LECTURE NOTES

ON

AIRPORT PLANNING AND OPERATIONS

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UNIT-1
AIRPORT AS A SYSTEM

The airport forms an essential part of the air transport system bz it is the physical site at which a modal.
Transfer is made from the air mode to the land mode or vice versa It is the point of interaction of the three major components of the air transport system. The airport, including its commercial & operational concessionaires, tenants, and partners, plus. These discussion purposes, the airways control system.

- The airline
- The user

The interaction among these three major components must be made to have successful rate and planning and operation is also must. To operate well, each should reach some form of equilibrium with the other two.

In the absence of a competitive option, total demand levels will be depressed below levels achievable In the optimal state. Sub-optimality can become manifest in a number of ways. Deficit operations at the airport. Deficit operations by the airlines at the airport Unsatisfactory working conditions for airline airport employs.In adequate passenger accommodation

In sufficient flight supply, Unsafe operations, High operational costs to useless, In adequate support facilities for airlines, High delay levels for airlines of passengers, Inadequate access facilities, Sluggish passengers demand.

Function of the airport:

An airport is either an intermediate or terminal point for an aircraft on the air portion of a trip. In simple functional terms the facility must be designed to enable an a/c to land & take off In b/w their two operations, the aircraft may, if required, unload and load payload & crew & be serviced Airport operations are divided into airside & land side functions. After approach and landing an aircraft uses the runway, taxiway and apron prior to docking at a Packing position, where its payload is processed through the terminal to the access system. The airport passenger and freight terminals are themselves facilities that have three distinct functions.

Change of mode: To provide linkage b/w the air vehicle of the surface vehicle designed to accommodate the operating characteristics of the vehicles on landside & airside respectively.

Processing: To provide the necessary facilities for ticketing, documentation and control of passengers and freight.

Change of movement type: To convert continual shipments of freight by trucks of departing passengers by car, bus, taxi & train to aircraft sized batches that generally depart according to a preplanned schedule or to reverse this process for arriving aircraft. Airports of a significant size must have an organization that can either supply or administer the following Faculties

The complexity of the Airport operation:

Until the deregulation & privatization of the air transport industry in the late 1970s & 1980s, it had been seen in many countries almost as a public service industry that required support from the Public purpose.

Airports such as Shannon in republic & Amsterdam in Netherlands, were among the first to develop income from commercial activities. By 1970s commercial revenues had become very inp lerms of total income. The larger airports became complex business with functions that extended well beyond the airfield or "traffic" side of operations. It is also clear that in most countries, airports maintain economic viability by developing a broadly based revece capability. As the relative and alxobute sizes of the non traffic element of the airports revenue increase, much more attention must be paid to developing commercial expertise, some of the largest airports have developed considerable in-house expertise in maximizing commercial revenues.

The non aeronautical activities found at airports are (ICA0) 2006;

Aviation fuel suppliers

Food & beverage sales (i.e restaurants, bars cafeterias etc)

Duty paid shopping

Banks / Foreign exchange

Airline catering services

Taxi services

Car rentals

Advertising

Airport /City transport services (i.e buses, limousines etc.

Duty free shopping (eg alcohol, tobacco, perfume, watches, optical)

Petrol/automobile service stations

Hair dressing/barber shop

Internet services

Casinos/gaming machines

Cinema

Vending machines for other than food

Freight consolidators

Art concerts

Music concerts

Souvenir shops

The degree to which airports go to a non aeronautical activity is likely to depend on the destination of the revenges generated from such activities. These go directly to the airport and add to the airports profitability There are number of situations that can act as disincentive to the airport company. Where income from non aeronautical sources goes directly to the national treasury. Where the government gives the dut-free franchise to the government-owned airline. Where the U. S airport is operated on a residual cost basis, and income from non aero sources is used to reduce landing fear for the airlines 5 does not accrue to the airport.

<u>Airport as an Operational system</u>

1. **Private airports and public use airports.**
   Airport planning is a systematic process used to establish guidelines for the efficient development of airports that is consistent with local, state & national goals. Key object of airport planning is to assure the effective use of airport resources in order to satisfy aviation demand in a financially feasible manner.

1. National system planning.
2. State airport system planning
3. Metropolitan airport system planning
4. Airport Master planning

Limitations of use:

FAA policies are applicable such as USC, united state code, public law (PL), code of federal regulations of official FAA policies.

Public & Private use airport

When we think of public airports, it is usually commercial service we think. However, Oregon's system of more than 100 public use airports includes a half dozen commercial service airports.

All public categories for purpose of oregano aviation plan.

Private air charter services, one advantage to use a private airport is the privacy factor. Travelling

Details are kept confidentially including the destination, members of travelling parity & Potential return dates.

1. **Commercial service airports**:
   There are publicly owned a/ps that have at least 2,500 passenger
   Boarding's each calendar year & receive schedule passenger service.
   Significant function is accommodate scheduled major/or national or regional/commercial air carrier service. And Is designated criteria is scheduled commercial service.
2. **General Aviation airports**:
   Their significant function is accommodating corporate aviation activity, including business jets, helicopters and other general aviation activities. Their designated criteria is 30,000 or more annual operations, of which a minimum of 500 are business related aircraft. Business use heliports.
3. **Regional airports**:
   Accommodate a wide range of general aviation users for large service areas in outlying parts of Oregon. Many also accommodate seasonal regional fire response activities with large a/c.
   Designation criteria
   Generally less than 30,000 operations. Geographically significant location with multiple communities in the service area.

   Changes in airport categorization will be based on measured changes against the designation criteria. Airports may request review by department

Generated traffic is traffic b/w hub airport H & airport , Although we tend to focus on the importance of transfer traffic at hubs, these are still highly dependent on non transfer traffic, since some flight sectors have important shares of non-transfer passengers & increase of direct services at the hub can produce a multiplying effection the generation of traffic from of to the hub. As a matter of fact, most hubs are located in regions with large local markets.

Airport by categories of airport activities, including commercial service, primary, cargo service, reliever and general aviation airports as shown below.

Categories of airport activities.

Air **Airport Classifications port Classifications**		**Hub Type: Percentage of Annual Passenger Boarding's**	**Common Name**
Commercial Service: Publicly owned airports that have *at least 2,500* passenger boarding's each calendar year and receive scheduled passenger service **§ 47102(7)**	**Primary:** Have *more than 10,000* passenger boarding's each year **§ 47102(16)**	**Large:** 1% or more	**Large Hub**
		Medium: At least 0.25%, but less than 1%	**Medium Hub**
		Small: At least 0.05%, but less than 0.25%	**Small Hub**
		Non hub: More than 10,000, but less than 0.05%	**Non hub Primary**
	Non primary	**Non hub:** At least 2,500 and no more than than 10,000	**Non primary Commercial Service**
Non primary (Except Commercial Service)		Not Applicable	**Reliever** **§(47102(23))** **General Aviation (47102(8))**

Of aviation of their categorization of any time, so move L/W categories, the airport must meet designation criteria using 3 year average. Inventory gets updated for every 5 years & a system-wide review of categories will be conducted general aviation airports. Airports with fewer than 2,500 annual enplaned passengers used exclusively by private business a/c act providing commercial air carrier passenger's service.

Hub classification:

Hub and spoke operations are typically achieved by consolidating originating and transfer passenger flows, which imply the existence of two dimensions of "hubbing" traffic generation & connectivity. Connecting traffic is traffic b/w Airport A&B via the hub airport H. Effective hubbing then generates Substantial volume of additional traffic at the hub airport the city-pair coverage that can be obtained is Significant, since increase in the number of airports served from the hub impacts exponenitiality on the Number of city-pairs served. Many small airports that provide little more than a simple passenger terminal for low-volume passenger Operations provide very little more than a passenger terminal facility. The operation of the airport is not Significantly more complex than that of a railroad station or an interurban bus station, Medium-or large-Scale airports are very much more complex and require an organization that can cope with such

Complexity, airports of a significant size must have an organization that can either supply or administer

Handling of passengers

Servicing, maintaining, and engineering of aircraft.

Airline operations, including aircren, cabin attendants, ground crew, and terminal and office staff

Business that provide services to passengers and are necessary for the economic stability of the airport

(e.g. concessionaries, leasing companies et)

Aviation support facilities

Components of Airport

Therefore, the **main components of airport are**

1. Landing Area of Airport

It is the airport components used for landing and takeoff operations of an aircraft. Landing Area includes ***Runways*** and ***taxiways***.

2. Terminal Area

The transition of passengers and goods from ground to air takes place in the terminal area. Various methods are used to accommodate and transfer the public and its goods arriving either by ground or by air. The degree of development in the terminal area depends upo9n volume of airport, operations, type of air traffic using airport, number of passengers and the airport employees to be served and the manner in which they are served and accommodated. Terminal area consists of the following parts ***Terminal building***, ***Apron***, ***Automobile Parking Area***, ***Hangers***.

Landing area is the component of airport used for landing and takeoff operations of an aircraft. Landing area includes

1. Runways
2. Taxiways

1. Runways

It is the most important part of an airport in the form of paved, long and narrow rectangular strip which actually used for landing and takeoff operations. It has turfed (grassy) shoulders on both sides. The width of runway and area of shoulders is called the landing strip. The runway is located in the center of landing strip. The length of landing strip is somewhat larger than the runway strip in order to accommodate the stop way to stop the aircraft in case of abandoned takeoff.

The length and width of runway should be sufficient to accommodate the aircraft which is likely to be served by it. The length of runway should be sufficient to accelerate the aircraft to the point of takeoff and should be enough such that the aircraft clearing the threshold of runway by 15m should be brought to stop with in the 60% of available runway length. The length of runway depends on various meteorological and topographical conditions. Transverse gradients should not be less than 0.5% but should always be greater than 0.5%.

2. Taxiways

Taxiway is the paved way rigid or flexible which connects runway with loading apron or service and maintenance hangers or with another runway. They are used for the movement of aircraft on the airfields for various purposes such as exit or landing, exit for takeoff etc. The speed of aircraft on taxiway is less than that during taking off or landing speed.

The taxiway should be laid on such a manner to provide the shortest possible path and to prevent the interference of landed aircraft taxying towards loading apron and the taxiing aircraft running towards the runway. The intersection of runway and taxiway should be given proper attention because during turning operation, this part comes under intense loading. If it is weaker then the aero plane may fell down from taxiway. Its longitudinal grade should not be greater than 3% while it s transverse gradient should not be less than 0.5%. It is also provided with a shoulder of 7.5m width paved with bituminous surfacing. The taxiway should be visible from a distance of 300m to a pilot at 3m height from the ground.

UNIT-2
AIRPORT PLANNING

2.1 Introduction

The passenger and cargo terminals have been described as interface points between the air and ground modes, the movement of passengers, baggage, and cargo through the terminals and the turnaround of the aircraft on the apron are achieved with the help of those involved in the ground handling activities at the airport (IATA 2012). These activities are carried out by some mix of the airport authority, the airlines, and special handling agencies depending on the size of the airport and the operational philosophy adopted by the airport operating authority. For convenience of discussion, ground handling procedures can be classified as either terminal or airside operations.

2.2 Passenger Handling

Passenger handling in the terminal is almost universally entirely an airline function or the function of a handling agent operating on behalf of the airline. In most countries of the world, certainly at the major air transport hubs, the airlines are in mutual competition. Especially in the terminal area, the airlines wish to project a corporate image, and passenger contact is almost entirely with the airline, with the obvious exceptions of the governmental controls of health, customs, and immigration. Airline influence is perhaps seen at its

Terminal
Baggage check
Baggage handling
Baggage claim
Ticketing and check-in
Passenger loading/unloading
Transit passenger handling
Elderly and disabled persons
Information systems
Government controls
Load control
Security Cargo

Airside
Ramp services
Supervision
Marshaling Startup
Moving/towing aircraft
Safety measures

On-ramp aircraft servicing
Repair of faults Fueling
Wheel and tire check
Ground power supply Deicing

Cooling/heating
Toilet servicing
Potable water
Demineralized water
Routine maintenance
Nonroutine maintenance
Cleaning of cockpit windows, wings, nacelles, and cabin windows

Onboard servicing cleaning
Catering
In-flight entertainment
Minor servicing of cabin fittings
Alteration of seat configuration

External ramp equipment
Passenger steps
Catering loaders
Cargo loaders
Mail and equipment loading
Crew steps on all freight aircraft

Extreme in the United States, where individual airlines on occasion construct facilities In these circumstances, the airlines play a significant role in the planning and design of physical facilities that they will operate. Even where there is no direct ownership of facilities, industry practice involves the designation of various airport facilities that are leased to the individual airlines operating these areas. Long-term designation of particular areas to an individual airline results in a strong projection of airline corporate image, particularly in the ticketing and check-in areas and even in the individual gate lounges.

A more common arrangement worldwide is for airlines to lease designated areas in the terminal, but to have a large proportion of the ground handling in the ramp area carried out by the airport authority, a special handling agency, or another airline. At a number of international airports, the airline image is considerably reduced in the check-in area when common-user terminal equipment (CUTE) is used to connect the check-in clerk to the airline computers.

Apron passenger-transfer vehicles are usually of the conventional bus type Both airline and airport ownership and operation are common, airline operation being economically feasible only where the carrier has a large number of movements. Figure 6.6 shoVvs a typical airport-owned apron bus. Where a more sophisticated transfer vehicle, such as the mobile lounges shown in Figure 6.7 are used, it is usual for the operation to be entirely in the hands of the airport authority.

2.3 Ramp Handling

During the period that an aircraft is on the ground, either in transit or on turnaround, the apron is a center of considerable activity (IATA 2004). Some overall supervision of activities is required (ICAO 2010) to ensure that there is sufficient coordination of operations to avoid unnecessary ramp delays. This is normally carried out by a ramp coordinator or dispatcher who monitors departure control. Marshaling is provided to guide the pilot for the initial and final maneuvering of the aircraft in the vicinity of its parking stand position. Marshaling includes the positioning and removal of wheel chocks, landing-gear locks, engine blanking covers, pitot covers, surface control locks, cockpit steps, and tail steadies. Headsets are provided to permit ground-to-cockpit communication, and all necessary electrical power for aircraft systems is provided from a ground power unit. When the aircraft is to spend an extended period on the ground, the marshaling procedure includes arranging for remote parking or hangar space. The ramp handling process also includes the provision, positioning, and removal of the appropriate equipment for engine starting purposes. Figure 6.9 shows an engine air-start power unit suitable for providing for a large passenger aircraft.

Safety measures on the apron include the provision of suitable firefighting equipment and other necessary protective equipment, the provision of security personnel where required, and notification of the carrier of all damage to the aircraft that is noticed during the period that the aircraft is on the apron.

2.4 Aircraft Ramp Servicing

Most arriving or departing aircraft require some ramp services, a number of which are the responsibility of the airline station engineer. When extensive servicing is required, many of the activities must be carried out simultaneously.

Fault Servicing

Minor faults that have been reported in the technical log by the aircraft captain and that do not necessitate withdrawal of the aircraft from service are fixed under supervision of the station engineer.

Fueling

The engineer, who is responsible for the availability and provision of adequate fuel supplies, supervises the fueling of the aircraft, ensuring that the correct quantity of uncontaminated fuel is supplied in a safe manner. Supply is either by mobile truck systems to ensure competitive pricing from suppliers and to give maximum flexibility of apron operation. Oils and other necessary equipment fluids are replenished during the fueling process.

Wheels and Tires

A visual physical check of the aircraft wheels and tires is made to ensure that no damage has been incurred during the last takeoff/ landing cycle and that the tires are still serviceable.

Ground Power Supply

Although many aircraft have auxiliary power units (APUs) that can provide power while the aircraft is on the ground, there is a tendency for airlines to prefer to use ground electrical supply to reduce fuel costs and to cut down apron noise. At some airports, the use of APUs is severely restricted on environmental grounds. Typically, ground power is supplied under the supervision of the station engineer by a mobile unit.

Cooling/Heating

In many climates where an aircraft is on the apron for some time without operation of the APU, auxiliary mobile heating or cooling units are necessary to maintain a suitable internal temperature in the aircraft interior. The airline station engineer is responsible for ensuring the availability of such unit

Where fixed air systems are used, cockpit controls can ensure either internal heating or cooling on an individual aircraft basis depending on the requirement. Studies indicate that the high cost of running aircraft APUs now means that fixed air systems can completely recover capital costs from the savings of two years of normal operation. Where airlines have infrequent flights to an airport, APUs are still used.

Other Servicing

Toilet holding tanks are serviced externally from the apron by special mobile pumping units. Demineralized water for the engines and potable water are also replenished during servicing.

Onboard Servicing

While external aircraft servicing is being carried out, there are simultaneous onboard servicing activities, principally cleaning and catering. Very high levels of cabin cleanliness are achieved by

- Exchange of blankets, pillow, and headrests
- Vacuuming and shampooing of carpets
- Clearing of ashtrays and removal of all litter
- Restocking of seatback pockets
- Cleaning and restocking of galleys and toilets
- Washing of all smooth areas, including armrests

Catering

Personnel clear the galley areas immediately after disembarkation of the incoming passengers. After the galley has been cleaned, it is restocked, and a secondary cleaning takes care of spillage during restocking. Internationally agreed standards of hygiene must be met in the handling of food and drink from their point of origin to the passenger.

2.5 Ramp Layout

During the design phase of a commercial air transport aircraft, considerable thought is given to the matter of ramp ground handling. Modern aircraft are very large, complicated, and expensive. Therefore, the apron servicing operation is also complicated and consequently time-consuming. Unless the ramp servicing procedure can be performed efficiently, with many services being carried out concurrently, the aircraft will incur long apron turnaround times during which no productive revenue is earned. Inefficient ramp servicing can lead to low levels of aircraft and staff utilization and a generally low level of airline productivity It can be seen that the aircraft door and servicing-point layout has been arranged to permit simultaneous operations during the short period that the vehicle is on the ground during turnaround service. The ramp coordinator is required to ensure that suitable equipment and staff numbers are available for the period the aircraft is likely to be on the ground.

Particular attention must be paid to the compatibility of apron handling devices with the aircraft and other apron equipment. The sill height of the aircraft must be compatible with passenger and freight loading systems. In the case of freight, there is the additional directional compatibility requirement. Transporters must be able to load and unload at both the aircraft and the terminal onto beds and loading devices that are compatible with the vehicles' direction of handling. Many transporters can load or unload in the one direction only. The receiving devices must be oriented to accept this direction.

Most mobile equipment requires frequent maintenance. In addition to normal problems of wear, mobile apron equipment is subject to increased damage from minor collisions and misuse that do not occur in the same degree with static equipment. Successful apron handling might require a program of preventive maintenance on apron equipment and adequate backup in the inevitable case of equipment failure. Safety in the ramp area is also a problem requiring constant attention. The ramps of the passenger and cargo terminal areas are high-activity locations with much heavy moving equipment in a high-noise environment. Audible safety cues, such as the noise of an approaching or backing vehicle, are frequently not available to the operating staff members, who are likely to be wearing ear protection. Very careful training of the operating staff is required, and strict adherence to designated safety procedures is necessary to prevent serious accidents (IATA 2012; CAA 2006).

2.6 Departure Control

The financial effects of aircraft delay fall almost entirely on the airline. The impact of delays in terms of added cost and lost revenue can be very high. Consequently, the functions of departure control, which monitors the conduct of ground handling operations on the ramp (not to be confused with ATC departure), are almost always kept under the control of the airline or its agent. Where many of the individual ground handling functions are under the control of the airport authority, there also will be general apron supervision by the airport authority staff to ensure efficient use of authority equipment.

The ramp coordinator in charge of departure control frequently must make decisions that trade off payload and punctuality. Effect of breakdown and delay on apron dispatch: (a) activity normal, no control action; delay through breakdown, control required. Action 1: Assess the nature of the problem and how long the problem (breakdown of the cargo loader) will take to sort out. Action 2: Take corrective action immediately or call equipment base and ask the engineer to come to the aircraft immediately or call up a replacement loader. Action 3: Advise all other sections/activities that will be affected by the breakdown. Give them instructions as necessary (e.g., notify movement control of a delay, tell passenger service to delay boarding, etc.).

2.7 Division of Ground Handling Responsibilities

There is no hard-and-fast rule that can be applied to the division of responsibility for ground handling functions at airports. The responsibility varies not only from country to country but also among airports in the same country.

Prior to airline deregulation, handling activities were carried out mainly by airlines (acting on their own behalf or for another airline) or the airport authority. At many non-U.S. airports, all handling tasks were undertaken by the airport authority (e.g., Frankfurt, Hong Kong, and Singapore). The converse was almost universally true in the United States. Virtually all airport ground handling was carried out by the airlines. (In the old Soviet Union, all aviation activities were the responsibility of one organization, Aeroflot. This included the functions of the civil aviation authority, the airline, and the airports.)

Since deregulation, there has been a general movement toward liberalization and the introduction of competition in airport operations. In the mid-1990s, the European Union introduced regulations that required airports to use two or more ground handing operators where the scale of operation made this economic (EC 1996). This policy has been mirrored all around the world. Specialist companies are now providing some or all ground handling services at most large and medium-sized airports. In some facilities, the airlines still prefer to use their own staff where there is major contact between the company and the public. Ticketing, check-in, and lounge services are retained by the airline, but on the ramp, functions such as marshaling, steps, loading and unloading of baggage and cargo, and engine starts are carried out by the handling companies. Table 6.2 shows the results of a recent survey of how ground handling varies for a number of selected airports (see Acknowledgments).

2.8 Control of Ground Handling Efficiency

The extreme complexity of the ground handling operation requires skilled and dexterous management to ensure that staff and equipment resources are used at a reasonable level of efficiency. As in most management areas, this is achieved by establishing a system of control that feeds back into the operation when inefficiencies appear. The method of control used at any individual airport depends on whether the handling is carried out by the airline itself, by a handling agency such as another airline, or by the airport authority.

Four major reporting tools help to determine whether reasonable efficiency is being maintained and permit the manager to discern favorable and unfavorable operational changes.

Monthly complaint report. Each month, a report is prepared that shows any complaints attributable to ground handling problems. The report contains the complaint, the reason behind any operational failure, and the response to the complainant.

Monthly punctuality report. Each month, the manager in charge of ground handling prepares a report of all delays attributable to the ground handling operation. In each case, the particular flight is identified, with its scheduled and actual time of departure. The reason for each delay is detailed. The monthly summary should indicate measures taken to preclude or reduce similar future delays. Typical aircraft servicing standards are 30 to 60 minutes for a transit operation and 90 minutes for a turnaround. Where LCC operations are involved, these times may be reduced considerably.

Cost analysis. The actual handling organization will, at least on a quarterly basis, analyze handling costs. These costs should include capital and operating costs.

General operational standards. To ensure an overall level of operational acceptability, periodic inspections of operations and facilities must be made. This is especially important for airlines carrying out their own handling away from their main base or at airports where they are handled by other organizations. For the airport operation, it is equally important. In all areas possible, the evaluation should be carried out using quantitative measures. Subjective measures should be avoided because they are not constant between evaluators and may not be constant over time even with a single evaluator.

2.9 General

Ground handling of a large passenger aircraft requires much specialized handling equipment, and the total handling task involves considerable staff and labor inputs. Good operational performance implies a high standard of equipment serviceability. In northern climates, it is usual to assume that equipment will be serviceable for 80 percent of the time during the winter and 85 percent during the summer. Backup equipment and maintenance staff must be planned for the periods of unserviceability.

Passenger services: Security

Personal search or scan efficiency Hand baggage search efficiency Inconvenience level and waiting times rassenger services: tscort and boarding

Effectiveness of directions and announcements Staff availability for inquiries at waiting and boarding points Assistance at governmental control points Control of boarding procedure Liaison level between check-in and cabin staff Service levels of special waiting lounges for premium ticket holders Special handling: Minors, handicapped

Passenger services: Arrivals Staff to meet flight

Information for terminating and transfer passengers Transfer procedures

Assistance through government control points Special passenger handling: Minors, handicapped Baggage delivery standards Assistance at baggage delivery Passenger services: Delayed/diverted/canceled flights Procedures for information to passengers Procedures for greeters

Messages including information to destination and en-route points Procedures for rerouting and surface transfers Meals, refreshments, and hotel accommodations.

Passenger services: Baggage facilities Compilation of loss or damage reports Baggage tracing procedures Claims and complaints procedures Passenger services: Equipment

Check security and condition of all equipment: Scales, reservations printer, seat plan stand, ticket printer, credit-card imprinter, calculators, etc. Condition and serviceability of ramp vehicles Serviceability and appearance of ramp equipment Maintenance of ramp equipment and vehicles Control of ramp equipment and vehicles Driving standards and safety procedures

Communications: Telephones, ground-air radio, ground-ground radio Ramp handling: Aircraft loading/unloading Care of aircraft exteriors, interiors, and unit load devices Adequacy of loading instructions and training Ramp equipment planning and availability Positioning of equipment to aircraft Loading and unloading supervision Securing, restraining, and spreading loads Operation of load equipment Operation of aircraft onboard systems Securing partial loads Ramp security Ramp safety Pilferage and theft Ramp handling: Cleaning/catering Standard of cockpit and cabin cleaning/dressing Toilet/potable-water servicing Catering loading/unloading Availability of ground air Air-jetty operations

Ramp handling: Load control (for airline only)

Load sheet accuracy and adequacy of presentation Load planning

Advance zero-fuel calculation and flight preparation Ramp handling: Aircraft dispatch Punctuality record Turnaround/transit supervision Passenger release from aircraft Passenger waiting time at boarding point Logs and message files Accuracy of records of actual departure times Right plan, dispatch meteorological information

Ramp handling: Post departure

Accuracy and time of dispatch of post departure records and messages Cargo handling: Export Acceptance procedures Documentation: Procedures and accuracy Reservations: Procedures and performance Storage: Procedures and performance Makeup of loads: Procedures and performance Check weighing

Palletization and containerization: Procedures and performance Cargo handling: Import

Breakdown of pallets/containers: Procedures and performance

Customs clearance of documents

Notification of consignees

Dwell time of cargo

Lost/damaged cargo procedures

Proof of delivery procedures

Handling of dangerous goods procedures

Handling of restricted goods procedures

Handling of valuable consignments procedures

Handling of live animals procedures

Handling of mail

Administration of ground handling Office appearance Furniture and equipment condition

Inventory records: Ramp equipment/vehicles/office equipment/furniture Budgeting: Preparation and monitoring.

UNIT-3

GROUND HANDLING AND BAGGAGE HANDLING

Baggage Handling

Introduction

This chapter deals with baggage handling at airports from process, system, and organizational perspectives. The chapter itself is divided into the following topics:

- Context, history, and trends
- Baggage-handling processes
- Baggage-handling equipment, systems, and technology
- Process and system design drivers
- Organization
- Management and performance metrics

Context, History, and Trends

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, including flight cancellations, along with all that such events entail for airlines and passengers.

Historically, baggage appeared near the top of passengers' list of complaints, but this is no longer the case. An analysis of customer complaints over the period 2009-2012 shows that bag-
gage-related issues accounted for less than 5 percent of all complaints. A total of 3.8 percent of complaints are attributable to third parties— airlines and their handlers—and only 0.3 percent are attributable to terminal operations-the baggage-handling systems themselves.

This improvement has been the result of an industry-wide appreciation of the costs associated with poor baggage-handling performance combined with investments in advanced, automated baggage systems around the worlck Even so, the cost to the airport and airline
community (and hence the traveling public) is still large—the International Air Transport Association's (IATA's) director general, Giovanni Bisignani, remarked at The Wings Club in February 2009 that the global costs of mishandled bags were US$3.8 billion.

Even though baggage handling is usually carried out by an airline or its appointed handler, this distinction is often unclear to passengers. Thus, if they suffer problems or delays with baggage, passengers will assume that it is a failing of the airport, thereby risking its reputation. In practice, both airports and airlines have important roles to play, and a collaborative approach to managing baggage handling leads to a better outcome for all parties.

Baggage-Handling Processes

A typical set of baggage processes in airports 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 interterminal transfer process connecting passengers and their bags arriving at one terminal with their departure flights in a different terminal. 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. The major elements in this process are described in turn in the following sections.

Bag Drop

Off-airport check-in can be offered in a number of ways including in-town airline offices, check-in counters at downtown train stations, and services supporting check-in and bag drop at hotels. For example, in Hong Kong, most airlines have check-in counters at both Hong Kong and Kowloon Stations. Airport Express passengers can check in and leave baggage at these facilities so that they are free to visit the city for the rest of day before leaving for the airport without having to carry their baggage around with them. Car-park and curbside check-ins are convenient ways to check in for a flight and to drop bags without having to take them through a crowded airport building. They typically operate as follows:

- Pull up to a booth in a car park or the curb adjacent to the departure terminal, and present a photo ID along with a confirmation number, destination, flight number, or e-ticket number to an agent.
- Hand checked bags to the agent, collect the baggage receipt and boarding pass, and proceed straight to security.

The second wave is a bag drop where passengers can deposit hold baggage Often these bag drops are physically indistinguishable from a conventional check-in desk and are staffed in the same way it is simply that they are used purely for baggage acceptance.

There is growing interest in self-service bag drops, 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 [or permanent radiofrequency ID (RFID) tags are used for frequent flyers] so that tvtien 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 (compared with 1 to 2 minutes or more for conventional check-in and bag drop), coupled with multiple bag drops, means that there are rarely queues of passengers waiting to deposit bags performed in waves one and two also can be performed, and they can deal with additional functions such as taking payment for excess baggage or rebooking.

Usually Bag drop will involve one or more of the following:

- Agents inspecting all baggage at check-in for size to capture all non-cabin-compatible items.
- Limits placed on the size of baggage at passenger screening, necessitating the prior check-in of items that cannot be carried in the cabin.

- Agents spotting passengers waiting in and around gate areas with unsuitable baggage so that the items can be tagged and loaded before boarding begins.

  Usually gate bags do not need to be rescreened because they will have been checked along with the passenger through the processes needed to reach the gate.

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. A typical European screening process is shown in Figure 7.7. Uncleared 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 con-fidently, so the image will be passed to a human operator for a level 2 decision. In most cases 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, which 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, where a physical examination of the bag will be carried out.

The multilevel protocol adopted in the United States is as follows:

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 percentage of total bags) are either resolved or disposed of by a local law enforcement officer.

The TSA has published guidelines and design standards for hold- baggage screening that provide an excellent introduction to the U.S. implementation of hold-baggage screening (TSA 2011).

Bag Storage

Originally, baggage-handling systems had no need to provide bag storage—bags for a flight were accepted at check-in only when the flight makeup positions were available for use, typically two to three hours before the scheduled departure time. Over time, the need for additional bag storage has increased. One factor is the growth in transfer traffic, which can mean that an inbound flight and its connecting bags arrive well before the planned flight makeup positions for the departing flight are open. Another reason is the desire to allow passengers to check in bags when they choose. And increasingly, bag stores can be used to manage and buffer the flow of bags to flight makeup positions, thereby enabling more efficient use of staff and infrastructure or even supporting robotic loading systems

The flight build process can be very simple, particularly for small, non-containerized aircraft where there are not many bags to be loaded. However, with larger, containerized aircraft and for airlines with more complex products, the flight build involves ensuring that bags are sorted and loaded by segregation. Segregations might include some or all of the following:

- Premium terminating.
- Economy terminating.
- Crew bags.
- Short-connect transfers.
- Long-connect transfers.
- Inter-terminal transfers (by departure terminal).
- Onward transfers (by transfer destination).

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.

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 appearance profiles of passengers and bags at reclaim should be similar. This ensures that neither the reclaim device nor the reclaim hall becomes too busy with bags and passengers, respectively.

7.4 Equipment, Systems, and Technologies

This section describes the equipment, systems, and technologies that are used to implement and support the processes outlined earlier.

Baggage-Handling-System Configurations

The design of the passenger terminal complex itself can radically affect the configuration of the outbound-baggage system. A number of design considerations are covered in IATA (2004).

Conventional centralized-pier finger airports, such as Chicago O'Hare, Schiphol Amsterdam, and Manchester International, operate on one or more central bag rooms in the main terminal area. These require elaborate sorting systems, but can be efficient in the use of personnel who are released when not needed in off-peak periods. Decentralized facilities, such as Frankfurt (Germany) and Dallas-Fort Worth, have a number of decentralized bag rooms that are closely associated with a few gates. The sorting requirements of these makeup areas are minimal, but it is more difficult to use staff efficiently in the decentralized situation, where there are substantial variations in workload between peak and off-peak periods. A third concept of baggage makeup area is the remote bag room. In 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.

Check-in and Bag Drop

Traditional check-in and bag-drop desks can be arranged in a number of ways:

- Linear
- Island
- Flow-through

Schematics of these three configurations are shown in Figure 7.10. Both linear and island check-in have the disadvantage that the flow of passengers leaving the desks can conflict with queues of passengers waiting to reach the desks. Flow-through arrangements, however, avoid this difficulty but are feasible only where the terminal has the space to accommodate vertical movement of bags within the check-in floor plate.

Sorting

Once baggage has entered a system (other than the simplest), it has to be sorted. Destinations include screening equipment, manual encoding stations, and bag storage or flight makeup locations. There are several methods of sorting bags, the choice of which is governed by a combination of factors, including

- Space
- Cost
- Required capacity

For low-capacity applications, conveyor-based merges and diverts may be chosen. For somewhat higher capacities, vertical sorting and merge units may be employed because these can switch sufficiently quickly to allow adjacent bags to be sorted to two different locations with a throughput of over 1,000 bags per hour.

In cases where loose baggage is handled, every merge, divert, incline, and sorter in-feed or output has the potential for a bag to become snagged or trapped with the risk of damage to the system and/or bag. Careful design and tuning of the system become necessary to minimize this risk; otherwise, there will be frequent system stoppages and the associated cost of staff being needed to free jams.

Hold-Baggage Screening

As screening technology develops, new and better machines become available. The control authorities build this into their regulations to ensure the best-possible chance of detection of known and potential threats. To date in Europe, three standards of x-ray screening equipment have been identified:

- *Standard 1*—a single-view technology
- *Standard* 2—a multi-view technology
- *Standard 3*—a computed tomo-graphic technology

Bag Storage

Bag storage can take one of several forms. At its simplest is a manual store in which bags are grouped, by hand, by flight or departure time. This involves little more than space on the ground or racks to accommodate the bags. Automated stores vary in functionality. At one extreme, they simply automate the manual process—accumulating groups of bags in conveyor lanes by flight or build open time. Such a store does not readily lend itself to the retrieval of a single, particular bag—a whole lane of bags would have to be released to access just one specific bag.

More sophisticated stores allow random access to any particular bag. These stores usually depend on bags being carried in totes, which enable them to be transported and tracked effectively. One type of store involves setting up long conveyor loops on which the toted bags circulate slowly. As the bags pass outputs, they can be diverted so that they leave the store. Another type of store makes use of a warehouse crane and racking approach (Figure 7.14). Toted bags entering the store are taken by crane and placed in a slot in a lane of racking. This, too, allows single bags to be retrieved and thereby offers the most flexible of storage systems.

Flight Build

The type and configuration of manual makeup devices are varied, including

- Chutes
- Carousels
- Laterals

Each offers a combination of advantages and drawbacks. Chutes can be arranged space efficiently, thereby ensuring a one-to-one mapping between chute and ULD and/or trailer. However, they suffer from poorer handling ergonomics than laterals. Carousels offer a flexible means of distributing bags to several makeup positions, but there can be concerns over the ergonomics of picking bags from a moving device. Laterals (Figure 7.15) can be set at an optimal height for operators and are compatible with modern manual handling aids.

New ways of handling flight build are being implemented, and these require different makeup devices. Of particular note are fully automated, robot-based build cells and semi automated batch build devices.

A build cell employs a robotic arm fitted with a specialized handling tool to receive a bag from the baggage-handling system and, using a machine vision system, then will place the bag into a trailer or ULD. The work rate achieved by such systems is typically three to four bags per minute—not necessarily faster than a human operator, but it is sustainable indefinitely and relieves handlers of the physical load. A build cell cannot operate unsupervised

Reclaim

The most common baggage reclaim device is a carousel, of which there are several variants. The two principal choices are

- Flatbed or inclined
- Direct or indirect infeed(s)

Process and System Design Drivers

Appearance Profiles

The appearance profile of bags at an airport is an important factor that influences the need for facilities to be open and available (e.g., check-in and transfer inputs), as well as the need for bag storage. The appearance profiles shown in Figure 7.19 are taken from a European hub airport for the major types of destinations. At first glance, the results suggest that the longer the journey, the earlier the bags will appear.

Bags per Passenger

Bag-per-passenger ratios are a key component in the design basis for baggage facilities, and they vary considerably by type of passenger

Parameter	Value
Check-in process	1-2 minutes per person
Bag drop process	0.5-2 minutes per bag (prelabeled to full-service)
ULD build rate	3-4 bags per minute
ULD break rate	8-12 bags per minute
In-line baggage-screening rate	15-20 bags per minute per machine (standards 1 and 2)
Aircraft ULD un/loading process	3 minutes per pair of AKE ULDs (one hold)
Reclaim input rate	20 bags per minute

TABLE **7.1** Processing Times

Processing Times

The number of facilities required to service a given demand depends on the processing times associated with that particular facility. Table 7.1 lists a number of important parameters.

Arrivals Delivery Performance

The speed of delivery of bags from an inbound aircraft to either a reclaim device (for terminating bags) or the input of the baggage handling system (for transfer bags) is the key measure of handler performance. Flight historically, this has been measured by first and last bag delivery times—for example, first bag on reclaim within 15 minutes and last bag on reclaim within 25 minutes of aircraft arrival on chocks. Such measures have the benefit of simplicity and can be used to

encourage good handler performance, but three trends mean that more refined targets are becoming necessary at some airports:

- An increase in the number of very large aircraft
- A desire to reduce minimum connection times
- An increase in the size of airports and hence distances between facilities

The implications of these trends are described in turn. First, a performance standard based on delivering, say, 250 bags from a medium sized aircraft becomes challenging to achieve for a very large aircraft with 500 or more bags. Second, the need to achieve reliable, short- transfer connection times (especially from very large aircraft with many transfer bags) means that a tighter performance standard needs to be applied to the time-critical transfer bags while allowing more time for non-time-critical bags. Third, large airports (without distributed arrival baggage systems) inevitably lead to longer driving times from some stands to reclaims than from others, making a "one size fits all" standard inappropriate.

In order to deal with the growth in size and scale, different priorities can be assigned to the four main categories of inbound bags:

- Premium terminating (e.g., first class, business class, frequent- flyer cardholders)
- Economy terminating
- Short-connect transfers (with scheduled connection times of less than about 2 hours)
- Long-connect transfers (with scheduled connection times of more than about 2 hours)

Logic dictates that premium bags should be delivered before economy bags and that short-connect bags should be delivered before long-connect bags. The only remaining choice is whether to prioritize premium bags over short-connect bags or vice versa. Long-connect bags should be given the lowest priority in any case. Of course, the ability to fine-tune the delivery of these different categories depends on the appropriate segregation and loading of the inbound aircraft.

For reclaim, it is desirable to set targets for the delivery of bags *relative to the arrival of passengers* in the reclaim hall. For example, the aim might be to deliver all premium bags before the first passengers reach the reclaim hall so that no premium passengers have to wait for their bags. A maximum-waiting-time target might be set for economy passengers. In practice, this can be hard to measure and control. While processes and systems can be put in place to log when a bag is delivered to the reclaim device, it is much harder to monitor the arrival times at reclaim of specific passengers.

COMPONENTS OF AIRPORT:

Therefore, the main components of airport are:

1. Landing Area of Airport

It is the airport components used for landing and takeoff operations of an aircraft. Landing Area includes ***Runways*** and ***taxiways***.

2. Terminal Area

The transition of passengers and goods from ground to air takes place in the terminal area. Various methods are used to accommodate and transfer the public and its goods arriving either by ground or by air. The degree of development in the terminal area depends upo9n volume of airport, operations, type of air traffic using airport, number of passengers and the airport employees to be served and the manner in which they are served and accommodated. Terminal area consists of the following parts ***Terminal building***, ***Apron***, ***Automobile Parking Area***, ***Hangers***.

Landing area is the component of airport used for landing and takeoff operations of an aircraft. Landing area includes

1. Runways

It is the most important part of an airport in the form of paved, long and narrow rectangular strip which actually used for landing and takeoff operations. It has turfed (grassy) shoulders on both sides. The width of runway and area of shoulders is called the landing strip. The runway is located in the center of landing strip. The length of landing strip is somewhat larger than the runway strip in order to accommodate the stop way to stop the aircraft in case of abandoned takeoff.

The length and width of runway should be sufficient to accommodate the aircraft which is likely to be served by it. The length of runway should be sufficient to accelerate the aircraft to the point of takeoff and should be enough such that the aircraft clearing the threshold of runway by 15m should be brought to stop with in the 60% of available runway length. The length of runway depends on various meteorological and topographical conditions. Transverse gradients should not be less than 0.5% but should always be greater than 0.5%.

2. Taxiways

Taxiway is the paved way rigid or flexible which connects runway with loading apron or service and maintenance hangers or with another runway. They are used for the movement of aircraft on the airfields for various purposes such as exit or landing, exit for takeoff etc. The speed of aircraft on taxiway is less than that during taking off or landing speed.

The taxiway should be laid on such a manner to provide the shortest possible path and to prevent the interference of landed aircraft taxying towards loading apron and the taxiing aircraft running towards the runway. The intersection of runway and taxiway should be given proper attention because during turning operation, this part comes under intense loading. If it is weaker then the aero plane may fell down from taxiway. Its longitudinal grade should not be greater than 3% while it s transverse gradient should not be less than 0.5%. It is also provided with a shoulder of 7.5m width paved with bituminous surfacing. The taxiway should be visible from a distance of 300m to a pilot at 3m height from the ground.

Passenger Terminal Operations

1 Functions of the Passenger Terminal

Analysis of the operation of an airport passenger terminal leads to the conclusion that three principal transportation functions are carried out within the terminal area (Ashford et al. 2011):

1. *The processing of passengers and baggage.* This includes ticketing, check-in and baggage drop, baggage retrieval, governmental checks, and security arrangements.

2. *Provision for the requirement of a change of movement type.* Facilities are necessarily designed to accept departing passengers, who have random arrival patterns from various modes of transportation and from various

points within the airport's catchment area at varying times, and aggregate them into planeloads. On the aircraft arrivals side, the process is reversed. This function necessitates a holding function, which is much more significant than for all other transport modes.

3. *Facilitating a change of mode.* This basic function of the terminal requires the adequate design and smooth operation of terminal facilities of two mode types. On the airside, the aircraft must be accommodated, and the interface must be operated in a manner that relates to the requirements of the air vehicle. Equally important is the need to accommodate the passenger requirements for the landside mode, which is used to access the airport.

An intimation of the complexity of the problem can be grasped from an examination of Figure 8.1, which is admittedly a simplification of the flow process for passengers and baggage through a typical domestic-international airport passenger terminal. When examining a chart of this nature, it must be remembered that the representation can only be in generalized terms and that the complexities of operation are introduced by the fact that flows on the airside are discrete and those on the landside are continuous. The substantial growth rate of air transportation since World War II has meant that many airports around the world are now large operations. Unlike the pre-1940 period, when air transportation was a fringe activity on the economy, the air mode is now a well-established economic entity. The result on passenger terminals has been dramatic (Hart 1985). More than a score of large international airport terminals are handling more than 30 million passengers per year, and the number continues to grow. Operations of this scale are necessarily complex.

Terminal Functions

Transportation planners use the term *high-activity centers* to describe facilities such as airport terminals that have a high throughput of users. In the peak hour, the largest passenger airports process well in excess of 10,000 passengers. With the increased security measures since 2001, departing international passengers are likely to spend *IV*2 to 2 hours in the terminal facility, and arriving international passengers spend at least 30 minutes. During the period that they spend in the terminal, passengers are necessarily engaged in a number of processing activities and are likely to use a number of subsidiary facilities put in the airport for their comfort and convenience, as well as for the airport's profit. Before discussing in some detail these individual activities, it is worth classifying the terminal activities into five principal component groups:

- Direct passenger services.
- Airline-related passenger services.
- Governmental activities.
- Non-passenger-related airport authority functions.
- Airline functions.

Either directly or indirectly, these functions, where conducted in the passenger terminal area, will involve some responsibility on the part of the terminal manager. Figure 8.4 shows the typical organization of these responsibilities for the terminal operation at a major airport.

The individual terminal functions are discussed in more detail.

3 Philosophies of Terminal Management

Although the basic operational procedures of airports as they relate to safety are generally similar throughout the world, the manner in which those procedures are operated and the organization used to effect them can differ quite radically. Perhaps nowhere in the airport do the operational philosophies differ as much as in the terminal area. The two extreme positions may be designated as

- Airport-dominant
- Airline-dominant

Where terminal operations are airport-dominant, the airport authority itself provides the staff to run terminal services. Apron, baggage, and passenger handling are either entirely or largely carried out by airport-authority staff. Services and concessions within the terminal are also mainly authority operated. Airport-dominant operations are sometimes called the *European model*, although similar arrangements are found throughout the world. Frankfurt is perhaps the best example of this form of operation, which involves high airport- authority staffing levels and high authority equipment costs with concomitant savings to airlines.

Most major airports around the world work on a mixed model, where the airport authority takes care of some terminal operations, and airlines and concessionaires operate other facilities. In some airports, competitive facility operation is encouraged to maintain the high service standards usually generated by competition. In the European Union, European Commission (EC) directives are forcing airports to introduce competition at airports where operation previously has been by a single organization. This trend away from singleauthority operation has been aided by the increasing trend toward total airport privatization, either by outright transfer of ownership outside the public sector or by the granting of long-term concessions for the operation of entire airports.

Competitive handling operations are also less vulnerable to a complete shutdown by industrial action. The final choice of operational procedure will depend on a number of factors, including:

- Philosophy of the airport authority and its governing body
- Local industrial relations
- International and national regulations
- Financial constraints
- Availability of local labor and skills

Direct Passenger Services:

Terminal operations that are provided for the convenience of air travelers and are not directly related to the operations of the airlines are normally designated as direct passenger services. It is convenient to further divide this category into commercial and noncommercial services. There is no hard-and-fast division between these two subcategories, but noncommercial activities are usually seen as being entirely necessary services that are provided either free of charge or at some nominal cost. Commercial activities, on the other hand, are potentially profitable operations that are either peripheral to the transportation function of the airport (e.g., duty-free shops) or avoidable and subject to the traveler's choice (e.g., car parking and car rental).

Typically, at a large passenger terminal, the following noncommercial activities will be provided, usually by the airport authority:

- Porter age
- Flight and general airport information
- Baggage trolleys
- Left-luggage lockers and left-luggage rooms[2]
- Directional signs
- Seating
- Toilets, nurseries, and changing rooms
- Rest rooms
- Post office and telephone areas
- Services for people with restricted mobility and special passengers[1]

Depending on the operating philosophy of the airport, commercial facilities will be operated either directly by the authority itself or leased on a concessionary basis to specialist operators. Typically, at a large airport, the following commercial activities can be expected to play and important part in the operation of the passenger terminal:

- Car parking
- Restaurants, cafes, and food bars
- Duty-free and tax-free shops
- Other shops (e.g., book shops, tourist shops, boutiques, etc.)
- Car rental
- Internet service
- Insurance
- Banks and exchange services
- Hairdressers, dry cleaners, and valet services
- Hotel reservations
- Amusement machines, lotteries
- Advertising

Business-center facilities large passenger terminals are generators of large commercial profits. If commercial exploitation of the airport is decided on, a number of operational policy decisions must be made. First, a decision must be made on the mode of operation. Five different modes are common; these are operation by

- A department of the airport authority directly
- A specially formed, fully owned commercial subsidiary of the airport authority
- A commercial subsidiary formed by the airport authority and the airlines
- A commercial subsidiary formed by the airport authority and a specialist commercial company
- An independent commercial enterprise

Other methods of control that have been used successfully include

1. *Length of lease.* Medium-term leases of 5 to 10 years have several advantages. They permit the concessionaire to run an established operation with medium-term profits. Successful operators usually are able to renegotiate for

renewed concessionary rights. Unsuccessful operators can be removed before long-term financial damage accrues to the airport.

2. *Exclusive rights.* In return for exclusive rights on the airport, the authority can demand contractual arrangements that protect the airport's financial and performance interests. There is a significant recent move away from granting exclusive rights in shopping concessions in order to encourage competitive pricing.
3. *Quality of service.* Many airports require contracts that restrict the concessionaire's methods of operation. These constraints include authority control over the range of goods to be stocked, profit margins and prices, and staffing levels, as well as detailed operational controls on such items as advertising, decor, and display methods.

Where the airport is privately owned, there are no limits on how the concessionary contracts can be drawn up. If the operator of the airport is itself a concession, the government may impose limits on how subconcessions are to be arranged.

Advertising is an area of financial return that has not been fully explored by many airports. The advertising panel shown in Figure 8.6 is an example of a very satisfactory modern display that adds to the decor of the terminal without clutter while paying a handsome return to the authority from a little financial outlay. Care must be taken in selecting advertising so that the displays do not interfere with passenger flow or obstruct necessary informational signs. Significantly, there are airports that ban internal advertising on aesthetic grounds, but these are growing fewer in number.

facilities (IATA 2004).

Airline-Related Operational Functions

Flight Dispatch

A major preoccupation for airline management in relation to airport terminal operations is the achievement of on-time departures. Many of the activities associated with this, such as the refueling and cleaning of aircraft, together with the loading of food supplies, are carried out on the ramp and are familiar to most airport staff. There is, however, a less familiar procedure that covers all the necessary technical planning without which a flight could not depart. The main activities associated with this procedure of flight dispatch are

- Flight planning
- Aircraft weight and balance
- Flight-crew briefing
- Flight watch

In the United States, this is a long-established procedure, and the work is carried out by aircraft dispatchers who work in close cooperation with the aircraft captain. Flowever, in the case of large airlines, the flight-planning process is carried out more often as a central function at the airline's home base (for American Airlines, this is Dallas). Although aircraft dispatchers are used by many international airlines, there is also the designation of flight operations officer for staff members who carry out this work.

The airline departments at airports concerned with flight dispatch will need access to airport operations departments, air traffic services, meteorological services, and communications facilities, including email, internet, teleprinters, telephones, and radios. Depending on the extent of their activities, many airline operations offices also will use a variety of computer facilities, although these latter may not necessarily be in-house systems.

Flight Planning

The primary purpose of flight planning is to determine how long an individual flight will take and how much fuel will be required. For long-range flights, there will be a variety of options in terms of altitudes, tracks, and aircraft power settings and speeds. Variations in weather, wind, and temperature also will have to be taken into account. Of course, computerized flight-planning tools are used by major airlines to perform these optimizations. Such tools examine feasible options so that a decision can be taken as to the most appropriate of the several alternatives. The evaluation might include an indication of comparative costs: A slower flight might prove desirable from a cost point of view. The analysis would include several altitude options. This often proves useful if, owing to the density of traffic, air traffic control (ATC) has to impose a last-minute altitude change.

For short-range flights, there are generally very few options, and in areas of very dense traffic, routings for all practical purposes are predetermined by the structure of the airways. In such cases, such as, for example, in Europe, the flight plans usually will be standardized to the extent that relevant extracts can be placed on permanent file with ATC. These are referred to in Great Britain.

As *stored flight plans* and are automatically printed out from ATC computer files in advance of flight departures. The airline flight plans, the operational or company flight plans, give a great deal of information, including the en-route consumption of fuel. Such details are not the concern of ATC, which requires altitudes and times in relation to the ATC system checkpoints, together with certain safety details (e.g., number of persons on board the aircraft and the detail of the instrument-flying aids and safety equipment carried by the aircraft). The international format for the ATC flight plan is shown in Figure 8.9.

Aircraft Weight and Balance

The *dry operating weight* of an aircraft is taken as the starting point for weight calculations. To this is added the anticipated payload, which consists of

- Cargo load
- Passengers
- Baggage

This provides the *zero-fuel weight.* The total fuel load is added, less an allowance for fuel used in taxiing before takeoff, to calculate the *takeoff weight.* The fuel that is expected to be consumed during the flight is deducted from the *takeoff weight* to calculate the *landing weight.*

It should be noted that these calculations may be in either pounds, which is the case in the United States, or in kilograms. However, before any actual load calculations can be carried out, account must be taken of the physical weight limitations, the design limits, of the aircraft structure in the various operation phases.

Takeoff

There is a *maximum takeoff weight* (i.e., at brake release) that the available power can lift off the runway and sustain in a safe climb. The value is established by the manufacturer in terms of ideal conditions of temperature, pressure, runway height, and surface conditions. Along with these values, the manufacturer will provide performance details for variations in any of these conditions.

In Flight

There are limits on the flexibility of the wings of each aircraft design. These are imposed by the upward-bending loads that the wing roots can sustain without breaking. The greatest load would be imposed if , there were no fuel remaining in the wings (fuel cells), which is why the *zero-fuel weight* is taken as a limitation on fuselage load.

Landing

Depending on the shock-absorbing capabilities of the aircraft undercarriage, there is a *maximum landing weight* that it can support on landing without collapsing. Thus the three design-limiting weights are maximum takeoff weight, maximum zero-fuel weight, and maximum landing weight. Typical examples of these values for a Boeing 747-300 are

- Maximum takeoff weight 883,000 pounds (377,850 kg)
- Maximum zero-fuel weight 535,000 pounds (242,630 kg)
- Maximum landing weight 574,000 pounds (260,320 kg)

The completed flight plan will provide two fuel figures:

Takeoff fuel. This is the total amount of fuel onboard for a particular flight. This does not include taxiing fuel but will include required fuel reserves for flight to an alternative destination or for holding or delay before landing.

Trip fuel. This is the fuel required for the trip itself, that is, between the takeoff and the point of first intended landing (it is also sometimes referred to as *burnojf).*

In order to arrive at the maximum permissible takeoff weight, we compare three possible takeoff weights:

- Takeoff weight' = maximum takeoff weight
- Takeoff weight" = aero-fuel weight + takeoff fuel
- Takeoff weight'" = landing weight + trip fuel

The lowest of these three values is the maximum allowed takeoff weight, and this value minus the operating weight will give the allowed traffic load. These and other values are used in relation to aircraft weight calculations and load, and they also appear on the load sheet, for which there is a format agreed on by the IATA. Together with the values for takeoff fuel and trip fuel, the following operational figures are included in a load-sheet calculation:

- *Dry operating weight.* The weight of the basic aircraft, fully equipped, together with crew and their baggage, pantry/ commissary supplies, and flight spares, but not including fuel and payload
- *Operating weight.* The sum of dry operating weight and takeoff fuel
- *Takeoff weight.* The operating weight plus payload (traffic load)
- *Total traffic load.* The sum of the weights of the various types of load, that is, passengers, baggage, cargo, and mail, as well as the weight of any unit-load devices (ULDs, containers) not included in the dry operating weight

All these various weights appear on the load sheet together with a breakdown of the weight distribution.

Balance/Trim

Having ensured that the aircraft load is within the permitted weight limitations, it is then necessary to distribute the load in such a way that the center of gravity is within the prescribed limits. This is calculated by means of a trim sheet, which might be a separate form or part of a combined load and trim sheet (Figure 8.10). On the trim diagram, each of the aircraft's compartments is given a scale graduated either in units of weight, for example, 1,100 pounds (500 kg), or blocks of passengers (e.g., five passengers). Starting from the dry-operating-index scale, the effect of weight in each compartment then is indicated by moving the required number of units along the scale in the direction of the arrow and dropping a line down from that point to the next scale, where the process is repeated, ending up with a line projecting down into the center-of-gravity (CG) envelope, where its value is noted as a percentage of the wing mean aerodynamic chord (MAC). The outer limits of the envelope are clearly indicated by the shaded areas. Certain sections of the load-sheet side of the form are also shaded to indicate data that should be included in a load message to be transmitted to the aircraft destination(s). These functions are now almost universally computerized.

Loading

The distribution of the load into various compartments must be detailed for the information of ramp loading staff, and this is achieved by the issue of loading instructions, usually in the form of computer-drawn diagrams. In Figure 8.11, the details are given of the various container positions. Where containers are not used, it will be necessary at this stage to take into account limitations in respect to dimensions, vis-a-vis the measurements of the hatch openings and also maximum floor loadings, and the loading instructions will be drawn up accordingly.

All matters relating to the load carried on an aircraft and the position of the CG have such a direct influence on flight safety that the documents used are of considerable legal significance, reflecting as they do the regulations of each country. For this reason, they have to be signed by the airline staff responsible for these various aspects.

Flight-Crew Briefing

The purpose is to present to flight crew appropriate advice and information to assist them in the safe conduct of a flight. The information will include a flight plan and load details together with information regarding en-route and destination weather and notices regarding any un serviceability’s of navigation or landing aids.

Passenger Information Systems

Passengers move through airport terminals under their own power. They are not physically transported in a passive manner, as is freight, although in larger terminals mechanical means are used to aid in movement through the facility (see Section 8.12). This, of course, does not refer to people with restricted mobility, who need special ramps and other necessities, which are beyond the scope of this book. Equally important, a large number of passengers reach airports in their own personal vehicles. There is therefore a need to ensure that the passenger has sufficient information both in the access phase of the journey and in passing through the terminal to

VIP lounge facilities. (Source: Bahrain International Airport.)

reach the correct aircraft gate at the right time with a minimum of difficulty and uncertainty. Additionally, the passenger requires information on the location of many facilities within the terminal, such as telephones, toilets, cafeterias, and duty-free shops. Information therefore is usually functionally classified into either directional-guidance or flight-information categories. Directional guidance commences some distance from the airport and normally involves cooperation with some local governmental authority to ensure that suitable road signage is incorporated into the road system on all appropriate airport access roads (Figure 8.15). Often such signs include an aircraft symbol to help the driver to identify directions rapidly. Nearer the airport, terminal-approach road signs will guide the passenger to the appropriate part of the terminal. It is essential that the driver be given large, clear signs in positions that permit safe vehicular maneuvering on the approach-road system. The driver must obtain information on the route to be taken with respect to such divisions as arrivals/departures and domestic/international flights and often to airline-specific locations (Figure 8.16). In multi-terminal airports, there will be signage to each individual terminal, either by terminal designation or by airline groups. Within the terminal, departing passenger flows are guided principally by directional- guidance signs, which indicate check-in, governmental controls, departure lounges, gate positions, and so on. Other terminal facilities that must be identified are concessionary areas and public service facilities such as telephones, toilets, and restaurants (Figure 8.17).

Information signs in terminal.

It is essential that the signage is carefully designed. The International Civil Aviation Organization (ICAO) has a set of recommended picto- grams for signage inside terminals. Many airports have adopted their own signage convention. In some cases, the signage used falls short of acceptable standards. Sufficient signage must be given to enable the passenger to find the facility or the direction being sought; equally, there cannot be such a proliferation of signs that there is confusion. It is essential that the signage configuration be designed to conform to available internal building heights, which itself must be set recognizing that overhead signage is essential. Once in the terminal, passengers receive information concerning the status and location of departing flights by the departure side of the flight information system. Historically, this information has been displayed on mechanical, electromechanical, or electronic departure flight information boards. However, these largely have been supplanted by cheaper visual display units (VDUs), which can be located economically at a number of points throughout the terminal.

UNIT-4
PASSENGER TERMINAL OPERATIONS AND CARGO OPERATIONS

1. Functions of the Passenger Terminal

Analysis of the operation of an airport passenger terminal leads to the conclusion that three principal transportation functions are carried out within the terminal area (Ashford et al. 2011):

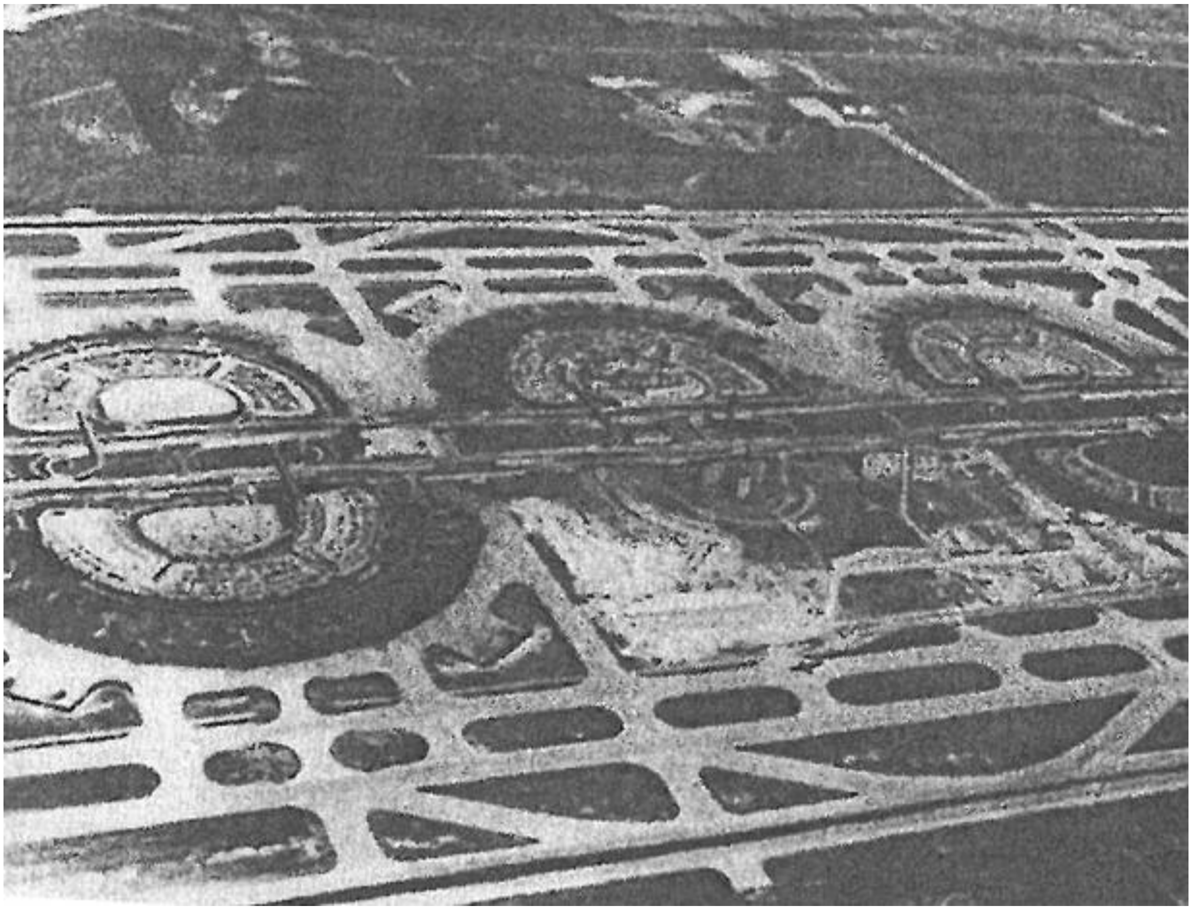
4. *The processing of passengers and baggage.* This includes ticketing, check-in and baggage drop, baggage retrieval, governmental checks, and security arrangements.
5. *Provision for the requirement of a change of movement type.* Facilities are necessarily designed to accept departing passengers, who have random arrival patterns from various modes of transportation and from various points within the airport's catchment area at varying times, and aggregate them into planeloads. On the aircraft arrivals side, the process is reversed. This function necessitates a holding function, which is much more significant than for all other transport modes.
6. *Facilitating a change of mode.* This basic function of the terminal requires the adequate design and smooth operation of terminal facilities of two mode types. On the airside, the aircraft must be accommodated, and the interface must be operated in a manner that relates to the requirements of the air vehicle. Equally important is the need to accommodate the passenger requirements for the landside mode, which is used to access the airport.

An intimation of the complexity of the problem can be grasped from an examination of Figure 8.1, which is admittedly a simplification of the flow process for passengers and baggage through a typical domestic-international airport passenger terminal. When examining a chart of this nature, it must be remembered that the representation can only be in generalized terms and that the complexities of operation are introduced by the fact that flows on the

Schematic of the passenger baggage flow system (G = gate control and airline check-in, if required; P = passport control; C = customs control; H = health control, if required; T = transfer check-in; S = security control). (Source: Ashford et al. 2011.)airside are discrete and those on the landside are continuous. The substantial growth rate of air transportation since World War II has meant that many airports around the world are now large opera-tions.

Unlike the pre-1940 period, when air transportation was a fringe activity on the economy, the air mode is now a well-established economic entity. The result on passenger terminals has been dramatic (Hart 1985). More than a score of large international airport terminals are handling more than 30 million passengers per year, and the number continues to grow. Operations of this scale are necessarily complex.

The relatively recent development of large air passenger volumes has required the provision of increasingly large facilities to accommodate the large peak flows that are observed routinely. Single terminals designed for capacities in the region of 10 million passengers per year often have internal walking distances of 3,500 feet.




Main Terminal and Concourse T
Concourse A
Concourse B
Concourse C
Concourse D
Concourse E (International)

(1,100 m) between extreme gates. Where capacities in excess of 30 million annual passengers are involved, largely single-terminal complexes, such as Chicago O'Hare and Schiphol Amsterdam, are likely to have internal gate-to-gate distances in the region of 5,000 feet (1,500 m). To overcome problems such as this, and to meet International Air Transport Association (IATA) recommendations on passenger walking distances, several "decentralized" designs were evolved, such as those now in operation at Kansas City, Dallas-Fort Worth, and Paris Charles de Gaulle II. Decentralization is achieved by

1. Breaking the total passenger terminal operation into a number of unit terminals that have different functional roles (differentiation can be by international-domestic split, by airline unit terminals, by long-haul-short-haul divisions, via airline alliance terminals, etc.)
2. Devolving to the gates themselves a number of handling operations that previously were centralized in the departure ticket lobby (e.g., ticketing, passenger and baggage check-in, seat allocation, etc.)

Coupling a decentralized operational strategy with a suitable physical design of the terminal can result in very low passenger walking distances, especially for routine domestic passengers. Where considerable interlining takes place, or where the passenger's outbound and inbound airlines are likely to differ, decentralization is likely to be less convenient to travelers. For example, one of the earlier decentralized designs, Dallas-Fort Worth (Figure *2a)*, can be less convenient for an interlining passenger who has to change terminals than the newer Atlanta design (Figure.2*b)*. International operations significantly affect the design of terminal facilities and the procedures, used. From this viewpoint, the airport planner and operator must be extremely careful in extrapolating U.S. experience, which, although well documented, is likely to be based overwhelmingly on domestic operations (FAA 1976, 1980, 1988). The infusion of governmental requirements necessarily associated with international operations (i.e., customs, immigration, health and agricultural controls, and especially security) can add considerable complications to the layout and operation of a terminal. Separation is required in some European Union countries for operations that are within the Schengen group and those which are not.

The Eurohub terminal at Birmingham, the United Kingdom has a most complex arrangement of the interlocking doors to allow for flows among international, domestic, and "common travel" passengers.

2. Terminal Functions

Transportation planners use the term *high-activity centers* to describe facilities such as airport terminals that have a high throughput of users. In the peak hour, the largest passenger airports process well in excess of 10,000 passengers. With the increased security measures since 2001, departing international passengers are likely to spend *IV*2 to 2 hours in the terminal facility, and arriving international passengers spend at least 30 minutes. During the period that they spend in the terminal, passengers are necessarily engaged in a number of processing activities and are likely to use a number of subsidiary facilities put in the airport for their comfort and convenience, as well as for the airport's profit. Before discussing in some detail these individual activities, it is worth classifying the terminal activities into five principal component groups:

- Direct passenger services
- Airline-related passenger services
- Governmental activities
- Non-passenger-related airport authority functions
- Airline functions

Either directly or indirectly, these functions, where conducted in the passenger terminal area, will involve some responsibility on the part of the terminal manager. Figure 8.4 shows the typical organization of these responsibilities for the terminal operation at a major airport.

3 Philosophies of Terminal Management

Although the basic operational procedures of airports as they relate to safety are generally similar throughout the world, the manner in which those procedures are operated and the organization used to effect them can differ quite radically. Perhaps nowhere in the airport do the operational philosophies differ as much as in the terminal area. The two extreme positions may be designated as

- Airport-dominant
- Airline-dominant

Where terminal operations are airport-dominant, the airport authority itself provides the staff to run terminal services. Apron, baggage, and passenger handling are either entirely or largely carried out by airport-authority staff. Services and concessions within the terminal are also mainly authority operated. Airport-dominant operations are sometimes called the *European model,* although similar arrangements are found throughout the world. Frankfurt is perhaps the best example of this form of operation, which involves high airport- authority staffing levels and high authority equipment costs with concomitant savings to airlines.

Most major airports around the world work on a mixed model, where the airport authority takes care of some terminal operations, and airlines and concessionaires operate other facilities. In some airports, competitive facility operation is encouraged to maintain the high service standards usually generated by competition. In the European Union, European Commission (EC) directives are forcing airports to introduce competition at airports where operation previously has been by a single organization. This trend away from singleauthority operation has been aided by the increasing trend toward total airport privatization, either by outright transfer of ownership outside the public sector or by the granting of long-term concessions for the operation of entire airports.

Competitive handling operations are also less vulnerable to a complete shutdown by industrial action. The final choice of operational procedure will depend on a number of factors, including

- Philosophy of the airport authority and its governing body
- Local industrial relations
- International and national regulations
- Financial constraints
- Availability of local labor and skills

4. Direct Passenger Services

Terminal operations that are provided for the convenience of air travelers and are not directly related to the operations of the airlines are normally designated as direct passenger services. It is convenient to further divide this category into commercial and noncommercial services. There is no hard-and-fast division between these two subcategories, but noncommercial activities are usually seen as being entirely necessary services that are provided either free of charge or at some nominal cost.

Commercial activities, on the other hand, are potentially profitable operations that are either peripheral to the transportation function of the airport (e.g., duty-free shops) or avoidable and subject to the traveler's choice (e.g., car parking and car rental).

Typically, at a large passenger terminal, the following noncommercial activities will be provided, usually by the airport authority:

- Porterage[2]
- Flight and general airport information
- Baggage trolleys
- Left-luggage lockers and left-luggage rooms[2]
- Directional signs
- Seating
- Toilets, nurseries, and changing rooms
- Rest rooms
- Post office and telephone areas
- Services for people with restricted mobility and special passengers

Depending on the operating philosophy of the airport, commercial facilities will be operated either directly by the authority itself or leased on a concessionary basis to specialist operators. Typically, at a large airport, the following commercial activities can be expected to play and important part in the operation of the passenger terminal:

- Car parking
- Restaurants, cafes, and food bars
- Duty-free and tax-free shops
- Other shops (e.g., book shops, tourist shops, boutiques, etc.)
- Car rental
- Internet service

- Insurance
- Banks and exchange services
- Hairdressers, dry cleaners, and valet services
- Hotel reservations
- Amusement machines, lotteries
- Advertising
- Business-center facilities

Figure shows examples of commercial duty-free shops and advertising at airports having an aggressive commercial policy. The degree of commercialization of airports varies substantially. Airports that have adopted policies promoting such activities, such as Frankfurt, Singapore, Amsterdam, London, and Orlando, have commercial revenues that account for up to 60 percent of total revenues. Other airports that have no strong commercial development, either as a policy decision or owing to a lack of opportunity, typically would expect up to only 10 percent of their income to come from commercial sources.

Early arguments in the aviation world against the commercialization of airport terminals are now clearly lost. It is generally accepted that there is a demand for such facilities generated by the high volumes of passengers who can spend on average two hours in a terminal.

Advertising display case.

Of this time, perhaps only 30 percent is required for processing. The high volumes of passengers, meeters, senders, and visitors constitute a strong potential sales market that invariably can be developed, if desired. Furthermore, the revenues generated by commercial operations can cross-subsidize airside operations, which often are only marginally profitable. Passenger terminals are recognized as part the generation of the airport's revenue stream that can make the facility self-sustaining or even profitable. Large passenger terminals are generators of large commercial profits. If commercial exploitation of the airport is decided on, a number of operational policy decisions must be made. First, a decision must be made on the mode of operation. Five different modes are common; these are operation by

- A department of the airport authority directly
- A specially formed, fully owned commercial subsidiary of the airport authority
- A commercial subsidiary formed by the airport authority and the airlines
- A commercial subsidiary formed by the airport authority and a specialist commercial company
- An independent commercial enterprise

Some publicly owned airports choose to retain direct control of commercial operations. This option, however, is unusual. Most airports that ran highly successful commercial operations, such as Dubai, Heathrow, Atlanta, and Frankfurt, generally prefer to use an approach of granting controlled concessions to independent enterprises with commercial experience in the particular area.

It is also interesting to compare the ways in which concessionaires are selected. Some governmental airport authorities are required by law to accept the highest bid for a concession. Schiphol Airport in Amsterdam developed a successful commercial policy based rather on maximizing the level of airport control on operating standards and pricing. In this way, the airport authority feels that it is more able to attain its own commercial ends while still using the expertise of the individual concessionary enterprises. Concessions at airports may be leased in a number of ways:

- Open tender
- Closed tender
- Private treaty

Of these three, it is most likely that the second option, closed tender, will meet a publicly owned airport's requirements. Private treaty is likely to be seen to be a too restrictive manner of handling public funds, leading to charges of preferential treatment. Open tender, on the other hand, while giving a free hand to competition, may well lead to bidding by organizations that will prove to be incompetent in reaching necessary performance standards.

In some countries, however, open tenders are legally required where public funds are involved. Under these conditions, it is sometimes permissible to have a prequalification arrangement to ensure that only competent and financially stable enterprises enter the bidding process. At privatized airports, the airport can use any legal means of granting the concessions it chooses.

Other methods of control that have been used successfully include

4. *Length of lease.* Medium-term leases of 5 to 10 years have several advantages. They permit the concessionaire to run an established operation with medium-term profits. Successful operators usually are able to renegotiate for renewed concessionary rights. Unsuccessful operators can be removed before long-term financial damage accrues to the airport.
5. *Exclusive rights.* In return for exclusive rights on the airport, the authority can demand contractual arrangements that protect the airport's financial and performance interests. There is a significant recent move away from granting exclusive rights in shopping concessions in order to encourage competitive pricing.
6. *Quality of service.* Many airports require contracts that restrict the concessionaire's methods of operation. These constraints include authority control over the range of goods to be stocked, profit margins and prices, and staffing levels, as well as detailed operational controls on such items as advertising, decor, and display methods.

6. Airline-Related Operational Functions

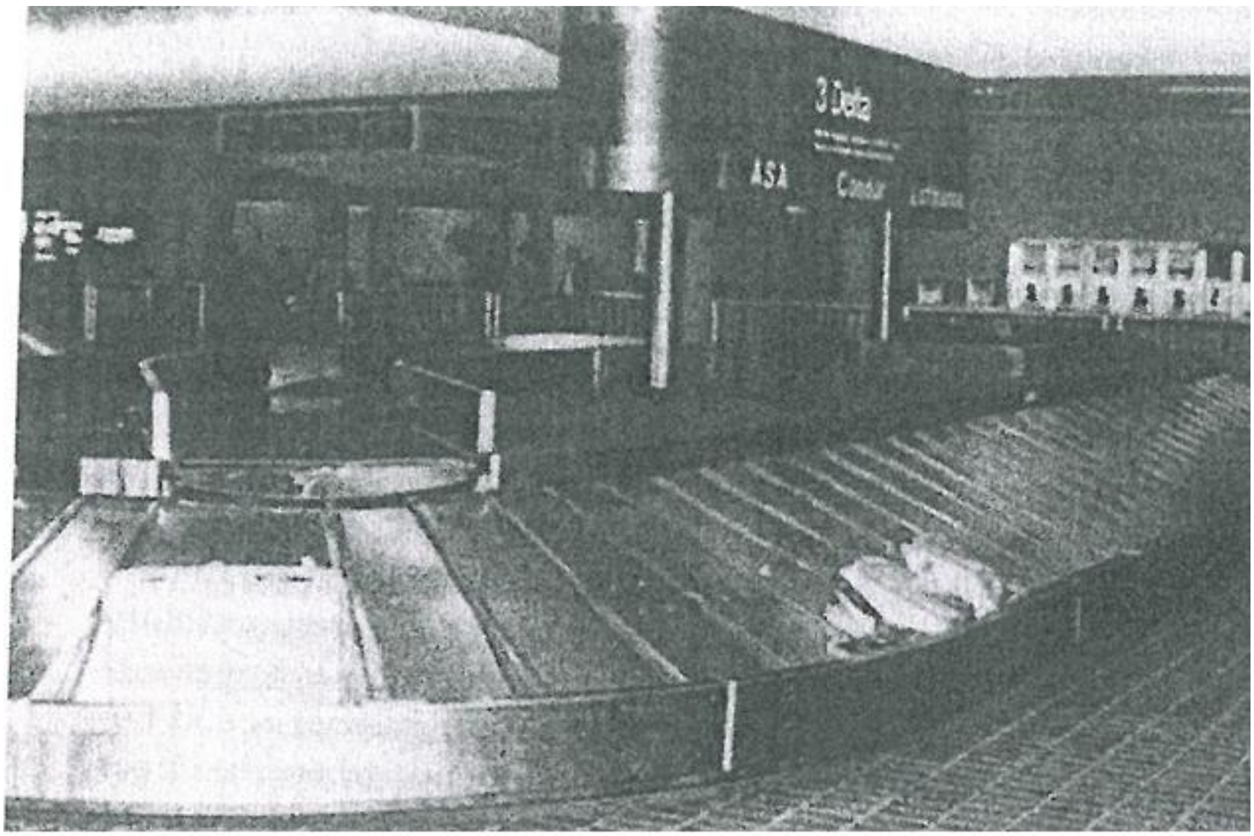
Flight Dispatch

A major preoccupation for airline management in relation to airport terminal operations is the achievement of on-time departures. Many of the activities associated with this, such as the refueling and cleaningof aircraft, together with the loading of food supplies, are carried out on the ramp and are familiar to most airport staff. There is, however, a less familiar procedure that covers all the necessary technical planning without which a flight could not depart. The main activities associated with this procedure of flight dispatch are

- Flight planning
- Aircraft weight and balance
- Flight-crew briefing
- Flight watch

In the United States, this is a long-established procedure, and the work is carried out by aircraft dispatchers who work in close cooperation with the aircraft captain. Flowever, in the case of large airlines, the flight-planning process is carried out more often as a central function at the airline's home base (for American Airlines, this is Dallas). Although aircraft dispatchers are used by many international airlines, there is also the designation of flight operations officer for staff members who carry out this work.

The airline departments at airports concerned with flight dispatch will need access to airport operations departments, air traffic services, meteorological services, and communications facilities, including email, internet, teleprinters, telephones, and radios. Depending on the extent of their activities, many airline operations offices also will use a variety of computer facilities, although these latter may not necessarily be in-house systems.



Designated baggage delivery system.

Flight Planning

The primary purpose of flight planning is to determine how long an individual flight will take and how much fuel will be required. For long-range flights, there will be a variety of options in terms of altitudes, tracks, and aircraft power settings and speeds. Variations in weather, wind, and temperature also will have to be taken into account. Of course, computerized flight-planning tools are used by major airlines to perform these optimizations. Such tools examine feasible options so that a decision can be taken as to the most appropriate of the several alternatives. The evaluation might include an indication of comparative costs: A slower flight might prove desirable from a cost point of view. The analysis would include several altitude options. This often proves useful if, owing to the density of traffic, air traffic control (ATC) has to impose a last-minute altitude change.

For short-range flights, there are generally very few options, and in areas of very dense traffic, routings for all practical purposes are predetermined by the structure of the airways. In such cases, such as, for example, in Europe, the flight plans usually will be standardized to the extent that relevant extracts can be placed on permanent file with ATC. These are referred to in Great Britainas *stored flight plans* and are automatically printed out from ATC computer files in advance of flight departures. The airline flight plans, the operational or company flight plans, give a great deal of information, including the en-route consumption of fuel. Such details are not the concern of ATC, which requires altitudes and times in relation to the ATC system checkpoints, together with certain safety.

The *dry operating weight* of an aircraft is taken as the starting point for weight calculations. To this is added the anticipated payload, which consists of

- Cargo load
- Passengers
- Baggage

This provides the *zero-fuel weight.* The total fuel load is added, less an allowance for fuel used in taxiing before takeoff, to calculate the *takeoff weight.* The fuel that is expected to be consumed during the flight is deducted from the *takeoff weight* to calculate the *landing weight.*

It should be noted that these calculations may be in either pounds, which is the case in the United States, or in kilograms. However, before any actual load calculations can be carried out, account must be taken of the physical weight limitations, the design limits, of the aircraft structure in the various operation phases.

Takeoff

There is a *maximum takeoff weight* (i.e., at brake release) that the available power can lift off the runway and sustain in a safe climb. The value is established by the manufacturer in terms of ideal conditions of temperature, pressure, runway height, and surface conditions. Along with these values, the manufacturer will provide performance details for variations in any of these conditions.

In Flight

There are limits on the flexibility of the wings of each aircraft design. These are imposed by the upward-bending loads that the wing roots can sustain without breaking. The greatest load would be imposed if , there were no fuel remaining in the wings (fuel cells), which is why the *zero-fuel weight* is taken as a limitation on fuselage load.

Landing

Depending on the shock-absorbing capabilities of the aircraft undercarriage, there is a *maximum landing weight* that it can support on landing without collapsing. Thus the three design-limiting weights are maximum takeoff weight, maximum zero-fuel weight, and maximum landing weight. Typical examples of these values for a Boeing 747-300 are

- Maximum takeoff weight 883,000 pounds (377,850 kg)
- Maximum zero-fuel weight 535,000 pounds (242,630 kg)
- Maximum landing weight 574,000 pounds (260,320 kg)

The completed flight plan will provide two fuel figures:

Takeoff fuel. This is the total amount of fuel onboard for a particular flight. This does not include taxiing fuel but will include required fuel reserves for flight to an alternative destination or for holding or delay before landing.

Trip fuel. This is the fuel required for the trip itself, that is, between the takeoff and the point of first intended landing (it is also sometimes referred to as *burnojf).*

In order to arrive at the maximum permissible takeoff weight, we compare three possible takeoff weights:

- Takeoff weight' = maximum takeoff weight
- Takeoff weight" = aero-fuel weight + takeoff fuel
- Takeoff weight"' = landing weight + trip fuel

The lowest of these three values is the maximum allowed takeoff weight, and this value minus the operating weight will give the allowed traffic load. These and other values are used in relation to aircraft weight calculations and load, and they also appear on the load sheet, for which there is a format agreed on by the IATA. Together with the values for takeoff fuel and trip fuel, the following operational figures are included in a load-sheet calculation:

- *Dry operating weight.* The weight of the basic aircraft, fully equipped, together with crew and their baggage, pantry/ commissary supplies, and flight spares, but not including fuel and payload
- *Operating weight.* The sum of dry operating weight and takeoff fuel
- *Takeoff weight.* The operating weight plus payload (traffic load)
- *Total traffic load.* The sum of the weights of the various types of load, that is, passengers, baggage, cargo, and mail, as well as the weight of any unit-load devices (ULDs, containers) not included in the dry operating weight

All these various weights appear on the load sheet together with a breakdown of the weight distribution.

Balance/Trim

Having ensured that the aircraft load is within the permitted weight limitations, it is then necessary to distribute the load in such a way that the center of gravity is within the prescribed limits. The outer limits of the envelope are clearly indicated by the shaded areas. Certain sections of the load-sheet side of the form are also shaded to indicate data that should be included in a load message to be transmitted to the aircraft destination(s). These functions are now almost universally computerized.

Loading

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Flight-Crew Briefing

The purpose is to present to flight crew appropriate advice and information to assist them in the safe conduct of a flight. The information will include a flight plan and load details together with information regarding en-route and destination weather and notices regarding any unserviceabilities of navigation or landing aids. This latter information is contained in *Notices to Airmen* (NOTAMs), an internationally

United Airlines flight-crew briefing sheet.

Agreed-on system whereby the civil aviation authorities of each country exchange information on the unserviceability of any of the facilities in their country (e.g., navaids and airports). Airline flight dispatch staff will obtain NOTAMs from the appropriate governmental agency, edit them, and where necessary, add details relating to any company facilities. Weather information also will be obtained from the meteorological department at the airport and might be augmented by in-flight reports received from other flight crews.

Flight Watch (Flight Control)

This is a procedure by which flight dispatch/flight operations personnel monitor the progress of individual flights. For this reason, it is also sometimes described as flight following [not to be confused with the flight following by ATC in the United States for visual flight rules (VFR) aircraft].

Owing to the worldwide nature of air transport, it is carried out using Greenwich Mean Time (GMT), sometimes written as Z *time.* Flight watch is not intended to be entirely passive; however, information about any unexpected changes in weather or serviceability or facilities is transmitted to aircraft in flight.

Depending on the extent of an airline route network, the responsibility for flight watch may be divided into areas. In addition, most larger airlines have one centralized coordinating operations center equipped with comprehensive communications facilities providing the latest information on the progress of all their aircraft.

The center for United Airlines is located at Chicago O'Hare; for Air Canada, at Toronto International Airport; and for British Airways, at London Heathrow Airport. It is useful for airport operations management to know the locations and telephone/telex addresses of such centers for airlines using their airports, as well as the organization of flight-watch responsibility.

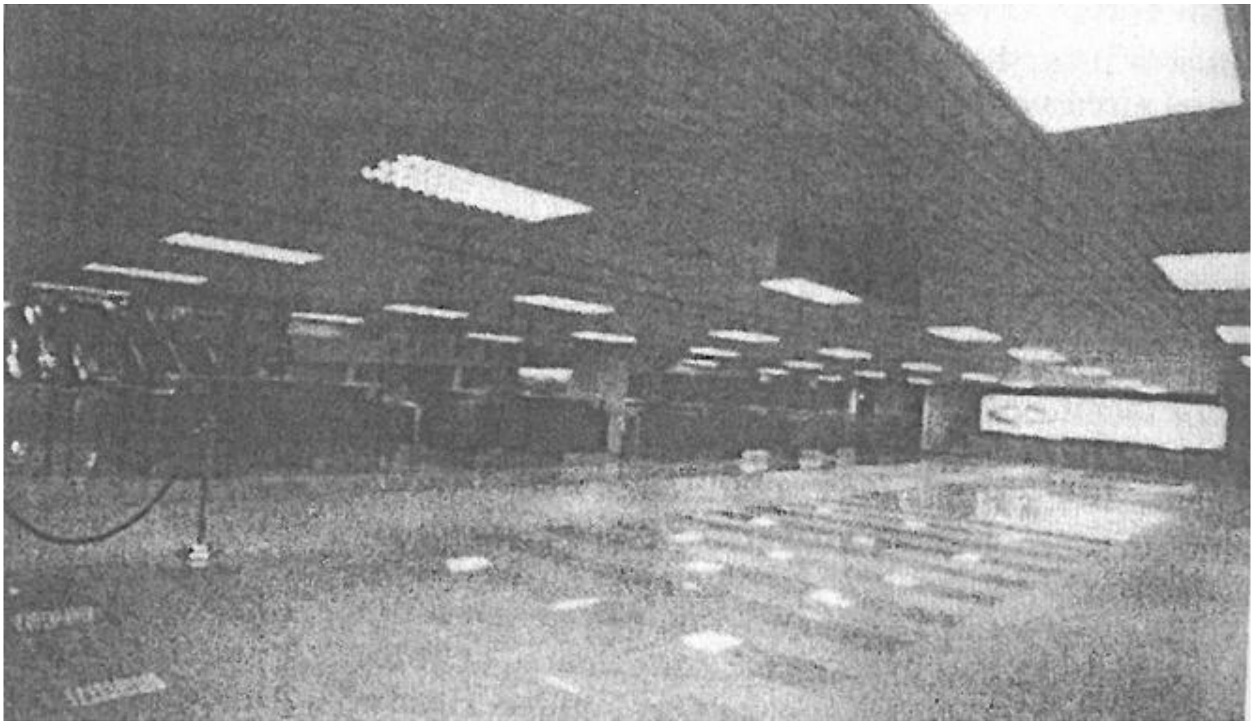
Governmental Requirements

Most airports handling passenger movements of any reasonable scale will be required to provide office and other working space in the vicinity of the passenger terminal for the civil aviation authority and the ATC authority, if this is constituted separately. At major airports where international passengers are handled, it is also possible that up to four governmental controls must be accommodated:

- Customs
- Immigration
- Health
- Agricultural produce

In most countries, the facilities necessary for health and agricultural inspection are not particularly demanding.

Conversely, customs and immigration procedures can be lengthy, and the requirements in terms of operational space for the examining process can be very great. Figure 8.13 shows the layout of an immigration hall at a major international airport. Because of the filtering effect of immigration and the relatively speedy processing at most customs examination halls, customs facilities are not usually extensive. The use of red/green customs procedures, especially in Europe, has materially improved customs processing time without any apparent deterioration in enforcement. Some countries, however, still have very time-consuming and involved



Arrivals, immigration-desk area.

customs examination procedures that require the provision of many desks and extensive waiting areas. In addition to their processing areas, most governmental agencies require office and other support space, such as rest, changing, and toilet areas.

8. Non-Passenger-Related Airport Authority Functions

It is often convenient at smaller airports to locate within the terminal building for ease of intercommunication all the airport authority's non-passenger-related functions. These include

- Management
- Purchasing
- Finance
- Engineering
- Legal
- Personnel
- Public relations

- Aeronautical services
- Aviation public services (e.g., noise monitoring)
- Plant and structure maintenance

At larger airports, it is customary to separate these authority functions into distinct buildings or buildings away from the terminal building to ease the level of congestion associated with busier terminals- At multiple airport authorities, such as Aeroports de Paris, the Port Authority of New York and New Jersey, and the privatized BAA in the United Kingdom, many of the management and staff functions are carried out entirely off-airport, only the line-operating functions being staffed by airport-based personnel. The detailed design of a terminal should take great account of the way in which the authority intends to operate its facility because space requirements revolve around operational procedures.

9. Processing Very Important Persons

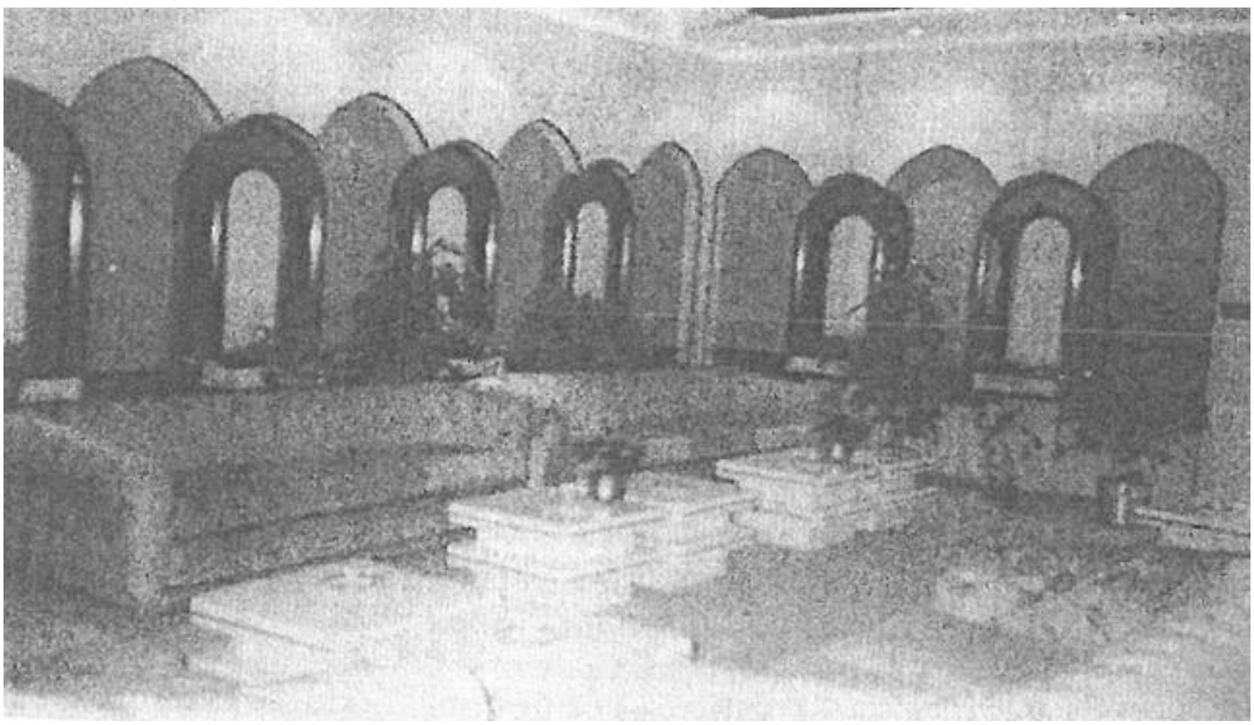
Air travel is still a premium method of travel, attracting important, famous, and very rich individuals. Some of the busier airports process a large number of very important persons (VIPs). For example, more than 1,000 groups of VIPs pass through London Heathrow every month. This requires special facilities and staff to ensure that the arriving and departing party can pass through the terminal with all necessary courtesies, sheltered from the conditions of the average traveler.

Consequently, VIP facilities have separate landside access, a fully equipped and comfortable lounge in which the party can wait for either landside or airside transport, and a separate access to the apron. The facility must be capable of holding fairly large parties; often traveling heads of state have VIP parties in excess of 25 persons. In addition to the need for sufficiently large and adequately equipped accommodation, the facilities must be safe from the security viewpoint because they may become the target of unlawful acts. Figure 8.14 shows the VIP lounge at a large airport. At multi terminal airports, there is the choice of either several VIP lounge facilities or one central facility to minimize congestion and inconvenience. The choice will depend on the ease of accessing aircraft across the apron for the range of flights involved.

10. Passenger Information Systems

Passengers move through airport terminals under their own power. They are not physically transported in a passive manner, as is freight, although in larger terminals mechanical means are used to aid in movement through the facility (see Section 8.12). This, of course, does not refer to people with restricted mobility, who need special ramps and other necessities, which are beyond the scope of this book. Equally important, a large number of passengers reach airports in their own personal vehicles. There is therefore a need to ensure that the passenger has sufficient information both in the access phase of the journey and in passing through the terminal.

Additionally, the passenger requires information on the location of many facilities within the terminal, such as telephones, toilets, cafeterias, and duty-free shops. Information therefore is usually functionally classified into either directional- guidance or flight-information categories. Directional guidance commences some distance from the airport and normally involves cooperation with some local governmental authority to ensure that suitable road signage is incorporated into the road system on all appropriate airport access roads (Figure 8.15). Often such signs include an aircraft symbol to help the driver to identify directions rapidly. Nearer the airport, terminal-approach road signs will guide the passenger to the appropriate part of the terminal. It is essential that the driver be given large, clear signs in positions that permit safe vehicular maneuvering on the approach-road system. The driver must obtain information on the route to be taken with respect to such divisions as arrivals/departures and domestic/international flights and often to airline-specific locations (Figure 8.16). In multiterminal airports, there will be signage to each individual terminal, either by terminal designation or by airline groups. Within the terminal, departing passenger flows are guided principally by directional- guidance signs, which indicate check-in, governmental controls, departure lounges, gate positions, and so on. Other terminal facilities that must be identified are concessionary areas and public service facilities such as telephones, toilets, and restaurants (Fig)



Information signs in terminal.

It is essential that the signage is carefully designed. The International Civil Aviation Organization (ICAO) has a set of recommended picto- grams for signage inside terminals. Many airports have adopted their own signage convention. In some cases, the signage used falls short of acceptable standards. Sufficient signage must be given to enable the passenger to find the facility or the direction being sought; equally, there cannot be such a proliferation of signs that there is confusion. It is essential that the signage configuration be designed to conform to available internal building heights, which itself must be set recognizing that overhead signage is essential. Once in the terminal, passengers receive information concerning the status and location of departing flights by the departure side of the flight information system. Historically, this information has been displayed on mechanical, electromechanical, or electronic departure flight information boards. However, these largely have been supplanted by cheaper visual display units (VDUs), which can be located economically at a number of points throughout the terminal. Figure 8.18 provides an example of a modern bank of VDUs.

The arriving passengers are given similar guidance information, which helps to convey them to the baggage-reclaim area and to the landside access area, stopping en route at immigration and customs in the case of international arrivals. It is necessary to have adequateexit signing within the terminal for all passengers and on the internal circulation roadways for passengers using the car mode. An example of an airport road exit signing is shown in Figure 8.19. Meeters who have come to the airport to greet a particular flight are informed of flight status and location either by an electromechanical arrivals board or by VDUs (Figure 8.20). Arrival and departure VDUs have the advantage that they are readily compatible with computerized information systems and can be updated easily. The units themselves, which are relatively inexpensive, are easily removed, replaced, and repaired in the case of failure.

Most airport operators supply at least one airport information desk per terminal on the departures side and less frequently on arrivals. This worker-staffed desk, an example of which is shown supplies information that goes beyond that supplied by the visual systems. Also, it is capable of assisting those unable to use the automatic system for one reason or another. In the case of failure of the automatic systems, the only means of providing flight status and location might be through a manned desk.

In an attempt to make information more available, airports are introducing self-service information kiosks. These have the advantage that they are relatively inexpensive, take up little space, and can be positioned flexibly to suit the needs of users.

Middle east grows rapidly, falling as oil prices fade. The area of the world generating. The highest growth rates of air cargo traffic are the developing Western Pacific Rim nations of the

Far East (e.g., China, India, and Indonesia). It is in these nations that the GDP is growing the fastest.

Cost

In real terms, there has been a secular and decline of the cost of air freight, but that rate of decline has been very irregular.

The economic slump was accompanied by a rapid decline in fuel prices and fuel surcharges. By

2012, oil prices were again on the rise. For the 20 years following 1989, freight yield had fallen by an average 4.9percent per year when adjusted for inflation (Boeing 2011)

Technological Improvements

Technological improvements are usually manifest in terms of lower freight costs through improved efficiency. Improvements to technology have taken place in three principles areas:

- In the air vehicle, with the introduction of wide-bodied large capacity aircraft.

- In the development of a wide range of unit load devices (ULDs) and the necessary subsidiary handling and loading devices on the aircraft, on the apron and in the terminal
- Finally, in facilitation with the maturing of freight-forwarding organizations, the rapid growth of integrated carries, and the development of computerized control and documentation.

Miniaturization

Various other secular trends have contributed to the increasing demand in air cargo. For
Example, miniaturization of industrial and consumer products has made items much more suitable for carriage by air.

Just-in-Time Logistics

Another factor is the increasing trend for industry to move away from regional warehousing and the high associated labor, construction, and land costs.

Rising Consumer Wealth

Real incomes are rising in the industrial countries, and more wealth falls into the bracket that can be designated as discretionary. Such income is lesssensitive to transport costs for goods purchased.

In the former, real incomes were rising, and in the latter, they were at best stagnant and in many countries were falling.

Globalization of Trade and Asian Development

With the liberalization and globalization of trade, some 40 percent by value of world trade is now carried by air.

Loosening of Regulation

Liberalization of the policies regulating international air services and “open-skies policies” as advocated by the United states and supported by the International Civil Aviation Organization (ICAO), the International Air Transport Association (IATA).

Cargo Types

1. *Planned*. For this type of commodity, the air mode has been selected as the most appropriate after analysis of distribution costs.
2. *Regular*. Commodities in this category have a very limited commercial life, and delivery must be rapid and reliable.
3. *Emergency*.Speed is vital and lives may depend on rapid delivery of emergency cargo such asserums and blood plasma.
4. *High Value*. Very high value cargo such as gemstones and bullion require special security precautions in terms of staffing and facilities.
5. *Dangerous (ICAO 2001).* The carriage by air of dangerous goods is a topic. Of much concern with airlines because of on-board hazard.

IATA includeswithin its definition of hazardous goods the following: combustible liquids, compressed gases, etiologic agents, explosives, flammable liquids and solids, magnetized materials, noxious and irritating substances, organic peroxides, oxidizing materials, poisons, and polymerizable and radioactive materials.

6. Restricted articles. In most countries, arms and explosives can be imported only under the severest restrictions, which include very strict security conditions.
7. *Livestock.* Where livestock are transported, arrangements must be made for animals to receive the necessary food and water and to be kept in a suitable environment.

Patterns of Flow

The cargo terminal, like the passenger facility, experiences significant temporal variations in throughput. Unlike the passenger terminal, freight facilities often demonstrate very large differences between inbound and outbound flows on an annual basis.

Cargo flow variations occur across the year, across the days of the week, and within the working day. The pattern of variation differs quite noticeably among airports and even may vary remarkably among airlines at the same airport.

Expediting the Movement

In order to provide an air shipping service, the freight forwarder performs functions that are likely to be beyond the expertise or capability of the shipper. These include

- Determining and obtaining the optimal freight rate and selecting the best mixture of modes and routes.
- Arranging and overseeing export and import customs clearance, including preparing all necessary documentation and obtaining requisite licenses (these are procedures with which the specialist freight forwarder is familiar)
- Arranging for the secure packing of individual consignments
- Consolidating small consignments into larger shipments to take advantage of lower shipping rates (the financial savings obtained by consolidation are shared between the forwarder and the shipper

- Providing timely pickup and delivery services at both ends of the shipment.

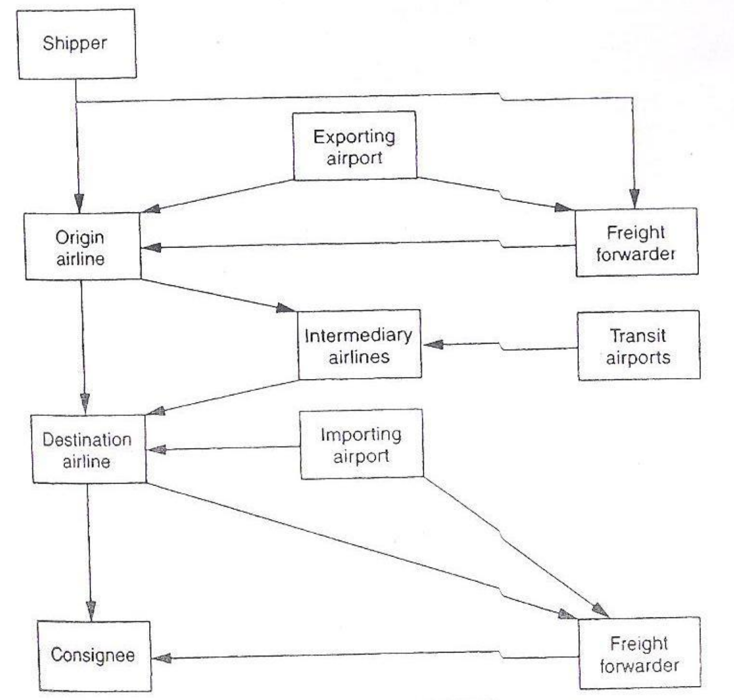


FIGURE 10.2 Relationships among actors in the movement of air cargo.

To encourage shipments that are more economical to handle, airlines have a complex rate structure, of which the main components include

- General cargo rates. These apply to general cargo between specific airport pairs.
- Specific commodity rates. Often over particular routes, there are high movement volumes of a particular commodity. The IATA approves specific commodity rates between specific airports. For general cargo and specific commodity rates, there are quantity discounts.
- Classified rates. Certain commodities, because of their nature or value, attract either a percentage discount or surcharge on the general commodity rate. Classified rates frequently apply to the shipment of gold, bullion, newspapers, flowers, live animals, and human remains.
- ULD rates. This is the cost of shipping a ULD container or pallet of specified design containing up to specified weight of cargo. ULDs are part of the airline's equipment and are loaned to the shipper or forwarder free of charge, provided that they are loaded and re lodged with the airline within a specified period, normally 48 hours.
- Consolidation rates. Space is sold in bulk, normally to forwarders at reduced rates, because the forwarder can take advantage quantity and ULD discounts. The individual consignee receives the shipment through a break bulk agent at destination.

- Container rates. Containers in this context are normally owned by the shipper rather than the airline. They are usually nonstructural, of fiberboard construction, and suitable for packing into the aircraft ULDs. If a shipment is delivered to them in approved containers, airlines provide a reduction in air-freight rates.

The very rapid movement of air freight requires accurate documentation. This is provided in terms of the airlines air waybill, sometimes called the air consignment note, an example of which is shown in figure 10.3. The air waybill is a documents with multiple uses. It provides the following:

- Evidence of the airline's receipt of goods
- A dispatch note showing accompanying documentation and special instructions
- A form of invoice indicating transportation charges.
- An insurance certificate, if insurance is effected by the airlines
- Documentary evidence of contents for export, transit, and import requirements of customs.
- Contents information for constructing the loading sheet and flight manifest
- A delivery receipt.

Handling Within the Terminal

The system used to achieve this physical movement will depend on the degree of mechanization to be used to offset personnel costs. The terminal types are threefold, and any particular terminal may well be made up of a combination of types.

Low Mechanization/High Manpower

Typically, in this design, all freight within the terminal is manhandled by workers over roller systems, which are either unpowered or partially powered. Forklift trucks are used only for building and breaking down ULDs. On the landside, freight is brought to the general level of operation in the terminal by a dock-leveling device. This operational level, which is maintained throughout the terminal, is the same as the level of the transporting dollies on the airside.

Open Mechanized

The open mechanized system has been for some time in developed countries at medium-flow terminals. All cargo movement within the terminal is achieved using forklift vehicles of various designs that are capable of moving fairly small loads or large aircraft container ULDs.

Fixed Mechanized

The very rapid growth in the use of ULDs in aircraft has led to cargo terminal operations in which extensive fixed mechanical systems are capable of moving and storing the devices with minimum use of labor and low levels of container damage in the handling process. Such fixed-rack systems are known as transfer vehicles (TVs) if they operate at one level and elevating transfer vehicles (ETVs) if they operate on

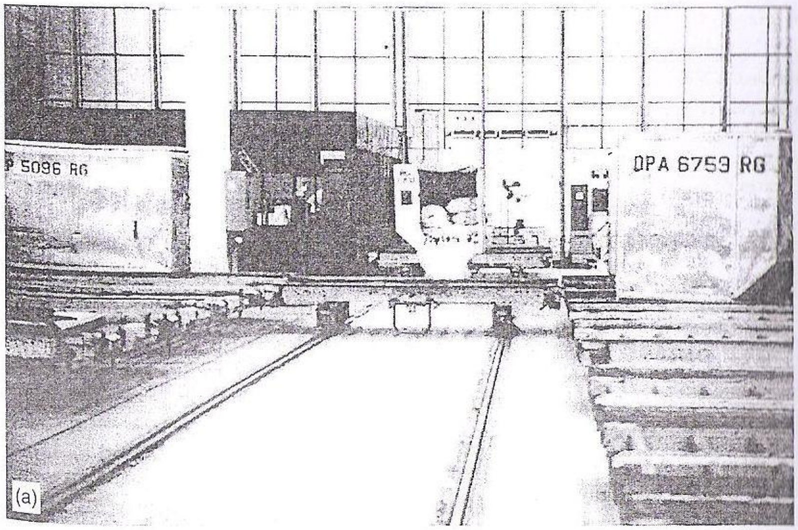


FIGURE 10.7 (*a*) Air cargo interior—low-technology freight terminal. (*b*) INFRAERO cargo terminal, São Paulo International Airport. (*Courtesy of INFRAERO, Brazil.*) (c) An ETV. (*Courtesy of INFRAERO, Brazil.*)

Cargo Apron Operation

Even though much freight is carried by other than all-cargo aircraft, very large volumes are moved by such operation through the air cargo aprons. All cargo aircraft are capable of very high productivity, provided that there is a sufficient level of flow to support these productivity levels. The maximum payload of a B747-8F in over 295,000 pounds (133,900kg) (Boeing 2008). Figure 10.8 shows that with containerized cargo, the operator estimates that it is possible to off-load and load 245 tons in under an hour using the nose and side doors or an hour and a half using only the nose door.

The times given by the manufactures must be regarded as ideal times, where the load is immediately available and sequenced for loading. Real-world apron operations often mean that load control of the aircraft seriously increases actual turnaround time. For a series 100 747F aircraft with only side-door loading, a turnaround time of 1 ½ hours would be considered very good; for a series 200 aircraft with nose loading only, 2 ½ hours is more likely. The latter time can be reduced by simultaneously loading the nose and side doors of the main deck, but this ties up two high-lift loaders.

Examples of Modern Cargo Terminal Design and Operation

Lufthansa redesigned its Frankfurt air cargo terminal in 1995 to handle a capacity of approximately 1 million tons per year. Figure 10.12 shows a schematic layout of the facility, which, in common with most modern terminals, is extensively mechanized for the handing of ULDs. Frankfurt has a very high proportion of transfer freight, some of which requires reconsolidation within the cargo terminal itself. The handling system within the terminal saves both labor and space by the employment of extensive mechanization.

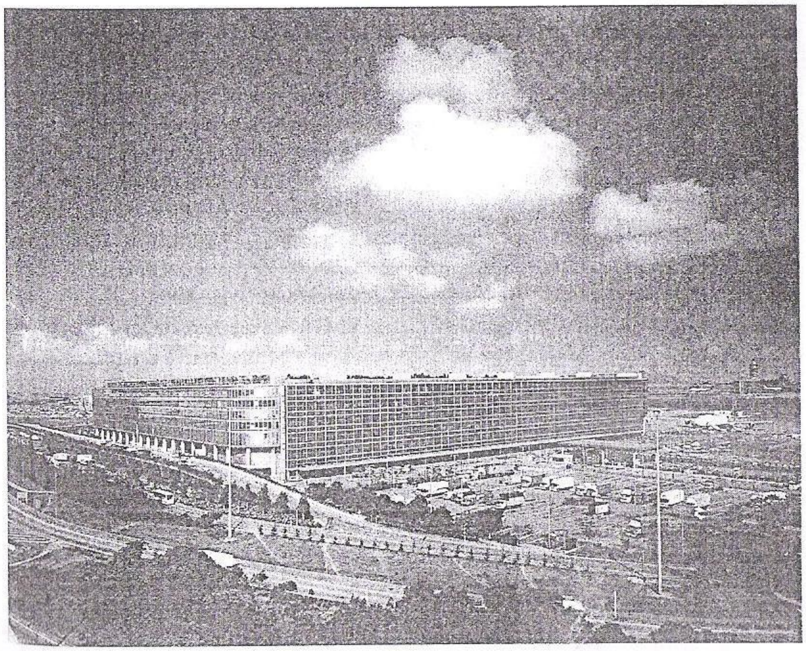


FIGURE 10.13 HACTL Terminal, Hong Kong. (*Courtesy: Hong Kong International Airport.*)

Cargo Operations by the Integrated Carries

Operation of the IC's air cargo terminals is quite different from that of conventional terminals, and it is difficult to draw comparisons between the two operations even at the same airport. The terminals of the ICs have very high daily peaks and are characterized by lack of the required storage space because very little cargo dwells in the terminal for any significant time. The principal characteristics that differentiate this type of terminal from the conventional cargo terminal include

- Cargo is under the physical control of one organization throughout the whole of its journey.
- Delivery to the exporting airport and pickup at the importing airport are by the IC itself; the landside loading and unloading area is more easily controlled and organized.
- No freight forwarders or clearing agents are involved.
- ICs generally use their own fleets and but may use other commercial airlines in the international arean (DHL and TNT frequently use available commercial aircraft to overcome the problems with international air services rights).
- All-cargo aircraft are used, and the characteristics of the fleet are well known to the terminal operator, the IC itself.
- The cargo is given a guaranteed delivery time; this implies rapid clearance through the airport facility.
- Documentation and facilitation are through one company's system.
- High security and limited access to the terminal are possible because no outside organizations are involved other than customs.

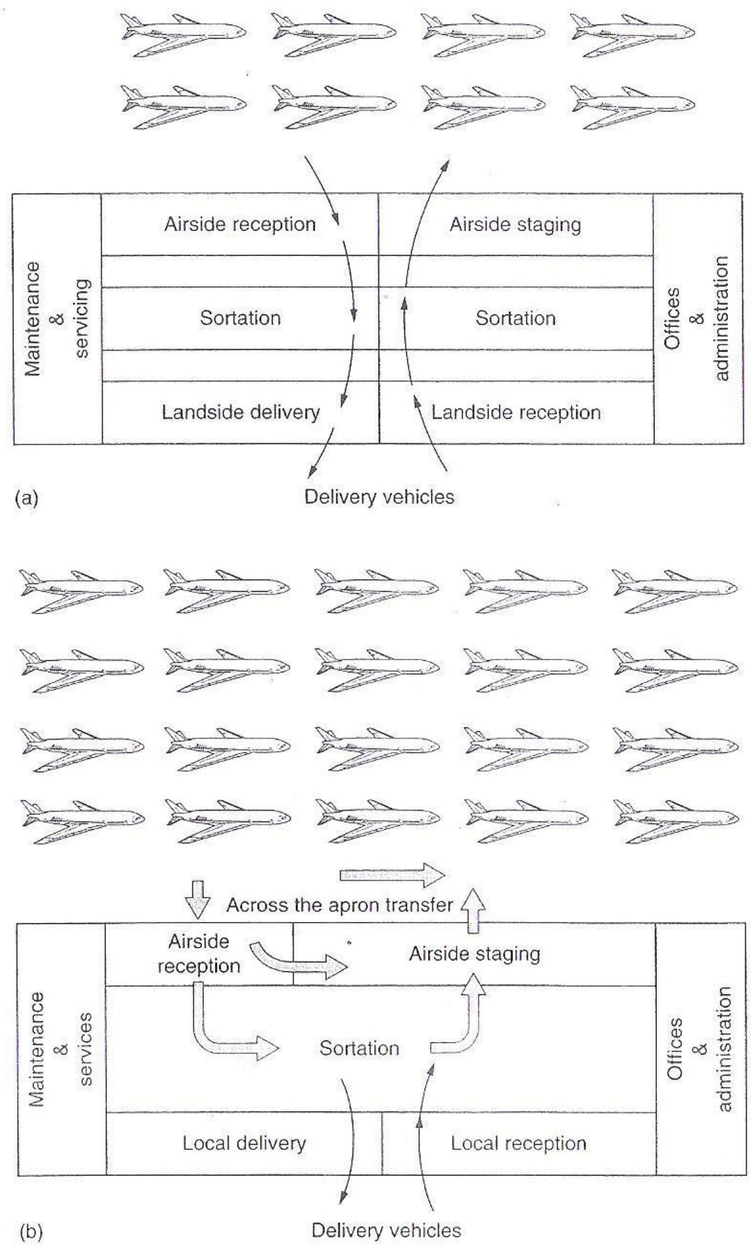


Figure 10.14 (*a*) Schematic of flows in a spoke terminal of an integrated carrier. (*b*) Schematic of flows in a hub terminal of an integrated carrier.

UNIT 5

AIRPORT TECHNICAL SERVICES AND AIRPORT ACCESS

Various operational services found at air carrier airports and be conveniently grouped together under this general heading. They are concerned with the safety of aircraft operations in terms of control, navigation and communications, and information.

Safety Management System

Airports Council International (ACI) agreed with the principle of certification in accordance with ICAO standards, but stated that "in the context of the ICAO programme

Of safety audits for airports, Recommended Practices, for airport design should not become 'de-facto' Standards for airport operation, since they do not have same status as Standards, may be difficult to apply to existing airports (notably those concerned with airfield dimensions), and are not based on a defined and consistently-applied 'target level of safety".

Fundamental Changes

Air traffic control (ATC) capability was already under scrutiny in the 1970s, in that it was questionable that existing paradigms could ever provide capacity that would be consistent with demand. The concern was both in terms of peak movement capacity and the minimization of environmental impact. The latter has become increasingly relevant over subsequent time.

In 1983, ICAO established a special committee on the future air navigation system (FANS), and while the name implied that it terms of reference were limited to the navigation function, it was charged with developing very wide-ranging operational concepts for ATC. The newer-generation systems have since evolved under the title air traffic management (ATM). The FANS report was published in 1988 and laid the basis for the industry's future strategy for ATM through digital communication, navigation, and surveillance (CNS) using satellites and data links.

Function of ATC

The primary purpose of ATC is the prevention of collisions between aircraft in flight and also between aircraft and any obstructions either moving or stationary on an airport. Additionally, it is concerned with promoting an efficient flow of air traffic. Efficient flow has tended to mean using up to the maximum capacity available in airspace, accepting that as the capacity limit is approached there will be an increasing level of delay.

International ATC Collaboration

These hasbeen considerable change over time in the way that the air traffic service function has been viewed internationally. Whereas it was always a "national" service, the advantage of imposing pan national service-quality attributes has been long recognized. In Europe in 1960, Euro control was formed as a unit funded by national governments to address the fundamental operational issue of the control of aircraft in the physically restricted volume of airspace over Belgium, the Netherlands, and Luxembourg (Benelux countries) This resulted in the successful establishment of an ARTCC at Maastricht, in the Netherlands, that had control authority over the Benelux region and the upper airspace regions of northern Germany (at that time the Federal Republic of Germany (West Germany).] An attempt to spread the application of this philosophy at Karlsruhe, in southern Germany, was not as successful, and this ARTCC was later placed into German ownership.

Flight Rules

There are three sets of flight rules depending on the circumstances listed:

General flight rules: Observed by all aircraft in any class of airspace.

Visual flight rules (VFR). Observed by aircraft flying in weather conditions equal to or above prescribed limits.

Instrument flight rules (IFR). Observed by aircraft in weather conditions below VFR limits and/or in Class A airspace.

General Flight Rules

As the name implies, these rules refer to the conduct of flight in such general matters as the safeguarding of persons and property on the ground, avoidance of collision, right-of-way rules, and air-craft navigation lights. Details are listed in the various regulatory documents of each country. For example, in the United States, this is Part 91 of the Federal Aviation Regulations; the appropriate regulation in the United Kingdom is achieved by means of the Air Navigation: Order and Regulations.

Visual Flight Rules

In addition to observing the general flight rules of the air, each flight has to be conducted according to either visual flight rules (VFRs) or instrument flight rules (IFRs). In the case of VFRs, the flight is conducted on a see-and-be-seen basis in relation to terrain and other aircraft. It is therefore necessary for a pilot to have certain minimum weather conditions known as visual meteorological conditions (VMCs). Anything worse than these conditions is referred to as instrument meteorological conditions (IMCs). General international usage is VFR and IFR conditions.

Instrument Flight Rules

When visibility and/or proximity to clouds are less than the quoted VFR limits (VMC), flight has to be conducted under IFRs. With respect to flight under IFRs in controlled airspace, the rules require that ATC must be notified of flight details in advance by what is known as an ATC flight plan.

Meteorology

Function

Aviation meteorological services are provided by governmental organizations in all ICAO Member States, and their services are organized to conform with ICAO Annex 3. Some countries employ their military to produce aviation-related weather products, but most use the civil meteorological organization.

World Area Forecast System

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.

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.

Meteorologic Observations and Reports

Meteorologic observations are vital to forecasting, and reports are generated by meteorogic services worldwide. In context with aviation four types of routine observations of surface weather have been established by ICAO and are produced in either hourly or half-hourly intervals at many airports and partly at other geographically relevant sites.

- Aviation routine weather report (METAR)
- Aviation selected special weather report(SPECI)
- Local routine met report (met report)
- Local special met report (special)

METAR and SPECI

The METAR is the most common surface weather report for aviation purposes

Usually METARs are disseminated at half-hour intervals, although some stations only produce METARs hourly.

The METAR includes the following data:

- Station identification and time of observation
- Surface wind direction and speed (direction in true north)
- Visibility
- Runway visual range (RVR) when appropriate and available
- Present weather
- Cloud amount and type [only cumulonimbus and towering cumulus (CB and TCU)]
- Temperature and dew point
- QNH or atmospheric pressure above mean sea level (amsl)
- Supplementary information

- Trend forecast
- Remarks when applicable (national dissemination only)

Aircraft observations and Reports

Meteorologic data obtained from aircraft in flight provide valuable information about weather conditions in places where either no surface or upper-air observations are available or no observation is possible.

Pilot Reports (PIREPs)

The pilot report is a weather observation by an air crew relayed to ATC via either voice communications or ACARS data link. It contains the following elements.

- Message identifier (UA or UUA) for routine or urgent messges.
- Position and flight level of the observing aircraft
- Time of report
- Aircraft type (important for reports on icing or turbulence)

Possible weather data include

- Wind direction and speed [(true north or magnetic north (United States)]
- Cloud cover
- Icing (light, moderate, or severe)
- Turbulence (light, moderate, or severe)
- Temperature
- Visibility
- Remarks

Significant Weather Forecasts and Charts

Significant weather forecasts (SIGWXs) and charts (SWCs) as well as upper-air forecast charts are generated and disseminated by the world area forecast centers (WAFCs) in London and Washington. They are then produced and locally distributed by the national meteorologic authorities. Where local distribution is not available, the charts provided by the WAFCs are usually used.

Aeronautical Information

Scope

The complexities of civil aviation are such that it is almost impossible to conduct a flight of any kind, even a short GA flight, without having recourse to considerable amount of aeronautical information such as ATC requirements (including airspace restrictions), airport layout, hours of operation, and availability of fuel.

These specify that an aeronautical information service is responsible under international agreement for

- The preparation of an aeronautical information publication (AIP)
- The origination of NOTAMs
- The origination of aeronautical information circulars (AICs)

Urgent Operational Information

NOTAMs are urgent notices for the attention of flight crews and operations personnel.

NOTAMs are distributed electronically. This replaces the previously used methods of teleprinter or fax, and while these are still the media used in remote areas, most nowadays will get very rapid electronic dissemination worldwide.

Access as part of the Airport System

Few years ago, It was customary for airport operators to consider that the problem of getting to the airport was chiefly the concern of the urban or regional transportation planner and the surface transport operators.

Congestion and difficulties in accessing airports have, as will be seen, very strong implications on their operations. Therefore, the airport administrator has an unavoidable vital interest in the whole area of access and accessibility, perhaps one of the most difficult problem areas to face airport management.

Figure below Is a conceptualized diagram indicating how potential outbound passengers and freight traffic

Through an airport will be subject to capacity constraints at the various points in the system; a similar chain operates in reverse for inbound traffic.

Lack of access capacity is far from being a hypothetical occurrence. Several of the world's major airports already face severe capacity constratints in the access phase of throughput. Using direct traffic-estimation methods, urban transport planners can show that some of the most severe access problems can occur at airports set in the environment of large metropolitan areas, if these airports depend largely on road access.

Department of Airports proposed that the total number of aircraft operations should be determined as follows:

Where AEDT=average number of vehicles entering the central terminal area in the prior six months.

ANPO=average number of annual passengers per actual air operation in the prior six months.

ASOP=actual number of air operations divided by the proposed number for the prior six months

CHTF=critical-hour traffic factor: the three-hundredth highest hour of vehicular traffic during the prior 12 months divided by the average number of vehicles entering the central terminal area daily.

MTAO= Maximum Takeoff and Approach operations

PPV=average number of air passengers per inbound vehicle

RCAP=entering central terminal area roadway capacity in terms of vehicles per hour

0.90=constant.

This procedure was an attempt to ensure that the scheduled airside activities would not impose unacceptable loads on a landside access system.

At nearly all airports, much of the access system in terms of the highways, the urban bus and rail systems, and taxis is outside the control of the airport administrator, both financially and operationally

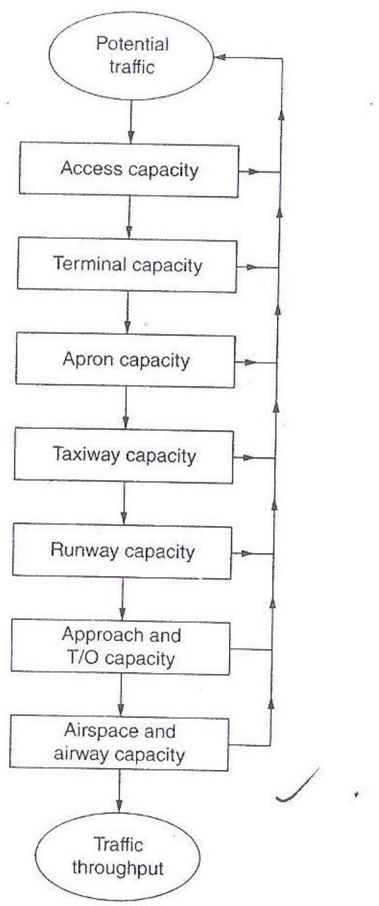


FIGURE 13.1 Sequential capacity constraints on outbound airport throughput.

Access users and modal choice

Airport passengers often, but not always, constitute the majority of persons entering or leaving an airport. Excluding individuals making trips as suppliers to the airport, the airport population can be divided into three categories.

- Passengers-originating, destined, transit, and transfer.
- Employees-airline, airport, government, concessionaires and such
- Visitors-greeters, senders, sightseers, and such

The transit and transfer passengers make use of the access system. There is no single figure for the division of the airport population among these categories. Among airports and depends on such factors as the size of the airport; and the type of air service supplied. Large airports with large base airline fleets have extensive maintenance and engineering facilities.

Over the past 50 years, a number of superficial solutions have been proposed for the access problem, many of which have involved the use of some dedicated high-speed tracked technology to link the airport with the city center in an effort to reduce the demonstrated dominance of the automobile.

Consequently, the airport traveler competes with the urban dweller for road space and transit capacity during peak-hour periods. The passenger using the automobile, taxi, and bus, this means delay through congestion; for those using urban and intercity rail systems, it means possible difficulties in finding seats and handling baggage in crowded facilities.

Rail has been used successfully in connecting two major new European airports, Munich and Oslo.

The rail connection of Changi Singapore to the Singapore rail network is also a significant success, but the length of the network is necessarily small in the island republic.

Experiences in Europe of connecting directly into the high-speed rail (HSR) systems have shown varied success even in the same country.

Access Interaction with Passenger Terminal Operation

The method of operation of the passenger terminal and some of the associated problems of

Terminal operation depend partly on access in as much as this can affect the amount of time that the departing passenger spends in the terminal. it is the departing passenger who places most demands on the airport terminal system. Departing dwell times depend chiefly on the length of access time, reliability of access time, check-in and security search requirements, airline procedures, and the consequences of missing a flight.

Length of Access Time

It is likely that the amount of time for a particular access journey is a random variable that Isnormally distributed about its mean value. The variance of the individual journey time about the mean is in some way proportional to the mean.

Reliability of Access Trip

The effect of reliability on departing terminal dwell times is shown in Figure 13.4 if these are two access trips each with the same mean trip time of tbut with standard deviations of tandt, it can be seen that the mean terminal dwell time, under assumptions of normality and 99.5 percent arrivals by K minutes before STD, are t and t respectively.

Check-in Procedures

Check-in requirements are not the same for all flights. For many long distance international flights, check-in times are a minimum of one hour before scheduled time of departure, whereas for domestic and short-haul international flights, this is usually cut to 30 minutes. With long-haul passengers spending an average of 22 more minutes in the terminal than short-haul passengers. Similar differences are often observed between check-in procedures for chartered and scheduled passengers.

The effect of longer closeout times is to increase passenger dwell time in the terminal prior to departure.

Consequences of Missing a Flight

Depending on the type of flight and the type of ticket, the passenger will have a very different attitude toward arriving after the flight has closed out and consequently missing the aircraft. This can be exemplified by considering a hypothetical trip maker making three different flights from Tampa international Airport. The first flight is on a normal scheduled ticket at full fare to Milami; the second is on a normal scheduled full-fare ticket to Buenous Aires; and the third is a special chartered holiday flight to London. The implications of missing the three flights are not at all the same. Should the passenger miss the first flight, there will soon be another flight, and there is no financial loss. In the case of the second flight, the ticket remains valid, but because the connections will now be lost and there might not be an alternative flight rapidly available, there is serious inconvenience and maybe some financial loss. Missing the third flight, however,

Could cause much inconvenience through a spoiled holiday and serious financial los because the ticket is no longer valid. The passenger therefore will arrange his or her arrival at the airport in such a way that the risk of missing each flight is different.

In the arrival patterns at individual airports are a mixture of all these factors. The variation between arrival times can be seen in figure 13.8, which shows the cumulative arrival curves for four European airports. Its access times were reasonably predictable, and most flights were short haul.

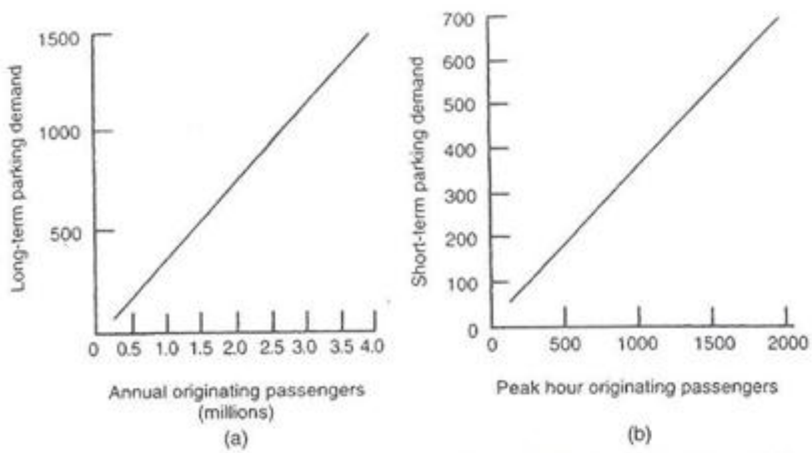
Research examining the effect of the length and reliability of access times has confirmed that unreliable access times can cause congestion in the check-in area and long dwell times in the departure lounges.

The manner in which access is provided to the passenger becomes critical to the operation of airport terminals at many vacation locations. Airports such as Punta Cana in the Dominican Republic and Palma, Majorca, have large landside deliveries of passengers at times that have little to do with the scheduled time of departure of their flights. It is not uncommon for departing passengers to be delivered, by fleets of charter buses, to the departures area several hours before the scheduled time of departure, even before the check-in desks and baggage-drop facilities are open for their flights.

Access Modes

Automobile

In most developed countries, the private car is the principal method of accessing airports. Since the inception of commercial air transport, and the situation seems most unlikely to change in the foreseeable future. Airports must integrate a substantial parking capability into their design and operation.



As airports grow in size, it becomes difficult to provide adequate parking space within reasonable walking distance of the terminals. In the case of centralized operations, it is common to divide the parking areas into short-term facilities close to the terminal and both medium-and long-term parking areas often served by shuttle services.

Serious internal circulation congestion can limit the airport's capacity if too many cars attempt to enter the facilities close to the terminal, a condition that has caused problems with the operation of the Terminal 1 at Paris Charles de Galle airport, where parking is integral to the terminal, and access is via a tunnel under the apron.

Major airports relying overwhelmingly on the automobile as the major access mode find that it is not solely in the matter of supplying and operating car parking that this decision materially affects the operation of the passenger terminal. The first solution leads to highly decentralized passenger terminal complex with possible difficulties in interlining, especially for baggage-laden international passengers. The second solution almost certainly will lead to the segregation of departing and arriving passenger flows throughout the terminal building.

Taxi

For the air traveler, the taxi is perhaps the ideal method of accessing the airport from all aspects except one-cost. In general, this mode involves the least difficulty with baggage, is highly reliable, operates from a real origin or destination, and provides access directly to the airport curbside.

The airport has an interest in maintaining a reasonable balance of supply and demand of taxis at the airport.

Many airports do not permit taxis to pick up a fare on airport property without a special license, for which the taxi operator must pay annually. In the United Kingdom, it is recent common practice for taxis to incur a charge for both a drop-off and a pickup an airport. As airports become large, it is not unusual that they suffer from too many cruising taxis, which cause congestion on the terminal access roads.

Limousine

Limousine services, which are reasonably common in the United States and number of other countries, are either minibuses or large automobiles that provide connection between the airport and a number of designated centers (usually hotels) in the city.

In small cities, the limousine usually operates to only one central location; in larger cities, to designated multiple locations.

Operationally, a limousine is similar to a bus, and where bus services are feasible, it is unusual to have limousines as well. The contracts are lucrative to the limousine operator because passenger load factors are high, and therefore, the concessionary fees that go to the airport operator can be high in comparison with the cost of providing facilities. Because limousines are in fact a form of public transport, they relieve road congestion and the need for parking.

Rail

In the last 20 years, there has been a great deal of activity at large airports to move in the direction of providing more access by rail (TRB 2000,2002). Airports are widely spread across the globe as Chicago O'Hare, JFK, London Heathrow, Hong Kong, Beijing, Singapore, and Seoul Incheon are just some of the airports that have added rail access routes. The rail access facilities fall into three categories.

Provision of a connection into an existing rail rapid-transit system for example, Atlanta, Chicago O'Hare, Ronald Reagan Washington National, Paris Charles de Gaulle, and London Heathrow.

Direct connection to an existing national intercity rail network-for example, Zurich Kloten, Schiphol Amsterdam, Franfurt, London Gatwick, and Brussels.

Dedicated link from airport to city center location or locations-for example, Munich, Oslo, Beijing, Inchon, and Shanghai.

If rail services is to be successful for all three rail modes (i.e., urban rapid transit, conventional intercity rail, and dedicated links), it requires a compact connection at the airport end.

The access rail system and any system to which it connects must be able to accommodate storing of luggage on the trip.

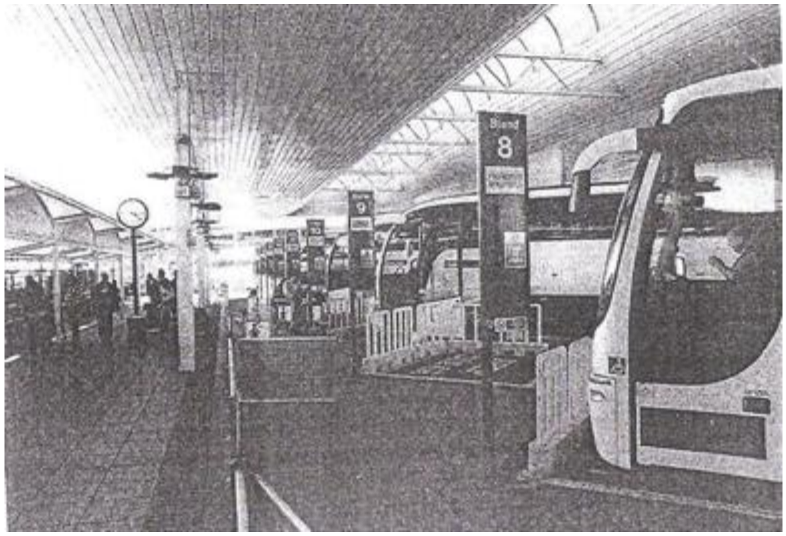
Access time, provided that it is reasonable for the distance covered, is not extremely important to passengers, so the cost of supplying very high speeds may not be worth striving for.

Access journey time does not appear to be critical to air travelers, except in the very shortest hauls with competitive surface modes. The selection of an access mode is much more affected by the ability to cope with inconvenient and heavy baggage and the total cost to the traveling party.

Bus

Around the world, virtually all airports carrying reasonable volumes of passengers by scheduled and charter operators are connected by bus to the city center. Normally this is arranged by contract between the bus operator and the airport authority whereby the bus company usually pays the airport a concessionary fee or percentage for the exclusive right to provide an agreed-on scheduled service. Service is supplied to a number of point in large cities but perhaps to only one point in a small urban area.

Buses become extremely important at airports serving many resorts. Bus loading and unloading areas are designated and must be kept clear of taxis and automobiles. Bus parks are as important as car parks, and the airport operator has an interest in ensuring that the bus parks are kept operational and clear. Figure shows bus park that caters to chartered buses for vacation passengers.



Dedicated Rail Systems

In the area of airport access, nothing has caught the public imagination more than the concept of some form of futuristic high-speed, tracked vehicle, that will convey passengers from the airport to the town center unimpeded by surface-road or rail traffic. High-speed tracked airport-access vehicles on dedicated rights-of-way are unlikely to be built anywhere in the world where the economics of access costs are correctly considered. High-speed links are unnecessary, save little time over trains operating nonstop at conventional speeds, are likely to cost half as much as the remote airport they purport to serve, and can move passengers only to and from the central city, where most travelers probably have no wish to go. More-over, if they require public subsidy, they raise an ethical question as to whether the air traveler has any right to expect to travel to the urban area at a higher speed than any other traveler. Even so, it is likely that they will continue to receive a disproportionate amount of public and media interest.

In-Town and Other Off-Airport Terminals

Experience with in-town terminals with check-in facilities has been varied. Originally opened in 1957, when the West London Terminal serving Heathrow was closed, only 10 percent of passengers were using the facility. As well as being uneconomic, it was difficult to have reliable connections between the off-airport terminal and the airport owing to increasing road congestion on the airport access routes. Examples of successful in-town airline bus terminals with no check-in facilities are more numerous.

Because of the availability of online ticketing and online check-in, there has been little recent development in remote check-in by the airlines. attractive service can perform poorly if the convenience level of the traveler is debased by long walking distances with baggage, frequent changes of level by stairs, crowded vehicles, and inadequate stowage space.

Factors Affecting Access-Mode Choice

The level of traffic attracted to any access mode is function of the traveler's perception of three main classes of variables:

- Cost
- Comfort
- Convenience

Decisions in terms of these variables are made not only on the level of service provided by a particular mode but also on the comparative level of service offered by competing access modes.

Transportation planners have numerous models ranging from the simple to the complex to explain the modal selection procedure.