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Review article

An insight to effective management of airport environment and aviation safety

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ABSTRACT

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The compatibility of an airport with its environs is an ideal that can be achieved by proper planning of the airport, control of pollution-generating sources, and land use planning of the area surrounding the airport. Airport Planning must be recognized as an integral part of an area-wide comprehensive planning programme, EAC, (No.139-16). The location, size and configuration of the airport need to be coordinated with patterns of residential, industrial, commercial, agricultural and other land uses of the area, taking into account the effects of the airport on people and, flora, fauna, the atmosphere, water resources, air quality, soil pollution and other facets of the environment. Within the comprehensive planning framework, airport development and operations should be coordinated with planning, policies and programmes for area where the airport is located. In this way, the social and economic and economic impact, along with the environmental effects of the airport, can be evaluated to ensure the greatest extent possible that the airport environs are compatible with the airport, and conversely that the physical development and use of the airport is compatible with the existing and proposed patterns of land use. An effective management of Airport environment is a must pre-requisite for attaining safety in Airport Environment and in all aviation activities.

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1. Introduction

Management comprises planning, organizing, staffing, leading or directing, and controlling an organization (a group of one or more people or entities) or effort for the purpose of accomplishing a goal, Wikipedia,(2013). Resourcing encompasses the deployment and manipulation of human resources, financial resources, technological resources and natural resources. Since organizations can be viewed as systems, management can also be defined as human action, including design, to facilitate the production of useful outcomes from a system. This view opens the opportunity to 'manage' oneself, a pre-requisite to attempting to manage others. An effective manager should have the following skills.

Communication Skills:

- Listening skills
- Presentation skills
- Feedback Skills
- Report writing skills

Conflict Management Skills:

- Identifying sources of conflict – functional and dysfunctional conflicts
- Understanding personal style of conflict resolution
- Choosing the best strategy for dealing with a conflict and
- Developing skills in promoting constructive conflicts in organization and teams.

Negotiation Skills:

- Distinguishing distributive and integrative negotiations, position and principle negotiation
- Identifying common mistakes in negotiation and ways to avoid them
- Developing rational thinking in negotiation and
- Developing effective skills in negotiation that benefits all parties involved.

Self-Awareness and Improvement:

- Understanding the concept of self-management
- Evaluate the effectiveness of self-management
- Developing creative and holistic thinking
- Understanding the importance of emotions in works as well in self-development
- Understand of self-motivation and
- Effectively managing self-learning and change.

The compatibility of an airport with its environs is an ideal that can be achieved by proper planning of the airport, control of pollution-generating sources, and land use planning of the area surrounding the airport. Airport Planning must be recognized as an integral part of an area-wide comprehensive planning programme, EAC, (No.139_16). The location, size and configuration of the airport need to be coordinated with patterns of residential, industrial, commercial, agricultural and other land uses of the area, taking into account the effects of the airport on people and, flora, fauna, the atmosphere, water resources, air quality, soil pollution and other facets of the environment. Within the comprehensive planning framework, airport development and operations should be coordinated with planning, policies and programmes for area where the airport is located. In this way, the social and economic and economic impact, along with the environmental effects of the airport, can be evaluated to ensure the greatest extent possible that the airport environs are compatible with the airport, and conversely that the physical development and use of the airport is compatible with the existing and proposed patterns of land use.

1.1. Environmental management system and safety management system

The Environmental Management System (EMS) and Safety Management System (SMS) are continuous improvement systems that use and enhance existing environmental and safety approaches. Both systems provide a formal, structured methodology to identify aspects of operations that pose a risk to the safety, security, or efficiency of the commercial space industry and the environment, FAA, (2007). The management systems are based on the International Organization for Standardization (ISO) standards that use the “Plan-Do-Act-Check” model as described below.

Plan – The organization identifies how its operations might harm the environment or public safety and develops measures to reduce this harm.

Do – The organization implements measures to assess levels and functions of its operations.

Check – The organization assesses the effectiveness of the measures for managing environmental impacts and public safety risks.

Act – Based on its assessment of the implemented measures, the organization makes systems adjustments to promote continuous improvement.

The benefits of this type of model include developing a planned approach to accomplishing goals, which includes assigning qualified personnel and providing appropriate funding to accomplish tasks. In addition, this type of system promotes accountability and record keeping, meaning that individuals are responsible for ensuring that a task is complete and efforts are documented. Finally, the check portion promotes anomaly reporting while the corrective action system determines ways to fix any problems that are found. The continuous improvement of the system allows it to adapt to the dynamic nature of the organization's operations and to remain relevant and viable for its intended purposes.

2. Environmental management

The environmental management of an airport can be divided into three basic categories

Environmental awareness

Planning and monitoring and

Remedial measures.

The objective of the environmental management awareness programme is to promote increased environmental consciousness and to make individuals aware of their own environmental protection responsibilities, both in decision-making and in day-to-day work of the airport, The International Institute for Sustainable Development (1992). This is accomplished primarily through employee education, training and incentives. Most of the environmental activities at the airports involve planning and monitoring, this includes:

Environmental assessment

Monitoring and compliance

Environmental audits, where necessary; and

Environmental emergency plans

Usually, periodic inspections are undertaken in order to provide a thorough assessment of the environmental implications of operations and management practices at a given point in time and to determine the degree of compliance with the applicable regulations, guidelines and code of practice. The inspections are used to assess whether or not the monitoring and compliance programmes are functioning properly and to identify any problems not previously detected. They provide the basis for action plans. In addition, such inspections are valuable tools for identifying opportunities for enhancing environmental management practices as a whole. Although the ultimate goal of a proactive environmental strategy is to minimize the creation of environmental problems, in the interim, there need for remedial measures to correct situations resulting from material handling and management practices of the airports in general have an obligation to protect the physical environment by evaluating the impacts of their policies and regulatory decisions on the environment and by promoting and meeting environmental standards while serving the public to optimal satisfaction and safety EAC, (NO. 139_16). By adopting ISO 14000 standards and implementing an environmental management system (EMS), it is expected that airports will make a major push towards achieving environmental standards and objectives.

2.1. Environmental problems in the airport

This deals with environmental problems related to airport and aircraft and aircraft operations. It identifies most of the major environmental problems that may be directly associated with air transport and civil aviation in particular. Excluded are problems concerning the conditions for passengers and crew (such as the effects of smoking, ozone, high altitude radiation, or noise and variation within the cabin) and problems concerning the working conditions of airline and airport employee, these are defined as occupational health and safety issues.

2.2. Aircraft noise

Since the introduction of Jet Aircraft, noise has been considered to be perhaps the most important environmental problem associated with civil aviation, ICAO,(1993). Noise levels in the vicinity of airports are affected by two opposing trends; the replacement of noisy aircraft by quieter ones and the increasing number of

aircraft movements. As a result, the problem of noise may decline at some airports and increase at others. The noise problem has prevented the expansion of airport capacity in some cases, thereby contributing to congestion. Because of this and some other problems some states are considering limiting aircraft operations at airport based on environmental considerations, rather than on airport capacity. In other words, the standard "operational airport capacity" is replaced by measures of capacity based on environmental parameters, Airport Planning Manual (2004).

2.3. Air quality in the vicinity of airports

Air quality in the vicinity of airports is affected by aircraft engine, emission, emission from airport motor vehicle and access traffic, and emissions from other sources (e.g heating/power plants and incinerators). Air pollution refers to a condition of the air marked by the presence therein of one or more air contaminants that can:

- Affect health, safety or welfare of person
- Interfere with normal enjoyment of life and property
- Endanger the health of animal life; or
- Cause damage to plant life or to property

Air pollution is a major environmental problem in most countries especially in urban areas, and is generally recognized to contain:

- Carbon dioxide (CO₂)
- Carbon monoxide (CO)
- Oxides of Nitrogen (NO_x)
- Volatile organic compound (VOC)
- Hydrocarbons (HC) and
- Ozone (O₃)

Carbon dioxide (CO₂) is produced by the oxidation of carbon in fuel, which carbon monoxide (CO) is a product originating from incomplete combustion of hydrocarbon fuels. Nitrogen oxides result from high temperature combination of nitrogen and oxygen in aircraft engines and internal combustion sources. Volatile organic compounds which are directly emitted from the combustion process are considered carcinogenic and chronic exposure to VOCs could cause health problems. Hydrocarbons (HC) cover a wide range of pure and impure hydrocarbons (methane, olefins, aldehydes, ketones and terpenes) whose sources include fuelling activities and incomplete combustion processes. Ozone (O₃) is simply a byproduct of photochemical reactions and is known to play an important role in chemistry of NO_x and HC. It is an irritant gas, which can cause health problems, such as irritation to the nose, eyes and throat as well as respiratory problems, and damaging effects on plant and animal. Although the air quality in the vicinity of airports is generally no worse, and in fact is often better than that found in most urban areas, it is nevertheless a cause for concern.

2.4. Global environmental problems associated from airport use

In recent years, evidence has emerged that the ozone layer around the earth, which protects us from harmful ultraviolet radiation, is being depleted as a result of complex chemical reactions involving man-made gases. Ozone depletion can be defined as the diminishing of the earth's protective stratospheric ozone layer primary due to human activity. The leading causes of ozone depletion are chlorofluorocarbons (CFCs) and halons, foams, solvents and manmade chemicals that are commonly used in air conditioners and refrigerators. Since CFCs and halons are very stable and not easily breakdown in the lower atmosphere, they are able to rise to the stratosphere where they are broken down by ultraviolet radiation and through a variety of chain reactions, destroy the ozone layer. Airlines and airports use CFCs and other ozone depleting substance (such as chlorinated solvents and oxides of nitrogen) in air- conditioning and chilling systems, degreasers in heavy maintenance operations, cleaning of avionics circuit boards, fumigation operations, and fire extinguisher on aircraft and computer rooms. The principal cause of ozone-depletion problem is considered to be chlorofluorocarbons which are primarily employed as aerosols propellants or as refrigerants. Although civil aviation uses CFCs, it only uses small quantity.

2.5. Environmental problems arising from construction and expansion of airports or associated infrastructure.

The environmental problems described in this section are mainly concerned with land use, soil erosion, impacts on surface and subsurface water drainage, and the impact on flora and fauna. Environmental problems

arise not only when new airports are being developed but also when existing airport facilities are expanded, Airport Planning Manual (2002). The nature of the problems varies from one airport to another. As a consequence of vegetation clearing and interference with watershed patterns, land on an airport or within its vicinity may be vulnerable to soil erosion by natural elements and, to a limited degree, by aircraft jet blast. This problem can mostly be prevented by replanting, however, in arid areas it may be necessary to take artificial erosion protection measures, such as facing of escarpments, paving of taxiway shoulders and lining of drains. Particular consideration should be given to possible water pollution during the construction phases of airports. Construction activities likely to cause stream pollution include clearing, grubbing and pest control. For instance the clearing of vegetation generally results in greater soil erosion into streams. Pest control, particularly the use of sprays, can introduce long-life toxic chemicals into water. Fuel spillages from equipment and chemicals used in building and pavement construction work can disrupt the hydrological balance of water ways in the area. Changes to the natural drainage patterns of an area due to the construction of an airport can overload certain streams and give rise to flooding. Diversion of flow may cause streams to dry up. The utilization of land for airport purposes can also cause disturbances to flora and fauna. Airport development work frequently entails clearing and cutting back trees and other vegetation changes to the topography of the area, and interferences with watershed patterns. Thus airports may destroy the natural habitat and feeding grounds of wildlife and may deplete certain floras that are vital to the ecological balance of the area. There are also potential impacts on human beings for example. Airport construction may destroy sources of food or firewood, or may cause agricultural land loss, a major concern in certain areas of the world. An important consideration related to the airport operational safety is the prevalence and habits of birds in the area and the associated risk of aircraft bird strikes. Bird hazards at proposed new airports can be minimized by careful selection of the site to avoid established bird migration routes and area naturally attractive to birds and by using the land surrounding the airport for purposes, which will not attract concentration of birds to the area. At existing airports, the bird's problem may be controlled by scaring techniques and by making airport and its environment unattractive to birds. As far as these environment problems are concerned, airport construction is not significantly different from any large construction site. In many countries, the issue is governed by general legislation on planning and development of construction site, Airport Planning Manual, (2002).

2.6 Water and soil pollution in the vicinity of the airports

Water pollution can result from direct and indirect discharge of substances in the aquatic environment, leading to alterations in the properties of the natural ecosystems and water chemistry and having subsequent effects on human health. Surface water is most often affected, as pollution run off the airport pavement and enter into the streams, rivers, lakes, etc. However, sub-surface water may also become contaminated when leaks or spills of fluids seep through the soil into the ground water. Airport use a variety of chemicals in their day-to-day operation. If not properly controlled, these contaminants may have harmful effects on nearby surface and/or sub-surface (ground) water. Water contaminants at airports and their sources include:

- Glycol, from de-icing/anti-icing of aircraft
- Urea, from de-icing/anti-icing of runways, aprons, and taxiways
- Fuel, from spills during refuelling and leaks from pipes or tanks
- Fire suppressant chemicals and foams dispersed in fire fighting exercises
- Dust, dirt and hydrocarbon from paved surfaces; and
- Herbicides and pesticides.

The servicing of aircraft and ground vehicles can result in the discharge of industrial effluent e.g paint stripping, metal coating, detergent from aircraft, and vehicle and pavement washing.

2.7. Waste at airports

The disposal of environmentally harmful materials used in aircraft servicing and maintenance (e.g oils, cleaning fluids and paints) and of waste from the airport and incoming aircraft should be managed effectively. Although airports are not considered as industrial complexes, daily activities, such as movement of aircraft and ground vehicles, fuelling operations, aircraft maintenance and repair work (including painting and metal work), engine test cell operations, and ground vehicle maintenance are all sources of airport industrial waste, ICAO (Doc 9184).

2.8. Environmental problems arising from aircraft accidents/incidents involving dangerous goods and emergency procedures.

In order to ensure that responses to environmental emergencies are implemented quickly. It is important to establish an environmental emergency plan ICAO (Doc 9184). The types of environmental emergency plan at airports include, but not limited to, fuel and chemical spills and incidents involving dangerous good or hazardous materials that may affect the environment. The objective of environmental emergency plan is to provide a complete and immediate response to an environmental incident. Many aircraft are not structurally able to withstand a landing at maximum take-off mass. In the event of an emergency requiring an overweight landing, it is sometimes necessary to dump fuel into the atmosphere, although this is a rare occurrence. Air traffic control (ATC) establishes specific areas where fuel can be dumped in case of an emergency.

3. Land use

Land use around airport will impact the operational safety of the airport as well as the safety of the surrounding communities, ICAO (Doc 9184). Hence, the activities around an airport that can affect the safety and efficient operations of aircraft should be taken into consideration when planning land uses in the vicinity of the airports. As airport noise has become the major airport environmental problem impacting the development of land use around airport, its relationship with land use is a main concern in the development of land around airports. As guidance on proper airport and land use compatibility planning, this paper presents a variety of possible land uses with broad appreciation of their relative sensitivity to aircraft noise exposure and describes their compatibility or incompatibility to aircraft noise and to airport operations.

3.1. Natural land use

Every airport is different, as are the areas surrounding them. Natural area such as forest, open land, rivers, and swamps, bays-with and without wildlife are found in varying degrees in the vicinity of airports. In many cases, the presence of natural areas influences the selection of the airport site. In other cases, the selection is based on different factors, but the existence of natural areas provides additional benefits. The presence of natural features in the approach and climb-out areas has done much to mitigate the aircraft noise problem. An example is a new airport, which has been situated in the bend of a river to take advantage of the close-in water approaches under both ends of the runway. Runways located on filled land on the edge of bays also afford unobstructed approaches over water. Natural features have been, and can be, used to advantage not only in protecting the airport against noise complaints but also in adding natural beauty and interest to the airport. Nevertheless, where rivers, lakes, bays or swamps are found in the airport area, bird hazard problem may exist. At some airports, this problem had been so serious as to cause accidents. Compatible and incompatible land uses around airports with a view to minimizing bird problems.

3.2. Agricultural land uses

While it may not always be possible to use land for agricultural purposes in the metropolitan areas, many airports may wish to do so in order to increase airport revenues. Privately owned land around airports may also be used for farming, provided this activity does not attract birds which represent a hazard to aviation. The agricultural use of land contributes several important factors to an airport programme, this includes:

The production of income from what might otherwise be waste or idle land

The provision of crop cover and prevents soil erosion

The elimination of the expenses to the airport of mowing or taking care of the land.

Furthermore, land that has been turned over to agriculture is still available for industrial or commercial development, recreational facilities, or public utilities at a later period. Crop cultivation may however have an adverse effect on aircraft operation due to the presence of birds, which are attracted by seeds. All agricultural uses have proven to be compatible with aircraft noise, with the exception of poultry farms. Location of these farms within approximately 5km of an airport is not recommended because of the adverse reaction of the fowl to high levels of aircraft noise. It should be noted that birds might be attracted to some pig farms where garbage is used as fodder.

3.3. Highways and railways

In view of the existing vast network of highways and railways and the constant building, realignment and rebuilding that will take place in the future, it is only sensible that highways or railways planning be coordinated

with noise abatement plans of airport. In planning highway and railway systems near an airport or in planning one, which includes an access road or railway to the airport, coordination with the airport officials can be often result in the highway or railway being coordinated beneath the approach and climb-out paths of the aircraft. This is acceptable as long as potential obstacles such as high vehicles or road lighting (which may potential cause confusion or endanger aircraft safety) are avoided and designated safety zones are maintained. The highway or railway construction can take the place of housing projects, which would be adversely affected by noise, while adjacent areas can be more easily adapted to commercial, industrial and recreational uses and parks. Not only can residential areas be removed but also they can actually be prevented from developing in critical noise areas by locating the highway and railway there.

3.4. Recreational land use

Every community needs recreational facilities and there are numbers of outdoor recreational uses that are compatible with airport operations. When such facilities must serve large population areas, a considerable amount of land is involved. Many airports have sufficient undeveloped adjacent land which, through proper planning, can be developed into complete recreational complexes. It should be remembered, however, that any land use in the vicinity of the airport must not present or create a hazard to aircraft operations, such as attracting birds. Among possible recreational uses, golf courses are increasing in popularity; parks require little development and are idle for hiking and riding trails, and outdoor living facilities, swimming pools, tennis court, playgrounds, and athletic fields (non-spectator) may be grouped with a clubhouse-restaurant facility (except under the approach areas). Botanicals garden can be incorporated into these activities, and ponds blend with parks and golf courses. All add interest, beauty and activity to the airport surroundings.

3.5. Municipal utilities

The sitting of municipal utilities at an airport is not only compatible but also logical. The industrial, residential and commercial growth of the airport creates increasing demands for water, sewage disposal and power utilities, and the concentration of these municipal requirements in the airport has proven to be economical and wise. However, while all municipal utility uses are compatible in the sense that there is no noise problem, electrical plans and power lines are considered a hazard by many airport lanners. Landfills and incinerators may create a smoke problem. Moreover, water storage, landfills and sewage treatment may attract birds ,EAC,(No.139-16).

3.6. Commercial land uses

Commercial activity is similar to residential activity in that there are people going into and out of buildings and the area. However, the bulk of commercial operations is carried out during a daylight hours and is not affected by the problem of noise at night or during sleeping hours as residential areas are. In addition, persons pursuing the normal business activities found in commercial areas are not generally as disturbed by aircraft noise as are those in residential areas. Commercial activities established in or around the airports can range from shopping centres to pet cemeteries. Here too, the potential risk and effects of aircraft accidents should be considered. Although commercial operations can be situated in areas subject to higher noise levels than residential developments, they generally cannot be carried out in areas as industrial operations, which are performed primarily indoors and have a higher associated noise level. Sound conditioning and air conditioning should be incorporated in the construction of commercial structures to the extent necessary in order to reduce exterior noise to a level acceptable for conducting business inside the building.

3.7. Industrial land use

The location of industrial sites at the airport has generally been found to be compatible with aircraft noise because of the relatively higher ambient noise level, internal and external, associated with industrial activity. This factor combined with the ever growing need for industrial land around airports, has contributed to the development of industrial parks in and around commercial and general aviation airports. Business has learned to take advantage of the unique benefits that air transportation can offer, and many major commercial enterprises are also located at airport. With respect to Industrial sites around airports, the potential risk and effect of an aircraft accident should be taken into account when planning activities involving a large number of people. Encouraging industrial development in airport areas can lead to important benefits. First, the industrial noise tends to make inhabitants more amenable to aircraft noise. This should not, however, deter industrial developers from

using sound and air conditioning to reduce aircraft noise. Second, as a result of its location near airport, these industries will usually become supporters of the airport and be interested in airport operations. In addition, airport owners and operators can drive a substantial income by selling or leasing the undeveloped land, or by developing the land and subsequently leasing or selling it to industrial firms. However, prospective sites for industrial development must still satisfy the following basic requirements:

- Desirable geographical location, considering the communities in question;
- Availability of land of sufficient size to accommodate the planned industrial development;
- Access to commercial transportation facilities, in addition to air transportation, if necessary;
- Present and/or future availability of needed utilities;
- Access to nearby residential areas for the industrial employees, with reasonable commuting time; and
- Compatibility of proposed industrial development with other land users.

It should be noted, however that due consideration should be made before those industries that emit offensive noise, odours and smoke, or that create electronic interference with airport operations are sited at the airport or its vicinity.

3.8. Residential and institutional land use

In this research, residential housing refers to single-family dwelling, and estates, institutional housing refers to community facilities such as schools, hospital and churches. All these facilities should be planned and situated with thorough consideration of airport noise and potential risk of aircraft accident. In single-family dwelling in temperate and warm climates, families live outside during many of the daylight hours, especially in the summer months. This is also true of estates and, to a lesser event, of multi-family dwellings, particularly where a community swimming pool exists. It is the outdoor activity that creates the real noise compatibility problem for residential property in the vicinity of the airport. Institutional dwellings may require a greater degree of sound conditioning than do residential structures because a lower sound level is necessary for indoor use. The requirements of patients in hospitals and of the speech level in schools, churches and mosques demand special evaluation if these facilities are located in the vicinity of the airport.

3.9. Recommendation on best practice for an effective environmental management

The following recommendations are made for a better environmental Management at Airports: The land use system in place should reflect an integrated approach adopted jointly by the airport operators, the state government and the local authorities. There should be harmonious link between the community surrounding the airport and the airport management for a proper noise zoning planning so as to ensure compatibility of the urban and airport planning process.

Commercial building and houses in the airport should adequately be sound-proofed.

Airport environment should be given special control to keep the land free from food and shelter for birds.

A noise monitoring system should be installed in the airport because it provide the basis for flight report which shows arrival and departure tracks on quarterly basis. It also provides the basis for regular reviews of aircraft operators and noise abatement procedure.

There must be as appropriate a comprehensive environmental impact assessment (EIA) for any airport improvement to assess the technological and socio-economic impact of improvements.

Government with the support of private participation should made fund available to the airport for a better land use and environmental control.

Training and re-training of personnel especially those involved with environmental management should be given due consideration.

Air quality test should be conducted at intervals to check the safety of the air.

Water quality test should be conducted at intervals to check the effect that may arise from oil leakages from aircrafts, since the airport relies on underground water.

4. Land use guidelines for the avoidance of bird's hazards

The land uses tabulated below should not be considered as an exhaustive listing, but merely as examples of how various land uses may be graded in two areas, Areas A and B, surrounding an airport. These areas are drawn up by describing two concentric circles (Radii 3 and 8 Km, respectively) around an airport, centred on the airport

reference point. Any land use that has the potential to attract birds to the airport vicinity should be the subject of a study to determine the likelihood of bird strikes to aircraft using the airport, Transport Canada (1997).

Land use (Agricultural)	Area A	Area B
Landscape Nurseries	Yes	Yes
Stock Farming	Yes	Yes
Dairy Farming	Yes	Yes
Sod Farming	No	Yes
Piggeries	No	Yes

Land use (Commercial)	Area A	Area B
Offices	Yes	Yes
Retail Sale	Yes	Yes
Hotels and Motels	Yes	Yes
Restaurants	Yes	Yes
Parking Lots	Yes	Yes
Indoor Theatres	Yes	Yes
Warehouses	Yes	Yes
Shopping Centres	Yes	Yes
Service Stations	Yes	Yes
Cemeteries	Yes	Yes
Drive- in-Restaurants	No	Yes
Food processing Plants	No	Yes
Municipal Utilities	Yes	Yes
Water Treatment	Yes	Yes
Non-food garbage landfill	Yes	Yes
Food garbage disposal	No	No

Land use (Recreational)	Area A	Area B
Golf Course	Yes	Yes
Parks	Yes	Yes
Playgrounds	Yes	Yes
Athletic Fields	Yes	Yes
Riding Trails	Yes	Yes
Tennis, Lawn Bowling	Yes	Yes
Picnic Grounds	Yes	Yes
Race Tracks	No	Yes
Fair Grounds	No	Yes
Outdoor Theatres	No	Yes

Source: Transport Canada (1997)

5. The concept of safety

Depending on the perspective, the concept of safety in aviation may have different connotations, such as:

- a) Zero accidents or serious incidents — a view widely held by the travelling public;
- b) Freedom from hazards, i.e. those factors which cause or are likely to cause harm;
- c) Attitudes of employees of aviation organizations towards unsafe acts and conditions;
- d) Error avoidance; and
- e) Regulatory compliance.

Whatever the connotation, they all have one underlying commonality: the possibility of absolute control. Zero accidents, freedom from hazards, and so forth, convey the idea that it would be possible — by design or

intervention — to bring under control, in aviation operational contexts, all variables that can precipitate bad or damaging outcomes. While the elimination of accidents and/or serious incidents and the achievement of absolute control is certainly desirable, they are unachievable goals in open and dynamic operational contexts. Hazards are integral components of aviation operational contexts. Failures and operational errors will occur in aviation, in spite of the best and most accomplished efforts to prevent them, Safety Management manual, (Doc. 9859) No human activity or human-made system can be guaranteed to be absolutely free from hazards and operational errors. Safety is therefore a concept that must encompass relatives rather than absolutes, whereby safety risks arising from the consequences of hazards in operational contexts must be acceptable in an inherently safe system. The key issue still resides in control, but relative rather than absolute control. As long as safety risks and operational errors are kept under a reasonable degree of control, a system as open and dynamic as commercial civil aviation is considered to be safe. In other words, safety risks and operational errors that are controlled to a reasonable degree are acceptable in an inherently safe system. Safety is increasingly viewed as the outcome of the management of certain organizational processes, which have the objective of keeping the safety risks of the consequences of hazards in operational contexts under organizational control. Thus, for the purposes of this presentation, safety is considered to have the following meaning:

Safety: The state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management. Several different factors put the rough edges on the Liveware block. Some of the more important factors affecting individual performance are listed below:

- a) Physical factors. These include the human's physical capabilities to perform the required tasks, e.g. strength, height, reach, vision and hearing.
- b) Physiological factors. These include those factors which affect the human's internal physical processes, which can compromise physical and cognitive performance, e.g. oxygen availability, general health and fitness, disease or illness, tobacco, drug or alcohol use, personal stress, fatigue and pregnancy.
- c) Psychological factors. These include those factors affecting the psychological preparedness of the human to meet all the circumstances that might occur, e.g. adequacy of training, knowledge and experience, and workload.
- d) Psycho-social factors. These include all those external factors in the social system of humans that bring pressure to bear on them in their work and non-work environments, e.g. an argument with a supervisor, labour-management disputes, and a death in the family, personal financial problems or other domestic tension

5.1. Effective safety reporting

One of the most influential aspects of an organizational culture in terms of the management of safety is that it shapes safety reporting procedures and practices by operational personnel. Identification of hazards is a fundamental activity underlying the management of safety. Nobody is in a better position to report the existence of hazards, and what works the way it is supposed to and what does not, than operational personnel, who have to live with and face hazards on an everyday basis. Effective safety reporting of hazards by operational personnel is therefore a cornerstone of the management of safety, safety management manual, (Doc. 9859). Therefore, an operational environment in which operational personnel have been trained and are constantly encouraged to report hazards is the prerequisite for effective safety reporting. Effective safety reporting builds upon certain basic attributes, such as:

- a) Senior management places strong emphasis on hazard identification as part of the strategy for the management of safety, and as a consequence there is an awareness of the importance of communicating hazard information at all levels of the organization;
- b) Senior management and operational personnel hold a realistic view of the hazards faced by the organization's service delivery activities, and as a consequence there are realistic rules relating to hazards and potential sources of damage;
- c) Senior management defines the operational requirements needed to support active hazard reporting, ensures that key safety data are properly registered, demonstrates a receptive attitude to the reporting of hazards by operational personnel and implements measures to address the consequences of hazards;
- d) Senior management ensures that key safety data are properly safeguarded and promotes a system of checks and balances so that reporters of hazards feel confident that hazard reporting will not be put to use other than for which it was implemented (the management of safety);

- e) Personnel are formally trained to recognize and report hazards and understand the incidence and consequences of hazards in the activities supporting delivery of services; and
- f) There is a low incidence of hazardous behaviour, and a safety ethic which discourages such behaviour.

5.2. Effective safety reporting — five basic traits

There are five basic traits that are universally associated with effective safety reporting systems, these five basic traits are related to the basic attributes of effective safety reporting discussed, and the traits are:

5.2.1. Willingness

As a consequence of deliberate efforts by senior management to define the operational requirements needed to support active hazard reporting and to ensure that key safety data are properly registered, operational personnel are willing to report hazards, operational errors that might arise from exposure to hazards, as well as their personal experiences as appropriate.

5.2.2. Information

As a consequence of the formal training to recognize and report hazards and to understand the incidence and consequences of hazards in the activities supporting delivery of services, operational personnel are knowledgeable about the human, technical and organizational factors that determine the safety of the system as a whole.

5.2.3. Flexibility

As a consequence of holding realistic views of the hazards underlying the organization's service delivery activities and the development of realistic rules relating to hazards and to potential sources of damage, operational personnel can adapt hazard reporting when facing unusual circumstances, shifting from the established mode to a direct mode thus allowing information to quickly reach the appropriate decision-making level.

As a consequence of the awareness of the importance of communicating hazard information at all levels of the organization, operational personnel have the competence to draw conclusions from safety information systems, and the organization has the will to implement major reforms.

5.2.4. Accountability

People are encouraged (and rewarded) for providing essential safety-related information. However, there is a clear line that differentiates between acceptable and unacceptable behaviour.

5.3. The need for safety management

Traditionally, the need for safety management has been justified based on a predicted industry growth and the potential for an increase in accidents as a consequence of such growth. While accident reduction will always remain

a priority of aviation, there are more compelling reasons than statistical projections underlying the transition to a safety management environment in international civil aviation worldwide. Aviation is arguably the safest mode of mass transportation and one of the safest socio-technical production systems in the history of humankind. This achievement acquires particular relevance when considering the youth of the aviation industry, which is measured in decades, as compared to other industries whose histories span centuries. It is a tribute to the aviation safety community and its unrelenting endeavours that in a mere century aviation has progressed, from a safety perspective, from a fragile system to the first ultra-safe system in the history of transportation.

5.4. Safety management strategies

5.4.1. Predictive method

The predictive method captures system performance as it happens in real-time. Normal operations to identify potential future problems.

5.4.2. Reactive method

The reactive method responds to events that have already happened, such as incidents and accidents.

5.4.3. Proactive method

The proactive method looks actively for the identification of safety risks through the analysis of the organization's activities.

5.5. Standard operating procedures

The introduction of standard operating procedures employed by airport operators, airlines, pilots, air traffic control organizations, as well as the companies that provide important services such as ground handling and re-fuelling, have played a very important role. Often extra safety margins are built in to operational procedures which add a further layer of safety to an already safe system. Standard operating procedures cover all parts of an airport's operations on the airfield, on the apron, at gates and in maintenance areas. Vehicles driving on the apron must adhere to strict rules regarding speed, crossing of taxiways, distance to be respected behind aircraft with running engines, and so on. For driving on the airfield, even more stringent measures are in force, including radio contact with the tower. Personnel must also follow a set of procedures designed to ensure their own safety and that of aircraft and passengers (for example wearing high-visibility jackets, hearing protection and remaining at a set distance from operating aircraft). Such procedures are trained and rehearsed to become deeply ingrained in operating practice, enhancing the 'safety culture' in the industry. In parallel with these, is an important need for the instilling of a safety culture from the top management down, including the notion of a 'just' culture, whereby reporting of safety hazards and occurrences is encouraged, with the intention of learning from these events and discussing solutions, which leads to a continuous reduction in the rate of accidents. Technology, systems and equipment Progress in systems and equipment at airports has also.

enabled major gains in safety, in areas such as:

New lighting systems.

Precision approach and landing systems, from radio-frequency guidance (ILS), to satellite-based navigation Surface movement radar Visual docking guidance systems for aircraft parking.

Automated meteorological systems.

So on and so fold.

6. Conclusion

Flying is the safest form of transport" - a common expression of which the aviation industry is justifiably proud. The safety and security of our air transport system is no coincidence throughout the history of flight, safety has been top of- mind. While most people know that the industry is safe, people who do not work in aviation are seldom aware of the extraordinary lengths gone to by airport operators, airlines, pilots, aircraft manufacturers, air traffic control organizations, meteorological information and service providers to retain this good record and continually strive for improvement. Therefore effective environmental management and aviation safety is everybody's business.

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