operations.

➤ **Cancellation of Flights :**

During a recovery process if the allocated resources to fly a flight is not feasible or if the flight can be flown but the delays to fly the flight would exceed a time limit the flight is cancelled. The cancellation of any flight incurs a very high loss to the airline company and this is the last option that any airline company undertakes in a disruptive situation.

➤ **Swapping Resources (Rerouting) :**

This is a very common method of recovery undertaken by airline companies to optimize the resources in hand and utilize them to mitigate disruption. Often airline companies operate more than one flight to a particular destination from an airport. In event of a disruption, airline companies often accommodate passengers in other flights at different schedules.

If the disruption is due to crew members substitute crew members available at an airport is used for managing the aircraft.

If the disruption is due to any mechanical failure the crew is reassigned to other routes and the aircraft when recovered is also re assigned to a different route.

Often airline companies station reserved resources at busy routes and these resources help to plug emergency situations arising out of disruptions.

➤ **Speed Controlling :**

Speed controlling is a recovery operation that modifies the flight time to reduce the impact of a disruption and further delay.

➤ **Passenger Reallocation :**

In event of itineraries getting disrupted passengers often are reallocated to itineraries with the same origin and destination at different schedules or in partner airlines or through stopover flights.

➤ **Deadheading and Ferrying :**

When the crew is moved to another airport as passengers it is known as Deadheading. When an aircraft is assigned as an unscheduled flight without passengers it is known as Ferrying. Both the methods adopted during disruptions are very costly and are rarely used except for extreme conditions.

There are multiple recovery operations that are undertaken simultaneously according to the airline and their capacity and resources available. Any challenge that the airline undergoes due to disruption is an opportunity for a recovery. The challenges are bifurcated into different sub challenges during a recovery process so that prioritization of solutions can be undertaken. The recovery of an aircraft affected by disruption is given the priority followed by crew recovery and passenger recovery.

■ **Models for Solutions of Recovery :**

➤ **Aircraft Recovery :**

In event of any disruption crew recovery and passenger recovery is entirely dependent on the availability of an aircraft. Aircraft recovery aims at rescheduling of aircraft routes affected by disruptions at minimum cost ensuring that flights after the period of recovery shall not be affected by any further disruption. Further the subsequent planned flights of the aircraft recovered shall also be planned so that further disruptions are not manifested. There are different models used for the recovery process of aircrafts and some of the same are the General Path based model and the Arc based model.

The Arc based model is proposed by Hane et al and is widely used in fleet assignment problems. The model is used in handling disruptions such as airport closure. The model has 3 defined types of nodes and 3 arcs. The first node is identified as the SUPPLY node that acts as the indicator for the recovery period at each airport. The second node is the INTERMEDIATE node with a time station information representing the departure or arrival of a specific flight. The third node is the DEMAND node that indicates the end of the recovery period. Arcs represent the flight with its scheduled departure and arrival times at different stations. Arcs are used in aircraft recovery problems formulated mathematically on a time space network. The Path based model was devised by Arguello et al, Rosenberger et al, Eggenber et al and Liang et al based on paths (routes). The disruptions involving an individual aircraft can be handled through a Path based model that assigns aircraft to a route that includes detailed information such as flight delay and rerouting of airlines. The objective of the path based model is to minimize the assignment and

the cancellation cost. The objectives of the models is to mathematically calculate the disruptions on the time space model and

- Minimize the total assignment cost for recovery
- Minimize the total delay and cancellation cost
- Management of a flow balance of aircrafts by ensuring a supply at the demand nodes
- Management of flight coverage constraints
- Ensuring optimum slot capacity control at the airport

➤ **Recovery with Delay :**

Recovery of a flight that is delayed is an important operation. Each flight operates with a buffer time to facilitate and manage any short time delay. The departure and arrival times of flights are decision variables in models. Akturk et al propose aircraft rescheduling considering swapping, delaying and adjusting cruise speed in which the departure delay and cruise time are decision variables.

➤ **Recovery with Maintenance :**

Maintenance is the most common activity undertaken during aircraft recovery. Recovery in maintenance can be undertaken through a path based model. Swapping of scheduled maintenance improves flexibility of recovery, probability of finding better recovery solutions.

➤ **Crew Recovery :**

Crew scheduling involves a set of flight tasks within a period for the pilot so that each flight in the schedule can be operated by one or more crews. Flights are grouped by fleet and crew scheduling is solved for each fleet. Crew schedules obey government regulations to ensure security. Crew recovery involves reducing the scale of any problem and finding a solution with a minimum cost for reassigning available crews to affected flights. Stojkovic is the first to solve and design a mechanism to resolve the crew recovery problem during daily operation. Two methods designed are adopted known as the First in First out scheme and dynamic programming to minimize the ground time of a crew.

3.3 SERVICES AND FACILITIES :

Airport operators globally have reworked their business models and have facilitated more commercial outlook and orientation to offer a wide range of services and facilities. The re consider of customers is varied and airports continuously work on fulfilling needs of the customers. The facilities extended are connected either to the airfield or the terminal with ground handling services providing better linkage between passengers, their baggage, the cargo with airfield and terminals. Airports have considered different aspects to develop when the physical airport infrastructure and its technical capabilities are being assessed. This includes the number of runways, their length and configuration; ATC services; instrument landing, lighting and weather monitoring systems; ramp and apron space

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allocation, stand and gate provision; fire, rescue and policing/security services. The main areas in the airside (runways, apron, gates) will each have an overall capacity associated with them, and the airfield infrastructure will determine what type of airline is able to use the airport. Developing infrastructure of the airside would lead to more airlines being operational from an airport and more facilities incorporated. Terminals too have been planned with the required design for futuristic expansion and keeping the volume of traffic in the process. Service standards are designed for the planning process of the terminal. Space requirements for various activities are worked out prior to terminal execution.

Historically, most airports offered a fairly common set of services and facilities in trying to serve their airlines, passengers and other users, regardless of the specific needs of the different market segments within these customer groups. Very little segmentation took place at the airports, with product differentiation being limited to separate check-in for economy and business-class passengers, and remote stands rather than air bridges for passengers travelling on charter airlines. This level of segmentation was then increased, with business travellers having access to 'fast-track' systems that guide them swiftly through various processes, including immigration and customs. At the same time, airline lounges for premium class and frequent flyer passengers became more popular. In spite of these developments, the overall focus was still predominantly on a one-size-fits-all airport for all airport users. However, in recent years stronger competitive forces have led airports to pay far greater attention to differentiating their services and facilities in order to meet the requirements and expectations of different market segments. At the same time, the range of different airline models has become more varied (e.g. alliance member, LCC, cargo specialist).

Airports across the globe have started a new wave of transformation and are providing wide range of services and facilities. These include

- Better linkage and connectivity for passengers in terms of flight operations and connectivity. Airports are working continuously to utilize the facilities and create demand in the market by operating flights to different destinations. Airport teams have been working on incorporating more flights.
- Introducing efficient Baggage handling systems. Though airports have increased in size, baggage handling activity is planned scientifically so that there is minimum waiting time for the passenger at the airport. Baggage handling as an efficient function also facilitates transit passengers whose baggage need to reach the next aircraft before time so that there is no holding or congestion. The lesser the time taken, the faster airline operators can turn around with a connecting flight and more aircrafts can be accommodated at the airport.

- With airline companies forming alliances across the globe, passengers too have become aware of the facilities that partnering airlines provide and as a result alliance companies have stepped up their facilities so that passengers can get the same service quality with both the airline companies under alliance.
- Airline companies have stepped up better ground transport facilities. Airline companies that do not use an air bridge have good transport facilities to make passengers board the aircraft comfortably.
- Access to the airports were often challenging at many places. Working on stepping up infrastructure and creating better surface access links have been priority of the airports for their development in association with the regulatory authorities. Bigger terminals have provided inter terminal coaches for ease of passengers to be transferred from one terminal to the other. Metro rail services have been incorporated in many airports to augment the ease of travel for passengers.
- Parking infrastructure facilities were always a challenge for passengers travelling to busy airports. Modern airports have augmented parking facilities and have designed infrastructures for parking to facilitate passengers.
- Commercial facilities at airports have increased. Airports today are hub of retail activities. There are global brand of eateries, retail outlets of various products, beauty salons, entertainment facilities, technology related facilities. Many airports have hotels, conference facilities and offices within their infrastructure.
- Premium and Business class passengers of different airlines are being given privileges at all airports. The range of privileges depends from airport to airport. Many airports provide a premium waiting lounge for high valued premium class passengers. They offer high end catering, refreshments, facilities for a business centre, technology support. Many airport premium lounges include secretarial services, personal assistants and valet services too.
- Premium passengers have the privilege offered by all airlines to have a faster hassle free check in. Passengers are not required to stand in the queue for a check in process and the same is undertaken through assisted service by the airline.
- Airports like Bahrain and Copenhagen have separate security check zones and immigration services for premium passengers. They have fast track zones that reduce or eliminate any unnecessary waiting time for the passenger.
- Airports like Doha have a separate terminal dedicated to premium passengers and at the Frankfurt airport in Germany there is a separate terminal for premium passengers of Lufthansa Airline.

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- There are airports in the world that have been designed keeping only the premium passenger into consideration. The London City Airport is an airport that is used by charter flights and private jets. The passengers using the airport have a very high average income. Regular commercial flights are not permitted from the airport. British Airways though uses Heathrow airport but for its business class flights to New York the London City Airport is used.
- The airport provides chauffeur and valet services, personal airport concierge service and upmarket retail outlets catering to the needs of the passengers.
- Many airports across the globe have pay and use facilities for the passengers. There is Plaza premium lounge at airports like Kuala Lumpur, New Delhi, Hyderabad that offers a relaxed environment to passengers with many services like food, rest, workstations and shower.
- Amsterdam airport has a lounge for babies and children. They have cubicles and beds and seating for the family. The area has play area for the kids and bath e facilities.
- Airports at a lot of European countries have a facility of fast tracking check in procedure through payment of a fee. Many airline companies have also started the facility of fast tracking airline check in process by payment of fees.
- There are a lot of airlines that provide additional facilities to passengers who are part of a loyalty program. Even passengers who are members of VIP clubs with high membership fees and are affiliates of the airline get special privileges.

Check Your Progress – 1 :

1. The cost of delay due to disruption may include _____ relocation
 - a. Airline
 - b. Crew
 - c. Passenger
 - d. All the options
2. The following measures help to reduce disruption
 - a. Non availability of crew at certain airports
 - b. Irregular maintenance schedules
 - c. Tracking of Real time flight data
 - d. Reduced ground resource support for passengers
3. Efficient baggage handling system at an airport leads to
 - a. More broken baggage
 - b. Faster turn around of aircrafts
 - c. Increased baggage loss
 - d. Higher costs
4. Faster movement of passengers from one terminal to another can be done by
 - a. Better surface access links
 - b. More Parking facility
 - c. Helicopter services
 - d. None of the options

3.4 MINIMUM CONNECT TIME (MCT) :

Globally airline companies have been undertaking alliances with different airlines to establish a global footprint. Through code sharing and different alliances passengers today can travel to destinations where the airlines they have booked do not operate. The airline companies operate through connecting flights at various airports. Many airports function as hub airports for transfer. These alliance aircrafts work on a minimum time of transfer of passenger and baggage to board the connecting flight. This is known as Minimum Connect Time (MCT). Airports play a very important role infrastructurally and technologically in minimizing the MCT. Improvements across the globe have been made through creation of transfer hubs. Copenhagen airport reduced transfer time from 40 minutes to 30 minutes and enabled 70 extra transfer flights. The transfer of passengers from domestic terminals to international terminals is still a challenge at many airports. The transfer time at Indian airports are around 90 minutes and airports like T3 at Indira Gandhi International Airport, New Delhi are continuously working on reducing the same. The measures taken by majority of the airports include

- Less walking time by passengers during the transfer process. Use of moving walkways, escalators, battery operated carts have reduced the time taken.
- Usage of display boards that indicate the way for transfer. Often passenger's get confused and take a lot of time in searching the right terminal and the gate for transfer.
- Dedicated personnel deployed by airlines and airports to facilitate the transfer process for passengers.
- Inclusion of special baggage transfer procedures for transfer flights that are easy and fast. Technology has been adapted at many airports that has made the task faster. At Rotterdam airport in Netherlands and Hong Kong airport robots have been introduced for luggage transportation. Robots like Anstar at Incheon airport and Josie Pepper at Munich airport undertake luggage transfers efficiently. British Airways in association with Bots and us are using artificial intelligence technology at Terminal 5 of Heathrow airport to enhance punctuality of passengers.
- Inclusion of easy transfer processes by using technology.

3.5 LOW COST CARRIERS :

Low Cost Carriers have dominated the skies with their focus on efficiency of time, faster turnarounds and lower pricing. Low cost carriers do not need much area inside terminals to operate as they are involved in basic processes. The low cost model discourages passengers to carry too much luggage and many airlines charge for check in baggage also. The same leads to less baggage handling and less utilization of manpower and other resources. Airports include many different business models for

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low cost carriers. A simple table into the model of operations that includes service facility at the airport required will describe the needs of a low cost carrier

Service Facility at The Airport	Low Cost Carrier Need
Terminal Design	Simple and low in operating cost
Check in Baggage	Lower numbers
Airline Lounge	Not Required
Security	Efficient process. No delay to the aircraft
Transfer Facilities	Majorly not required
Air Bridge	Prefer steps for quicker boarding and disembarking.
Airfield bus	Prefer passengers walk to terminal building where permissible
Office area	Simple

As the quotient of business is high for a Low cost carrier airports too have adopted various models. Airports are sceptical about low cost carriers because many airports that restructured for facilitation of services have suffered business losses due to the volatile nature of the operation of these carriers. Malmo airport in Sweden lost its value due to the closure of low cost carrier operations. Many airports across the globe are undertaking the following measures for low cost carrier operations

- Low cost carriers in many airports have occupied unused areas within the airports. The same have suited business model for low cost carriers and also faster turn around of the aircrafts.
- Many airports like Budapest, Copenhagen, Helsinki serving both low cost carriers and full service flights have separate low cost terminals for the low cost carriers with lesser facilities. The same facilitates both the airport as well as the airline.
- John F Kennedy airport in USA has separate low cost terminal for JetBlue airlines.
- The low cost carrier separate terminal model is difficult to be implemented in Asia Pacific due to lack of secondary or regional airports. However, Singapore and Kuala Lumpur airports have separate budget terminals for Air Asia airline.
- Brussels airport developed facility for low cost carriers but could not open due to objection and legal challenges from full service operators.
- At Geneva airport the major airline connecting the city is Easy Jet. There were plans to connect the Old terminal to a new Low Cost

terminal. There was objections by KLM airlines, Air France as lower passenger charge would have competitive advantage for Easy Jet.

3.6 MODERN CONCEPTS AND MAJOR DEVELOPMENTS AT AIRPORTS :

Airports are becoming increasingly diverse in what they offer to users. The diversity extends not only in terms of passenger facilities and baggage handling but in other areas too. Some of the airports are looking forward to incorporate different dimensions. To elucidate some of the major developments they are

- The airports are working as hubs for connecting facilities of cargo operators and integrators. Liege Airport in the United Kingdom is working as a Flexport. The airport is offering a secure cargo connecting process. The airport has no curb on movement of heavy vehicles. It has easy motorway and approach for cargo vehicles. The airport also has a huge number of warehouses and a long runway for heavy cargo planes.
- A lot of airports undertake pre-clearance for customs and immigration at the point of boarding and the passenger is treated as a domestic passenger at the destination country. The passenger need not undergo any hassle at the destination location. It is done for the United States at some of the Canadian airports, Abudhabi, Bahamas, Oslo, London and many other places.
- Virtual airports have been built were passengers Check In, undertake shopping, pre order services and purchase customised services. The same is done to reduce actual pressure on the main airport terminal. Before the departure of flight the passengers are transferred to the actual airport. Volaris International Airport, Mexico, Etihad airlines for Abu Dhabi airport have such facilities.

3.7 TECHNOLOGICAL CHANGES AND CUSTOMER EXPERIENCE :

Diversity, Differentiation and Innovation are the 3 keys to any business and airports too have applied the fundamentals to bring a new experience for passengers. Technology plays a crucial role in various aspects of operation and passenger experience. Technological advancement and implementation of new perspectives are bringing revolution at many airports. To highlight some of the advancements in technology

- Delta Airlines through their Fly Delta app have installed parallel display screens for passengers at airport lounges. The app contains captivating entertainment options, full body wearable exoskeletons and artificial learning operations platform.
- Baggage handling being undertaken by unmanned robots using artificial intelligence.

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- Aerial Unmanned vehicles(UAVs) are used in the test phase at airports for status checks and security purpose at Frankfurt airport.
- Drone delivery of food and drinks at airport terminal is under trial at Edmonton airport at Canada.
- Telepresence is the experience of virtual reality and is being live tested at Japanese airport and is a project of Japanese airline ANA. The company is working on Telepresence of passengers for 2020 football World cup.
- Sitalabs has developed a 3 dimensional 86 inch touch screen interface and installed it at United States East Coast airport known as the Digital Twins. The device improves operational decision making by providing a holistic view of the airport operations. The device has a playback facility that allows effective ways of investigation and managing disruption.
- Chat Bot applications that are artificial intelligence powered resolves passenger queries and assist in providing services. The chat bots are designed for continuous learning and enhancing passenger experiences. Air Asia Virtual All Star (AVA) , the chat bot for Air Asia has won an award for the Best Passenger Experience initiative.
- Airports are introducing 5 G technology. Many airports in the United States, China, United Kingdom, South Korea, Germany are working towards promoting 5G technology. Vodafone has installed a 5G enabled Blastpod at Manchester airport. Passengers can download movies and other content to test the speed.
- Inflight Virtual Reality experiences have been introduced by many airlines. A company named Renacen introduced 3 Dimensional virtual reality seat map that provided a 360 degree view of the cabin. The same has been used for seat upselling by many airline companies like Emirates, Etihad, Austrian etc.
- Innovative autonomous wheel chair at Abu Dhabi airport and self driven electric wheel chairs at Narita International airports are installed with robotic elements and are self guided.
- Real time translation in 26 languages has been introduced by American Airlines for its passengers using club lounge facilities at Los Angeles airport.

In recent years there has been increased attention on the 'passenger experience' when considering service quality, passenger satisfaction and other related issues at airports. Some airports are using it as a key differentiator of their offer rather than relying on 'good' service provision as indicated with their service quality measures. In essence, as Boudreau et al. (2016) explained, the airport experience is a net impression of all of the experiences a passenger has in an airport as judged by a passenger's individual standards, expectations and perceptions. Passenger experience at airports are essential because

- Passenger experiences have led to the growth of non aeronautical revenue considerably.
- A good experience leads to more spending by the passenger and they feel relaxed.
- As airports compete against each other a good experience of a passenger at a particular airport leads to repeat visits through that airport.
- Airports are the gateways for countries and carry the first impression of country. A great airport enhances reputation.
- The crux of customer focus leads to clear goals and objectives of the organization.
- Pride for an airport for the people working there brings better experiences and leads to all positive outcomes.
- Great passenger experiences leads to better media attention leading to more publicity.

The key activities focussed on customer channels in the right direction at an airport leads to a value proposition

3.7.1 Challenges for Airport Operators for Managing Disruptions :

There are many challenges that the industry faces to manage airline disruptions. Airports and airline companies are acting as catalysts to recover every disruption through measures that encompass a wide range of parameters.

- Diverse customers with diverse needs, uneven spread of demand and airport infrastructure often unable to meet the needs of the customer.
- Congestion management and capacity allocation at different airports leading often to disruptions.
- Optimising airport infrastructures and capacities to a maximum poses a big challenge at many airports of the world. Many urban airports have no space for expansion and capacity utilization becomes a challenging task.
- Up-gradation of technology and its use and implementation is not undertaken at majority of the airports leading to challenges that lead to disruption.
- Skilled manpower shortages for tasks that lead to safety, security and efficiency of an airport.
- Airside, terminal and surface links to airports need expanding and upgrading across the industry. Given airline pressure on airports to keep costs low, non-aeronautical revenues and passenger facility charges (PFCs) are two funding sources that need to expand.
- Investment in Cyber security to detect and prevent any potential threat is essential and many airports lack measures to encounter the same.

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- Environmental norms and airports adhering to the norms are a big challenge for airports. The commitment towards environment needs a clear agenda and a future oriented planning by airports.
- Accessibility between terminals often pose a challenge for many passengers at different airports.
- In a fragile and constantly changing world – with terrorist attacks or global epidemics and pandemics – security measures and safety precautions need to be identified, evaluated and adapted more quickly.
- Service is a combination of activities undertaken by different bodies working and each body has a different perception of service and goals to be achieved.

The future airport facilities should be designed for greater flexibility and rapid change. Processes change over time due to new systems and changing practices or by replacing hardware components in the terminal with apps or software (e.g. check-in). Seamless travel shall be a key element of most major airports in the future. Contactless handling processes, easy baggage check-in, automated processes with biometric support result in shorter waiting times and easier and faster access to the boarding gates. It therefore follows that the passenger journey itself will become an increasingly commercial experience. The importance of this trend was even increased through the current pandemic. Airports must be prepared for the next disruptive event to avoid another hard hit and massive traffic decline. Building trusted and standardised processes on a global level is the key to ensuring financially sustainable operations.

☐ Check Your Progress – 2 :

1. The acronym MCT stands for
 - a. Minimum Connect Time
 - b. Maximum Connect Time
 - c. Movement Correct Time
 - d. None of the options
2. Liege airport at England is working as a hub for cargo clearance and is known as a
 - a. Funport
 - b. Flexport
 - c. Flexiport
 - d. Freeport
3. Artificial intelligence powered software used in resolving passenger queries and assist in providing services are known as
 - a. Chatterbox
 - b. Chatterbot
 - c. Chatbot
 - d. Chatbox
4. A 3-Dimensional virtual reality seat map that provided a 360 degree view of the cabin has been introduced for
 - a. Virtual flight experience
 - b. Passenger gaming
 - c. Crew Members
 - d. Upselling of seats

3.8 LET US SUM UP :

Airline companies operate in challenging environments which affect operations from sources that are internal as well as external. Disruptions

are the causes that lead to operational inefficiency and higher costs for any airline. Disruptions may happen from weather conditions to natural disasters or from security threats or technical issues. Disruptions lead to cost implications for any airline and recovery from disruption efficiently is the key objective of any airline. There are many scientific approaches that airline companies implement for disruption management. The efficiency of managing a disruption lies in real monitoring of aircraft operations, faster and cost effective decision making, efficiency improvement, passenger satisfaction, crew management, flexibility and seamless scalability based on situation. There are many recovery operations undertaken by airline companies in event of a disruption. Customer management and satisfaction in the entire process is very vital and airports with enhanced facilities and infrastructure play a pivotal role in management of passengers affected by disruption. The unit also highlights some of the services and facilities offered by different airports that aid in passenger management. Preventive steps in disruption management also is a key for airline companies and many airports facilitate faster processing of passengers, baggage movement, terminal transfer through efficient use of technology, skilled manpower and robust processes. There are many challenges that any airport or airline company face during disruption, however, effective planning, coordination, decision making and implementation reduces the impact.

3.9 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. c 3. b 4. a

Check Your Progress – 2 :

1. a 2. b 3. c 4. d

3.10 GLOSSARY :

PNR : Passenger Name Record

Disruption : Problems that interrupt an activity, event or process.

Scalability : The capacity to be changed in size or scale.

ATC : Air Traffic Control

Linkage : The action of linking or the state of being linked.

Customs : Authority or agency in a country responsible for collecting tariff and controlling flow of goods into and out of a country.

Chatbot : Software application used for conducting an on line chat conversation

Catalyst : A person or thing that precipitates an event.

3.11 ASSIGNMENT :

List the 5 steps that shall be undertaken by the following agencies in event of an earthquake that damages a part of the airport terminal.

- a. Airport Authorities b. Airline Authorities c. Civic Bodies

3.12 ACTIVITIES :

List 5 measures that aircraft companies (3 international carriers) undertake for passenger recovery in event of a disruption.

3.13 CASE STUDY :

A flight of a Low Cost Carrier arrived at an airport delayed by 25 minutes. The cause of the delay was technical glitch of the aircraft from the destination point. On arrival the ground maintenance staff within minutes gave a clearance for a go ahead for the next flight. The passengers for the next flight were seated but the pilot was dissatisfied and refused to fly the aircraft and not taking risk for the same. The maintenance staff again rechecked all the aspects and gave a clearance for the flight but the pilot was not convinced. There was a meeting between the pilot, management of the airline and the maintenance head. After a long discussion the passengers were deplaned. There was no backup plan of the aircraft company for the passengers of the aircraft. After a wait of 45 minutes at the terminal the passengers started quarrelling with the ground. The ground staff had no options nor was any backup plan being communicated to them from the head office. A moment later passengers started getting abusive and the management scheduled an alternative flight that was to arrive 2 hours later. It was a bad experience for passengers and the staff at the airport.

1. What were the wrong aspects that the aircraft company undertook ?
2. How could the airline company resolve the problem in the first place ?

3.13 FURTHER READING :

1. Disruption Recovery in Air Traffic by Prabhu Manyem
2. Airport Operations by Norman J Ashford
3. www.flightware.com

UNIT STRUCTURE

- 4.0 Learning Objectives**
- 4.1 Introduction**
- 4.2 Aircraft Noise**
- 4.3 Noise Control Strategies**
 - 4.3.1 Quiet Aircrafts**
 - 4.3.2 Noise Preferential Runways**
- 4.4 Operational Noise Reduction Procedures**
 - 4.4.1 Noise Reduction During Takeoff**
 - 4.4.2 Noise Reduction on Approach**
 - 4.4.3 Runway Operations**
 - 4.4.4 Sound Insulation**
 - 4.4.5 Noise Certification**
- 4.5 Noise Monitoring Procedures**
- 4.6 Night Curfews**
- 4.7 Noise Compatibility and Land Use**
- 4.8 Let Us Sum Up**
- 4.9 Answers to Check Your Progress**
- 4.10 Glossary**
- 4.11 Assignment**
- 4.12 Activities**
- 4.13 Case Study**
- 4.14 Further Reading**

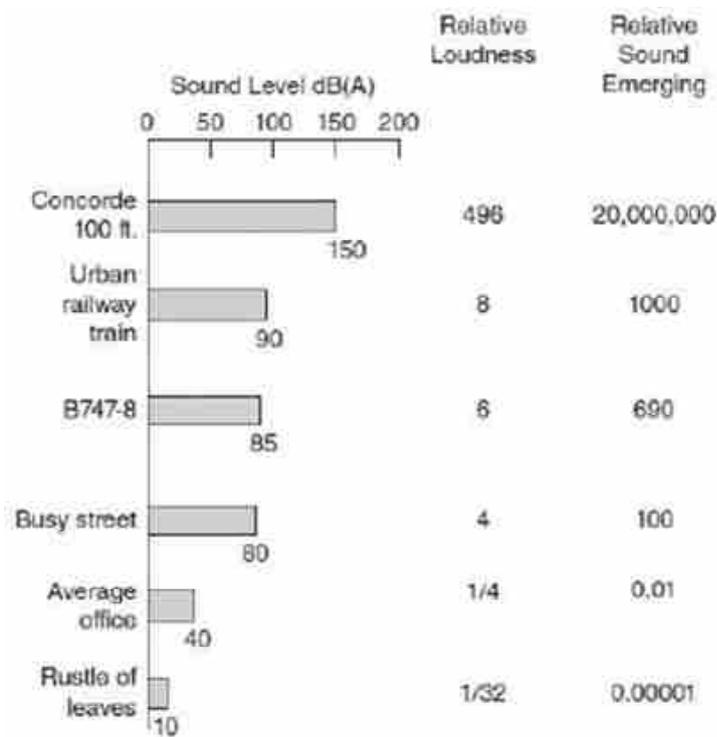
4.0 LEARNING OBJECTIVES :

- To define aircraft noise and its impact.
- To enumerate on different noise control strategies and operational control procedures adopted globally.
- To list noise monitoring procedures.

4.1 INTRODUCTION :

Airport noise is a worldwide problem. It inhibits the development of new airports and can seriously constrain the efficient and economic operation of existing facilities. In 1968, the assembly of the International Civil Aviation Organization (ICAO) recognized the seriousness of the

problem and, knowing that the introduction of new, noisier aircraft types could aggravate the situation, instructed its council to call an international conference on the subject of aircraft noise in the vicinity of airports. This took place in 1969, providing the source document for Annex 16 to the Convention on Civil Aviation in 1971. Since then, Annex 16 has been revised through several editions (ICAO 2008a). The annex contains the essential international guidelines for noise control at airports in the form of standards and recommended practices (SARPS). Sovereign governments, such as the United States, have their own regulations (FAA 2012). In some cases, these are more stringent than those of ICAO. However, all such SARPS are designed to combat perhaps the most significant airport problem—noise. Noise, which can be defined as unwanted sound, is a necessary by-product of the operation of transportation vehicles. Aircraft produce noise from their engines and from the aerodynamic flow of air over the fuselage and wings. Airports of themselves generate little noise. It is the noise generated by aircraft in and around airports that causes problems.



Scale of Noise and Sound

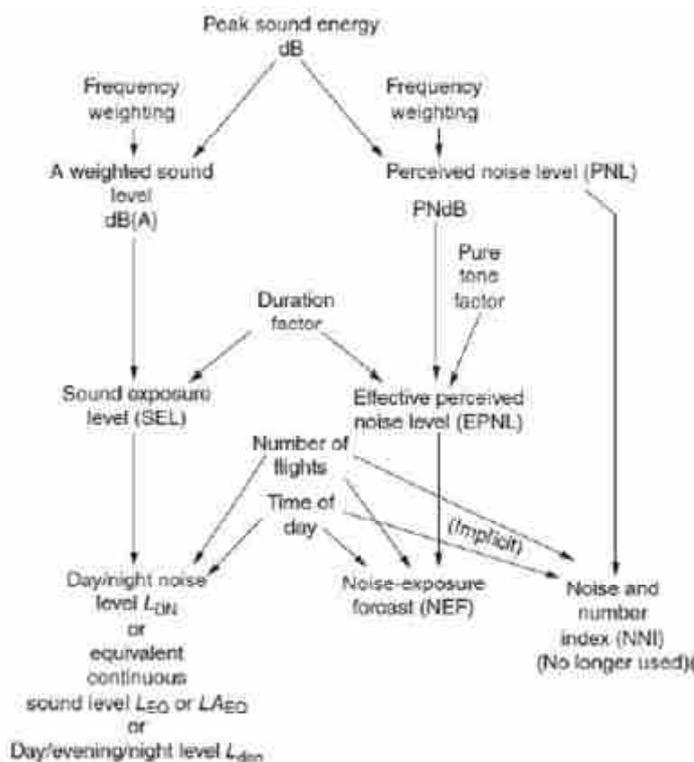
4.2 AIRCRAFT NOISE :

The audible spectrum of our ear is 20 to 20000 Hertz. The maximum sensitivity of sound as perceived by the ear is in the middle of the range.

- Aircraft noise can be described by measuring the level of noise in terms of sound intensity. It has been recognized for some time that the ear is particularly sensitive to frequencies within the A-range. Sound is therefore normally measured using A-weighted decibels dB(A), which reflect the sensitive ranges.
- Where a noise-level measure is required, the simple dB(A) method is not entirely satisfactory. Researches undertaken at John F Kennedy

Airport at United States indicate that our ears deciphered noise in a much more complicated way than the measurement scale intensity. Another noise level measure was devised known as the Perceived Noise Level (PNL).

- Noise intensity by itself is not a complete measure of noise. Intensity requires the factor of duration, which has been found to have a strong influence on the subjective response to noise. The principal measures of single-event noise used are effective perceived noise level (EPNL or LEPN) and sound exposure level (SEL, sometimes abbreviated to LSE or LAE).
- Annex 16 to the Convention on Civil Aviation of ICAO recommends use of EPNL, which modifies the PNL figure by factors that account for duration and the maximum pure tone at each time increment.
- In the case of noise nuisance generated in the process of airport operation, it is not simply the magnitude of the worst single noise event that gives a measure of environmental impact. Over the operational day of the airport, many noise "events" occur. Therefore, single-event indices are not useful methods of measuring aircraft noise disturbance, which is related to annoyance and interference with relaxation, speech, work, and sleep.
- There is a wide range of individual responses to noise from aircraft operations in the vicinity of airports. Noise levels that are extremely annoying to some individuals cause little disturbance to others. The reasons for these differences are complex and largely socially based. Research has indicated that unlike individual reactions, community response is more predictable because of the large number of individuals involved.



4.3 NOISE CONTROL STRATEGIES :

There are many ways in which operations on and in the vicinity of airports can be modified to control noise and to decrease its impact on airport neighbours (ICAO 2007). Some of the strategies that have been adopted are

4.3.1 Quiet Aircrafts :

Noise of an aircraft is majorly due to the aerodynamic flow of the wind over the aircraft frame and the engine of the aircraft. Engines are the major source of noise and the prime reason being high velocity gas flows and air flows in the compressor fan system. Engines have been highly modified and bypass systems have been attached to reduce the amount of noise. Some of improvements that have been undertaken and in process are

- Low Noise Fans
- Quiet Intake Liners, bypass and core stream liners.
- Improved nozzle jet noise suppressors
- Active Noise Control Fans
- Reduction in Airframe noise.
- Low Noise Inlets
- Low Noise flaps and gear systems.

Both the National Aeronautics and Space Administration (NASA) and the European Commission (EC) had research and development programs that sought to reduce aircraft noise through improved low-noise design resulting in a 6-to 7-dB reduction from the levels of aircraft in the mid-1990s.

4.3.2 Noise Preferential Runways :

- Modern aircrafts are not susceptible and sensitive to the crosswind component during landing and takeoff. An optimally designed runway can cut the noise levels in the surrounding areas. Schiphol airport Amsterdam is an example of an airport that might well have abandoned the use of a particular runway as it created direct noise for the suburbs of Amsterdam. The over the ocean approach and take off at Los Angeles airport for particular periods of time curbs the noise factor into the suburbs.
- Very much related to the noise-preferential runway concept is that of minimum-noise routings (MNRs) or preferred-noise routings (PNRs), which are designed to direct departing aircraft to follow routes over areas of predominantly low population density. This drastically reduces the disturbance footprint.
- In United Kingdom the noise advisory council has directed the practice of using MNRs and has recommended its continuation as being the best course of action for the community as a whole.

Check Your Progress – 1 :

1. The unit of measurement of sound is
 - a. Heart
 - b. Buzz
 - c. Hush
 - d. Hertz
2. The acronym PNL stands for
 - a. Paranoid Noise Level
 - b. Perceived Noise Layer
 - c. Perceived Noise Level
 - d. None of the options
3. The acronym SEL stands for
 - a. Sound Emergency Level
 - b. Sound Exposure Level
 - c. Song Exposure Level
 - d. Sound Exposure Layer
4. The acronym EC stands for
 - a. European Commission
 - b. English Commission
 - c. European Country
 - d. English Country
5. The acronym MNR stands for
 - a. Maximum Noise Route
 - b. Maximum Noise Routing
 - c. Minimum Noise Route
 - d. Minimum Noise Routing

4.4 OPERATIONAL NOISE REDUCTION PROCEDURES :

There are certain techniques adapted in operations that can significantly bring down noise levels during takeoff and approach phases. ICAO in its manual too recommends the use of such procedures.

4.4.1 Noise Reduction During Takeoff :

To reduce noise over a settlement community aircrafts can cut back on power on achieving a safe altitude for operation. Once the aircraft reaches a depopulated area the power can be resumed. This cut back operation reduces noise over a populated area considerably. The procedure is also known as Noise Abatement during takeoff. The procedure is very common at many airports of the world.

4.4.2 Noise Reduction on Approach :

Noise on approach can be reduced by adopting operational Noise Abatement Procedures that keep aircraft at increased heights above the ground. Some of the following have been used at various airports:

- Aircrafts are restricted from unnecessary low flying through interception of glide slope at higher altitudes. Aircrafts use the visual approach slope indicator system (VASIS). Airports like Manchester prohibit aircrafts to descent below 2000 feet until the glide scope is intercepted.
- The descent of the aircrafts are undertaken at a steeper than normal angle. The low grade approach requires reduced flap settings and

lower engine power. The reduced flap settings show reduction in noise.

- The use of continuous or height information using secondary surveillance radars. This prevents the use of power in a stepped descent and consequently reduces noise under some parts of the descent path. A combination of low-power and low-drag approach procedures has been used in the past with considerable success at Frankfurt Airport, which has severe environmental noise problems owing to its position within an urban area.

4.4.3 Runway Operations :

The most significant improvement in noise impact that can be achieved when aircraft are on runways is control of the use of thrust reversal. Although thrust reversal is usually about 10-dB below takeoff noise, it is an abrupt noise that occurs with little warning. Aircraft operations should be restrained from the use of thrust reversal on noise- nuisance grounds, except in cases where no other adequate means of necessary deceleration is available or where the airport setting does not require noise-control strategies.

4.4.4 Sound Insulation :

Sound insulation can provide relief to community surrounding the airports. A lot of airports use different techniques for sound insulation. Glazing is one of the techniques that act as insulators and the same is followed in airports at London and Amsterdam. A very different approach was undertaken at Los Angeles airport, where the airport authorities purchased homes and businesses in the vicinity of the airport affected by noise.

4.4.5 Noise Certification :

The resolution of September 1968, ICAO established international specifications recommending the noise certification of aircraft that have reached acceptable performance limits with respect to noise emissions. Individual countries have developed their own parallel standards. The ICAO has categorized aircrafts under Chapter 1 , Chapter 2 , Chapter 3 and Chapter 4 based on the evolution of aircrafts. The regulations of ICAO are stringent in the modern times to ensure that older fleet of aircrafts are phased out in a periodic manner. There are Three noise-measurement points that are defined under the approach and takeoff paths and laterally to the side of the runway. Maximum noise levels are set at these references noise-measurement points; permitted noise levels are set to be dependent on maximum certificated takeoff weights, with the rationale that small, very noisy aircraft are socially undesirable and therefore should not be certificated. There are absolute maximum noise limits for even the largest aircraft.

In October 2001, the ICAO plenary meeting adopted a new and stricter Chapter 4 standard. This banned Chapter 2 aircraft from operating

in major aviation states after April 1, 2002. Starting on January 1, 2006, newly certificated airplanes were required to meet Chapter 4 noise standards, as were Chapter 3 airplanes for which recertification to Chapter 4 was requested. The principal differences in requirements include

- A cumulative 10 db over Chapter 3 levels
- The sum of the improvements at two measurement points to be at least 2 dB
- No permission granted for trade offs.
- Specific exemptions permitted for new operating restrictions in developing countries.

The ICAO's prime policy on aircraft noise is the "Balanced approach to Aircraft Noise Management", adopted by the ICAO assembly in its 33rd session and provided in ICAO Doc, 9829. The Balanced Approach consists of identifying the noise problem at a specific airport and analyzing various measures available to reduce noise through the exploration of various measures which can be classified into four principal elements. The goal is to address noise problems on an individual airport basis and to identify the noise-related measures that achieve maximum environmental benefit most cost-effectively using objective and measurable criteria. The 4 measures that comprise of the Balance Approach are

- Reduction of noise at the source. The same indicates reduction in the noise of the aircraft.
- Land Use planning and Management around the airport.
- Noise abatement operational procedures
- Operating restrictions.

The ICAO has been assessing global trends of exposure due to aircraft noise and have developed noise technology goals in association with different countries of the world to conduct research and development and monitor outcomes. Some of the trends that are being followed globally to monitor noise levels at the airport are

- Documentation under ICAO DOC 10127, Independent Expert Integrated Technology Goals Assessment and Review for Engines and Aircraft (2019). This was the first time that ICAO developed technology goals for noise, local air quality and CO₂ emissions in an integrated manner, with full consideration of the interdependencies between the technologies.
- Study of noise trends have been undertaken at 315 airports worldwide with indicators of total contour area and population residing in the same. These airports had an average day night noise level of 55 dB. The study was based on certain assumptions related to technological advancement of aircrafts and population growth in the contour areas. It has been studied that the long-term total Day Night Level of 55 dB contour area is lower by about 10%, compared with

the prior trends projections. This decrease can be attributed to a combination of quieter aircraft entering the fleet, as well as a reduction in the long-term traffic demand.

- Introduction of aircraft noise reduction technology for different category of aircrafts. Technology like reduction in aircraft fan pressure ratio, acoustic liner technology, reduction in jet velocity, design changes to reduce airframe noise and many other technological innovations are continuously in process to reduce noise.
- Airspace modernization and, in particular, the deployment of Performance Based Navigation (PBN) can improve the management of air traffic and help to ensure that the capacity demands of the flying public can continue to be met while reducing the industry's environmental footprint. While PBN can offer opportunities to mitigate the noise impacts associated with aircraft operations, through operating enhancements such as quieter Continuous Descent Operations (CDO), it can also alter community noise patterns surrounding airports.
- New innovative technologies and energy sources for aviation are under development in a fast pace, and ICAO is closely following up these developments to prepare for their timely environmental certification, as appropriate. In that regard, ICAO is maintaining the E-HAPI, a website with a non-extensive list of ongoing projects that have been identified globally.

4.5 NOISE MONITORING PROCEDURES :

Airport authorities across the globe have been implementing Noise management as a key perspective in airport operations. Monitoring of noise around the vicinity of an airport is an effective program that is implemented as a part of noise management. The most beneficial programs have been those which have honestly and conscientiously monitored the status of noise pollution and encouraged an open exchange of information among the airport operator, the airlines, airline crews, the public, other airport authorities, and researchers in the field. The effectiveness of any such program is measured in terms of the computed reduction owing to implementation of monitoring procedures. The entire program is highly interactive and cooperative among different stake holders and many airports have benefitted from the same. Manchester airport is the world leader in noise monitoring and noise control procedures. Mobile noise monitoring units are deployed at different locations to track effectively. The following procedures are followed

- To monitor noise levels from start of the roll of an aircraft to a certain extent of the flight path.
- To measure in the vicinity of the airport where there is a built up area.
- To track individual flights for noise levels in correlation with ATC data.

- High noise level flights are immediately recommended for maintenances and measures to be undertaken.
- A certain noise level benchmark is set during day and night.
- Even a penalty is levied for aircrafts that exceed the noise level threshold at the monitoring points.
- Monitored noise level data is published by the airport each month.
- The noise monitoring provides a continuous feedback to airline operators, airport operators and airport consultative committees to step up and work towards measures in decreasing the noise levels.
- Noise compatibility programs are followed in various airports across the globe.

4.6 NIGHT CURFEWS :

In many countries across the globe, large transport aircrafts that create a lot of noise are not permitted to fly in the night. The operations of such aircrafts can cause intolerable night conditions in the vicinity. Consequently, night curfews on aircraft operations exist at many airports throughout the world (e.g., Zurich and Sydney). The nature of the curfews varies substantially among airports. At some facilities there is a complete ban on all operations, and the runways are effectively closed. Other airports permit the operation of some propeller aircraft that have low noise characteristics. Frequently, night freight movements are made by such "quiet" aircraft. Some airports such as London Heathrow allow for a quota of night movements that permits a heavily reduced level of operation. In Amsterdam, London, and Frankfurt, some curfew exemptions are granted under certain operational and scheduling circumstances to permit operations by noise-certificated aircraft. London, Tokyo, and Paris bend the curfew rules to allow delayed flights to land, but some airports operate a very restrictive curfew period that allows no exemptions. Sydney has a curfew from 11:00 p.m. to 6:00 a.m. During these hours, general passenger jets are excluded. Small propeller-driven aircraft, low-noise jets, and a limited number of freight movements are permitted, but during curfew hours, aircraft must operate over Botany Bay. The airport can get dispensation for unavoidable and unforeseeable circumstances that cannot be solved by alternative arrangements. Breaching the curfew at Sydney can incur a fine.

The nature of the curfew depends greatly on the local political atmosphere, the location and physical climate of the city involved, and the nature and volume of air transport through the airport. Curfews can be very effective in limiting night time disturbance. However, before activating a curfew, an airport must examine very carefully the effect that this constraint will have on airlines. Curfews increase the problem of peaking, and stringent curfews that accept no delayed aircraft, such as that in operation in Sydney, can produce alarming scheduling-window constraints when located at the end of long flight.

4.7 NOISE COMPATIBILITY AND LAND USE :

Airports induce commercial activity in the vicinity where it develops. As airports are workplaces and terminal points for a mode of transport, they generate urban development in their vicinities. This is likely to be in the form of residential areas for those working at the airport. Additionally, commercial and industrial development tends to be attracted to the airport because of commercial linkages with the aviation activities or convenient access to air transport. These directly associated land–use changes themselves generate secondary growth in the form of residences for the industrial and commercial workers, shops, schools, and a variety of other developments necessary for an expanding community. Because it is a large employer and consequently a generator of urban activity, without land–use control, an airport will very rapidly find that it has developments in its immediate vicinity that are incompatible with its own function. Residential areas are recognized as being highly sensitive to aircraft noise and, therefore, every effort must be made to discourage the development of residential land use in the vicinity of airports. Some types of commercial and industrial uses are less sensitive; uses such as manufacturing and resource extraction, where internally generated noise levels can be very high, are usually reasonably compatible with a large, modern airport. Many governments across the world have stringent laws related to development of residential areas around an airport.

Many airports that originally were put down on green field sites have found themselves severely constrained within 20 to 30 years of operation. The airport administration therefore has a strong and legitimate interest in ensuring that future viable operation of the facility is not constrained by piecemeal development of incompatible neighbouring land uses.

☐ Check Your Progress – 2 :

1. Cutting on aircraft power over settlement colony is known as
 - a. Noise Increase
 - b. Noise Apathy
 - c. Noise Drive
 - d. Noise Abatement
2. Thrust reversal on runway is about _____ dB below original noise
 - a. 8
 - b. 9
 - c. 10
 - d. 11
3. _____ process acts a sound insulator
 - a. Mazing
 - b. Glazing
 - c. Hazing
 - d. None of the options
4. The acronym PBN stands for
 - a. Performance Based Navigation
 - b. Parameter Based Navigation
 - c. Perimeter Based Navigation
 - d. None of the options

4.8 LET US SUM UP :

The noise created by aircrafts at airports is a big problem for the population staying in the vicinity of an airport. Noise is defined as an unwanted sound and an aircraft produces a lot of sound from its engines and aerodynamic flow of air across its frame. The apex body ICAO in its guidelines laid down measures on noise control at airports in the form of standard procedures known as SARPs. There are different strategies that have been adopted worldwide by airline companies and governments to reduce the impact of noise. Aircraft companies are using aircrafts that have reduced noise technology; runways have been designed at airports that cut noise levels in the surrounding areas; noise reduction techniques have been adopted during takeoff and approach; noise certification bodies and standards have been devised for control aircraft noise and continuous monitoring have been undertaken by various agencies to ensure procedures and standards are implemented and there is a substantial reduction in the noise levels.

4.9 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. c 3. b 4. a 5. d

Check Your Progress – 2 :

1. d 2. c 3. b 4. a

4.10 GLOSSARY :

Hertz : The unit of frequency in sound is measured by Hertz.

Decibel : The unit of amplitude in sound is measured by Decibel

Aerodynamic : A shape that reduces friction from the air moving past.

Abatement : The act or process of reducing.

Plenary : A session attended by everyone.

Contour : An outline of a curved or irregular figure

Curfew : A regulation that controls movement.

4.11 ASSIGNMENT :

What is a Greenfield Airport? Discuss some of the measures undertaken by Greenfield Airports to reduce impact on the environment and carbon footprint.

4.12 ACTIVITIES :

List 5 International airports and enumerate the strategies adopted by these airports to curb noise.

4.13 CASE STUDY :

A new airport project was announced by the government in a particular city. The land allocated for the same was of the government for the project. There were 17 villages surrounding the land that started protesting about the different environment hazards that they shall be facing due to the airport being constructed and especially noise related problems. The villagers argued that the pollutants emanating from the airport through sewage shall destroy their land and affect crop growth. They also argued that the government was planning to alter the course of the only water source a monsoon river, which will lead to huge crisis for crops. The government had several meetings with the villagers but there was no resolution. There were protests and the matter was sub-judice. The construction of the airport was put on hold by the government and a committee was formed on advice by the court to study the impact of the airport on the villages and submit report.

1. What were the wrong steps undertaken for the construction of the airport ?
2. List some of the strategies that should always be worked out to make a plan for an airport right ?

4.14 FURTHER READING :

1. Aircraft Noise by Frederick Miller
2. Airport Noise Grants by FAA
3. Aviation Noise Impact Management by Laurent Leylikiyan
4. <https://www.icao.in>

BLOCK SUMMARY

In the block you have studied about the importance of Air Traffic Control in managing the entire operations of aircrafts and preventing them from any mishaps. You have also studied about the technology being used for the same globally. The block has also provided you with the insight about how airports gear up to prevent and combat emergencies and the equipments used for the same. Disruptions lead to a major loss of revenue for the aircraft companies and the block has highlighted the causes and possible ways of managing disruptions. Aircraft Noise at airports is an issue that has been raised globally and governments across the world are implementing measures to curb the same. The unit acquaints you to the implementation of some of the global measures technologically and operationally.

BLOCK ASSIGNMENT

Descriptive Questions :

1. Why is noise control in the vicinity of an airport important ? List some strategies for noise control that are implemented globally ?
2. What is airline disruption ? Enumerate on the different sources of disruption, its impact on operations and recovery procedures ?
3. What are the different types of emergencies that can happen at an airport ? Explain mitigation procedures for emergencies ?
4. Elaborate on the purpose of Air Traffic Control ?

Short Questions :

1. List some of the procedures for Noise monitoring at airports ?
2. What is Minimum Connect Time and how does it benefit an airport and airline ?
3. Describe an Airport Emergency plan ?
4. What is disaster planning ? Enumerate on the 3C's of disaster planning ?
5. Explain in detail about the different flight rules ?

Airport Operation & Management

❖ Enrolment No. :

1. How many hours did you need for studying the units ?

Unit No.	1	2	3	4
No. of Hrs.				

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____

3. Any other Comments

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AIRPORT OPERATION & MANAGEMENT



**DR. BABASAHEB AMBEDKAR OPEN UNIVERSITY
AHMEDABAD**

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ISBN 978-93-91071-24-0

Edition : 2022

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ROLE OF SELF INSTRUCTIONAL MATERIAL IN DISTANCE LEARNING

The need to plan effective instruction is imperative for a successful distance teaching repertoire. This is due to the fact that the instructional designer, the tutor, the author (s) and the student are often separated by distance and may never meet in person. This is an increasingly common scenario in distance education instruction. As much as possible, teaching by distance should stimulate the student's intellectual involvement and contain all the necessary learning instructional activities that are capable of guiding the student through the course objectives. Therefore, the course / self-instructional material are completely equipped with everything that the syllabus prescribes.

To ensure effective instruction, a number of instructional design ideas are used and these help students to acquire knowledge, intellectual skills, motor skills and necessary attitudinal changes. In this respect, students' assessment and course evaluation are incorporated in the text.

The nature of instructional activities used in distance education self- instructional materials depends on the domain of learning that they reinforce in the text, that is, the cognitive, psychomotor and affective. These are further interpreted in the acquisition of knowledge, intellectual skills and motor skills. Students may be encouraged to gain, apply and communicate (orally or in writing) the knowledge acquired. Intellectual- skills objectives may be met by designing instructions that make use of students' prior knowledge and experiences in the discourse as the foundation on which newly acquired knowledge is built.

The provision of exercises in the form of assignments, projects and tutorial feedback is necessary. Instructional activities that teach motor skills need to be graphically demonstrated and the correct practices provided during tutorials. Instructional activities for inculcating change in attitude and behavior should create interest and demonstrate need and benefits gained by adopting the required change. Information on the adoption and procedures for practice of new attitudes may then be introduced.

Teaching and learning at a distance eliminates interactive communication cues, such as pauses, intonation and gestures, associated with the face-to-face method of teaching. This is

particularly so with the exclusive use of print media. Instructional activities built into the instructional repertoire provide this missing interaction between the student and the teacher. Therefore, the use of instructional activities to affect better distance teaching is not optional, but mandatory.

Our team of successful writers and authors has tried to reduce this.

Divide and to bring this Self Instructional Material as the best teaching and communication tool. Instructional activities are varied in order to assess the different facets of the domains of learning.

Distance education teaching repertoire involves extensive use of self- instructional materials, be they print or otherwise. These materials are designed to achieve certain pre-determined learning outcomes, namely goals and objectives that are contained in an instructional plan. Since the teaching process is affected over a distance, there is need to ensure that students actively participate in their learning by performing specific tasks that help them to understand the relevant concepts. Therefore, a set of exercises is built into the teaching repertoire in order to link what students and tutors do in the framework of the course outline. These could be in the form of students' assignments, a research project or a science practical exercise. Examples of instructional activities in distance education are too numerous to list. Instructional activities, when used in this context, help to motivate students, guide and measure students' performance (continuous assessment)

PREFACE

We have put in lots of hard work to make this book as user-friendly as possible, but we have not sacrificed quality. Experts were involved in preparing the materials. However, concepts are explained in easy language for you. We have included many tables and examples for easy understanding.

We sincerely hope this book will help you in every way you expect. All the best for your studies from our team!

AIRPORT OPERATION & MANAGEMENT

Contents

BLOCK 4 : AIRPORT MANAGEMENT

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Unit 2 Airport Business Plan

Introduction, Airport Business Plan, Value of a Business Plan, Elements of a Business Plan, Market Analysis in a Business Plan, Environment Analysis in a Business Plan, Financial Plan, Importance of a Business Plan

Unit 3 Airport Financial Management

Introduction, Scope of Financial Management, Objectives of Financial Management, Functions of Financial Management, Airport Funding, Airport Expenses, Operating Expenses, Operating Revenues, Revenue Strategies Adopted by Airports, Residual Cost Approach, Compensatory Cost Approach, Budget Appropriation, Sources of Funding for Airports, Government Funding, Private Funding, Build Operate Transfer (BOT) Model, Management Contract, Lease Contract, Joint Venture, Engineering Procurement and Construction (EPC), Hybrid Annuity Model (HAM), Build Own Operate Transfer (BOOT), Airport Revenue, Financial Accounting, Contents of a Balance Sheet, Financial Control, The Chicago Convention and Financing

Unit 4 Airport Slot System Operations

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Unit 5 Model Airports of The World

Introduction, Dubai International Airport, Singapore Changi Airport, Indira Gandhi International Airport, New Delhi, India, Heathrow Airport, London, United Kingdom, Incheon International Airport, Seoul, South Korea, Hamad International Airport, Doha, Qatar



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Airport Operation & Management

BLOCK 4 : AIRPORT MANAGEMENT

UNIT 1 : AIRPORT AND AIRLINE RELATIONSHIP

UNIT 2 : AIRPORT BUSINESS MANAGEMENT

UNIT 3 : AIRPORT FINANCIAL MANAGEMENT

UNIT 4 : AIRPORT SLOT SYSTEM OPERATIONS

UNIT 5 : MODEL AIRPORTS OF THE WORLD

AIRPORT MANAGEMENT

Block Introduction :

Airlines in order to survive in the business need to continually scrutinize and work on all strategic plans to lower their operational costs. A good partnering with an airport with strategic business deals often lead to optimization of airline budgets and generation of better revenue. Airports on the other hand are continually being challenged with the demand beyond its capacity. To manage effectively and earn maximum potential revenue, airports too are working on strategic business relationships to manage capabilities and build suitable requirements in order to fulfil business demands. The Unit 1 gives an insight into the different monetary exchanges that happen between an airport and an airline related to fees and the impact. It also highlights the international guidelines in levying charges. Business Plans are critical to establishment of airports and operating them. Business plans are blue prints that guide towards the objective of existence for any airport. The 2nd unit details a business plan for an airport and discusses the various elements, importance and guiding documents associated with the same. Finance is the key to any project and airports operate under huge financial transactions. Effective management and implementation of strategies in finance is essential. The 3rd unit details revenue strategies and practices adopted by airports in managing finance. Airports globally to optimize the inflow and outflow of aircrafts and manage an optimum balance and carrying capacity follow a system of slots for different airlines. The unit details the system, principles of allocation and the advantages of a slot system for an efficient airport operation. The last unit deals with some of the leading global airports and the facilities provided by these airports.

Block Objectives :

- To list the structure, impact and the regulations guiding aeronautical charges and enumerate various related components associated with it.
- To define, list and enumerate the elements, process overview, importance and guiding documents for a business plan.
- To list the scope, objective and functions of financial management.
- To explain different revenue strategies and practices of financial accounting adopted by airports.
- To define slots, stake holders, principles and enumerate on objectives and conditions for allocation of slots at airports.
- To list and discuss facilities provided by some of the leading global airports of the world.

Block Structure :

Unit 1 : Airport and Airline Relationship

Unit 2 : Airport Business Management

Unit 3 : Airport Financial Management

Unit 4 : Airport Slot System Operations

Unit 5 : Model Airports of the World

UNIT STRUCTURE

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- 1.12 Further Reading**

1.0 LEARNING OBJECTIVES :

- To list the structure of aeronautical charges and enumerate various related components.
- To detail the impact of aeronautical charges on airline operations.
- To list the regulations that guide airports in levying aeronautical charges.

1.1 INTRODUCTION :

The relation between airport operator and airlines is the fundamental structure for success of any airport business. Airlines in order to survive in the business need to continually scrutinize and work on all strategic plans to lower their operational costs that have increased considerably. Business models of many airlines have been reworked and operational elements have been modified. Fuel prices are not within the control of airlines and hence airline companies work on lowering costs of other elements within the operational gamut. A good partnering with an airport with strategic business deals often lead to optimization of airline budgets and generation of better revenue. Airports on the other hand are continually

being challenged with the demand beyond its capacity. To manage effectively and earn maximum potential revenue, airports too are working on strategic business relationships to manage capabilities and build suitable requirements in order to fulfil business demands.

1.2 STRUCTURE OF AERONAUTICAL CHARGES :

The Aeronautical charges constitute of the amount paid by any airline for operating its flight from an airport. Aeronautical charges vary from airport to airport and encompass a lot of strategic plans and decisions to optimize revenue as well as airline movements from the airport. Traditionally airports used to charge a weight based landing charge. Calculations related landing charges were simple and passenger fees were calculated depending on the number of passengers travelled. Modern airports have changed the perspective of dealing with airline companies and have introduced market based complex charging procedures. The strategy has been adopted by airports to mete out challenges at airports like increased facilities, rising maintenance costs, more requirement and adequate deployment of manpower, additional security costs according to global norms and even cost towards concern for environment. There are several categories of charges levied by any airport from airline operators and to categorize they are as

1.2.1 Landing Charge :

Every airline landing at any particular airport pays a certain amount to the airport operators. One of the charges that an airline pays to airports is the landing charge. Majority of the airports in USA and European countries charge aircrafts based on maximum takeoff weight or maximum authorized weight (the charge is calculated in tonnes and simple calculations are undertaken USD X Per Tonne weight). The size of the aircraft does not matter and is not the factor for charges. In this type of scenario airlines with higher capacity of seating benefit.

Many Airports like Delhi charge higher unit rates for larger aircrafts. Size becomes a determining factor. The operational belief or strategies of these airports are that airline companies using larger aircrafts are in a better financial position to pay higher charges. Many airports justify these higher charges with runway wear and tear by larger aircrafts, congestion, slower aircraft movements and other reasons.

The airports that are busy and congested have imposed a movement related charge that is higher for smaller aircrafts to discourage them from flying at busy airports. Airports like Heathrow charge a fixed charge for all aircrafts above 16 tonnes whereas Tokyo airport and Frankfurt airport charge a minimum for 66 tonnes irrespective of the size or weight of the flight. The same is a loss to smaller light weight aircrafts that fly for non commercial purposes. At Rome airport and Mexico City airport there is a differential charge prevalent by time of the day. Dublin airport has a differential charge based on the time of the year. The peak time

of the year carries a higher charge than the lean time. In some airports of the world domestic and short haul aircrafts pay a lesser landing charge than international and long haul aircrafts. These airports in a way support more regional services of airline companies which are expensive to operate than international carriers. There is a social linkage of the airport towards regional communities.

Air Traffic Control services and support are majorly included in the landing charge that the airline company pays. Many airports that have unique business models charge separately for Air Traffic control. If the charges are levied separately the same is related to the weight of the aircraft and these charges are then not part of the landing charges. The same happens when there are multi level stake holders in the operation of a single airport and control is fragmented. Noise and emission related charges are levied at some airports separately.

1.2.2 Passenger Charge :

Passenger Charge or Passenger Service Charge as it is known is one of the prime source of aeronautical revenue. The charge is levied on the basis of per departing passenger. Many airports across the globe have differential passenger charges for international and domestic travellers. It is lesser for domestic passengers. Many airports levy mixed charges. European Union countries with Schengen visa levy lesser charges as a part of treaty. Passenger charges may also vary depending on the diplomatic, political or social links that countries may have. Passenger charges in some countries reduce with higher load capacity of the aircraft. A 10% rebate is offered at Budapest and Frankfurt airport with 90% to 92% load factor. Dusseldorf airport has a scheme of volume rebate and offers 5.5% rebate for 6 million passengers departed for any particular airline. When a passenger makes a stopover at a particular airport Transfer fees are applicable as a part of passenger charge. Many airports to generate business have lower transfer fees eg. Paris, Singapore, Heathrow. Airports like Dubai do not charge any transfer fee.

1.2.3 Security Charge :

Security is a major concern at all airports. It includes safety of passengers, property and aircrafts. After the 9/11 attacks, the standards of airline security have been continually evolving. Technology has been incorporated as a key differentiator to ensure a fool proof process. Costs involving measures to be implemented at airports are according to international protocol and guideline. The same involves several equipments, technological aids and trained manpower. The security at airports are generally managed by

- Own employees
- Private companies under contract
- Government agencies. The security at Indian airports is managed by the Central Industrial Security Force (CISF).

The financing of security personnel and measures are either paid by the government through measures of general taxation or through a special government departure tax. Airports at the United States apart from passenger tax levy a security charge per passenger separately. The security charge at Frankfurt airport is based on the tonnage of the aircraft and number of passengers. There have been incidents where airline companies have refused to charge security charges to passengers due to policy issues. In such cases the passengers have to directly pay the same at the airport. Security charges vary from country to country. It may be as low as 1% as in Mexico or as high as 33% as in Hong Kong.

1.2.4 Other Charges :

There are several charges that are levied apart from landing, security and passenger charges. They are

➤ Parking Charge :

Aircrafts have to pay parking charges at airports. Every airport has its own parameters for levying parking charges. The ways that are undertaken for parking charges are

- The weight of the aircraft is the deciding factor at many airports and charges are directly proportional to the weight.
- The space occupied by the airlines at a particular airport. A negotiation between the airport authorities and airlines happens in regard to the amount of space being allocated to the airline on a permanent basis and a negotiated amount being paid for the space. The same depends on the frequency of the airline from that particular airport. The more space being occupied the lesser is the charge. Singapore airport follows this principle.
- A lot of airports decide a particular percentage of landing fee as parking fee and charge airlines based on the same. Beijing airport operates on this fundamental.
- A lot of airports allow a free parking charge for a particular period (1 to 4 hours) and then levy a parking charge. The same is undertaken for a smooth turn around by an airline. The scenario depends on congestion and the number of flights departing from the particular airport. Many airports that have lower number of flights even allow 12 hours of free parking. Airports like Frankfurt do not give any relaxation of hours and charge a parking fee. Heathrow airport allows only 30 minutes of free parking.
- Many airports like Bangkok and Amsterdam levy a 24 hour parking charge.
- At Paris airport different areas of the airport have different charges and even charges vary between day and night time.

Parking charges for aircrafts is normally less than 5% of the total charges. Many airports across the world introduced Development fee levied directly from the passengers. Delhi airport started collecting the

same after privatization but discontinued the same in 2016. Athens airport charges an Airport Improvement Fund as development fee.

➤ **Cargo Charge :**

Cargo charges are again a particular type of charge levied by airports from airline companies and it is differential at airports across the globe. Normally the charge is based on the weight of the loaded or unloaded cargo from an aircraft. The charge may be free at many airports and may only be charged to cargo flights.

➤ **Ground Handling Fee :**

Ground handling fee is a charge levied by some airport operators for the services provided on the ground to an aircraft and the same vary from airport to airport. The nature of services provided also varies at different airports.

➤ **Fuel Charge :**

Fuel charges are levied by fuel companies for refuelling of aircrafts at the airport. The fuel charges are decided on multiple factors and are a complex calculation. There are however, no fuel charges levied in Middle Eastern countries apart from the cost of the fuel.

➤ **Government Taxes :**

The taxes charged by governments of different countries are different from one country to the other. These charges are often not bifurcated separately in a passenger ticket from other charges. Airports like Amsterdam levy a tax on noise mitigation measures. There is a solidarity tax that has been introduced in France in 2006 and is charged to fund health aid to poorer countries.

➤ **Other Facilities :**

Different airports have charges for various facilities that they provide.

- Many European airports levy a direct charge of the services that are provided from passengers with reduced mobility.
- Passenger based infrastructure charge is levied at Vienna and Copenhagen airports.
- Airports like Bangkok, Mumbai, Lisbon and many others charge an aerobridge fee.
- Many airports may have charges separately for Ramp handling, Passenger handling, Apron bus, aircraft cleaning and others.

➤ **Aeronautical Charges Table :**

You have studied till now the type of charges that airports levy on airline companies. If we tabulate the same distinguishing it on the basis for the charge and whether the airport earns revenue, your understanding of the charges shall be clearer.

Airport Operation & Management

Type of Charge	Basis for Charging	Airport Operator Earning
Landing	Majorly on the weight of the aircraft	Yes
Terminal Navigation	It is included in landing charge	Most of the times
Passenger	Departing passenger	Yes
Security	Included in Passenger charge	Yes
Parking	Based on the fundamental of each airport	Yes
Infrastructure	Included in landing charge	Yes
Ground Handling	Depends on Airport to airport and the type of services availed	Sometimes
Fuel	Volume of fuel	No
Government Taxes	Departing passenger	No

❑ Check Your Progress – 1 :

1. Charge paid by airline to operate flight from airport is known as
 - a. Airport Charge
 - b. Airline Charge
 - c. Aircraft Charge
 - d. Aeronautical Charge
2. The landing charge of an aircraft is calculated on the basis of
 - a. Amount x Number of persons
 - b. Amount x Per Kg Weight
 - c. Amount x Per Tonne Weight
 - d. None of the options
3. Passenger Service Charge is levied
 - a. Per Arriving Passenger
 - b. Per Departing Passenger
 - c. Total number of passengers
 - d. All the options
4. Parking charge of an aircraft is less than _____ % of total charges
 - a. 5
 - b. 4
 - c. 3
 - d. 2

1.3 IMPACT OF AERONAUTICAL CHARGES ON AIRLINE OPERATIONS :

The fees collected by airports as part of aeronautical fee are fixed costs and airports have a control on the same and can project their part of the income from these charges. Passenger based fees for an airport is variable costs and increased number of passengers at an airport drives revenues. Airports across the globe are working towards various aspects to bring more passengers and earn through an increased variable cost. Leighfisher study conducted in 2012 revealed that a large number of

factors affect airport charges. Some of the factors to be considered are

- Size of the airport
- Runway utilization at the airport.
- The city in which the airport is located.
- Regulatory requirements at the airport.
- The mix of airlines that are catered by the airport.
- The average aircraft size that the airport caters.
- The distribution of short haul and long haul aircrafts at the airport.
- The destination mix and airline mix at the airport.
- The nature of ownership at the airport.
- The services provided by the airport.
- The commercial revenue factors at the airport.

In United States, it has been seen that unit aeronautical revenues went down with more traffic and were lower at airports facing competition from neighbouring airports that were giving competition and had comparatively lower charges. Choo (2014) found that large hub airports had higher aeronautical charges than other airports. Meanwhile, in Europe, Bel and Fageda (2010) concluded that the charges were higher at larger airports and lower when there were competing nearby airports. In addition, they found a negative relationship with airline concentration, suggesting that in this case the airlines had stronger countervailing market power. Bilotkach et al. (2012) also observed a positive relationship with traffic and hubs, but no nearby airport effect.

The impact of costs to airline companies and airports has led to an impact that has led to both the parties working towards measures. They are

- Cost analysis and scrutiny by airlines leading to cost saving initiatives like outsourcing activities, reduced staffing measures and reduced wages.
- Continuous yield management of passengers and destinations for increasing the capacity per aircraft.
- Working on dynamic operational strategies that are continuously in a state of flux.
- Inducing airports to cost cutting and cost optimizing measures at all levels of its operation.
- Usage of more secondary airports that is adjacent.
- Re-routing flights and working on schedules from peak hours to non-peak hours at airports with differential pricing. Peak pricing introduced by BAA operator for its airports at London with complex pricing policies in the 1970's was especially criticized by US airlines flying to London. The matter escalated and was later resolved

through arbitration by the two governments leading to BAA authorities discontinuing peak charges.

- Planning of new routes by airline companies often get affected due to airport pricing policies.
- Cross subsidization among airports within a same private group leads often increased pricing and charges at smaller airports too. The area is a matter of debate and concern between airlines and airport operators.
- Pre-financing of future airport infrastructure through airport charges is often a non acceptable feature by airlines as there is no guarantee that the airlines paying the charges will actually be the airlines that will receive benefit from the new infrastructure.
- Airlines are always of the opinion that airports should work towards single till concept increasing non aeronautical revenue as the same would lower the aeronautical expenditure. Airports on the other hand prefer to capitalise on a dual till concept and commercialize business.

1.4 AIRPORT REGULATORY ENVIRONMENT :

Airports primarily are involved with different regulations at both international and national levels. Many of these regulations are technical related to operations, environmental, safety and security aspects of managing an airport. Economic regulations are also a part of regulations with the main focus being on charge or tariff control. Other economic aspects of operation, including handling activities and slot allocation, are also often regulated. The Chicago convention lays the basic guideline for charging at airports. Article 15 clearly states that there should be a non discriminatory policy followed by all airports also emphasizes the principle of cost related transparent charging. These guidelines are often overlooked and misinterpreted by different countries. Airports are working towards commercialization leading to over pricing and market based ability to pay pricing strategies. Bilateral agreements between countries are also overlooked leading to disputes. European Union passed a common directive in 2009 and is implemented in all its member countries. The directive assures to follow the guidelines of ICAO and greater transparency with modified pricing approaches has been introduced. Airline companies are given a detailed report or breakdown of the charges to be paid at airports within the European Union. The ICAO principle of non-discrimination is maintained. Airports can differentiate their services as long as the same is transparent. It is mandatory to have an agreement on charges between airports and airlines and an independent supervisory authority helps to settle disputes over charges between airports and airlines.

Main Features of European Union 2009 airport charges directive

Airport and Airline Relationship

Policy	Details
Non Discrimination	No discrimination between users. Can be modulated in public or environmental interest.
Common Charging Systems	Airport operators to introduce common and transparent charging systems. Transparency parameters shall be discussed and formulated.
New Infrastructure	Airport authorities to consult the users before construction of any infrastructure.
Independent Supervisory Authority	Independent Supervisory authority is required to comply with directive.

There are 3 ways in which organizations like airports can be regulated. They are

➤ **ROR or Cost Based Regulation :**

The Cost based regulation is used extensively to regulate or prevent monopolies. The aim is to generate enough revenue to cover costs and make a profit which provides a reasonable return on the asset base. Price increases can be justified only when an increase in costs is incurred. This type of mechanism guarantees a ROR regardless of other developments and can encourage airports to adequately invest, as larger profit can be made if the capital investment is higher to produce the same overall return. . The cost-based regulation keeps focus primarily on the cost of providing the service (rather than investment) and so whilst this is a simpler method it still provides no incentives to reduce costs.

➤ **Incentive Based Regulation :**

To overcome cost based shortcomings, alternative regulatory systems were sought. In the 1980s, 'incentive' regulation began to be used – for example in the United Kingdom, where a number of the state utilities, including gas and electricity, were privatised. This type of regulation, often called incentive regulation, was considered to be more favourable because it can provide the regulated company with incentives to reduce costs while simultaneously controlling price increases. The most popular form of incentive regulation is a price cap that works by establishing a formula that provides a maximum price that can be set. Though the regulated company may still have an incentive to overstate the CAPEX needed, which will be discouraged only by careful scrutiny of the regulator. In spite of shortcomings, incentive regulation has been the most popular approach adopted for privatised airports.

➤ **Conduct Based Regulation :**

Conduct based regulation is a 'light-handed' approach. While the technical definition of these vary somewhat, the general principle is that the regulator will become involved in the price-setting process only if

the airport's market power is actually abused or if the company and its customers can–not reach agreement. In this case it is the threat of regulation, rather than actual regulation, which is used to provide an effective safeguard against anti–competitive behaviour. Sometimes, with reserve regulation for example, there may be a predetermined regulatory model that will become effective at this stage. In recent years, primarily because of the increasingly competitive environment, the arguments for a more light–handed approach, or even total deregulation relying on competition law, have been given increased attention.

1.5 IMPORTANCE OF CONTRACTS BETWEEN AIRPORT AND AIRLINE :

The relation between airline and airports is a two way process where one supports the other to optimize revenues. The relation that an airport has with the airline determines a lot of factors in business and operational ease. Many airports have strategically partnered with different airlines breaking through traditional models of doing business and are working towards to achieve a benchmark. Contracts are essential tools that formally act as road maps for both airports and airlines. It is a benchmark for service delivery and a commitment from the airline to induce more business. The essential features of a contract in a airport airline relationship are

- Historically a contract was a non–formal document that stated the terms of use and described the services that an airport shall provide to a particular airline in lieu of aeronautical fees charged by the airport. The first of the contracts in the relationship were neither formalized nor were any standards defined in the same.
- The contracts had no rights or obligations defined for both the parties nor there were any redressal mechanism defined for any disputes.
- The first contracts that were formalized were introduced by airports of United States. These contracts were legally binding.
- The modern contracts between an airport and an airline clearly define the fees and rentals to be charged and the method that shall be adhered while charging the same. The contracts are transparent for both the parties and also state the condition for usage of facilities. The contracts define service standards for airports to be delivered.
- Contracts are essentially long term for a mutual benefit. The average duration of contracts is between 5 to 20 years.
- Contracts undertaken are highly confidential and secrecy of the same is maintained by both the parties.
- Contracts are undertaken for mutual benefit of all stake holders. Airport operators offer discount on fees and charges for a long term commitment from the airline whereas on the other hand airport

operators also incorporates guarantees from airline operators to increase its operation from the airport in a phased manner.

☐ Check Your Progress – 2 :

1. Passenger fee at an airport is a _____ cost
 - a. Fixed
 - b. Moving
 - c. Running
 - d. Variable
2. _____ tool leads to increased capacity of airlines in a particular route
 - a. Crisis Management
 - b. Human Resource Management
 - c. Yield Management
 - d. Benchmarking
3. The charges at the airports should be non-discriminatory as per Chicago convention Article _____
 - a. 14
 - b. 15
 - c. 16
 - d. 20
4. Cost based regulations are used for airports to prevent
 - a. Monopoly
 - b. Monogamy
 - c. Taxes
 - d. Revenue

1.6 LET US SUM UP :

Business models for airport operations depend on strategies that meet the demands of airline companies and managing of relationships for fulfilment of these demands. To manage an airport, there are aeronautical and non aeronautical charges. Aeronautical charges are amount paid by airline companies for operating its flights from a particular airport. The unit provides a detailed insight into the type of aeronautical charges paid by airline companies and the basis of payment by these companies to the airport. The fee component that airports earn is both fixed as well as variable. There are several factors that determine airport charges and airport management strategically plan on measures to increase operations and passenger flow from a particular airport. There are certain guidelines initiated by international bodies to regulate the charges levied and airports work towards overall development of the airport as a whole.

1.7 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. c 3. b 4. a

Check Your Progress – b :

1. d 2. c 3. b 4. a

1.8 GLOSSARY :

Contract : A written legal agreement

Redress : To correct something that is wrong or unfair

Benchmark : Evaluate something by comparison with a standard

Capex : Capital Expenditure

Incentive : Something that encourages or incites towards bigger action.

Cross Subsidization : The practice of charging higher prices to one type of customers to artificially lower prices for another group.

1.9 ASSIGNMENT :

List the different taxes that an airline company pays to the government in India in order to operate flights from a particular airport?

1.10 ACTIVITIES :

Make a list of the parking charges for aircrafts at 10 different International airports of the world and undertake a comparative study of the same ?

1.11 CASE STUDY :

A low cost carrier (X) operated from Airport (A) with its flights connecting to 6 destinations from A. With rapid demand of slots at airport A and bigger airline companies willing to pay more fees, the management of the airport, operating another smaller airport 45 km from airport A, cross subsidized with Carrier X offering them exclusive terminal zone and lesser fees, to accommodate the bigger airline companies at A. The carrier X initially denied taking the offer; however, when the contract between the carrier and the airport was on the verge of renewal; the carrier negotiated further with the airport management and shifted their operations to the new airport. Within a span of 3 months, the carrier faced huge challenges in terms of passenger complaints related to distance and connectivity for the new airport. Flight companies operating from A on similar routes started doing better business and that too on competitive scales. The overall business of the carrier X declined by 15% in 7 months and upto 35% on competitive routes.

1. What steps should carrier X undertake to ensure recovery in business ?
 2. What could have been done by Carrier X for not moving to the new terminal and also renewing contract ?
-

1.12 FURTHER READING :

1. Airport Operations by Norman J Ashford
2. Managing Airports by Anne Graham

UNIT STRUCTURE

- 2.0 Learning Objectives
- 2.1 Introduction
- 2.2 Airport Business Plan
- 2.3 Value of a Business Plan
- 2.4 Elements of a Business Plan
- 2.5 Market Analysis in a Business Plan
- 2.6 Environment Analysis in a Business Plan
- 2.7 Financial Plan
- 2.8 Importance of a Business Plan
- 2.9 Let Us Sum Up
- 2.10 Answers to Check your Progress
- 2.11 Glossary
- 2.12 Assignment
- 2.13 Activities
- 2.14 Case Study
- 2.15 Further Reading

2.0 LEARNING OBJECTIVES :

- To define business plan and list its elements
- To enumerate on the guiding documents and process overview for business plan
- To list the importance of a business plan

2.1 INTRODUCTION :

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and inter-national commerce. They are where the nation's aviation system connects with other modes of transportation. As an operations system, airports are self sustained business with huge growth potential. The general aviation airports play a key role in the national aviation system. A general aviation airport is much more than infrastructure—it is an economic engine that facilitates the provision of vital air transportation and emergency services and serves as a gateway to the community.

2.2 AIRPORT BUSINESS PLAN :

Airports are key lines of business to a lot of stake holders. They act as a linkage with the customers, vendors and other entities. The

effectiveness of modern airport operations depends on strategies that determine performance; its response to customer and competition demands and designing of processes. Airports need to function strategically; continually evaluating and monitoring their business performances; encompassing infrastructural development and building an environment to fulfil commercial achievements. A Business plan is a guideline of how an airport needs to be managed. There are clear cut goals and objectives that are pre-determined and action plans are formulated to achieve the goals and objectives. Airports that have a business plan in place

- Generate more revenue than airports without a business plan.
- Reduce expenses or even eliminate them to increase profitability.
- Secure better capital funding from various sources.
- Become independent and do not rely on subsidies.
- Create better opportunities in all aspects.
- Is more financially self sustaining for a longer duration.
- Optimize the use of assets present effectively.
- Meets the needs of the customers through quality infrastructure, services.

2.3 VALUE OF A BUSINESS PLAN :

A business plan is a written document that describes in detail how a business defines its objectives and how it is to go about achieving its goals. A business plan lays out a written roadmap for the firm from marketing, financial, and operational standpoints. Business plans are important documents used for the external stakeholders as well as the internal stakeholders of the company. Operating without a business plan leads to lot of impediments for an organization and often may lead to closure and downfall of the organization. The airport business plan acts as an important planning tool, a critical management and communications tool for all the stake holders involved. An airport business plan

- Clearly states the vision, mission, goals and objectives of an airport with definite time lines.
- Set forth the tasks and action plans for achieving the goals.
- Establishes definite parameters to track and monitor the progress.
- Incorporates changes whenever and wherever necessary to prevent deviations from the goals.
- Helps the stake holders to undertake defensible and prudent decisions concerning the operation and management of airport.

The business plan of an airport as a management tool plays an important part by implementing key elements in its preparation phase.

- Keeping the focus of all stake holders towards the laid down objectives.

- Allowing all stake holders to be informed and getting a buy in obtained from all for designing the elements of the plan, the process of developing and implementing the plan.
- Laying down the approach to the plan and a core planning team with key players for its effective implementation. The planning team carries the value of the business plan and then formulates the appropriate process for its implementation.

Once the planning team is briefed and the parameters are defined the development phase starts for implementing the business plan. The development phase has the following aspects that are incorporated as part of the plan. They are

- Develop mission, vision and value systems that act as a blue print for the plan.
- Conducting SWOT Analysis
- Establishing and prioritizing goals
- Identification of the airport primary areas
- Formulate action plans and budgets
- Draft, review and finalize the plan.
- Obtain approval of the plan.

After the airport business plan has been approved by policymakers, the following steps, which are consistent with best-practices approach, should be taken to implement the plan:

- Execute all the action plans
- Check progress of the plans and make adjustments wherever necessary
- Report results to policy makers, stake holders and the planning team.
- Update, review and finalize plan after amendments.
- Obtain policymaker approval on amended plan.
- Execute amended and updated plan
- Communicate plans and take feedback continuously
- Prepare a work plan with dates and spread sheet for follow up.

2.4 ELEMENTS OF A BUSINESS PLAN :

It is said that undertaking decisions is not difficult when an organization is clear about its values. Vision and Mission statements of an organization are part of the value system that helps to provide direction to each individual working in the organization. Value system of an airport may indicate the following parameters

- Community focus
- Innovative solutions leading to new opportunities
- Employee growth and well being
- Environmental commitment

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- Priority and conscious effort on safety and security.
- Mutual integrity, trust and respect in the working environment.
- Service Excellence.
- Transparent finances

➤ **Mission and Vision :**

A statement conveys the reason for an airport's existence. Clear mission statements help in better decision making, dictate conduct and shape up day to day performance. An example of a mission statement of St. Louis airport reveals "provide and promote aeronautical services and commercial business, safely and efficiently."

A vision statement articulates the future success of the organization, the road it aspires to travel. A vision statement of Vancouver airport reveals, "We will provide quality and safe aviation support services for both permanent residents and travellers at a competitive cost. We will service local recreational flying, business operations, and support Vancouver as a desirable tourist destination."

Formulating a clear mission and vision statement is a priority of the airport operators and the same takes time to be articulated as it reflects the value system of the organization.

➤ **SWOT Analysis :**

The formulation of goals for the actual development of the airport is the most crucial process and the same begins with the categorization of an organization's actual and perceived Strengths, Weaknesses, Opportunities and Threats.

The analysis is undertaken by a team led by the authorities and every parameter is considered that are related to the airport before undertaking a SWOT.

Strengths and Weaknesses are internal aspects of any organization. The strengths of the organization need to be preserved and developed more so that they become the value proposition for the organization. The weaknesses of an organization are the opportunities that an organization needs to work upon and find solutions to overcome. Weaknesses too are internal aspects of an organization. Weaknesses hinder the performance of an organization.

Opportunities are external to an organization and need to be capitalized. The environment for any organization is in a dynamic state and opportunities are generated by the environment for any organization. Threats are also external to an organization and are typically identified by studying changes or trends within the industry and the local marketplace. Threats need to be managed or, if possible, eliminated. The basic parameters of study for a SWOT analysis of an airport can be identified through under the following heads divided in 4 quadrants.

➤ **STRENGTHS :**

- Assets, infrastructure, Amenities
- Competitive Advantages
- Good experience and expertise
- Good brand positioning
- Knowledge Resource and good data reserves
- Strong finances
- High Quality products, services and facilities
- Superior geographic location
- Excellent systems, processes, policies and procedures

➤ **WEAKNESSES :**

- Competitive disadvantage
- Poor infrastructure
- Poor experience and expertise
- In adequate finances
- Deferred maintenance and repair
- Inferior geographic location
- Lack of processes, policies and procedures

➤ **OPPORTUNITIES :**

- Development of new technology
- Expansion of non aeronautical revenue
- Collaborations and partnerships
- Expansion of tenant revenue
- Product, service and facility development
- Increased customer base

➤ **THREATS :**

- Political environment
- Funding challenges
- Market Demand
- Seasonality
- Competition
- Opposition to airport
- Encroachments
- Incompatible land use
- Alternative use of the airport

➤ **GOALS :**

The formulation of goals is the next stage of a business plan. A goal is a statement of a desired result or outcome that needs to be realized to fulfil the mission and vision of the airport. A goal should be positive and easily understood by all the stakeholders. Goals should be specific about the particular airport and establishment of goals is a collaborative effort. The SMART model helps in establishment of goals for any organization. It helps in assessing existing goals and facilitating new goals. SMART is an acronym for

- **SPECIFIC** – A goal should be simple, straightforward and to the point. In 5 years the airport shall be financially self sustaining is an example of a specific goal.
- **MEASURABLE** – An effective goal is one that can be measured through tangible parameters. Eg. Operating revenues of an airport shall cover the operating expenses and no subsidy is required is a measurable goal for an airport.
- **ATTAINABLE** – The goal may be challenging but possible for all the stake holders to achieve. Eg. Financial sustainability of an airport may be achieved in 3 years for which the operating revenues are to be increased and operating expenses reduced.
- **RELEVANT** – The goals have to be realistic in order to attain the same. Eg. A company cannot plan a break even of an airport in one year. It would not either be relevant nor realistic for the organization to achieve the same.
- **TIME BOUND** – All goals have a definite time period. A business plan drafted today will have a definite time period for execution otherwise it becomes irrelevant and obsolete in due course of time.

The GROW model developed by John Whitmore is also used in the process to refine the goals. The elements in a GROW model includes

- **Goal** – A goal indicates the desired outcome or a level to be attained in the fulfilment of a vision and needs to be SMART.
- **Reality** – The component of the model focuses on the current state where the goals need to be achieved, the quantum of work in the particular area, the planning process incorporated to achieve the same and the people involved in achieving it.
- **Options** – The component is oriented towards the ways of achievement of the goals and indicates on the various alternatives available with their pros and cons and choosing the best alternative in the fulfilment of the goal.
- **Will** – This component indicates the probability of the performance of the resources in fulfilment of the goals. The element is very subjective and focuses more on the willingness of people involved in fulfilment of the goals.

Once goals are formulated, organization and prioritization of the same is of prime importance. The goals are again broken down to byte sized elements for achieving the same and are known as action plans. An action plan answers some of the questions like

- Who is going to perform the tasks ?
- When are the tasks going to be completed ?
- Where are the tasks going to be completed ?
- Why do the tasks need to be performed ?
- How are the goals going to be achieved ?

The 6 W's (Who, What, When, Where, Why and How) are an integral part of an action plan.

☐ Check Your Progress – 1 :

1. A Business plan is a _____ document
a. Verbal b. Owners c. Mission d. Written
2. The acronym SWOT stands for
a. Sadness Weakness Others Threats
b. Strength Weakness Others Threat
c. Strength Weakness Opportunity Threat
d. None of the options
3. A statement that conveys the reason for existence of business is called _____ statement
a. Vision b. Mission c. Goal d. Objective
4. The GROW model was developed by
a. John Whitmore b. John Baltimore
c. John Hopkins d. John F Kennedy

2.4.1 Guiding Documents of an Airport Business Plan :

These documents are integral in the formulation and implementation of the Business plan of an airport. The primary guiding documents of a business plan consists of

- General provisions and definitions of all the key terms as listed in a business plan.
- Leasing / Rentals and the fees policy pertaining primarily to parameters of leasing airport land and outline the process for establishing and adjusting rents and fees.
- The standards for any entity to indulge in commercial aeronautical activity at the airport.
- The rules and regulations for safe and efficient use of the airport.
- The development guidelines and its parameters governing the design, development, construction, or modification of improvements at the airport.

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- Applications, Permits and Agreements related to statutory compliances as laid down by the laws of the land for engagement of commercial activities.

The primary planning documents are planning tools used by airport managers and policymakers to help achieve goals and realize the mission and vision for the airport. In comparison, primary guiding documents are policies, which are typically binding on the airport sponsor, customers, and stakeholders, that are used to govern the operation and management of the airport.

2.4.2 The Process Overview of a Business Plan :

The airport business planning process consists of three significant phases as a work plan. The phases are

- Preparation
- Development and
- Implementation.

➤ Preparation Phase :

The preparation phase begins well before an airport business plan is actually drafted and involves all the stake holders involved in the planning process. It includes

- Educating airport management and staff about the reasons for and the value of an airport business plan, the elements of a plan, and the process for developing and implementing a plan.
- Obtain a buy in from the policy makers.
- Decide on the approach for a Business plan. An approach can be categorized as an internal approach or an external approach or a combination of both.
- Preparation and formation of a dedicated team involved in the planning process with an able leader to guide the process.
- Understanding the value of the business plan by the team and developing the same through the values as the guidelines.

➤ Development Phase :

Once the planning is synchronized with the purpose of the plan and the values that guide the planning process the following steps are undertaken

- Development of vision, mission and the values
- SWOT Analysis
- Goal prioritization
- Prioritizing objectives
- Designing of the draft plan
- Review and finalization of the draft plan
- Obtaining buy in of different stake holders

➤ **Implementation Phase :**

Implementation happens once the different stake holders clear the plan. Best practice approaches are undertaken for the implementation process and are consistent. The approaches include

- Execution of the plan into action
- Check regular progress according to the plan and work on deviations
- Monitor and report the results to stakeholders
- Update and review plan for any changes if necessary and implement

2.5 MARKET ANALYSIS IN A BUSINESS PLAN :

The thorough assessment of a market that reduces the risk of establishment of the business and helps in decision making through better information is known Market Analysis. Market Analysis is an integral part of a Business plan as it informs the stake holders about the dynamics of your market, such as volume and value, potential customer segments, buying patterns, competition, and other important factors. Market analysis is undertaken through compilation, analysis and interpretation of data of different elements. A marketing analysis can reduce risk, identify emerging trends, and help project revenue. A detailed market analysis will usually be part of your business plan, since it gives you a greater understanding of your audience and competition, helping you builds a more targeted marketing strategy. The major benefits of conducting a market analysis are

➤ **Risk Reduction :**

Knowing the market reduces the risk in formulating and executing the business plan. Since airports are huge business investments knowledge about the customer pattern, behaviour, the progress and development of the region in terms of business, the future plans that airline companies have regarding the place, the investment index in the region, the demand of people for travel and the need of airlines, the destination mix of travel and may more areas related to the market gives a clear insight to the developer of the airport about the market and how the airport shall contribute to the market.

➤ **Emerging Trends :**

The market analysis contributes towards the orientation of developers about the current market trends. An Airport is the gateway to many countries and cities and the trends at any airport often reflect the culture, the people and also the progress of the nation. Also trends often help in operational excellence, customer engagement, faster processing of operational challenges and multiple aspects.

➤ **Benchmark Setting :**

Market analysis leads to creation of standards and benchmarks within an organization to achieve the standards. Many airports that are

not located in mainstream cities have set benchmarks for excellence in various fields of operation creating a niche market for themselves.

➤ **Revenue Projections :**

A market analysis helps in forecasting of the future market leading to estimations in calculation of profit. The same leads to detailing and chalking out the business plan in the direction and budget accordingly. If for example there is demand for non-aeronautical revenue through different activities and shops selling various products airport authorities can always reorient the business plan and work towards better profits.

➤ **Marketing Optimization :**

The market analysis depicts the current needs of the market and the approaches to be undertaken by the organizations to tap the market. It also guides organizations through indicators to thrust on key areas that need attention and application of different strategies.

2.6 ENVIRONMENT ANALYSIS IN A BUSINESS PLAN :

Environment affects business and analyzing the environment both internal and external is crucial for undertaking business. The analysis acts as a systematic effective decision making tool for the stake holders of the business. The technical tool used to analyze business environment is an acronym PESTEL. Each letter denotes a factor that may affect business directly or indirectly.

A systematic process of analyzing the environment to identify those environmental factors affecting a company determines its impact on the business and developing strategies to take advantage of them or limit their effects. After a business has implemented a strategy, the process will monitor the business environment to ensure that it is working and does not require modification or change.

➤ **Political Factors :**

Political factors affect the business and are a part of environment. Any business would be sceptical in investing in a country where there is civil war and unrest and the government has no stability. Airport being a huge investment with lot of stake holders involved in the financial planning, political factors play a considerable role in every project. The political factors that may affect business include

- Government policies towards business and investment in business.
- Tax laws and Tariff
- Regulations governing the business
- Stability of government
- Business orientation towards projects

➤ **Economic Factors :**

Economic factors are crucial to the business as it determines whether the product/service the business is dealing in, has a market or not. There

are several economic parameters that influence the business. Airport being a huge financial investment depends a lot on the economic factors that govern the country or area where an airport is being built. Some of the economic factors that investors are concerned are

- Rates of inflation
- Rates of Interest
- Disposable income of Buyers
- Annual growth rate of allied business
- Credit Accessibility
- Fiscal policies of the government
- Forex Rate
- Unemployment ratio

➤ **Social Factors :**

Social factors also affect the business in many ways. Airports being large business units involve and impact the society in a big way. An acceptance of the business is prime to the society for operational ease and manageability of the business. An opposition from the society and inhabitants in the vicinity of the airport may be detrimental towards its functioning. Some of the social factors that are critical to the business are

- Cultural implications
- Gender and connected demographics
- Social lifestyle
- Domestic structure
- Educational level
- Distribution of Wealth

➤ **Technological Factors :**

Technology is the key to success at any airport. Airports are technological hubs and the advancement of technology in a country is a major determinant of how good the operations of the airport can be and how quicker the airport can scale up in business. Some of the technological determinants are

- New discoveries
- Speed and cost of technology
- Research and Development
- Levels of Automation
- Advantage of technology

➤ **Legal Factors :**

These are the statutory laws that are related to the business and affect the business from different perspectives. Airports being businesses

on a big scale have several different components creating a direct correlation with legal aspects integrated in all its strata of planning.

➤ **Environmental Factors :**

Airports directly impact environment and its one of the most challenging aspects of the planning phase. Different stake holders including the governments of different countries are directly involved in the sustainable planning process to preserve the environment and reduce impact. The sustainability of an airport and its operations depend a lot on the environmental factors and the steps that the airport undertakes in managing them. Environmental factors may include waste disposal, noise pollution, carbon emission, natural resource depletion or crisis and many other aspects.

2.7 FINANCIAL PLAN :

The financial section of a business plan determines whether or not the business idea is viable and will be the focus of any investors who may be attracted to the business idea. Airports being cost intensive projects need a detailed study on this aspect. The same would lead to attracting investors to pitch in for investment in the business. Financial plans are chalked out even before other aspects of the plan are executed. Each area of airport development needs a lot of finance and the same is finalized in the planning process before the tasks are executed. The financial section of any plan is composed of four financial statements:

- the income statement/ Plan (Revenues, Expenses and profit for the period)
- the cash flow projection (the amount of money to flow in and out of business)
- the balance sheet (Statement of assets, liabilities and capital of business at a particular point of time)
- the statement of shareholders' equity.

It also should include a brief explanation and analysis of these four statements. The financial plan is the end of the business plan and is the most important part for the investor.

2.8 IMPORTANCE OF A BUSINESS PLAN :

A Business plan is a critical decision making tool and keeps any organization well planned to meet challenging circumstances. There are many important aspects of a business plan. To enumerate the key important areas are

- A business plan is often put into place before starting an actual business. It is a tool which often is helpful in deciding whether the business venture to be undertaken is viable or there needs to be a reframing of the entire model and perspective for undertaking the business.

- Helps in decision making for key critical business decisions before time. The different areas of strategic research and interpretation of data for the same helps the business to pre-empt situations and enable quick and justified outcomes.
- A business plan sets objectives for the team that is involved in fulfilling the vision and goals for the organization. It acts as a path to walk forward with clear expectations from the people working in the team. A plan structures and prioritizes the responsibilities for all the stake holders involved in executing the plans.
- A business plan identifies the target customers for the business and identifies their preferences that the business needs to fulfil. Understanding the needs leads to creation of better products and services by the business.
- A key component of a business plan is to determine the financial implication of the business and whether the stake holders are able to meet the financial obligations of the business and run it. The raising of capital for the business, the sources of funds, the financial projections etc all form a part of the business plan.
- A formal business plan is the base for attracting investors to the business. A business plan acts as a proposal and answers the questions of investors.
- A good business plan forms the basis for attracting the best of the talent, investors, and partners and leads to a definite course for focussing of efforts. It also uncovers a lot of hidden opportunities that the business can look into.
- A good business plan gives a clear picture or a road map for reaching customers and helps in preparing a good marketing plan for the business.

☐ Check Your Progress – 2 :

1. Market Analysis in a business plan leads to
 - a. Risk reduction
 - b. Risk
 - c. Risk mitigation
 - d. Risk augmentation
2. The technical tool used for analyzing business environment is
 - a. GROW
 - b. PESTEL
 - c. SWOT
 - d. NEXT
3. The letter "L" in the acronym PESTEL stands for
 - a. Law
 - b. Lavish
 - c. Legal
 - d. Loyal
4. Business plan is used for
 - a. Attracting investors
 - b. Raising Capital
 - c. Identifying target customers
 - d. All the options

2.9 LETS US SUM UP :

The effectiveness of a modern airport depends on strategies that determine its performance. The Business plan is a guideline of how airport's need to be managed to achieve the pre-determined goals and objectives. A business plan is a written document that describes in detail the various aspects of functioning of a business from perspectives of marketing, finance and operations. The organizations that do not operate without a business plan face a lot of challenges. The business plan is a key management tool towards the achievement of the vision and the goals of an organization. Business plans are drafted with meticulous planning and involves significant phases like preparation, development and implementation. Any business plan encompasses a lot of analysis from various perspectives to ensure the feasibility of any business. A business plan is the base for attracting potential investors to the business and a road map for building customers in business.

2.10 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. c 3. b 4. a

Check Your Progress – 2 :

1. a 2. b 3. c 4. d

2.11 GLOSSARY :

Goal : the object of a person's ambition or effort; an aim or desired result.

Vision : the ability to think about or plan the future with imagination or wisdom.

Mission : A concise statement on organization's reason for existence.

Prudent : Acting with or showing care and a thought for the future.

SWOT : Strength Weakness Opportunity Threat

Service Excellence : the ability of service providers to consistently meet and exceed customer expectations

Statutory : Required, permitted and enacted by statute.

2.12 ASSIGNMENT :

You have been hired as a consultant to focus on market feasibility, market research and analysis for the expansion of a terminal building and construction of a new terminal building.

1. List the activities that you shall undertake for the above in fulfilling the objectives of the organization.

2.13 ACTIVITIES :

Compare Marketing activities of 3 international airports and make a detailed report of the same.

2.14 CASE STUDY :

An airport having a lot of adjacent land on the landside outside the terminal building decided to develop a retail park project in the same to attract customers from the city and also serve passengers. The management of the airport formed a consortium and undertook the necessary clearances required to start the project. Since the plan for the project was big, more partners were required for investment. The management approached affluent companies for investment and partnership but their proposal was turned down by majority of the companies. The reasons cited for the same were

- The distance of the airport was 30 km from the city and the project would not attract customers from the city.
 - The airport was mid size and there was not enough traffic to suffice the break even for the project through purchases.
 - The city being tier 2 catered mainly to Low Cost Carriers.
 - Investment was a risky proposition as the stake holders of the airport did not appoint an expert committee or hire external consultancy firms to check the viability of the same.
 - No financial plans for return of investments documented or structurally presented.
1. What according to you are the wrong steps that the stake holding company undertook in the project ?
 2. How should the approach have been for the stake holding company for such ventures ?
 3. What steps should the stake holding company undertake to attract investors in the project ?

2.15 FURTHER READING :

1. Airport Business Plan by Aviation Management Consulting Group, Gary R Shafer, Kramer Aerotek, Southern Illinois University

UNIT STRUCTURE

- 3.0 Learning Objectives**
- 3.1 Introduction**
- 3.2 Scope of Financial Management**
- 3.3 Objectives of Financial Management**
- 3.4 Functions of Financial Management**
- 3.5 Airport Funding**
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 - 3.9.2.6 Hybrid Annuity Model (HAM)**
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3.16 Assignment

3.17 Activities

3.18 Case Study

3.19 Further Reading

3.0 LEARNING OBJECTIVES :

- To list the scope, objective and functions of financial management.
- To enumerate on different sources of funding for an airport and the global models associated in the same.
- To explain different revenue strategies adopted by airports.
- To list the practices of financial accounting for effective financial management.

3.1 INTRODUCTION :

The effective management of funds of an organization, its efficient and optimized usage is known as Financial Management. Financial Management indicates planning, organizing, directing and controlling of the financial activities such as procurement and utilization of funds of the enterprise. It means applying general management principles to financial resources of the enterprise. It includes organizational financial strategies and is handled by the finance department of an organization. Airport operations are vast and include a lot of operational and capital investment. Managing the right way leads to effective operation as per international standards. The unit shall guide you through the different expenses that an airport undertakes and the various sources of revenue. The unit shall also provide an insight into the various models used by different airports to manage their financial aspects effectively.

3.2 SCOPE OF FINANCIAL MANAGEMENT :

Airports have huge operational expenses and must generate sufficient revenue for meeting the same. Investment decisions at an airport includes investment in fixed assets (called as capital budgeting) and Operational and Maintenance costs. The investment in current assets is also a part of investment decisions known as working capital decisions. The finance team at any airport has mainly to deal with

➤ **Financial Decisions :**

They relate to the raising of finance from various resources which will depend upon decision on type of source, period of financing, cost of financing and the returns thereby.

➤ **Dividend Decision :**

The same includes decisions with regards to the net profit distribution. Net profits are generally divided into two :

- a. Dividend for shareholders – Dividend and the rate of it has to be decided.
- b. Retained profits – Amount of retained profits has to be finalized which will depend upon expansion and diversification plans of the enterprise.

Finances of an airport depend on size, facilities, its scale of operations and the services provided.

3.3 OBJECTIVES OF FINANCIAL MANAGEMENT :

The financial management is generally concerned with procurement, allocation and control of financial resources of a concern. The objectives of financial management at an airport can be diverse and encompass the following.

- Ensuring regular and adequate supply of funds to the airport for management of its financial aspects.
- Ensuring adequate returns to the shareholders which will depend upon the earning capacity, market price of the share, expectations of the shareholders.
- Planning for optimum funds utilization and implementation of tools to implement correct financial decisions. Once the funds are procured, they should be utilized in maximum possible way at least cost.
- Driving a safety on investment of funds in ventures that shall provide adequate rate of return.
- Planning of a sound capital structure that leads to a sound and fair composition of capital so that a balance is maintained between debt and equity capital.

3.4 FUNCTIONS OF FINANCIAL MANAGEMENT :

The functions of financial management at an airport are similar to other organizations. It is the difference of scale that finance managers work on. The functions when enumerated are as

➤ **Estimation of Capital Requirements :**

A finance manager has to make estimation with regards to capital requirements of the company. This will depend upon expected costs and profits and future programmes and policies of the establishment. Estimations have to be made in an adequate manner which increases earning capacity of the establishment.

➤ **Determination of Capital Composition :**

Once the estimation is made, the capital structure is decided for the establishment. This involves short– term and long– term debt equity analysis. This will depend upon the proportion of equity capital a company is possessing and additional funds which have to be raised from outside parties.

➤ **Choice of Sources of Fund :**

For additional funds to be procured, a company has many choices like –

- a. Issue of shares and debentures
- b. Loans to be taken from banks and financial institutions
- c. Public deposits to be drawn like in form of bonds.

Choice of factor will depend on relative merits and demerits of each source and period of financing.

➤ **Investment of Funds :**

The finance manager has to decide to allocate funds into profitable ventures so that there is safety on investment and regular returns is possible.

➤ **Disposal of Surplus :**

The net profits decision has to be made by the finance manager. This can be done in two ways :

- a. **Dividend Declaration :** It includes identifying the rate of dividends and other benefits like bonus.
- b. **Retained Profits :** The volume has to be decided which will depend upon expansion plans, innovative insight and diversification plans of the establishment.

➤ **Management of Cash :**

The finance manager has to make decisions with regards to cash management. Cash is required for many purposes like payment of wages and salaries, payment of electricity and water bills, payment to creditors, meeting current liabilities, maintenance of enough stock, purchase of raw materials, etc.

➤ **Financial Controls :**

The finance manager has not only to plan, procure and utilize the funds but he also has to exercise control over finances. This can be done through many techniques like ratio analysis, financial forecasting, cost and profit control, etc.

❑ **Check Your Progress – 1 :**

1. Investment in fixed assets is known as _____ budget
 - a. Surplus
 - b. Cash
 - c. Maintenance
 - d. Capital
2. Distribution of profits to share holders is known as
 - a. Profit
 - b. Loss
 - c. Dividend
 - d. Debenture
3. The total liability of a company divided by the Shareholder equity is known as _____ ratio
 - a. Debt equal
 - b. Debt Equity
 - c. Dearness Equity
 - d. Double Equity

4. The sources of funds for a company can be through
a. Shares b. Debentures c. Bonds d. All the options

3.5 AIRPORT FUNDING :

The development and maintenance of an airport requires a continuous source of large amount of funds. The sources of capital for airport development include

- Grants and Funds from the government of the country.
- Loans and grants from International organizations or governments.
- Commercial Loans from financial institutions.
- Equity of Debt (typically bonds) from commercial capital markets. This may include private investors, banks, investment houses or fund pools.
- Extension of credits from contractors and suppliers.
- Investments undertaken by foreign governments for an under developed nation.
- Retained Earnings

Commercial loans incur high interest rates; however, the same are reduced by lending institutions through governmental loan guarantees. Retained earnings are only applicable to existing airports that have a corpus of capital development amount reserved over a period of time. Foreign governments for promotion of trade and commercial activities may fund airport projects in underdeveloped nations. Some nations have developed social and economic development programs in various parts of the world, providing loans for various resources required for an airport. There are specialized exports promoting agencies like Export Import Bank of Japan, HERMES of Germany that may provide direct loans or guarantee private loans. Some international banks and fund organizations have been established to aid developing nations. These international banks fund projects and also execute the same. Airport projects in developing nations are also funded under the UNDP (United Nations Development Programme) and the involvement of UNDP extends into planning, feasibility, technology, expertise and construction. Loans under UNDP are either given to the government of the country or to a private agency guaranteed by the government of the country.

3.6 AIRPORT EXPENSES :

To manage an airport involves multiple areas that require considerable amount of expenses. The expenses at an airport can be broadly categorized under two cost heads

- Capital Improvement Costs which are periodic in nature and
- Operational and Maintenance Costs that are on day to day basis.

3.6.1 Operating Expenses :

Operating expenses are the daily expenses that the airport incurs to manage its operation and function effectively. On the Air side the expenses may be for the taxiway, Apron area, parking area, runway maintenance, equipment services, electricity supply to the airfield and others. At the terminal and ground side expenses arise from waste disposal, landscaping, access roadways, parking and other facilities. The general and administrative expenses encompass all payments for salary, administrative facilities and maintenance. Non Operating Expense includes interest on outstanding debts and contribution to government bodies. To manage the expenses, airports have to earn from various sources.

3.6.2 Operating Revenues :

The revenues earned by an airport can be divided under various heads. They are as

Air Side– Air side revenues are earned from

- Landing fees for scheduled and unscheduled airlines.
- Fuel taxes
- Maintenance facility lease.
- Cargo facility lease.
- Hangar parking fees.

Terminal and Ground Side revenues include rents, charges or fees from

- Restaurants and retail outlets
- Travel Services
- Car Rental companies
- News stands
- Catering services
- Baggage services
- Fuel providers
- Parking facilities

Airlines pay rental charges for the space they occupy at ticket counters, gates, baggage handling, maintenance and catering facilities. Airline companies also pay takeoff and landing fees, parking fees and fuel fees. Airports also get revenue from other leased areas apart from concessionaires and airlines that may include offices, ground equipments and other allied services and facilities. The non operating income of an airport comes from interest on government investments in the airport.

3.7 REVENUE STRATEGIES ADOPTED BY AIRPORTS :

Revenue is the key to any effective commercial airport operation. To ensure facilities to be rendered, the airport authorities govern terms

and conditions at airports either through legal contracts or agreements. There are basically two financial practices or strategies adopted by airports to generate revenue. They are

- Residual Cost Approach
- Compensatory Cost Approach

3.7.1 Residual Cost Approach :

In the residual cost approach method the following are the key elements

- The financial aspect for the airport operations is undertaken by the airline operator.
- The airline operator accepts any financial risk and agrees to generate revenue to pay the airport its operational expense and any debt services.
- The airline under an agreement sets its rates for the fees it pays for various services it undertakes at the airside.
- Airports under this type of an agreement deduct an agreed amount of non airline revenue for its expenses and rest of the revenue is passed on to the airline.
- Airlines also have a say in any capital expenditure that the airport initiates and in many airports in the United States working in this model airlines also enjoy a veto power to overrule any decisions of capital expenses planned by the airport.

3.7.2 Compensatory Cost Approach :

In the compensatory cost approach the following are the key elements

- The model exists at airports that have matured over a period of time and generate ample amount of revenue to meet its expenses. The risk of meeting the expenses is borne by the airport.
- The entire airport is subdivided in to various cost centres(e.g. Airfields, terminals, parking etc).
- Airlines pay a share of the costs depending upon the amount of space occupied. The cost for each service is agreed upon and airlines pay equal to the facilities availed for different services.
- The concessionaire revenue is retained by the airport for development of further facilities and investment in capital.

3.8 BUDGET APPROPRIATION :

Appropriation of funds under different heads is an important task of the financial department of any airport. Budgets are prepared for every airport and the same quantifies the financial plan for operating and maintaining the airport for a definite period. It is a written financial plan that involves a lot of future plans of an airport and optimization of various funds for development. There are 3 different methods used for budget appropriation of airports. They are

➤ **Lump Sum Appropriation :**

The same is a very non specific approach for preparation of budget for an airport and is considered the simplest form of financial planning. In this method parameters are defined within which funds can be utilized. There is no capping on the usage of funds within these parameters and an element of flexibility is appropriated. This often helps in managing need based contingencies but as a result often rightly planned need based requirements lose priority.

➤ **Activity Based Appropriation :**

In this approach the financial quantum is allocated for specific purposes. All major activities are first planned and prioritised and funds and allocated based on the need, importance and contribution the activity shall incur.

➤ **Line Item Budgeting :**

The estimation of the total revenue that is projected from different revenue sources from the airport is first calculated. The total expenditures of the airport at different sources is also calculated. Based on activities the estimation of total expense vis a vis cost is appropriated. The allocation of finance is undertaken under separate lines. Budgets are drawn for shorter period of time and finances allocated for each line is monitored closely for its utilization and optimization.

3.9 SOURCES OF FUNDING FOR AIRPORTS :

Airport finances are difficult to manage and maintain. They are ever increasing and sources of funds have to be secured to manage the huge quantum of expenses.

3.9.1 Government Funding :

A lot of funding for runways, taxiways, terminals that are related to the airport capital infrastructure development come from Central and State grant programs. These programs incorporate the movement of funds provided by the Central government for airport development. In India Airports Authority of India is the sole discretionary body to manage airports. In the United States the same is managed through taxes under Airport Improvement Program collected through every ticket purchased and through General Airport Revenue Bonds (GARBs) issued by municipalities that are tax free. GARBs is the medium of financing that is being preferred for construction of any new airport, expansion or renovation. The interest payable by GARBs is generally higher and runs for a period of 25 years. Bond financing depends on the size of the airport and the investment varies with the type of air traffic served.

3.9.2 Private Funding :

Private investment in airports is a source of moving funds and managing airports across the globe. The global decline in resources and scrutinized public funds has led governments of nations to fill the gaps

between the existing infrastructure of airports and the actual need. India as a nation is expected to emerge as the third largest aviation market as projected by 2025. Zurich Airports International AG won the bid to operate the Jewar airport near Delhi for 40years. The Tata group has made a deal with Singapore's sovereign wealth fund GIC Pte limited and Hong Kong based SSG Capital Management limited to buy 44.44% stake in GMR Airports Ltd. Companies like GMR and Adani are planning to acquire the airport segment seeing the potential cash flow and sustained earnings and are working towards unlocking the value of the shareholders. Governments of developed countries view airports as assets as well as business. Their government sells all or a partial interest in existing airports or airport authorities.

Developing countries lack the resources for airport development; hence they rely on private capital and expertise. Their governments tie up with private sector organizations to finance and develop new terminals or airports. Private sector businesses can manage airports and also business in better ways. The benefits of privatization of airports are

- Increased functionality and efficiency
- Increased revenues
- Increased passenger amenities
- Reduction in risk of unwise investment

Investments in airports made on Public Private Partnership (PPP) model are categorized under 3 types. They are

3.9.2.1 Build Operate Transfer (BOT) Model :

The BOT model is a funding model whereby the organization entering into a contract commits to finance, construct, operate and undertake maintenance for an agreed number of years. This period is known as the free use period with potential revenue rights and is usually for a longer period of time. Once the agreed period finishes, the organization transfers the facility to the government. The BOT model is widely used for various reasons. They are

- It expands the range of potential funding sources.
- The investment cost in a BOT model can be balanced by the operational cost as the same organization invests as well as manages the airport.
- It is a way of shifting risk by the governments from the public to the private sector as the investors undertake the financial risks of investment in the model.

3.9.2.2 Management Contract :

This is a short to medium term contract given to the private sector for maintenance and operation of all public facilities and services at the airport. The on-going daily management control and authority, for the services to be managed, lies with the private entity. The private company

is paid a pre-determined rate as per the contract but the ultimate obligation lies with the public sector.

3.9.2.3 Lease Contract :

Under the lease contract mechanism, the assets of the airport are given to a private organization for a particular period of time, usually for a short term period for its management and maintenance. The rates are agreed upon by the airport authorities and the private organizations. Lease contracts may be fragmented where parts of assets are given to different private parties or may be unified.

3.9.2.4 Joint Venture :

A joint venture is a business arrangement in which two or more parties agree to pool their resources for accomplishment of a single objective. Joint ventures are partnerships that can have a legal structure. Joint Ventures help foreign collaborators to partner with local business.

3.9.2.5 Engineering Procurement and Construction (EPC) :

The cost in this form of model is borne by the government where private players bid for any construction or maintenance work of the airport. The procurement cost of raw material and construction costs are met by the government. The participation of the private sector is task based and limited.

3.9.2.6 Hybrid Annuity Model (HAM) :

It is a sharing model where the aspects related to build, operate and transfer are shared using a particular ratio of the total project costs.

3.9.2.7 Build Own Operate Transfer (BOOT) :

In this model the private sector builds and owns the facility for the duration of the contract and recovers the construction costs from operations. At the end of the contract the facility is handed over to the government. The commercial risk remains with the private sector for the length of the contract. In a Build Operate Lease Transfer (BOLT) model the government gives concessions to private entities to do the construction and later lease the facility for a particular period of time as per the agreement. On completion of the term, the facility handed back to the government.

3.10 AIRPORT REVENUE :

An airport needs to generate sufficient revenue to meet the operating expenses and repay debt. As you have studied earlier in this module, airports generate revenue from landing fees and terminal leases, departure taxes, passenger facility charges, parking fees and from many other sources. Airport revenues are categorized under two categories; the revenue that is earned from air traffic operations and revenue earned from ancillary operations.

The major source of revenue comes from air traffic operations and the same includes landing charges, parking charges, passenger and cargo charges, lease of hangars and gates.

The ancillary sources of revenue are derived from land rentals, space rentals, equipment rentals, shops, services like baggage handling and parking and various other fees specific to different airports.

Around 55% of revenue comes from air traffic operations and around 45% comes from ancillary services.

The fees for concessionaires as part of ancillary source of revenue may be fixed or variable. Percentages on net profits or volume of sales are ways of setting variable fees. A stipulated payment is also fixed for all variable payments. Fixed fees are only levied from concessionaires that yield modest profit. Airports often designate zones and vary fees according to the zones.

3.11 FINANCIAL ACCOUNTING:

Financial accounting and control procedures are crucial to managing economic resources of an airport properly. The airport does the following to maintain an even finance for the establishment.

- Constitute a team of able professionals of finance to lead the department and carry essential tasks for the economic benefit of the airport.
- Accounting procedures are undertaken in accordance to recognized accounting rules, practices, standards and conventions.
- Collate essential financial data for management for effective operations and decision making.
- Making periodic Profit and Loss Statements and Balance Sheets as per standard procedures of the airport.
- Facilitating and monitoring a periodic budget for the airport to increase efficacy of any financial plan implemented.
- Facilitating all departments of the Authority with speedy clearance of the proposals while ensuring financial propriety.
- Timely payments to outside agencies that supply goods or render Services.
- Timely payment to the statutory authorities.
- Proper accounting of invoices raised and realized (Aero and Non-aero charges).
- Disbursement of staff related payment as per schedule. Compilation and monitoring of Capital and Revenue Budgets.
- Compilation and evaluation of various MIS reports required by Management, GOI and other agencies.
- Compilation of Annual Accounts.

- Presenting the Accounts for Audit by Government Auditors, Tax Audit and other statutory Government agencies.

3.11.1 Contents of a Balance Sheet :

The contents of a balance sheet in financial accounting for an airport constitute of the following

Assets	Equity and Liabilities
Current Assets	Current liabilities
Cash	Trade accounts payable
Short term investments	Short term liabilities
Receivable	Taxes payable
Inventory	Accrued liabilities
Prepaid Expenses	Current liabilities
Deferred Charges	Total current liabilities
Other Current Assets	Long term liabilities
Total Current Assets	Long term liabilities on credit
Fixed Assets	Total Long term liabilities
Long term investments	Owner Equity
Intangible assets	Joint stock equity
Total Long term assets	Additional paid in capital
Total Assets	Retained earnings uncovered loss
	Total Owner equity and liability

3.11.2 Financial Control :

The system of monitoring financial performance is to ensure that the expenses and the flow of income are in line with the plan formulated. Effective monitoring prevents any misuse of funds and ensures that the money of investors is utilized correctly. Strict auditing procedures are followed by airports both internal and external to assure that all financial data is accurate and all financial transactions undertaken are legal. Financial control follows a 3 step process

- Comparison of the actual income and expenses with the plan.
- Determining if there is a variance from the actual and how much problem the deviation shall lead to.
- Determining the immediate corrective actions if any that should be implemented to manage the deviation.

3.12 THE CHICAGO CONVENTION AND FINANCING :

The Chicago Convention states in its Article 15 that every airport in a contracting country open for public use by its national carrier shall be open to aircrafts of other contracting countries in uniform state. The airport and air navigation charges imposed for both shall be uniform. All the charges and fees are supposed to published and communicated to the ICAO by any contracting country. In event of any complaint from a member country, ICAO has the rights to review the air navigation charges and fees. There are certain recommendations that have been mentioned by ICAO. They are

- Landing charges shall be based on aircraft maximum permissible take off weight. Formulas have been devised by ICAO for calculating load.
- Suggests that airport charges shall be of minimal margin that is reasonable.
- No discrimination between airport and air navigation charges for domestic and foreign carriers.
- Airlines are not to be charged for the facilities they do not use or are not allocated to them.

☐ Check Your Progress – 2 :

1. The funding of an airport can be undertaken by
 - a. Government of a Country
 - b. Commercial Financial Institutions
 - c. Bonds from commercial capital markets
 - d. All the options
2. The acronym UNDP stands for
 - a. United Nations Distribution Programme
 - b. United Nations Dividend Programme
 - c. United nations Development Programme
 - d. United Nations Deliberate Programme
3. Airside revenue is a part of
 - a. Non operating revenue
 - b. Operating revenue
 - c. Tax
 - d. Facility
4. Breaking down of different areas of an airport into several cost centres is known as _____ cost approach
 - a. Compensatory
 - b. Residual
 - c. Bifurcated
 - d. None of the options
5. The acronym PPP stands for _____ model
 - a. Public Private Partner
 - b. Public Private Partnership
 - c. Private Part Partnership
 - d. Public Part Partnership

3.13 LET US SUM UP :

The effective management of procurement and utilization of funds is what financial management of any organization is based upon. The discipline and function involves all the essential features and functions of management. Airports are super structures and involve a sound strategy for optimization of finances. The estimation of capital requirements and composition decides how funds shall be gathered for any airport. The funding is one of the key element in the plan for building an airport and the same is undertaken from multiple sources and models adopted depending on the country and its rules for governance. Revenue is the key to any investment and airports use different revenue strategies for effective commercial operation. The article 15 of Chicago convention lays down guidelines and recommendations related to charges and tax that airline company's pay at airports. Airports across the globe manage their finances with a team of experts, correct accounting procedures suited to their model and vivid norms to undertake feasibility of the super structure and generate revenue.

3.14 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. d 3. d 4. d

Check Your Progress – 2 :

1. d 2. c 3. b 4. a 5. b

3.15 GLOSSARY :

Debt : A Sum of money that is due.

Equity : The value of shares issued by a company. Equity is measured by subtracting liabilities from the value of assets.

Fund : Pool of money for a particular purpose.

Corpus : The total money invested in a particular project by all investors.

Dividend : Reward, cash or otherwise that a company gives to its shareholders.

Capital : Wealth in the form of money or other assets owned by a person or company or available for a purpose of starting a company or investing.

Revenue : The total amount of income generated by the sale of goods and services related to the primary operations of the business.

3.16 ASSIGNMENT :

Enumerate and discuss on the financial model that the Government of India has undertaken at Ahmedabad International Airport, Gujarat.

3.17 ACTIVITIES :

List and discuss on the operating and financial model of any 5 International airports across the globe.

3.18 CASE STUDY :

The government of a proposed airport at a particular country undertook the Build Own Operate Transfer model for the first and invited investments for a lease period of 10 years. The city at which the airport was proposed was an upcoming tourist hub with domestic tourism contributing to majority of the inflow. With the government showcasing the destination there are higher chances of more tourist influx. The government is also investing in all round development of the region through different models. The policies of the government in the aviation sector had been of absolute control till now and norms for promoting foreign investment in the tourism sector had been rigid. Tourism was not looked upon as a priority of the country but with diversification models of revenue the government has involved itself as a major potential for earning in the country. The tourism policy for foreign tourists which was complicated have also been relaxed and the ministry is working on simpler means and collaborations with different countries to ease the process. There is a word in the market that investors are still reluctant to invest in the project and the government is in continuous talk with the investors regarding the same.

1. What steps shall the government undertake to ensure investment ?
2. What steps shall the investors undertake to convey to the government for an investment ?
3. How can situations like these in a country be resolved for its betterment ?

3.19 FURTHER READING :

1. Airport Planning and Management by Alexander T Wells
2. Managing Airports by Anne Graham

UNIT STRUCTURE**4 0 Learning Objectives****4.1 Introduction****4.2 Airport Slots****4.3 Objectives of Slot Coordination****4.4 Stake Holders in Airport Coordination****4.5 Conditions for Airport Coordination****4.5.1 Conditions for Designation of Airports****4.6 Principles of Airport Coordination****4.7 Role of Industry Groups in Airport Coordination****4.7.1 IATA Slot Conference****4.8 The Facilitator / Coordinator and Their Role in Coordination for Slots****4.9 Key principles of Slot Allocation at Level 3 Airports****4.9.1 Priorities for Slot Allocation at Level 3 Airports****4.9.2 Holding and Returning of Slots****4.9.3 Slot Mobility for Airlines****4.10 Let Us Sum Up****4.11 Answers to Check Your Progress****4.12 Glossary****4.13 Assignment****4.14 Activities****4.15 Case Study****4.16 Further Reading**

4 0 LEARNING OBJECTIVES :

- To define slots and enumerate on objectives for slots at airports.
- To list stake holders at airports for optimizing availability and conditions for allocation of slots.
- To list the conditions for designation of different airports.
- To enumerate the principles of slot coordination at airports and discuss the role of the industry and different international bodies in the process.

4.1 INTRODUCTION :

You must have heard that flights often get stranded and delayed at particular airports because they are unable to get slots at the next airport. Airports across the globe are categorized under different levels. Any airport that is busy and is categorized under a particular level by the authorities ensures that airlines follow a slot system. In this unit you shall learn about slots and how they are allocated and how different airlines earn revenues from the slots they hold at key airports.

4.2 AIRPORT SLOTS :

An airport slot (or 'slot') is a permission given by a coordinator for a planned operation to use the full range of airport infrastructure necessary to arrive or depart at a Level 3 airport on a specific date and time. To understand a slot system you shall have to first understand the bifurcation of airports under different levels and how coordination at the airport is important to manage airport capacity. Airport coordination is a way of managing airport capacity through a set of rules devised and implemented by Worldwide Airport Slot Guidelines (WASG). Coordination involves the allocation of constrained or limited airport capacity to airlines and other aircraft operators to ensure a viable airport and air transport operation. Coordination is also a process to maximize the efficient use of airport infrastructure. The coordination provides a temporary solution to airport capacity constraints and permanent solutions lie with the airports to increase capacity.

4.3 OBJECTIVES OF SLOT COORDINATION :

There are several objectives for slot coordination at busy airports. To enumerate the same they include

- Optimization of capacity at airports to benefit consumers incorporating the interest of both the airport and the airlines.
- Improve global connectivity and enhance passenger choice.
- Provide consumers with convenient schedules that meet demand and are reliable in terms of airline operation.
- Ensuring that slots are allocated at congested airports in an open, fair, transparent and non-discriminatory manner by a slot coordinator acting independently.
- Realizing the full capacity potential of the airport infrastructure and to promote regular reviews of such capacity and demand that enable effectual capacity declarations for slot allocation on a seasonal basis.
- Balancing of airport usage opportunities for existing and new airlines.
- Providing flexibility to the industry to respond to changes in market conditions and customer demands.
- Minimizing congestion and delays.

➤ **Level 3 Airports :**

These are airports where capacity providers have not developed sufficient infrastructure, or where governments have imposed conditions that make it impossible to meet demand. A coordinator is appointed to allocate slots to airlines and other aircraft operators using or planning to use the airport as a means of managing the declared capacity.

4.5.1 Conditions for Designation of Airports :

Airports are designated based on the following parameters

- Demand and Capacity analysis using best practice methods by airport managing body or any competent authority.
- Official capacity declaration is undertaken by the airport for each scheduling season taking into account all the functional limitations.
- The analysis undertaken is transparent and uses all quantitative data. Airports may reconsider designations upon increased infrastructure, introduction of new flights and other aspects.
- Levels are decided after detailed analysis and consultation of all the parameters involved in the designation process.

4.6 PRINCIPLES OF AIRPORT COORDINATION :

You have studied earlier in 4.5 that level 1 airports do not require a slot system as the capacity is adequate demands at all point of time during the day. There are certain principles for Level 2 and Level 3 airports that are implemented.

The principles for coordination at Level 2 airports are

- Schedule facilitation is based on a process of schedule adjustments mutually agreed between the airlines and facilitator to avoid exceeding the airport's coordination parameters.
- No slots are allocated at a Level 2 airport. The concepts of historic precedence and series of slots do not apply at Level 2 airports.
- The facilitator should adjust the smallest number of operations by the least amount of time necessary to avoid exceeding the airport's coordination parameters.
- Facilitators must be independent and act in a neutral, transparent, and non-discriminatory way.
- An airline or other aircraft operator must advise the facilitator of all planned operations prior to operating at a Level 2 airport and of all changes to planned operations. Certain types of flights (for example, humanitarian or state flights, and in some cases general and business aviation) may be exempt or subject to special local procedures.
- Airlines and other aircraft operators must not intentionally operate services at a significantly different time or in a significantly different way than agreed with the facilitator.

- Planned times of operation are based on the planned on–block (arrival) and off–block (departure) times.
- IATA Standard Schedules Information Manual message formats are used for communication at level 2 airports.
- A Calendar of Coordination Activities to be followed between airlines and facilitators with deadline dates.
- All activities involving slots, including the determination of historic slots, are in UTC, unless otherwise agreed.

The principles for coordination at Level 3 airports are

- Slots are allocated to airlines by a duly appointed coordinator only for planning purposes at a Level 3 airport.
- Slots are allocated to airlines and other aircraft operators.
- An airline or other aircraft operator must have a slot allocated to it before operating at a Level 3 airport. Certain types of flights (for example, humanitarian or state flights) may be exempt or subject to special local procedures.
- Airlines and other aircraft operators must not intentionally operate services at a significantly different time or intentionally use slots in a significantly different way than allocated by the coordinator.
- A series of slots is at least 5 slots allocated for the same or approximately same time on the same day–of–the–week, distributed regularly in the same season.
- An airline is entitled to retain a series of slots for the next equivalent season if they were operated at least 80% of the time during the period for which they were allocated. This is referred to as historic precedence.
- Historic slots may not be withdrawn from an airline to accommodate new entrants or any other category of aircraft operator. Confiscation of slots for any reason other than proven intentional slot misuse is not permitted.
- Slots may be transferred or swapped between airlines, or used as part of a shared operation, subject to the provisions of these guidelines and applicable regulations.
- Coordinators must be functionally and financially independent of any single interested party and act in a neutral, transparent, and non–discriminatory way.
- The allocation of slots is independent from the assignment of traffic rights under bilateral air service agreements.
- IATA Standard Schedules Information Manual message formats are used for communication at level 2 airports.
- Slot times are based on the planned on–block (arrival) and off–block (departure) times.

- All activities involving slots, including the determination of historic slots, are in UTC, unless otherwise agreed.
- Monitoring of the use of allocated slots should be performed in a timely manner by the coordinator at a Level 3 airport.

4.7 ROLE OF INDUSTRY GROUPS IN AIRPORT COORDINATION :

The prime objective of airport slot coordination is to ensure the most efficient declaration, allocation and use of available airport capacity in order to optimize benefits to consumers, taking into account the interests of airports and airlines. There are a lot of stake holders that are involved to set standards regarding the system and provide a guideline for its global implementation.

- The Worldwide Airport Slot Guidelines (WASG) is a set of standards and best practices developed by airports, airlines and slot coordinators/facilitators. These guidelines are a comprehensive set of procedures for the allocation and management of airport capacity. The principal users of these guidelines are airports, airlines, coordinators and facilitators.
- The WASG is maintained jointly by ACI, IATA and WWACG under the supervision of the Worldwide Airport Slots Board (WASB), which is comprised of an equal number of airports, airlines and slot coordinators/facilitators.
- The mandate of the WASB is to propose areas of policy development, consider ways of improving the procedures, and review and analyse future trends and technology.
- The WASB is responsible for establishing Airport Slot Working Groups (ASWG) to carry out focused and specific work on any issues deemed of interest for the industry. The mandate of the ASWGs is to recommend changes to the WASG for consideration and approval by the WASB, develop and support implementation of the standard. Any changes in the WASG are approved by WASB.
- The WASG is considered to be a benchmark by airlines and airport operators. If governments intend to implement their own rules and procedures in this aspect, the principles of the guidelines of WASG are followed.
- The WASG provides a consistent, transparent, and fair method for the allocation and management of airport capacity.

4.7.1 IATA Slot Conference :

IATA being a key player in the WASG process organizes a forum for the coordination of Level 2 and Level 3 airports. The forum is held twice a year for the summer and the winter season. The discussions about pooling of flights, pricing, market entry, or any other competitively sensitive activities beyond the scope of the forum are not discussed. The delegates of the forum are accredited representatives of airlines, coordination organization, airport operators and facilitators.

4.8 THE FACILITATOR / COORDINATOR AND THEIR ROLE IN COORDINATION FOR SLOTS :

Facilitators play an important role as a linkage between the airport and the airline in allocation of slots and coordination for day to day landing and departure of aircrafts. The appointment of the facilitator is undertaken with consultations of the airport managing body, the airlines using the airport and all the representative organizations. The facilitator is an expert in scheduling of aircrafts and provides facilitation services according to guidelines. The facilitator is a neutral entity and plays a transparent and non-discriminatory role. The role of the facilitator in a Level 1 and 2 airport includes

- Ensure the feasibility of the plans submitted by an airline so the coordination parameters of the airport are not exceeded.
- Make available to relevant stakeholders details of the coordination parameters and utilization of the declared capacity. The facilitator shall inform the airlines as soon as possible and at least 14 days and not later than 7 days before the Initial Submission Deadline.
- Advise airlines if planned operations will exceed coordination parameters and facilitate a process of mutually agreed schedule adjustments to avoid exceeding these parameters.
- Attend and participate in all forums.

The facilitator at a Level 3 airport is known as the Coordinator and the role is bigger than Level 1 or 2 airports as Slot systems are followed in Level 3 airports. The roles include

- Allocation slots to airlines and other aircraft operators in a neutral, transparent, and non-discriminatory way, on the basis of the applicable coordination parameters, and in accordance with the priority criteria of the WASG and any local guidelines and regulations.
- Make available to relevant stakeholders details of the applicable coordination parameters, local guidelines and regulations, and any other criteria used in the allocation of slots, as soon as possible and at least 14 days and not later than 7 days before the Initial Submission Deadline for each forum, where possible. The coordinator shall inform the airlines as soon as possible and at least 14 days and not later than 7 days before the Initial Submission Deadline.
- Make available to the airlines and to the airport managing body, as soon as a list of slots allocated, remaining slots available and the reasons why slots were not allocated as requested.
- Monitoring of all slots including historic slots.
- Address problems arising from conflicting requirements in such a way as to avoid any need for external intervention.

A coordination committee is established at level 3 airports to advise coordinators related to capacity, slot allocation and monitoring of slots.

The committee plays a bigger role providing guidance and mentorship to the airport authorities, airlines and coordinator. It also acts as the mediator in event of any dispute arising out of the slots allocated and their utilization.

4.9 KEY PRINCIPLES OF SLOT ALLOCATION AT LEVEL 3 AIRPORTS :

The key principles of slot allocation at level 3 airports can be stated as

- The allocations of slots are undertaken by a duly appointed coordinator.
- An airline or other aircraft operator must have a slot allocated to it before operating at a Level 3 airport. Certain types of flights (for example, humanitarian or state flights) may be exempt or subject to special local procedures.
- Airlines and other aircraft operators must not intentionally operate services at a significantly different time or intentionally use slots in a significantly different way than allocated by the coordinator.
- A series of slots is at least 5 slots allocated for the same or approximately same time on the same day-of-the-week, distributed regularly in the same season.
- An airline is entitled to retain a series of slots for the next equivalent season if they were operated at least 80% of the time during the period for which they were allocated. This is referred to as historic precedence.
- Historic slots may not be withdrawn from an airline to accommodate new entrants or any other category of aircraft operator. Confiscation of slots for any reason other than proven, intentional slot misuse is not permitted.
- Slots may be transferred or swapped between airlines, or used as part of a shared operation, subject to the provisions of these guidelines and applicable regulations.
- Coordinators must be functionally and financially independent of any single interested party and act in a neutral, transparent, and non-discriminatory way.
- The allocation of slots is independent from the assignment of traffic rights under bilateral air service agreements.
- Slot times are based on the planned on-block (arrival) and off-block (departure) times.
- Monitoring of the use of allocated slots should be performed in a timely manner by the coordinator at a Level 3 airport.

4.9.1 Priorities for Slot Allocation at Level 3 Airports :

As you have studied earlier that forums are organized twice a year for all the stake holders related to slot allocations. The airlines submit their slot allocation plans for the level 3 airports according to the parameters that guide the same. The priorities of slot allocation happen in the following sequence.

- Historic Slots held by airlines for a long period of time is awarded to the same airline. If only an airline decides to move from that slot it is reallocated.
- Post allocation of historic slot a slot pool is created. 50% of the slot pool is allocated to new entrants.
- The remaining slots are transparently distributed according to parameters as decided. If slots cannot be allocated to an airline in a particular season it is reconsidered in the next season. The airline remains on the waitlist of the slot pool for the particular airport.

4.9.2 Holding and Returning of Slots :

At busy airports there is always a dearth of slots. If a particular airline decides not to operate a flight at a particular allotted slot at an airport, the airline should return the slot so that other airlines can use the same. There is a deadline to return the slots once allocated, however, the same can be reallocated by the authorities. Airlines possessing a series of slots and returning the same receive a low priority for slot allocation in forthcoming season.

If a series of slots allocated to an airline is not used to 80% of the capacity the same will be lost by the airline in the next season. Coordinators monitor slot usages and warn airline to initiate action on unused slots at Level 3 airports. However, interruption of air services due to unforeseeable circumstances that is outside the control of the airlines, is informed to the coordinator.

4.9.3 Slot Mobility for Airlines :

There are certain norms related to mobility of slots. They are as

- Slots are neither route specific nor flight number specific and can be changed by the airline for any route.
- The same needs to be confirmed with the coordinator.
- Slots can be swapped or interchanged by airlines on a one to one basis and the same is permitted with the coordinator being informed of the same. The final decision of the swap lies with the coordinator.
- All details pertaining to the swap must be mandatorily conveyed to the coordinator for approval.
- Slots can be shared by airlines unless the rules of the country do not prohibit the same.
- The slot holder is responsible for all slot management activities.

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- Slots are only held by airlines having valid operating licence. In event of bankruptcy of an airline or discontinuation of its services, the coordinator discusses with the airline and the committee for the slots the airline holds.
- Slot monitoring is done by the coordinator and in event of any misuse the coordinator enters into dialogue with airline authorities.
- Slot performances are monitored and the report of the same are forwarded to concerned authorities.

Slot availability is a continuous challenge at Level 3 busy airports. Airline operators have been holding historic slots and there is little scope for new slots and new entrants. Lot of airlines enter into legal confrontation for slots and often there is a lot of trading happening between airlines for slots. Some countries do not allow trading for sale of slots but allow leasing; one of the most expensive deals to make media attention was the purchase in 2016 of a pair of slots by Oman Air from Air France–KLM for US\$75 million. Similarly, top prices were paid in 2015 by American Airlines – \$60 million for a pair of slots from SAS. With the high value of slots, airlines would not want to lose their slots unnecessarily. This often leads to inefficient scheduling to ensure they are used. They may use smaller aircraft more often, for example, in order to keep more slots. The most extreme examples are when an airline operates empty flights just to keep the slots for future use. These so-called 'ghost flights' are sometimes seen at busy airports. One such case that raised media attention (for example with the BBC), was British Mediterranean Airways operating empty flights from Heathrow to Cardiff. This came about after they terminated their service to Tashkent. The airline flew empty six days a week for almost six months until they started another route using the slot. There is a huge demand for slots at busy airports. Around 43% of air traffic depart from slot coordinated airports and every airline wants a share there to be in business. IATA is working towards even coordination to resolve the issues, however, the system still would require a lot of interventions from multiple stake holders.

☐ Check Your Progress – 2 :

1. Airports with potential for congestion during some periods are known as _____ airports
 - a. Level 1
 - b. Level 2
 - c. Level 3
 - d. Level 4
2. The condition for designation of airports depend on
 - a. Demand and Capacity
 - b. Infrastructure
 - c. Functional limitations
 - d. All the options
3. All planned activities of aircraft operator need to be informed in advance to _____ at a level 2 airport for smooth operations
 - a. Facilitator
 - b. Airport Manager
 - c. Airport management
 - d. HR

4. To retain a slot at a level 3 airport, airport operators must have used the slot for at least _____ % during the period it was allocated for
- a. 70 b. 75 c. 80 d. 85
5. _____ % slot pool at an airport is allocated to new entrants
- a. 40 b. 50 c. 60 d. 70

4.10 LET US SUM UP :

Airports at different locations across the globe are busy hubs that undertake arrival and departure of many flights belonging to different airline operators. Every airport has a distinct and optimum carrying capacity of the flights operating from it. An overburdened airport would lead to inefficient operations with a very high probability of delay, congestion or even accidents. To streamline airport operations, airports are categorized strategically under different parameters and a planned operating system for an airline is undertaken known as the slot system. A slot is a permission provided by an airport facilitator to an airline to use airport facilities for a particular duration of time. The objectives of a slot system lead to optimization of aircrafts, enhancement of connectivity from an airport benefitting the airline, airport and the customer. There are a lot of stake holders involved in the coordination process of slots and global parameters are laid down for different categories of airports. The principles used are governed by a lot of international bodies and are transparent and facilitative.

4.11 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. c 3. b 4. a

Check Your Progress – 2 :

1. b 2. d 3. a 4. c 5. b

4.12 GLOSSARY :

WWACG : Worldwide Airport Coordinator's Group

WASG : Worldwide Airport Slot Guidelines

ACI : Airport Council International

ASWG : Aviation Security Working Group

IATA : International Air Transport Association

4.13 ASSIGNMENT :

List 5 airports of India that follow a slot system and 5 airports that do not follow a slot system.

4.14 ACTIVITIES :

Study and enumerate the slot system followed at Indira Gandhi International Airport, New Delhi.

4.15 CASE STUDY :

A flight arrived 1 hour late from its scheduled time of arrival at a level 1 airport. The airport had a small runway and as a result heavier aircrafts land with lesser quantity of fuel. The flight was scheduled to depart for its onward journey to a level 3 airport. The pilot had a miscommunication with the ATC at the level 3 airport and takes off for its destination. On arrival, the ATC does not give clearance to the aircraft for landing as there was no slot available due to heavy traffic and congestion at the airport. The aircraft could not circle for long as it had limited fuel for flying. The captain took clearance and landed the aircraft at another level 2 airport located 250 km away. The flight waited for another one hour for its clearance at the level 3 airport, refuelled and flew to its destination. The aircraft which was already delayed by 1 hour reached its destination with a delay of 3 hours causing passenger dissatisfaction and cost implications for the airline company.

1. What should have been done by the pilot of the airline to avoid the above situation ?
2. List the methods of communication that the airline and the pilot should have observed and made the situation better for the flyers ?

4.16 FURTHER READING :

1. <https://www.iata.org>
2. www.icao.int
3. Managing Airports by Anne Graham
4. Airport Operations by Norman J Ashford

UNIT STRUCTURE

- 5.0 Learning Objectives**
- 5.1 Introduction**
- 5.2 Dubai International Airport**
- 5.3 Singapore Changi Airport**
- 5.4 Indira Gandhi International Airport, New Delhi, India**
- 5.5 Heathrow Airport, London, United Kingdom**
- 5.6 Incheon International Airport, Seoul, South Korea**
- 5.7 Hamad International Airport, Doha, Qatar**
- 5.8 Let Us Sum Up**
- 5.9 Answers to Check Your Progress**
- 5.10 Glossary**
- 5.11 Assignment**
- 5.12 Activities**
- 5.13 Case Study**
- 5.14 Further Reading**

5.0 LEARNING OBJECTIVES :

- To list some of the leading global airports of the world.
- To discuss the facilities provided at some of the leading airports of the world.
- To enumerate the ratings conferred to different hotels by international agencies.

5.1 INTRODUCTION :

You have studied in the earlier units related to all the technical aspects that make an airport a viable business model. In this unit we shall take an insight into some of the famous airports across the globe and why the airport is notable in its own aspect. Every year a lot of rating companies involve passengers about their experiences at particular airports and set parameters to give scores to different airports across the globe. Based on the ratings and votes airports are ranked in different categories. You shall acquaint yourself to some of these airports across the globe.

5.2 DUBAI INTERNATIONAL AIRPORT :

The Dubai International Airport has an IATA code of DXB is the busiest airport in terms of international passenger traffic across the globe.

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The airport caters to Dubai as well as the United Arab Emirates. The airport is also one of the busiest cargo airports of the world. The airport caters to the highest average passengers per flight. The 2017 statistics indicate that Dubai International airport catered to 88 million passengers, 2.65 million tonnes of cargo 409,493 airport movements. The airport is spread in 7200 acres. The Terminal 3 of the Dubai airport is the second largest building in the world by floor space and the largest terminal in the world. Dubai Airport is hub to Emirates Airlines and is the largest in the Middle East. Emirates handle 51% of air traffic at Dubai airport, and have their own terminal at Terminal 3 of the Dubai Airport. The airport being a hub has over 60% of connecting passengers. Airline companies fly across the continents at over 270 destinations from Dubai airport.

The Dubai airport is expanding since its inception in 1937. Today the airport has the capacity to handle more than 75million passengers per annum. The land side of the airport were restructured to allow construction of 2 metro railway stations. With expansions done in phases, the airport today has 3 terminals and 3 concourses. The airport also has 2 cargo mega terminals, an airport free zone, an expo centre with 3 large halls, a major aircraft maintenance hub and many other facilities. The airport plans to expand more and host more than 90 million passengers per annum. The Terminal 1 and Terminal 3 are connected with a transit area that is common and passengers can move freely between the terminals. The Terminal 2 is on the opposite side and shuttle services ply between the terminals. The Terminal 1 and 3 handles international passengers and 85% of the traffic at Dubai airport. For premium passengers there is an Executive Flight Terminal with its own check in facilities and transportation to the aircraft. The Terminal 3 of the Dubai airport is the largest building by floor space and is partly underground. It is capable of handling more than 60 million passengers per annum. The Terminal 3 is a multilevel underground structure with 180 check in counters, 2600 car parking spaces, lounges, restaurants, shopping facilities, 72 immigration counters and 14 baggage carousels. Dubai International airport has the largest baggage handling system in the world and one of the largest cargo mega terminals of the world. Dubai is the hub of flower imports and exports across the globe. Flowers need special facilities for storage and handling. Dubai international airport has a flower centre for import and export.

The airport has a massive contribution to the Dubai economy as it employs 90.000 people and provides approximately 400.000 jobs, that is about 21% of the Dubai employment. The services provided at the Dubai airport include

- Free Wi-Fi is available on the whole territory of the airport and might be accessed via to the 'DXB Free WiFi' or 'DWC Free WiFi' from networks list.
- There are several ATMs located across three terminals of the airport and currency exchange facilities like Al Ansari Exchange, Dubai

Express Exchange, ENBD Money Exchange, Sharaf Exchange, Travelex Currency Exchange, UAE Exchange and others.

- For those traveling with the business purposes, there is a Business Center that is located in Dubai International Hotel. There are meeting rooms, Internet, photocopying, fax, and conference facilities available.
- Children's play area called 'Kids Area' might be found between Gates B7 and B8 at the Concourse B of the Terminal 3.
- Baby Care Rooms are provided across all of the three terminals of the airport.
- Baggage Storage enables passengers to leave the baggage for some time to not carry it around. The service is available at the Terminal 1 and 3. The fee for the service is 40 AED–50 AED for every 12 hours of storage.
- Prayer Rooms may be found by following the airport signs. They are available in the car parking areas as well.
- Smoking Lounges are equipped with the ventilation systems and allow the smoking passengers not to leave the territory of the airport to smoke. The lounges are located at the Terminal 1 near the Gate 1, at the Terminal 2 near the departure area, and at the Terminal 3 near the Gates A2, A23, B7, B27, C9, C23.
- Showers are available at the Terminal 3. There are six man showers at the A Gates area, one at the B Gates area, and one at the C Gates area. There are six female showers at the A Gates area, two at the B Gates area, and two at the C Gates area.
- Medical Centre, as well as the pharmacies, is operational 24 hours a day, seven days a week.
- The Shopping Centre includes brands from across the globe and duty free areas. There are food outlets from across the globe with presence of international brands.
- Special assistance is provided to passengers with restricted mobility and special needs.

5.3 SINGAPORE CHANGI AIRPORT :

The Singapore Changi International Airport has an IATA code of SIN and is one of the largest and the busiest transportation hubs in Asia. It is the world's busiest airport in terms of international passenger and cargo traffic. The airport has been rated the World's best airport by Skytrax, the renowned United Kingdom based consultancy and rating agency for eight consecutive years. The Changi airport is also rated as the world's cleanest airport and a highly rated transit airport. The airport is a blend of artistry, architecture and nature in a single structure. The airport caters to more than 100 airlines operating across the continents. The airport is located in the Changi district of Singapore and is situated in a 15 square km area. The airport is hub to Singapore Airlines and

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Jet Star Asia Airways. The airport is also the cargo hub for Fedex express Asia. The airport handles around 70 million passengers per annum and is operated by the Changi group a wholly owned subsidiary of the Ministry of Finance, Government of Singapore. There are around 7400 flights that arrive or depart from Changi airport each week. The airport handles more than 2 million tonnes of cargo per annum making it one of the busiest cargo airports of the world.

- The Changi airport has 5 passenger terminals with a capacity to handle around 85 million passengers per annum. There is a privately run luxury terminal called the Jet Quay CIP terminal accessible to passengers with the payment of a fee. A nature themed entertainment and retail complex, known as the Jewel Changi Airport has been built within the Changi airport connecting Terminals 1,2 and 3. The centre of the jewel terminal comprises of world's tallest (40 metre high) indoor waterfall known as the Rain vortex, surrounded by a forest setting. The Jewel includes retail and dining outlets, gardens, attractions and many passenger related facilities. The Jewel is around 10 storeys and receives around 3 lakh visitors every day. The Jewel has been built to increase the capacity of the terminals in use at the airport. A new terminal is in progress at Changi airport which is projected to be bigger than the existing terminals.

The number of passengers at the airport has been phenomenally growing and in 2018, Changi airport had a passenger flow of 65.8 million. Due to pandemic the airport terminals remained non operational and has reopened from September 2021. The cargo division of the airport is the 7th busiest hub in the world. Electronic goods comprise a large part of the cargo business that the airport handles. The security of the airport is managed according to the AVSEC policies and is managed by the Singapore Police Force and other security agencies of the managing group. For passenger experience the airport boasts of the following

- The only Pokemon Centre outside of Japan is located at Changi airport and official merchandise for fans of all ages is available.
- The Experience Studio is a journey of fun and discovery where a passenger can explore and enjoy 10 content zones. It lets a user experience simulated airport functions and also makes a user aware of the making of Changi airport. There is state of the art technology content to be enjoyed.
- There is a Jewelrassic quest that virtually teleports users to forests with dinosaurs and adventures.
- A Manulife sky nets bouncing and walking where travellers feel like bouncing among trees and a balance thrill through fun filled adventure.
- The Mirror maze is a kaleidoscopic escape that boasts of a unique cover of greenery branching overhead creating an endless illusion.

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seats. The airport is also a hub airport for many Indian carriers like Air India, Indigo airlines, Go First, Spice Jet and others.

The airport was initially operated by the Indian Air Force and its management was later transferred to the Airports Authority of India. In May 2006, the management of the airport was passed over to Delhi International Airport Limited (DIAL), a consortium led by the GMR group. With the inauguration of the Terminal 3 in 2010, the airport has become the largest aviation hub in the country and in South Asia. The terminal 3 has a capacity to handle around 34 million passengers annually and is the 8th largest passenger terminal of the world. In the year 2020, IGI airport handled 67.3 million passengers.

The Indira Gandhi International airport has been conferred with many awards international acclamations. The notable among them are

- 4th Best Airport award in the 15 –25 million category in 2010.
- Most Improved Airport Award in the Asia Pacific region by Airports Council International.
- Best Airport in the World in the 25 – 40 million passenger category in 2015.
- Best Airport Service Quality award in 2015 by Airports Council International.
- Best Airport in Central Asia and Best Airport Staff in Central Asia award in 2015 at the Skytrax World Airports Awards.
- Adjudged "World's Best Airport" at Airport Service Quality Awards 2017 in the highest category of airports handling more than 40 million passengers annually.
- Best Airport in Asia Pacific in 2020 by Airports Council International.
- Special Covid 19 Airport Excellence award for enforcing Covid 19 protocols strictly.
- First airport in India to be awarded the Leadership Energy and Environment Design (LEED) Gold rating

In 2006 the management of the Delhi Airport was handed over to a private consortium DIAL (Delhi International Airport Limited). DIAL is a consortium of the GMR Group and Fraport. The biggest stake holder is the GMR group and Airports Authority of India also has 26% stake in the IGI airport. There are approximately 80 airlines that are serving the airport. The airport has the following terminals

- Terminal 1 – The terminal is used by low cost domestic carriers. The terminal had a capacity of 15 million passengers per year and with the refurbishment and addition of Terminal 1 D the capacity has been increased to 30 million passengers. The Terminals 1 A has been merged with Terminal 3, Terminal 1B and 1 C has been closed down with construction of Terminal 1 D.

- Terminal 2 was revamped and a lot of operations of domestic airlines were shifted to Terminal 2.
- Terminal 3 was designed in consultation with Mott Mac Donald and is a two tier building spread over 20 acres. The lower floor is for arrival and the upper floor is for departure. The terminal boasts of 168 check-in counters, 78 aerobridges, 95 immigration counters, 54 parking bays, 15 X ray screening areas and a lot of facilities for shopping, retail, dining and others. The terminal is connected by 8 lane Delhi Gurgaon Expressway and the Delhi Metro Airport Express Line. The airport has a multi level car park of seven levels with automated parking management system. The airport has 14 baggage carousels at the arrival terminal. The cargo terminal at IGI airport is located 1 km from Terminal 3 and has separate Brownfield and Greenfield terminals.
- The terminals at the IGI airport are equipped with the best of the retail outlets for shopping. From local brands to international chains, the IGI airport boasts of a grand shopping experience. Dining at IGI airport ranges from quick service restaurants to fine dine restaurants of local brands as well as international players.
- The services that are offered at IGI terminals include free Wi fi, ATMs, Money exchange, Taxi services, Metro services, Tourism related services, medical services, baggage wrapping services, hotel bookings, paid porter service, pet fly service for relocation of pets, game zone that incorporates simulators, telecommunication network provider services.
- There is a provision of 24 hour plaza premium lounge at all the terminals of the IGI airport and passengers can avail the services of the lounge for duration of time upon payment of some amount. Some air carriers have their own lounge for first class passengers at Terminal 3.
- Holiday Inn Express, IGI Airport, Terminal 3 is accessible from the 5th level of the Terminal 3.
- There are plans for expansion of the airport with Terminal 4, 5 and 6 to be built in future to handle international carriers.

5.5 HEATHROW AIRPORT, LONDON, UNITED KINGDOM :

The Heathrow airport was also known as the London Heathrow airport has an IATA code of LHR. The Heathrow airport is located at the city of London and is the largest of the six airports serving the city of London. Gatwick, Stansted, Luton, City and Southend are the other airports that cater to the city. Heathrow airport was the 7th busiest airport of the world in 2021 by international passenger traffic. It is Europe's one of the busiest airport. The airport has been continually developed since its inception in 1929 and now the airport boasts of four terminals and one cargo terminal. Heathrow airport is used by 80 carriers flying to 185

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destinations in 84 countries. It is a hub airport for the British airways and a base airport for the Virgin Atlantic airlines. Heathrow airport follows a strict noise curb procedure and maintains strict runway operations. There are restrictions on flights operating during the night time and noisiest aircrafts cannot be scheduled during the night. Arrivals too are worked upon during night voluntarily with carriers and the same are not permitted at the airport since early morning. The airport has introduced "Fly Quiet and Green" mission since 2017. The airport operates two runways and operates at 98% of its capacity. The airport is working with airline carriers to operate larger aircrafts in order to accommodate more passengers. The increase in landing slots and increase operations from the airport is difficult for all airlines. The mixed mode usage of runways in operations, a decision undertaken by the management of the airport would help in increasing the capacity of flights.

The Heathrow airport has 4 terminals with 115 gates. Out of the gates at the airport 66 gates are able to support wide bodied aircrafts. Due to the Covid 19 pandemic two of its terminals were shut down and airline operations were shifted to the rest of the terminals. Even runway operations were brought down to the usage of a single runway. The Terminal 2 of the Heathrow airport is the most recently developed terminal and has been named as the Queen's Terminal. The terminal was originally designed by the Spanish architect Luis Vidal. The terminal operates all flights that are members of the Star Alliance under the policy of "Move under one roof". The Terminal 2 was the oldest terminal of the airport but was demolished along with Queen's building that housed airline offices and converted to a new terminal. The Terminal 3 was built in 1961 to accommodate passengers of long haul flights to United States, Asia and far East destinations. In 1970 the terminal was expanded with an arrival building. Virgin Atlantic has its own Check in area in the terminal known as Zone A. The terminal has 28 gates and in 2011 handled around 20 million passengers. Terminal 3 also handles all carriers that are part of the One World membership. The Terminal 4 was opened in 1986 and is majorly operated by carriers of the Sky Team. Majority of the flights at Terminal 4 are from Central Asia, North Africa and the Middle East. The terminal has 22 gates and accommodates about 45 airlines. The Terminal 5 was opened by Queen Elizabeth II in 2008. The terminal has 50 gates and majorly is the hub for flights of the British Airlines. Flights to John F Kennedy airport in USA also operate from this terminal. The Terminal 5 was voted Skytrax World's Best Airport Terminal in 2014. The terminal boasts of a 3800 multilevel car park and is also connected to the Heathrow Express Metro line and Picadilly Line. The terminal boasts of an Automated People Mover System known as the Transit to transport passengers between satellite buildings. The terminal has dedicated concourses and each concourse has dedicated stands for wide bodied aircrafts.

There are lot of facilities for different categories of passengers at Heathrow Airport. For a traveller with little kids there is a dedicated area assigned at each terminal. The area offers complimentary kids meals, dedicated play areas, change areas and family friendly parking. The airport has a host of dining facilities that include global brands, cafe chains, bistros, traditional pubs and others. There are charging points across all terminals, free Wi-Fi, multi faith prayer rooms, postal services, shower facilities, a chapel, meeting rooms, smoking zones, ATM machines, currency exchange, retail outlets and luxury shops for shopping encompassing global brands.

5.6 INCHEON INTERNATIONAL AIRPORT, SEOUL, SOUTH KOREA :

The Incheon International airport is located at Seoul, the capital city of South Korea having an IATA code of ICN. It is the largest airport of South Korea and is also one of the largest and busy airports of the world. The airport is created on an artificial piece of land between two islands. The airport is one of the biggest and the best hub airports of North East Asia. The airport opened in 2001 replacing the Gimpo International Airport that serves as destination for domestic flights and flights to Eastern part of Asia. The airport is the hub for Korean Air, Asiana Airlines, Jeju Air. The airport was the 5th busiest airport in the world and the 3rd in Asia in terms of cargo traffic and 19th busiest airport in the world and 8th in Asia in terms of passenger traffic. The airport has won a lot of awards on the global front. Some of the prestigious awards that the airport has bagged are

- Winner of World's Best Transit Airport 2020.
- The Terminal 2 of Incheon International Airport was named the World's Best Terminal in 2020.
- It was awarded the 4th Best Airport in the World by Skytrax.
- It was also awarded the World's Best International Transit Airport and one of the world's Cleanest Airports by Skytrax.
- The Airports Council International (ACI) has ranked the airport as Best Airport Worldwide from 2005 to 2011.
- The airport has been awarded the Best International Airport in the Asia Pacific from 2006 to 2011 by ACI.
- The Duty Free Shopping mall was awarded the best by Business Traveller in 2013 for 3 years.

The Incheon International Airport boasts of a lot of facilities that range from a Golf course, Spa, private sleeping rooms, casino, indoor gardens, video games centre, museum and others. The airport is considered to be the fastest in processing of custom formalities of passengers and is considered to be the world's fastest airport in terms of handling departures and arrivals. The speed of processing baggage at the airport

is also the fastest with minimal error rate globally. There is a passenger concourse with 30 gates and 6 lounges connected to Terminal 1 with underground passages that have the latest Intra Airport Transit. Airlines of Star Alliance, One World, Sky Team are allocated to the terminal.

The Terminal 2 was opened in 2018 and flights of different airlines started operation from this terminal. The airport has 3 runways operating at the airport. The terminal has increased the passenger experience and its ability to handle more passengers. The terminal provides a great architecture, cultural elements of the country, passenger comfort and blend of modern technology. The public transport system at the airport is one of the best in the world. Intercity buses are well connected to the airport. Regular, Deluxe and Jumbo taxis are available round the clock for the airport. The Airport Railroad Express links the airport directly to Seoul station. There is also a ferry service to a particular point from Incheon.

There is a huge selection of duty free shops, convenience stores and bookshops. The airport food court has a wide range of food outlets that are local, oriental and western. The airport has communication facility with free Wi-Fi. There are facilities for the disabled with special parking zones at the airport. There is a special hi tech observation deck at the airport that allows passengers to enjoy the view of the aerodrome and there is a facility that explains the history and details of the airport. Passengers can rest and watch the entire aerodrome from the observatory deck. A special place called the Bridge has a flying seagull sculpture that reminds of a flying airplane above the runway. The PR zone of the airport shows the history and the future of Incheon airport and the vision of a future of a airport complex city. The airport has a 360 degree Virtual Reality tour at the observatory experience zone that helps the passengers observe the inside of the baggage handling system of the airport. The Time Slice Photo zone is a place to create memories for fun filled and amusing photos at the observatory. The archive at the airport provides interesting facts about the airport in 2D images from the total floor area.

5.7 HAMAD INTERNATIONAL AIRPORT, DOHA, QATAR :

The Hamad International airport at Qatar is located at Doha and has an IATA code of DOH. The airport is the hub for Qatar's carrier Qatar Airways. The airport was inaugurated in 2014 and is named after the Emir of Qatar and is an inspirational experience for travellers. The dramatic, curving building silhouette recalls ocean waves and sand dunes to project a powerful image as Qatar's gateway to the world. The airport construction work started in 2005 and the airport started in 2014. It is the 2nd largest airport in the Middle East region and the airport is increasing its capacity of handling passengers up to 93 million per annum. The airport is built on an Oasis theme on 22 square km of land and is 6.46 million square feet of space. The Terminal 1 has 5 Concourses from A to E with a First Class (Al Safwa) and Business Class lounge (Al Mourjan). The airport has a giant bronze statue of teddy bear with

its head inside a lamp. The untitled sculpture is known as "Lamp Bear" made by a Swiss artist. The airport also displays a new sculpture called the Small Lie made by an American artist. The airport has 2 operational runways.

The facilities at the airport are immense. The airport boasts of world class duty free shopping experience with world class brands. The Al Maha services of the airport include personalised service, assistance, expedited formalities and priority boarding. The platinum services at the airport include a 6 hour Oryx lounge apart from personalised services. There are multiple ATMs located around the passenger terminals that dispense cash in multiple currencies. Apart from ATMs there are 6 foreign exchange counters offering conversion of 40 plus currencies. The WDooha Hotel and Residences is a lifestyle hotel with its signature restaurants is located at the airport. The airport also provides complimentary hotel transfer to a lot of hotels at Doha and houses 2 five star category hotels within the airport. There are prayer halls separately for men and women and also a mosque just outside the airport. The shape of a water droplet inspires the mosque's architecture and provides a spectacular view. The airport has one of the world's largest duty free shopping areas with elegant boutiques and stores covering an area of 2,70,000 square feet. There are family facilities and services at the airport. The airport has baby strollers, Parents room for infant care, family toilets, Indoor activity nodes equipped with televisions, computers and play areas. A MICE travel trip is facilitated through QMICE offering a host of benefits to MICE travellers. The airport has 2 medical facilities for any emergencies and is fully equipped. The airport boasts of a state of the art wellness centre that includes a gym, hydrotherapy tub, showers, squash courts and a spa. There is a public art program within the airport premises that displays the art of acclaimed local and international artists.

Hamad International Airport has been awarded the World's Best Airport in 2021 by Skytrax. It was the 3rd World's Best Airport in 2020. The award is a result of dedicated services and customer satisfaction that the airport provides.

❑ Check Your Progress – 2 :

1. The Indira Gandhi International airport at New Delhi is managed by
 - a. DAIL
 - b. DAILY
 - c. DILA
 - d. DIAL
2. LEED rating for airports stands for
 - a. Leadership Efficient Environment Design
 - b. Leadership Efficient Energy Design
 - c. Leadership Energy and Environment Design
 - d. None of the options

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3. IGI international airport is managed by _____ group
 - a. Adani
 - b. GMR
 - c. GVK
 - d. Reliance
4. Heathrow airport London has IATA code of
 - a. LHR
 - b. LRH
 - c. HRL
 - d. HLR
5. The international airport at South Korea is known as _____
 - a. Inch
 - b. Inches
 - c. Incheon
 - d. Inox
6. The giant bronze statue of teddy bear at Doha airport is known as
 - a. Lamp Bear
 - b. Lamp Bore
 - c. Light Bear
 - d. Lumax Bear

5.8 LET US SUM UP :

The unit is focussed on some of the best global international airports. The prime objective of the unit is to acquaint you with the different operational aspects of the airport and the facilities that each airport provides to its passengers. The unit also discusses some of the architectural innovations and designs at these airports.

5.9 ANSWERS TO CHECK YOUR PROGRESS :

Check Your Progress – 1 :

1. d 2. c 3. b 4. a

Check Your Progress – 2 :

1. d 2. c 3. b
4. a 5. c 6. a

5.10 GLOSSARY :

Immigration : Place at an airport where government officials check the documents of passengers entering the country.

Vortex : a whirling mass of fluid or air, especially a whirlpool or whirlwind.

Plethora : a large or excessive amount of something.

Hub : the effective centre of an activity, region, or network.

Skytrax : Skytrax (originally known as Inflight Research Services) is a United Kingdom–based consultancy which runs an airline and airport review and ranking site.

LEED : LEED (Leadership in Energy and Environmental Design) is an ecology–oriented building certification program run under the auspices of the U.S. Green Building Council (USGBC).

5.11 ASSIGNMENT :

Which Company manages the operations at Chhatrapati Shivaji International Airport, Mumbai ?

List the facilities provided at Chhatrapati Shivaji International Airport, Mumbai. Compare the facilities with Indira Gandhi International Airport, New Delhi.

5.12 ACTIVITIES :

List 10 unique activities/features pertaining to some of the global airports of the world.

5.13 CASE STUDY :

An old couple with a boarding pass was supposed to catch a flight from an international terminal of a busy airport. They boarded a taxi and directed for Terminal 2. The taxi dropped them at terminal 2 departure. At the departure gate when they produced their boarding pass, they were told that the operations of the airline they are supposed to board have been shifted to terminal 3. When they enquired about how they can reach the terminal 3, they were guided to a metro station that was 300 metres away. With all the baggage, they somehow reached the station. There was no baggage drop facility and they had to pull all their luggage down to the basement, board a metro train and reach terminal 3. The terminal was around 350 metres away from the station and there was no facility of a trolley even outside the station. They asked for help from fellow passengers as it was too hectic for them to pull their luggage and somehow they managed to reach the terminal. They narrated their ordeal to the manager of the airline as they had received no message for a terminal change and had to face too much of challenge.

- a. What are the aspects that went wrong from the airline perspective and the airport perspective ?
- b. What should have been the facilities provided to have a better customer experience ?

5.14 FURTHER READING :

1. www.wikipedia.org
2. www.dubaiairports.ae
3. www.changiairport.com
4. www.newdelhiairport.in
5. www.airport.kr
6. www.heathrow.com
7. www.dohahamadairport.com

BLOCK SUMMARY

In this block you have been acquainted to units that details the different aeronautical charges paid by an airline at an airport and the principles governing the same. It also guides you on its relevance and impact on any airport. The units further talk about business plans that are critical in operation of an airport. Finance is one element that needs to be planned thoroughly for any operation and you have been acquainted with different models and strategies related to finance and an airport. The unit also provides insight into the different sources of finance. The block further provides you with the operational knowledge of slot systems and how the same is beneficial in optimizing the carrying capacity of an airport balancing operations and finance. Finally the block provides details of some of the leading airports of the world and the facilities offered by these airports. The same shall update you with the changes happening globally at airports related to passenger facilities from various perspectives.

BLOCK ASSIGNMENT

Descriptive Questions :

1. Explain in detail the various charges applicable at an airport levied from airline companies as aeronautical charges ?
2. What are the regulatory patterns followed by airports related to aeronautical charges ?
3. Define Business plan ? What are the elements of a business plan and write the importance of a business plan ?
4. What are the objectives of financial management ? List the functions of financial management ?
5. Write in detail about the different sources of funding for an airport ?
6. What is a Slot system ? What are the objectives and principles associated with a slot system ?

Short Questions :

1. List the aspects of an aeronautical charge table ?
2. Write in detail the impact of aeronautical charges on an airline and its operation ?
3. Indicate the main features and directives of European Union on airport charges ?
4. Write in detail the value of a Business Plan ?
5. What is SWOT analysis ? Mention its importance in a business plan ?
6. List some of the revenue strategies adopted by airports in managing finance ?
7. Write in detail about the role of industry in slot coordination ?

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❖ Enrolment No. :

1. How many hours did you need for studying the units ?

Unit No.	1	2	3	4	5
No. of Hrs.					

2. Please give your reactions to the following items based on your reading of the block :

Items	Excellent	Very Good	Good	Poor	Give specific example if any
Presentation Quality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Language and Style	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Illustration used (Diagram, tables etc)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Conceptual Clarity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Check your progress Quest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____
Feed back to CYP Question	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____ _____

3. Any other Comments

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