Accident Prevention Manual

(Doc 9422-AN/923)

FIRST EDITION — 1984
FOREWORD

1. At the 1979 ICAO Accident Prevention and Investigation Divisional Meeting there was an awareness among the aviation authorities of many States of the need for improved accident prevention efforts. As a consequence, the meeting recommended that ICAO produce an Accident Prevention Manual.

2. A study group assisted the ICAO Secretariat with the writing of this manual. Accordingly, it reflects their work and incorporates ideas and information distilled from many sources.

3. The aim of this manual is to:
   a) outline accident prevention concepts and methods;
   b) provide examples of practical applications; and
   c) foster an exchange of accident prevention ideas.

   It is expected that the manual will be useful to States and the aviation community for developing and maintaining accident prevention programmes.

4. The material in this manual is not exhaustive. Users are encouraged to expand and adapt its concepts to suit their own requirements or needs. Suggestions or material for improvement are invited and should be forwarded to:

   The Secretary General
   International Civil Aviation Organization
   1000 Sherbrooke Street West, Suite 400
   Montreal, Quebec, CANADA H3A 2R2

   Attention: AIG Section
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CHAPTER 1
INTRODUCTION

1.1 GENERAL

Regulatory safety and accident prevention

1.1.1 Aviation rests on a foundation of laws and regulations, most of which are aimed at maintaining or improving safety. This is particularly true for scheduled air transport which has achieved safety levels equal to public surface transport. This approach to safety, often referred to as regulatory safety, is an essential element of aviation.

1.1.2 In recommending that ICAO produce an Accident Prevention Manual, the Divisional Meeting agreed that such guidance material would greatly assist those States which did not have sophisticated prevention programmes. At the same time, the Meeting decided that accident prevention should be regarded in a specialized sense: “it should envisage activities which complement existing safety-related procedures or organizational arrangements in States or ICAO in such fields as airworthiness, operations, personnel licensing, training, communications, etc.” It was thus seen to differ from traditional regulatory safety in that it involved an active search for hazards that need to be eliminated or avoided. That decision has guided the writing of this manual, and the philosophy it presents.

1.1.3 Thus, accident prevention is presented here as being complementary to traditional safety related practices, whether undertaken by governments, manufacturers, operators or others. Naturally there are many ways in which one can view aviation safety and accident prevention and the viewpoint expressed in this manual is but one.

The meaning of terms

1.1.4 Some frequently used terms have been given a specific meaning in this manual. Since other interpretations are possible, the intended meaning is as follows:

Accident prevention: The detection and elimination or avoidance of hazards.

Hazard: Any condition, event or circumstance which could induce an accident.

Incident: An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation (from Annex 13).

Note.—Serious incidents are often investigated to the same extent as accidents.

Risk: The consequence of accepting a hazard.

These definitions have been kept simple so that they can be easily used in both written and spoken communications.

1.2 HISTORICAL DEVELOPMENTS

The past

1.2.1 In its infancy, aviation was the domain of the individual and no organized system existed for the exchange of safety information. World War I, however, provided a stimulus for the creation of large-scale aircraft industries. Aviation became a national resource and military criteria for performance and reliability were introduced. Large sums of money were spent acquiring aircraft and the traditions of standardization, approval and modification in the light of operational experience became part of the aviation industry. This approach to aircraft design, construction and operation largely remains today.

1.2.2 The tremendous growth of civil aviation since 1945 has necessitated increased government involvement. Regulatory bodies have found it necessary to intensify the control processes governing such disciplines as design, manufacture and operation. Throughout, ICAO has had a major role in the co-ordination and international standardization of these developments.
1.2.3 The success of any mode of transport is largely determined by the degree of speed, convenience, economy and safety it provides. The rapid growth of air transport indicates that it generally fulfils the public’s expectations in these areas.

The accident record

1.2.4 One method used by ICAO to illustrate the accident record of scheduled air transport is shown in Figure 1. This graph illustrates the number of passenger fatalities per 100 million passenger kilometres in scheduled airline operations since 1960.

1.2.5 The graph shows a remarkable improvement in safety. From the passenger’s point of view, scheduled airline operations are much safer today than they were in 1960. However, during the period 1975-1980 the fatality rate has levelled off, suggesting that the limits of the traditional, regulatory safety methods may have been reached. It therefore follows that different methods and programmes, such as those presented in this manual, may be needed to further reduce the accident rate.

1.2.6 Figure 1 does not include non-scheduled operations or general aviation. In recent years the fatality rate for non-scheduled services has been significantly higher than that for scheduled airlines. This rate, however, includes all types and categories of non-scheduled services thus introducing the factor of significantly different operating environments. For example, when non-scheduled operations using the same aircraft type and operating on the same routes as scheduled airlines are compared, the rates become much closer. The fatality rate for general aviation is considerably higher than either the scheduled or non-scheduled airline rate.

1.3 THE PRESENT (1983)

General

1.3.1 The high level of safety achieved in scheduled airline operations lately should not obscure the fact that most of the accidents that occurred could have been prevented. This suggests that in many instances, the safety measures already in place may have been inadequate, circumvented or ignored.

1.3.2 The challenge for the future lies in developing improved accident prevention methods and programmes, since hazards which are most apparent or easiest to avoid have largely been overcome, at least in airline operations. Further advances in aviation technology will introduce new or different hazards. Accident prevention activities must therefore keep abreast of these developments if success is to be achieved in reducing the accident rate even further.

The need for accident prevention

1.3.3 Aircraft accidents result in losses of vital resources, namely people and equipment. However, it is difficult to accurately assess the actual cost of aircraft accidents. Financially, they can be extremely expensive because of compensation claims, aircraft replacement costs and the effects of adverse publicity. The social costs involved are less tangible: the grief resulting from the loss of relatives or friends and the costs to society resulting from the loss of skilled and valued members are not quantifiable.

1.3.4 Nevertheless, one State has developed a model which provides an indication of the direct and indirect costs of its aircraft accidents. This model is a guide for its accident prevention efforts. The model examines a number of factors to determine the financial but not the social costs of an aircraft accident. These include:

- fatalities and injuries
- aircraft damage
- search and rescue
- investigation by government and non-governmental parties
- insurance costs
- financial impact on operator
- property damage.
The cost of accident prevention cannot be readily weighed against its benefits, because it is not possible to identify those accidents which did not occur as a result of accident prevention. However, accident prevention often leads to increased efficiency because it aims to eliminate errors and deficiencies at all levels. As an example, one major aircraft operator found that the landing gear on some of its aircraft occasionally could not be retracted after take-off. This necessitated the dumping of fuel and return to the departure aerodrome. Investigation showed that the landing gear microswitches were malfunctioning because of moisture. Improved microswitches reduced operating costs significantly because flights were no longer aborted for this reason.

The complementary approach to accident prevention

Any improvement in aviation safety requires the combined efforts of all sectors of the industry, particularly management, flight crews, engineers, manufacturers and government agencies. Each has a vital part to play and the absence of any one group will inevitably make the task more difficult and less successful.

In the past, the enforcement of regulations to enhance aviation safety was usually successful enough to be considered the only method needed. However, in recent years the accident record has not shown significant improvement. This has led to the belief that additional “non-regulatory” accident prevention measures are needed.

Other considerations which support the need for accident prevention programmes that complement traditional regulatory safety activities are:

a) accidents continue to occur in spite of the existence and enforcement of numerous rules and regulations;

b) the reluctance of persons to divulge self-incriminating information to an investigating organization that forms part of the regulatory body. Such information may be vital to a full understanding of the circumstances of an occurrence and hence to the prevention effort;

c) investigation organizations which form part of the regulatory body sometimes uncover deficiencies in the regulatory body itself, possibly creating:

1) conflicts of interest;

2) a perceived lack of credibility;

3) a potential for interference with the release of safety information.

These limitations are becoming more widely recognized and a number of States are placing increased emphasis on non-punitive accident prevention activities as a complement to regulatory safety procedures.

The objective of accident prevention

Very simply, the objective of accident prevention is to prevent aircraft accidents, thus improving public confidence in the safety of air travel, saving lives and money and reducing suffering. Although this may seem obvious, it needs to be clearly stated because this objective is sometimes overlooked in real life when other considerations are allowed to intrude. There are often temptations to add legal or other considerations, such as blame or liability, to this simple objective. When this occurs, the effectiveness of accident prevention efforts is compromised.

Fatalities/100 million passenger kilometres
Scheduled Airline Operations

Figure 1
2.1 ICAO

2.1.1 The Organization’s ‘regulatory-related’ role is to provide guidance and procedures for the safe conduct of international aircraft operations and to foster the planning and development of air transport. This is largely achieved by developing Standards and Recommended Practices (SARPs), which are contained in the Annexes to the Chicago Convention and reflect the operational experience of States. Procedures for Air Navigation Services (PANS) contain practices beyond the scope of SARPs, where a measure of international uniformity is desirable for safety and efficiency. Regional Air Navigation Plans detail requirements for facilities and services specific to ICAO regions. In essence, these documents reflect the safety practices of States, developed in the light of experience.

2.1.2 ICAO’s role in the accident prevention field includes:

   a) through this manual, outlining accident prevention concepts and providing guidance based on proven methods;

   b) establishing international procedures for accident and incident investigation and reporting. This is achieved through Annex 13 — Aircraft Accident Investigation, the Manual of Aircraft Accident Investigation and the Accident/Incident Reporting (ADREP) system;

   c) disseminating accident and incident information through the ADREP system and by other means;

   d) undertaking specific safety studies using ADREP data.

2.2 STATE ADMINISTRATIONS

2.2.1 In most States, the civil aviation department or authority has the responsibility of achieving a high standard of safety. It usually undertakes this by formulating regulations and procedures based on ICAO SARPs, tailored where necessary to meet local environmental or operational conditions. Inspection and enforcement processes are then established to ensure that the aviation community complies with the national regulations.

2.2.2 When States cannot, for whatever reason, adapt their national legislation to conform to ICAO SARPs, they are required to file a “difference”. This is published by ICAO, and indicates to other States, and users, that their legislation differs from internationally agreed standards. Most States comply with this important practice.

2.2.3 A State’s regulatory safety procedures usually include the following:

   — responding to discovered safety deficiencies;

   — incorporating technological advances;

   — continually reviewing regulations in the light of experience.

These procedures are usually well understood. For instance, States’ procedures relating to ICAO Annex 6 — Operation of Aircraft, Annex 8 — Airworthiness of Aircraft and the Airworthiness Technical Manual are well developed and documented. On the other hand, there is much less documentation regarding accident prevention activities outside the regulatory safety field. This manual attempts to overcome that deficiency.

2.2.4 In carrying out its regulatory functions, a State’s aviation administration not only promulgates aviation legislation but also ensures its enforcement. For example, a State controls the licences issued to its pilots, engineers and air traffic controllers. Enforcement action may necessitate the revocation of a licence if the holder fails to comply with regulations or fails to maintain the required standards. This is an essential feature of regulatory control. However, if applied arbitrarily, enforcement can provide a definite obstruction to the full understanding of
human failings.

2.3 AIRCRAFT MANUFACTURERS

2.3.1 The design and construction of aircraft and their components improve with advances in technology. Each new aircraft incorporates improvements based on the latest “state of the art” and operational experience. Manufacturers produce aircraft which comply with the airworthiness regulations of domestic and foreign governments, and meet the economic and performance requirements of purchasers.

2.3.2 Manufacturers also produce manuals and other documentation to support their products. In some States these may be the only guidance material available for the operation of a specific aircraft type or piece of equipment. Thus the standard of documentation provided by the manufacturer is very important. Additionally, through their responsibilities for providing product support, training, etc. manufacturers are probably the only source for the over-all safety record of a particular aircraft type or the in-service record of a component.

2.3.3 Aircraft manufacturers employ various specialists in the fields of design, manufacture and operation of their aircraft, as well as accident investigators. These persons are available for the investigation of accidents or incidents to aircraft of their manufacture.

2.3.4 Manufacturers can face costly litigation following an aircraft accident. On the one hand, this is a spur to optimize safety, while on the other, it can act as a deterrent to the voluntary correction of faults when this could be regarded as an admission of design or manufacturing deficiencies.

2.4 AIRLINES

2.4.1 Most major airlines employ some of the accident prevention activities outlined in this manual, while many of the smaller airlines and operators may not employ any. Where such activities do exist, they are usually carried out by a section which monitors over-all operating experience and provides independent advice to management on the preventive action needed to eliminate or avoid discovered hazards. Such activities may also lead to economies in the airline’s operation.

2.4.2 These prevention activities usually include some form of incident reporting, safety surveys and information feedback by means of periodic safety magazines, bulletins or news-letters.

2.4.3 The safety aspects of the engineering/manufacturing side of an airline are often the responsibility of a Quality Control Manager/Chief Inspector. Accident prevention programmes may tend to be oriented towards the flight operations side of the organization. Safety, however, must embrace the total organization and it is essential that a close working relationship be maintained between all parts of the organization.

2.5 GENERAL AVIATION

2.5.1 In many States, general aviation accidents constitute a major loss of resources. As a consequence, substantial benefits are to be gained from accident prevention programmes aimed at this group. In addition, general aviation operators often share facilities such as aerodromes, air traffic services, etc. with airline operators. This mixing of operations with differing requirements and performance standards may introduce hazards.

2.5.2 General aviation embraces a very wide range of aircraft types, crew qualifications and operating environments. It includes the growing areas of corporate or business flying, often operating sophisticated aeroplanes; helicopters flown by professional pilots, through to non-professional pilots who only fly occasionally for pleasure. Motivating an interest and awareness of safe aviation practices must be one of the first steps of an accident prevention programme aimed at this varied group.

2.5.3 Specialized general aviation operations, such as helicopters and aerial application, create unique hazards which have led some States to conduct safety programmes aimed specifically at these groups.
3.1 THE NATURE OF ACCIDENTS

Introduction

3.1.1 Seldom, if ever, is an accident the result of a single cause. Accidents are typically a combination of several different causes. When each such cause is viewed alone, it may often appear insignificant, but in combination with other causes it can complete a sequence of seemingly unrelated events that result in an accident. Accident prevention therefore involves identifying and eliminating these causes before the chain of events is complete. This concept is illustrated in Figure 2.

3.1.2 Frequently, causes of accidents or incidents are called factors or cause factors, particularly by accident investigators. In this manual, these causes or factors may also be called hazards. For simplicity, hazards have been categorized here into three groups: Man, Machine and Environment.

Man

3.1.3 While many see the pilot as the only “man” in the system, others include all persons directly involved with the operation of aircraft — flight crew, ground crew, ATC, meteorologists, etc. In its widest sense, the concept should include all human involvement in aviation, such as design, construction, maintenance, operation, and management. This is the meaning intended in this manual, since accident prevention must aim at all hazards, regardless of their origin.

3.1.4 Unfortunately, the study of “man” (or human factors) usually does not receive sufficient emphasis. For example, during a pilot's training he learns something of the mechanical aspects of the machine he flies, the hazards of the weather, the operating environment in which he flies, and so on. However, usually very little information is provided concerning his own behaviour, limitations, vulnerabilities and motivations.

3.1.5 As a result of refinements over the years, the number of accidents caused by the “machine” has declined, while those caused by “man” have risen proportionately. (See Figure 3.) Because of this significant shift in the relationship between man and machine causes, a consensus has now emerged that accident prevention activities should be mainly directed towards the “man”.

3.1.6 Man is naturally reluctant to admit to his limitations for a variety of reasons, such as loss of face among his peers, self-incrimination, fear of job-loss, or considerations of blame and liability. It is not surprising, therefore, that information on the human factor aspects of accidents or incidents is not readily forthcoming. This is unfortunate, since it is often these areas that hold the key to the “why” of a man’s actions or inactions.

3.1.7 Many questions arise when one considers the “why” of human failures. Successful accident prevention therefore necessitates probing beyond the human failure to determine the underlying factors which led to this behaviour. For example, was the individual physically and mentally capable of responding properly? If not — why not? Did the failure derive from a self-induced state such as fatigue or alcohol intoxication? Had he been adequately trained to cope with the situation? If not, who was responsible for the training deficiency and why? Was he provided with adequate operational information on which to base his decisions? If not, who failed to provide the information and why? Was he distracted so he could not give proper care and attention to his duties? If so, who or what created the distraction and why? These are but a few of the many “why” questions which should be asked during a human factor investigation. The answers to these questions are vital for effective accident prevention.

3.1.8 In the past, the view that the “man” involved only the pilot led to the frequent use of the term “pilot error” as a cause of accidents, often to the exclusion of other man related causes. As a consequence, any other hazards revealed by an investigation were often not addressed. Further, since the term tended to describe only what happened rather than why, it was of little value as a basis for preventive action. Fortunately, the term is now rarely used by investigation authorities.
3.1.9 The pilot is often seen as the last line of defence in preventing an accident. In fact, over the years the skill and performance of pilots have prevented many accidents when the aircraft or its systems failed, or when the environment posed a threat. Such occurrences usually do not receive the same attention and publicity as accidents, sometimes leading to an unbalanced perception of the skill and performance of pilots.

Machine

3.1.10 Although aviation technology has made substantial advances, there are still occasions when hazards are found in the design, manufacture or maintenance of aircraft. In fact a number of accidents can be traced to errors in the conceptual, design and development phases of an aircraft. Modern aircraft design therefore attempts to minimize the effect of any one hazard. For instance, good design should not only seek to make system failure unlikely, but also ensure that should it nevertheless occur, a single failure will not result in an accident. This is usually accomplished by so-called fail-safe features and redundancy in critical components or systems. A designer must also attempt to minimize the possibility of personnel using or working on the equipment from committing errors or mistakes in accordance with the inevitability of Murphy’s Law: “If something can go wrong, it will”. To meet these aims, some form of system safety programme is often used during the development of a new aircraft type. An example of one manufacturer’s system safety programme is found at Appendix A. Modern design must also take into account the limitations inherent in “man”. It thus includes systems which make man’s task easier and which aim to prevent mistakes and errors. The Ground Proximity Warning System (GPWS) is an example of such a system. It has significantly reduced the number of accidents in which airworthy aircraft collide with the ground or water while under the control of the pilot.

3.1.11 The level of safety of an aircraft and its equipment is initially set by the airworthiness standards to which it is designed and built. Maintenance is then performed to ensure that an acceptable level of safety is achieved throughout the life of the aircraft. Manufacturing, maintenance and repair errors can negate design safety features and introduce hazards that may not be immediately apparent.

3.1.12 As the service experience with a particular aircraft type increases, the maintenance programme needs to be monitored and its contents developed and updated where necessary to maintain the required levels of safety. Some form of reporting system is thus required to ensure that component or system malfunctions and defects are assessed and corrected in a timely manner.

3.1.13 The reliability of a component is an expression of the likelihood that it will perform to certain specifications for a defined length of time under prescribed conditions. Various methods can be used to express reliability. A common method for electronic components is the mean time between failure (MTBF) and the reliability of aircraft powerplants is usually expressed as the number of shutdowns per hundred thousand operating hours.

3.1.14 Failures normally arise in three distinct phases in the life of a component. Initial failures, caused by inadequate design or manufacture, usually occur early in its life. Modifications to the component or its use usually reduce these to a minimum during the main or useful life period. Random failures may occur during this period. Near the end of the life of a component, increased failures occur as the result of its wearing out. Graphic representation of this failure pattern gives rise to the typical “Bathtub” shaped curve (Figure 4).

Environment

3.1.15 The environment in which aircraft operations take place, equipment is used and personnel work directly affects safety. From the accident prevention viewpoint, this manual considers the environment to comprise two parts; the natural environment and the man-made environment.

3.1.16 Weather, topography and other natural phenomena are thus elements of the natural environment. Their manifestations, in forms such as temperature, wind, rain, ice, lightning, mountains and volcanic eruptions are all beyond the control of man. These manifestations may be hazardous and since they cannot be eliminated they must be avoided or allowance made for them.

3.1.17 The man-made portion of the environment can be further divided into physical and non-physical parts. The physical portion includes those man-made objects that form part of the aviation environment. Air traffic control, airports, navigation aids, landing aids and airfield lighting are examples of the man-made physical environment.
The man-made non-physical environment, sometimes called system software, includes those procedural components that determine how a system should or will function. This includes national and international legislation, associated orders and regulations, standard operating procedures, training syllabi, etc.

3.1.18 Many hazards continue to exist in the environment because the people responsible do not want to become involved in change, consider that nothing can be done, or are insufficiently motivated to take the necessary actions. Obstructions near runways, malfunctioning or non-existent airport equipment, errors or omissions on aeronautical charts, faulty procedures, etc. are examples of man-made environmental hazards that can have a direct effect on aviation safety.

Mission

3.1.19 Notwithstanding the Man, Machine, Environment concept, some safety experts consider the type of mission, or the purpose of the operation, to be equally important. Obviously the risks associated with different types of operation vary considerably. For example, crop spraying with a heavily loaded aircraft close to the ground is considerably more hazardous than scheduled airline operations. The many crashworthy features built into most aircraft engaged in aerial work are proof of that. Each category of operation (or mission) therefore has certain intrinsic hazards which have to be accepted. This fact is reflected in the accident rates of the different categories of operation and is the reason why such rates are usually calculated separately.

Man, machine and environment interaction

3.1.20 In spite of the use of Man, Machine and Environment as broad categories of hazards, a popular theory holds that most accidents or incidents can be traced to a human failure somewhere, not necessarily the person or thing immediately involved in the occurrence. For example, a machine is designed, built and operated by man. Thus a failure of the machine is really a failure of man. Likewise, man may not avoid or eliminate known environmental hazards, or may create additional hazards. These could thus all be considered failures of man rather than environmental failures. This interpretation therefore accounts for the wide discrepancy in the percentages of accidents attributed to human failure reported by different States. Typically, these range from around 50 per cent to close to 90 per cent.

3.1.21 Fortunately man is adaptable and is able to compensate for many inadequacies in the design or construction of the machine. However, the closer the match between man’s capabilities and the machine’s qualities, the greater will be the safety levels achieved. The larger the gap, the more likely it is that errors will occur or not be corrected. For example, operating the wrong lever or switch is more likely to occur if the handling of the aircraft is demanding, or the flight deck is poorly designed.

3.1.22 The design of an aircraft should therefore aim at reducing the likelihood of human error. In other words, the machine should be forgiving and accommodating of human error. If errors are not self-evident, then their occurrence should be clearly signalled to the crew. As aircraft and procedures become more complex, the role of the man in the system deserves greater expert attention, particularly his work-load in abnormal situations.

3.1.23 Risks associated with the mission can manifest themselves in any of the three basic categories. For example, one type of mission may place increased strain or pressure on the pilot, leading to his making errors or being placed in a situation for which he was not adequately trained or prepared. Likewise it may result in the aircraft or machine being used for a purpose for which it was not designed. This may lead to premature failure of components which again could increase the pressures on the pilot and the likelihood of his making an error. Accordingly, an accident involving an aircraft being used on a mission for which it was not designed may appear to be caused by a crew error, while the underlying management error is not readily evident.

3.1.24 Safe aviation therefore involves the integration of the mission into the three basic elements of Man, Machine and Environment. Each element can influence the others to varying degrees and they are often interdependent. A hazard in one can initiate a chain reaction leading to an accident in which all are involved. Likewise, when eliminating a hazard in one element, the effect on the others needs to be considered.

3.1.25 Many aviation hazards are brought about by problems at the interface between these elements. As man is involved in all three, it is vital that his inherent limitations be considered. This necessitates increased emphasis
3.2 HUMAN FACTORS

3.2.1 The term “Human Factors” has been used in many different ways to encompass many different subjects. Detailed coverage of the subject is beyond the scope of this manual, and all that has been attempted is to briefly indicate some aspects of human performance and human relationships which may have a bearing on accidents, incidents and their prevention.

3.2.2 At the outset it is important to accept the inevitability of human error. No person, whether designer, engineer, manager or pilot, will perform perfectly at all times. Also what could be considered perfect performance in one set of circumstances could be unacceptable in another. Thus, people need to be seen as they really are. To wish that they be intrinsically “better” or “different” is futile, unless, for example, such a wish is backed by a recommendation for better training, education, experience, motivation, etc. all of which influence human performance.

3.2.3 In this manual, the term “Human Performance” is used to include those factors which can affect an individual’s performance. Under the heading “Human Relationships”, man’s interaction with others is discussed.

HUMAN PERFORMANCE

Introduction

3.2.4 Accidents rarely involve a deliberate disregard of procedures. They are generally caused by situations in which a person’s capabilities are inadequate or are overwhelmed in an adverse situation. Thus when considering human performance in an accident or incident, a person’s decisions and actions should be evaluated against the reasonable degree of performance that could be expected from another person with equivalent knowledge, qualifications and experience. Man is subject to such a wide range of variables and different situations and circumstances that they all cannot be easily foreseen. Careful attention should therefore be given to all the factors which may have influenced the person involved. In other words, consideration must not only be given to the human failure, but also to why the failure occurred. The following factors are described in outline only, since a great deal of related literature is available.

Physiology and psychology

3.2.5 An individual's performance will be affected by physical and mental limitations. Some of these limitations can be assessed quantitatively, such as vision and muscle strength, while others will be affected by a history of injury, disability or disease. Still others will be affected by fatigue or physiological conditions such as low blood sugar, decreased partial pressure of oxygen, or the use of medicines, drugs or alcohol. Environmental factors, such as noise, temperature, vibration and motion can also be detrimental.

3.2.6 Many personal traits also influence and affect an individual’s performance. The following list briefly mentions some of these:

- perception: what we perceive is not always what we see or hear. For example, expectancy can greatly affect perception; (See Figure 5)

- motivation: is involved in arousing, directing and sustaining most human behavior;

- job satisfaction: the satisfaction derived from one’s work greatly affects the quality of the performance;

- emotion: can have a dramatic effect on how we respond to any set of circumstances;
— complacency: can lead to a reduced awareness of danger. The high degree of automation and reliability present in today’s aircraft, and the routines involved in their operation are all factors which may cause complacency;

— self discipline: discipline is an important element of organized activities. Lack of self-discipline encourages negligence and poor performance.

Risk perception

3.2.7 A person may act in an unsafe manner because of an incorrect assessment of the risks involved. A common phenomenon of human behaviour is that risk perception and acceptance varies according to the situation. For example, when driving an injured child to hospital, a driver may have his assessment of the risks involved considerably altered by perceived priorities. Thus, he may be tempted to take risks he would not normally take. Therefore, when attempting to determine why a person's response to a situation was inadequate, it is important to consider all of the factors which may have affected him, including his perception and acceptance of the risks involved.

Risk taking

3.2.8 Risk could be considered the opposite of safety. Since an element of risk is present in most human activities, risk taking is familiar to everyone in their normal daily lives. It has even been suggested that risk taking is a fundamental trait of human behaviour which has been largely responsible for human progress.

3.2.9 Risk will be present as long as aircraft fly and this has resulted in efforts to reduce or control risk by all possible means. These range from the redesign of unreliable components, to improvements in flight procedures and training. The result has been a gradual increase in safety in all areas of aviation.

3.2.10 While aviation is one area where the acceptance of risks cannot be completely avoided, it is also an area where the penalties for failure are high. Accordingly, the taking of risks needs to be carefully weighed against the perceived benefits.

If you are looking for perfect safety, you will do well to sit on a fence and watch the birds.

Wilbur Wright 1901

Judgement and decision making

3.2.11 One of man’s unique capabilities is his ability to exercise judgement. It enables him to evaluate data from a number of sources in the light of education or past experience and to come to a conclusion. Good judgement is vital for safe aircraft operations. Before a person can respond to a stimulus, he must make a judgement. Usually good judgement and sound decision making are the results of training, experience and correct perceptions. Judgement, however, may be seriously affected by psychological pressures (or stress), or by other human traits, such as personality, emotion, ego and temperament.

Knowledge and skill

3.2.12 The increasing complexity of aircraft and the aviation infrastructure has necessitated improvements in the technical knowledge and skill of all persons involved in aviation. An effect of this has been to increase the degree of specialization of individuals. For example, a maintenance engineer today will usually cover only a limited area in the maintenance of a large complex aircraft, whereas not so many years ago he would have been responsible for all work on the aircraft. Today there are avionics, powerplant, systems and airframe specialists because of the level of knowledge and skill required in these various areas. This specialization increases “man’s” interdependence and reliance on others in the aviation workplace.
HUMAN RELATIONSHIPS

Introduction

3.2.13 Aviation has developed many procedures so that the mistakes of an individual will not necessarily cause an accident. The “two-man concept” utilizes two or more persons capable of performing the required task. One completes the task and the other independently checks his actions to ensure they have been correctly performed. Crew members monitoring each other during aircraft operations and duplicate engineering inspections are examples of these procedures. Thus, redundancy is not only designed into the aircraft and its systems but also into the numerous maintenance and operating procedures involved. These procedures, as well as normal management functions, inevitably involve interactions among people. A number of factors can affect these inter-relationships, one of the more important being communication.

Communication

3.2.14 The term communication usually includes all facets of information transfer. In this manual, however, it is limited to the exchange of information among people, since an examination of human communication deficiencies is more rewarding for accident prevention.

3.2.15 Adequate communication requires that the recipient receives, understands and can act on the information gained. For example, radio communication is one of the few areas of aviation in which complete redundancy is not incorporated. Consequently, particular care is required to ensure that the recipient receives and fully understands a radio communication.

3.2.16 The efficiency of communications within an organization is a management responsibility. Clearly written and easily understood directives, instructions, manuals, etc. are required if staff are to understand their responsibilities and duties and how they are expected to carry them out. The same applies to verbal communications, since an instruction that is not understood by the recipient may result in the wrong thing being done, or in nothing being done at all.

3.2.17 There is more to communication than the use of clear, simple and concise language. For instance, intelligent compliance with directions and instructions requires knowledge of why these are necessary in the first place. Therefore, management must first determine if an instruction is really necessary and if so, ensure that the staff knows the reasons behind it. This enables the staff to respond more effectively.
Because of the high cost of aviation gasoline, a private pilot once wrote to his aviation administration and asked if he could mix kerosene in his aircraft fuel. He received the following reply:

"Utilization of kerosene involves major uncertainties.probabilities respecting shaft output and metal longevity where application pertains to aeronautical internal combustion power plants."

The pilot sent the following cable:

"Thanks for the information. Will start using kerosene next week."

He then received the following urgent letter:

"Regrettably decision involves uncertainties. Kerosene utilization consequences questionable, with respect to metalloferrous components and power production."

This prompted another cable from the pilot:

"Thanks again. It will sure cut my fuel bill."

The same day he finally received a clear message:

"DON'T USE KEROSENE. IT COULD KILL THE ENGINE — AND YOU TOO!"

3.2.18 Trust and confidence are essential ingredients of good communication. For instance, experience has shown that the discovery of hazards, through incident or hazard reporting, is only effective if the person communicating the information is confident that no retributory action will follow his reporting of a mistake.

3.2.19 Communications within the cockpit can be affected by what some psychologists call the Trans-cockpit Authority Gradient (TAG) which is an expression of the relative strength and forcefulness of the personalities involved. For safe operations the gradient between the captain and co-pilot should be neither too steep nor too shallow, thus encouraging free communication between the pilots, leading to improved monitoring of the aircraft operation. When, for example, the gradient is too steep, the co-pilot may be afraid to speak up thereby failing in his role of monitoring the captain's actions. When too shallow, the captain may not adequately exercise his authority.

Responsibility/accountability

3.2.20 Once an individual has been properly trained and provided with a clear description of his task and the necessary tools to do the job, he is then responsible for his own actions. Such accountability applies in most professions. For example, management should be able to expect a pilot to comply with proper flight procedures or an engineer to use a torque wrench when this is required. In short, the development and maintenance of a professional attitude and behaviour are the responsibility of the individual. These attributes should be fostered by both management and the individual's professional association. Professionals must subscribe to the highest possible standards and apply these objectives to their own performance.

3.2.21 Failure to perform to a designated standard may result in a person being held accountable. While this in itself is a spur to improved performance, it can often be an obstacle to the obtaining of true insights into the reasons
why a person’s performance was sub-standard.

Enforcement

3.2.22 People in aviation are usually sympathetic to the aims of accident prevention. However, if involved in an accident or incident, they may be faced with the dilemma of relating what actually happened and thereby risking punishment, or withholding the truth to avoid retribution. If the choice is the latter, the hazard may persist and induce another accident or incident.

3.2.23 Punishment or enforcement action undoubtedly has a place in the case of deliberate or repeated disregard of procedures, rules or regulations. It should be remembered, however, that enforcement based on information obtained from the accident prevention process will usually have a negative effect on subsequent accident prevention because people will be reluctant to provide hazard information if it is going to be used against them. Methods must be provided to obtain the necessary insight into hazards without threat to the informant.

3.2.24 Following an accident, the legal requirements of some States may require both a “technical” investigation and a judicial inquiry. The technical investigation will normally be carried out in accordance with the investigation objective stated in Annex 13, Aircraft Accident Investigation:

“The fundamental objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability.”

On the other hand, the objective of a judicial inquiry is often the allocation of blame and liability. If blame is assigned during an accident/incident investigation, it is understandable that those involved will be reluctant to disclose information which could lead to the punishment of themselves or their peers. This in turn may result in some or all of the hazards not being identified.

3.2.25 Since punishment is inappropriate for unintentional errors or mistakes, other corrective measures should be used, such as training, motivation, etc. Such measures create a climate of openness, foster safety awareness and encourage hazard reporting.

Peer pressure

3.2.26 Many people in aviation are naturally competitive, with a desire to do their best. This can create peer pressures, in which a person’s self-image is based on a high standard of performance relative to his peers. Such pressure can be beneficial in someone with the necessary competence and self discipline but may be dangerous in a person with inferior skill, knowledge or judgement. For example, a young inexperienced pilot may feel the need to “prove” himself and may therefore attempt tasks beyond his capability.

3.2.27 Man has many conflicting “needs” and the need to “prove” oneself is not limited to the young or inexperienced. Some persons, because of training or background, have a fear that others may consider them lacking in courage or ability. For such persons, the safe course of action may be perceived as involving an unacceptable “loss of face”. Accident prevention programmes should clearly address the insidious nature of such pressures. Far from resulting in a “loss of face” or appearing “scared”, the decision to adopt the safe course of action clearly demonstrates strength of character or conviction.

3.2.28 Peer pressure can also be helpful in eliminating aberrant behaviour. For instance, review committees comprised of pilots can be an effective means of modifying pilot behaviour towards safe operating practices and could be used to complement normal management processes.

Ego and pride

3.2.29 While these terms may have different definitions, their effect on a person’s behaviour tends to be similar. In general, both could be interpreted as meaning a person’s sense of individuality or self esteem. In moderate doses, they have a positive effect on motivation and performance.
3.2.30 A strong ego is usually associated with a domineering personality. For pilots in command this may produce good leadership qualities in emergency situations but it may also result in poor crew or resource management. The domineering personality may discourage advice from others or may disregard established procedures, previous training or good airmanship.

3.2.31 Piloting an aircraft is one situation where an overriding ego or sense of pride is hazardous. Although usually not specifically identified as such in accident reports, these traits may often be hidden behind such terms as: "pilot failed to overshoot", "descended below minima", "failed to divert to an alternate", "attempted operation beyond experience/ability level", "continued flight into known adverse weather", etc.

3.3 MANAGEMENT

General

3.3.1 The responsibility for safety and thus accident prevention in any organization ultimately rests with management, because only management controls the allocation of resources. For example, airline management selects the type of aircraft to be purchased, the personnel to fly and maintain them, the routes over which they operate and the training and operating procedures used. State administrations promulgate airworthiness standards, personnel licensing criteria, etc. and provide air traffic and other services. Manufacturers are responsible for the design and manufacture of aircraft, components and powerplants, as well as monitoring their airworthiness.

3.3.2 The slogan, "Safety is everybody’s business", means that everybody should be aware of the consequences of their mistakes and strive to avoid them. Unfortunately, not everyone realizes this, even though most people want to do a good job and to do it safely. Therefore management is responsible for fostering this basic motivation so that each employee develops an awareness of safety. To do this, management must provide the proper working environment, adequate training and supervision and the right facilities and equipment.

3.3.3 Management’s involvement and the resources it allocates have a profound effect on the quality of the organization’s prevention programme. Sometimes, because of financial responsibilities, management is reluctant to spend money to improve safety. However, it can usually be shown that accident prevention activities are not only cost effective but that they also tend to improve the performance of people, reduce waste and increase the over-all efficiency of the organization.

3.3.4 Management’s responsibilities for safety go well beyond financial provisions. Encouragement and active support of accident prevention programmes must be clearly visible to all staff if such programmes are to be effective. For example, in addition to determining who was responsible for an accident or incident, management’s investigation should also delve into the underlying factors that induced the human error. Such an investigation may well indicate faults in management’s own policies and procedures.

3.3.5 Complacency or a false sense of security should not be allowed to develop as a result of long periods without an accident or serious incident. An organization with a good safety record is not necessarily a safe organization. Good fortune rather than good management practices may be responsible for what appears to be a safe operation.

Management climate/morale

3.3.6 On the whole, management attitudes and behaviour have a profound effect on staff. For example, if management is willing to accept a lower standard of maintenance, then the lower standard can easily become the norm. Or, if the company is in serious financial difficulties, staff may be tempted or pressured into lowering their margins of safety by “cutting corners”, as a gesture of loyalty to the company, or even self-interest in retaining their jobs. Consequently, such practices can and often do lead to the introduction of hazards.

3.3.7 Morale within an organization also affects safety. Low morale may develop for many reasons but nearly always leads to loss of pride in one’s work, an erosion of self-discipline and other hazard creating conditions.
3.4 RISK MANAGEMENT

3.4.1 Risk management is a concept that has gained acceptance in many fields of business and industry. It stems largely from financial concerns and a realization that losses due to accidents must be either reduced or accepted. It is mentioned here because some of its aspects parallel or overlap considerations of aircraft accident prevention. The application of these concepts therefore reinforce several of the accident prevention ideas in this manual.

3.4.2 Risk management involves conserving assets and minimizing exposure to losses. This means looking ahead to detect hazards before they lead to losses and taking appropriate action when these risks cannot be eliminated. Risks are usually categorized by the broad areas they threaten, such as assets, income and legal liability. In the aviation industry, accidents usually involve all three areas. Since accidents can be considered as involuntary and unscheduled expenditures, managers are obliged to establish policies and procedures to attempt to eliminate or minimize them.

3.4.3 Although risk management programmes usually emanate from the chief executive level, their execution needs to be integrated into most processes within an organization. They are therefore conducted on behalf of the managing director or chief executive who monitors their effectiveness. A risk management programme normally contains the following basic elements:

a) formal and informal reporting systems;
b) an impartial review of incident/accident reports;
c) a process by which unrectified hazards are regularly brought to the attention of the chief executive;
d) a feedback process to ensure that persons submitting comments or proposals are informed of the outcome; and

e) a periodic summary prepared for the chief executive, containing an activity report and an assessment of the successes and failures and the areas designated for future improvement.

3.4.4 One of the major functions of management in a commercial organization is to maintain economic viability while providing an acceptable product or service. This requires that the cost-benefits of expenditures be determined and includes the evaluation of risks or hazards, as well as the consequences of accepting or not eliminating them. Often, the cost-benefits of correcting hazards cannot be assessed in the short term because present expenditures are used to buy future safety. Risk-taking is an accepted fact of commercial life, and can therefore influence management’s attitudes towards safety. An illustration of this fact could be management’s acceptance of non-standard equipment in an aircraft fleet rather than spending additional money to standardize the equipment. This will almost certainly introduce hazards since variations in the equipment installed in the same aircraft type are known to have caused accidents.

3.4.5 When considering risk management programmes, the safety/risk levels established by regulatory authorities are usually the minimum acceptable.
CHAPTER 4
ACCIDENT PREVENTION ACTIVITIES

4.1 INTRODUCTION

4.1.1 Accident prevention is a comprehensive activity involving many skills and techniques. Properly implemented prevention activities should not only increase safety levels but also improve the operational effectiveness of an organization.

4.1.2 Accident prevention as outlined in this manual involves:
   a) the discovery of hazards;
   b) the evaluation of hazards;
   c) the formulation of proposals to eliminate or avoid hazards;
   d) notification or reporting of hazards to the responsible organization;
   e) monitoring the response;
   f) measuring the results;
   g) safety promotion.

Figure 6 illustrates the first four steps of this process.

4.2 HAZARD DISCOVERY METHODS

Incidents — General

4.2.1 The reporting, investigation and analysis of incidents is a highly effective means of accident prevention. “If aviation man learned from his incidents, there would be few accidents.”

4.2.2 The most important characteristics of incidents are:
   a) their similarity to accidents, except that they lack the terminal event which causes the injury or damage in an accident. Incidents can therefore reveal the same hazards as accidents, without the associated injury or damage;
   b) they are far more numerous than accidents (estimates range from 10 to 100 times more numerous). Thus they are a plentiful source of hazard information;
   c) the people involved in incidents are available to provide additional information on the hazards which caused them.

4.2.3 It stands to reason that the introduction of a comprehensive incident reporting and investigation system requires money and manpower. However, experience has shown that such systems are cost effective, as incident investigation offers true “before the accident” prevention.

Principles of incident reporting

4.2.4 Although many incidents occur in aviation, they are not always made known to those responsible for safety.
Often, reporting systems are lacking, or people are not sufficiently motivated to report incidents. Experience indicates that successful incident reporting systems employ most of the following principles:

a) **Trust.** Persons reporting incidents must be able to trust the recipient organization and be confident that any information they provide will not be used against them. Without such confidence, people will be reluctant to report their mistakes and they may also be reluctant to report other hazards they are aware of. For an incident reporting system to be successful, it needs to be perceived as being non-punitive with regard to unintentional errors or mistakes. On the other hand, most people do not expect an incident reporting system to exempt criminal acts, or deliberate violations, from prosecution or disciplinary action.

b) **Independence.** Ideally an incident reporting system should be run by an organization divorced from the aviation administration since the administration is also responsible for the enforcement of aviation regulations. Accordingly, some States use a “third party” for the management of so-called “voluntary” reporting systems. The “third party” receives, processes and analyses the submitted incident reports and feeds the results back to the aviation administration and the aviation community. With so-called “mandatory” reporting systems, it may not be possible to employ a “third party”. Nevertheless, it is desirable that the aviation administration give a clear undertaking that any information received will be used for accident prevention purposes only. This principle also applies to an airline or any other aircraft operator which uses incident reporting as part of its accident prevention programme.

c) **Ease of reporting.** The task of submitting incident reports should be as easy as possible for the reporter. Reporting forms should be readily available so that anyone wishing to file a report can do so easily. They should be simple to compile, with adequate space for a descriptive narrative and they should also encourage suggestions on how to improve the situation or prevent a reoccurrence. Classifying information such as type of operation, light conditions, type of flight plan, weather, etc. can be presented in a “tick-off” format. The forms should ideally be self-addressed and postage free. Examples of reporting forms can be found in Appendices C and D.

d) **Acknowledgement.** The reporting of incidents requires considerable time and effort by the user and should be appropriately acknowledged. To encourage further reports, one State includes a blank report form with the acknowledgement letter.

e) **Motivation and promotion.** The information received from an incident reporting system should be made available to the aviation community as soon as possible, as this may help to motivate people to report further incidents. Such promotion activities may take the form of monthly news-letters or periodic summaries. Ideally all such methods would be used with a view to achieving maximum effort. Appendices C and D provide examples.

f) **Feedback.** Procedures or channels for forwarding hazard information to the regulatory authorities or management are needed as it is they who are ultimately responsible for hazard elimination.

**State incident reporting systems — General**

4.2.5 Effective incident reporting systems can be organized in many different ways. There are, however, two main types which characterize the majority of systems used by aviation administrations. They are herein referred to as “mandatory” or “voluntary”. To ensure success, both types should encompass the general principles highlighted in 4.2.4. In particular, it is important that some form of immunity from punitive action be provided for those who report incidents. This can be simply accomplished by not recording any identifying information. Effective reporting systems depend on a number of factors, such as the legal framework within the State, the organization implementing and running the system and whether the emphasis of the system is placed on people or equipment (man or machine). Examples of voluntary and mandatory systems are presented in Appendices C and D.

**Mandatory incident reporting systems**

4.2.6 In a mandatory system, people are required to report certain types of incidents. This necessitates detailed regulations outlining who shall report and what shall be reported. Otherwise, the mandatory system could not be enforced. To achieve this and avoid unnecessary duplication, those items requiring an incident report must be
segregated from the day to day problems, defects, etc. for which adequate control systems and procedures should already exist. In effect this means establishing a “base level” in terms of hazards, below which an incident report is not necessary. Unless this is done, the mandatory system may be flooded with reports, possibly obscuring important items. It is important to concentrate what are usually limited resources where they will be most effective.

4.2.7 The number of variables in aircraft operations is so great that it is very difficult to provide a complete list of items or conditions which should be reported. For example, loss of a single hydraulic system on an aircraft with only one such system is critical; on a type with three or four systems it may not be. A relatively minor problem in one set of circumstances can, when these circumstances change, result in a hazardous situation. The rule should be: “If in doubt — report.”

4.2.8 Because mandatory systems deal mainly with specific and concrete matters, they tend to collect more information on technical failures than on the human factor aspects. To help overcome this problem, at least one State with a well-developed mandatory reporting system has also introduced a voluntary incident reporting system aimed specifically at acquiring more information on the human factor aspects.

**Voluntary incident reporting systems**

4.2.9 In a voluntary system, pilots, controllers and others involved in aviation are invited (rather than required) to report hazards, discrepancies or deficiencies in which they were involved or observed. Experience in several States has shown that voluntary reporting requires a trusted “third party” to manage the system. In fact, in one State, an attempt to have the regulatory administration run such a system was unsuccessful. The reason, simply, is that people are reluctant to report their mistakes to the operator which employs them, or the government department which licenses them.

4.2.10 In voluntary systems, confidentiality is usually achieved by de-identification. This is often accomplished by not recording any identifying information. One such system returns to the user the identifying part of the reporting form and no record is kept of these details. Because of this confidentiality, voluntary systems tend to be more successful than mandatory systems in collecting human factor related information.

**Investigation of serious incidents**

4.2.11 The term “serious incident” is used here for those incidents which good fortune narrowly prevented from becoming a major accident, for example, a near collision with another aircraft, or with the ground, involving large passenger aircraft. Because of the seriousness of such incidents, they should be thoroughly investigated. Some States treat these incidents as if they had been accidents. Thus they use an accident investigation team to carry out the investigation, including the publication of a Final Report and the forwarding to ICAO of an ADREP incident data report. This type of full-scale incident investigation has the advantage of providing hazard information to the same standard as that of an accident investigation, without the associated loss of life, aircraft or property.

**Investigation of other incidents**

4.2.12 It is important that all other reported incidents be reviewed and a decision taken on which ones should be investigated and how deeply. The basis for such a decision should be the hazard discovery potential and the safety benefits likely to be derived from an investigation.

4.2.13 While it is desirable that all incidents be investigated “in the field”, this is seldom possible due to financial, manpower, geographical or other considerations. In such cases, it is important that some type of “call back” system be instituted, whereby the investigator can contact the originator of the report to obtain additional information or to confirm details which may be unclear.

4.2.14 As incidents far outnumber accidents, an incident reporting system aims at discovering hazards before they manifest themselves as accidents. The initial reporting of an incident only provides a clue as to the areas where hazards may exist. Reports must be assessed individually and in conjunction with similar cases to determine their hazard potential. When studied collectively, incident reports may also indicate such things as the safety level of a particular operator, the need for specialized training for pilots, the need for a safety campaign on the dangers
of flying in adverse weather, the lack of a stall warning system in one aircraft type, and so on. Because of their prevalence, incidents may also provide substantiating information when submitting safety proposals and recommendations to various authorities.

4.2.15 Lessons learned from incident reporting should have timely and wide distribution through the various forms of media. If this is not done, the system may lose credibility and foster a lack of participation. The information made available should be clear, brief and easy to read. Most people in aviation have little time or inclination to wade through long lists of incidents or other paperwork.

**Safety surveys and audits**

4.2.16 There are many areas of aviation activity which only rarely come under scrutiny as the result of an accident or incident investigation, while others are never subject to such scrutiny. It should not be assumed, however, that these areas are of no significance for accident prevention purposes. For example, the handling peculiarities of an aircraft type in certain circumstances may not be well documented in aircraft manuals and as a result could present the crew with a situation they had not been trained to expect.

4.2.17 Surveys of operations and facilities can provide management with an indication of the levels of safety and efficiency within its organization. In attempting to determine the underlying hazards in a system, such surveys are usually independent of routine inspections by government or company management.

4.2.18 The aviation administration in one State will carry out safety surveys of its operators should they request this. Only one copy of the report of the survey is produced and this is left with the operator on completion. It has been found that many operators are willing to participate in such a programme, since no other records are kept and the results are advisory only. Similarly, some aircraft manufacturers are prepared to undertake such surveys for their customers.

4.2.19 To determine if a particular facility or operation contains hazards, safety surveys usually involve the use of check lists and informal confidential interviews. Interviews in particular may elicit information which cannot be obtained any other way. Naturally, the validity of the information obtained may need to be verified before corrective action is taken.

4.2.20 At least one international aviation safety organization conducts operational safety audits on a contract basis. These audits include the observation and analysis of matters such as:

- management practices;
- operational policies and procedures;
- flight operations;
- safety promotion programmes;
- training;
- maintenance standards and procedures;
- quality control;
- manuals, documentation and other records;
- buildings and other facilities;
- support equipment;
- security.

These audits are carried out by a team of specialists in such fields as flight operations, safety management and
maintenance using the following methods:

— review of documentation, records and the systems of operation and maintenance control;
— observation of facilities, equipment and work practices;
— interviews with operations, maintenance, supervisory and support staff;
— review of crew qualifications and the conduct of flights.

4.2.21 Provided that confidentiality is maintained, most survey methods will yield some hazard information. For instance, it should be possible for two operators using similar aircraft for similar types of operation to exchange Accident Prevention Advisers (APAs), or establish a joint survey team to provide fresh insights into accident prevention.

**Accident investigation**

4.2.22 The accident and its investigation remain the most conspicuous source of insights and information leading to accident prevention. Accidents provide compelling and incontrovertible evidence of the severity of hazards. The often catastrophic and grossly expensive nature of accidents provides the spur for allocating resources to accident prevention to an extent otherwise unlikely.

4.2.23 In an accident investigation, it is essential that a clear and accurate analysis of the relevant factors be developed without delay. Further, the focus of the investigation should be directed towards effective preventive action as enunciated in Annex 13. This applies particularly to government authorities and operators. With the investigation directed away from “the chase for the guilty party” and towards effective preventive action, co-operation will be fostered among those involved in the accident, facilitating the discovery of the true causes of the accident. It is emphasized that the short term expediency of finding someone to blame for an accident is detrimental to the long term goal of preventing accidents.

4.2.24 By definition, an accident involves at least serious injury or substantial aircraft damage. There is therefore a likelihood that a legal process will result from an accident. As the official authority on the accident, the investigator is often seen as a ready source of information with which to establish culpability in the courts. Consequently, witnesses and other persons involved in an accident may be inclined to withhold information from the investigator, thereby preventing a full understanding of what occurred, particularly with respect to the human factor elements involved. Although Annex 13 clearly states that the purpose of an accident investigation is accident prevention rather than the apportioning of blame or liability, in reality the distinction is not quite so clear.

4.2.25 An accident investigation includes an analysis of the evidence to determine all the causes which induced the accident — a process leading to the formulation of safety recommendations. Safety recommendations regarding serious hazards should be made as soon as the hazards have been positively identified, rather than waiting until the investigation is completed. Annex 13 suggests that these safety recommendations be included in the final report on the investigation. This publicity of safety recommendations fulfils several functions:

a) it helps ensure that the recommendations are reasonable and realistic in the circumstances;

b) it enables other States, organizations and individuals to see what action was recommended. Although the recommendation was not specifically addressed to them, it may enable them to take action that avoids similar hazards;

c) it can provide pressure for a prompt and reasonable response. One State, in addition to publishing the safety recommendations, also publishes the responses to them.

Recommendations must cover all hazards revealed during the investigation — not just those directly concerned with the causes. In this way, accident investigation forms the basis of an effective accident prevention programme.

**Other sources of hazard information**
4.2.26 State administrations usually require specific routine reports, such as component defects, bird strike or wake turbulence reports. The primary objective of these reports is to collect data with which to appraise risk. These systems should therefore be monitored for any hazard information they contain.

4.2.27 Often, non-operational personnel will become aware of hazards. However, the lack of an internal reporting system may prevent this information from reaching management. Also, because of their distance from the operational area, such personnel may believe that hazards they observe cannot be of real significance — otherwise they would not have been tolerated. Non-operational personnel therefore need to be encouraged to report anything which they consider hazardous. If specific internal reporting methods are not available, normal administrative procedures can be used. However, there is then a risk that hazard information may be blocked, diluted or never reach management. To help overcome this, a special priority status and recording system could be assigned to hazard information passing through normal administrative channels. In other organizations a “suggestion box” may provide a simple but effective communication channel direct to management. All forms of hazard reporting require the active support and promotion of top management.

4.2.28 Some operators — particularly the larger ones — have implemented their own hazard reporting systems and often exchange information regarding significant hazards. Accident Prevention Advisers (APAs) should be familiar with such systems, particularly those of operators which have similar equipment and/or operating conditions. Inevitably there is sometimes reluctance to divulge information to competitors, a circumstance which creates a challenge for APAs who should constantly strive to improve such information exchange.

4.2.29 While management may see these reporting processes as being cost-beneficial for their own operation, there may be reluctance to divulge information for the benefit of the industry at large. This does not necessarily reflect a lack of concern for safety, but is more likely due to fear that the company could become involved in a legal process when an act of possible culpability was present, or because of commercial factors. Where a company does not have a safety-related reporting process, the APA should make a determined effort to convince management of the potential of such a system for improving safety. In addition to ICAO, other international aviation groups, such as the International Federation of Airline Pilots’ Associations (IFALPA), International Air Transport Association (IATA), International Society of Air Safety Investigators (ISASI) and the Flight Safety Foundation can provide assistance in this regard.

4.2.30 Still other aviation associations or groups can be a source of information. For example, airport, non-scheduled airlines and helicopter operators often have their own groups or associations. These can be valuable sources of information, particularly when they conduct their own incident or hazard reporting.

**Automatic recording systems**

4.2.31 Many modern air transport aircraft have automatic recording devices installed. The Flight Data Recorder (FDR) which monitors selected parameters of the flight, and the Cockpit Voice Recorder (CVR) which records voices and cockpit sounds, are installed to assist with the investigation of accidents and in some cases, incidents. An engineering recorder may also be installed to monitor aircraft systems. The data from this recorder can be used to detect impending failures, and to verify the adequacy of component life and overhaul schedules.

4.2.32 Automatic recorders which are installed in Air Traffic Control and Communication systems primarily for accident investigation purposes may also be used as a check on correct operating procedures.

4.2.33 FDRs and CVRs were initially installed to assist accident investigators in determining accident causes, particularly for catastrophic accidents to large aircraft. In some States, professional groups such as pilots and air traffic controllers accepted the philosophy that the installation of these recorders would be of significant benefit to the aviation industry in helping to determine accident causes. Accordingly, they agreed to their use provided that guarantees by operational and administrative agencies were negotiated and honoured, preventing disciplinary action from being taken on the basis of information determined from the recorders unless wilful negligence or dereliction of duty could be proven. Lately, the use of flight recorders for purposes other than accident investigation has created difficulties between some professional groups and some administrations. For this reason, in those States where this is appropriate, the use of flight recorders for incident investigations or other purposes should comply with formal agreements between the parties concerned.

4.2.34 Annex 13 recommends protection of the information derived from such devices. Nevertheless, in many
States, freedom of information legislation and normal legal processes may result in this information being used for other purposes. However, every effort should be made to preserve this unique source of accident prevention information.

4.2.35 Several States routinely use flight recorder information for accident prevention. They regard this as an invaluable source of safety insights and information on the operation of their aircraft. Standard flight profiles are usually programmed into a computer along with acceptable deviations. Recorded data is then compared with these standard profiles. Significant deviations are then examined to see if hazards could be present. If so, corrective action can then be taken. This method need not require the identification of individuals, since it is often the number and type of deviations which reveal hazards.

4.2.36 Some operators who routinely examine FDR records for indications of hazards, or deviations from standard operating procedures, have the findings reviewed by a committee consisting of retired captains or flight crew. This group has the respect of both management and pilots and thus avoids direct employer/employee contact. The fear of job loss or punishment is thus avoided and the accident prevention insights are more readily obtained.

**International exchange of safety data**

*General*

4.2.37 The international exchange of accident/incident data provides a broad range of experience on which to base safety guidance. Such information can be of particular value to smaller States or organizations who are not in a position to maintain an accident/incident reporting system, or whose data base is too limited to permit the identification of potential hazards. Safety data interchange is therefore encouraged among State Administrations and safety organizations. For maximum effectiveness, compatibility of the basic coding of the data in these systems is needed. This applies equally to simple manual systems or more complex electronic data processing systems (EDP).

4.2.38 For aircraft components and systems, the ATA 100 specifications — an internationally accepted code — provide a great deal of compatibility. These standard codes are used in the ICAO ADREP and some national systems.

4.2.39 A number of States use EDP systems for the storage, processing and dissemination of accident/incident data. Most of these States use compatible EDP formats and codes, making it possible to exchange data tapes, and thus benefit from each other’s experience.

4.2.40 In addition to the exchange of data from reporting systems, many of the larger States and organizations publish material dealing with many aspects of aviation safety. These include such things as films, magazines, summaries of accidents/incidents, etc. Appendix F lists some of these.

**ICAO Accident/incident reporting (ADREP) system**

4.2.41 The ICAO ADREP system is a data bank of world-wide accident/incident information for aircraft with a maximum certificated take-off mass of over 2 250 kg. Thus ICAO can provide States with accident prevention information based on wide international experience. The ICAO Accident/Incident Reporting Manual (ADREP) (Doc 9156) contains detailed information on this system. ICAO provides the following information based on ADREP data:

- **ADREP Summary**: a computer generated publication containing the ADREP preliminary reports and data reports received by ICAO during a two month period. It is issued six times a year. The last issue each year contains a comprehensive index of the accident and incident reports reported to ICAO during that year;

- **ADREP Annual Statistics**: an ICAO circular, containing annual statistics from the data bank. These statistics may be useful for safety studies and accident prevention programmes; and

- **ADREP Requests**: ICAO provides information in the form of computer printouts in response to specific requests from States. Guidance for the formulation of ADREP requests is contained in the ADREP manual.
4.2.42 The ADREP computer programmes are available to States wishing to utilize their computer systems for accident/incident recording. These programmes, in addition to promoting standardized coding, offer significant financial savings to States.

Other ICAO safety information

4.2.43 In addition, ICAO publishes the following aircraft accident/incident information:

— *Aircraft Accident Digest*: this publication contains narrative-type accident or incident final reports selected for their contribution to accident prevention, or the use of new or effective investigative techniques;

— *List of Final Reports Available from States*: a listing of narrative-type aircraft accident final reports available on request from the reporting States. The list is updated every six months on the basis of information supplied by States.

4.3 HAZARD EVALUATION

Data recording methods

4.3.1 Effective methods of recording accident and incident data allow for their subsequent analysis. In addition to evaluating their significance, such methods can also help to identify hazards. Recording systems vary greatly, from simple files to complex EDP systems, depending on the resources and requirements of the organization and the number of accidents/incidents involved. Because of the numerous variables inherent in accident/incident data and the number of different uses they may be put to, it is essential for recording systems to have a high degree of flexibility. This is one of the chief advantages of most EDP systems.

4.3.2 One of the simplest recording methods is to photocopy the synopsis or summary page of the report and to file copies under various headings, such as: aircraft type, type of occurrence, phase of flight, type of operation, etc. This method is only suitable for a small number of reports. Slightly more complex systems may use cards filed under various headings, either containing all the significant information or providing a reference to a master document, or both. Another card system uses “rim punching” so they can be mechanically sorted into categories. An example of this type of system is contained in Appendix A. The use of colour can be helpful in separating different years or different types of operations, etc. Development of an EDP system solely for accident/incident analysis may require considerable financial and manpower resources. However, small desk top computers are becoming readily available as cost-effective alternatives to manual recording and sorting.

4.3.3 Whatever system is chosen, it is important that the various groupings or categories be clearly defined. This may be done by the use of a coding manual or a “tick-off” coding form. The use of clear definitions for such categories as: “type of operation” or “type of accident” will ensure that while those doing the coding and filing may change, the classification of the data will not. This is essential if a useful data bank is to be established and developed.

4.3.4 In most States, the requirements and procedures for reporting and recording accidents and incidents differ. However, having both accidents and incidents in the same system makes the work easier and is more cost effective. Fully investigated incidents can be stored in an accident system if the classifications and codes are the same. Some States which use the ADREP classifications and codes to obtain a common data base often add other classifications which are unique to their national requirements. This allows States to exchange data with respect to the common data base, while at the same time meeting the special needs of such States. As well, the use of ADREP classifications and codes for the common data base simplifies the reporting of ADREP accident/incident data to ICAO.

Statistical studies

4.3.5 Once hazards have been identified and recorded they need to be analysed to determine their significance and severity. Priorities can then be allocated for their elimination or avoidance. Some States are developing
systems for identifying cause and effect relationships in their computerized records so that searches can be made for specific combinations of factors which have been proven to be hazardous.

4.3.6 Many accidents are caused by hazards that have been previously identified. However, these hazards have often been viewed in isolation and it is not until they are considered in conjunction with other hazards that their real significance can be understood. The application of analytical methods to such data can therefore highlight areas for correction and suggest priorities for remedial action.

**Fault tree analysis**

4.3.7 The fault tree analysis technique has been widely used in the safety analysis of complex systems. It is basically a logic diagram that can clarify complex processes and relationships and which may be adapted to show the cause-effect relationships that induce aircraft accidents. Fault trees thus assist in tracing the chain of events leading to a system failure. This “system” approach emphasizes that a failure in either man, machine or environment will most likely affect the other two.

4.3.8 Figure 7 is an example of a simplified fault tree (adapted from the SAE, ARP 926A Document) and includes the symbols commonly used in constructing such flow diagrams. Starting with the accident or incident at the top of the page and working backwards, the fault tree can be considered to progress downwards through different levels via “AND” or “OR” gates in response to the question “Why”. The branches become more detailed, as all available information is added, leading to basic causes or hazards. The fault tree shown in Figure 7 is not complete, and only illustrates the general development of a cause-event sequence. If continued for several more levels it would almost always arrive at a common cause — human error.

4.3.9 Use of the fault tree analysis technique requires an in-depth knowledge of the design, construction and operation of the affected component or system. As this technique assumes the total success or failure at each level or operation, it is of greatest value in the analysis of mechanical failures. When considering human failures, there are so many levels of performance between what could be considered success and failure that the technique is of lesser value.

4.3.10 Given a clearer picture of the cause/effect sequence leading to an accident or incident, it is easier to determine at what levels and in which areas accident prevention procedures could best be applied and the potential effectiveness of such action. Applied to existing aviation systems, the fault tree analysis technique can highlight areas where greater accident prevention effort is warranted and where it would have the greatest effect.

**Modelling**

4.3.11 Models can also be used as analytical tools to help understand various factors and their interrelationships in complex systems, procedures, operations, etc. Generally, two types of model are possible. Physical models for evaluating hardware, such as scale models, simulators, etc. and non-physical (symbolic or mathematical) models used for more abstract factors or subjects. The latter models can also be adapted for handling by computers.

4.3.12 To be effective, models must include the essential elements of the real system they represent and must obey all its operating rules and procedures. Once a model has been proven to be representative by using known values, the effects of changing variables can be determined. In this way the hazard potential of various factors can be simulated at low cost and with no risk.

**Use of simulators**

4.3.13 Some hazards in aircraft operations can be evaluated using flight simulators. Compared to simulations using aircraft, such as “reflying the accident” to near impact, these have the benefit of comparatively low cost and no risk. Simulators can be programmed to reproduce malfunctions and other hazards which can then be analysed with a view to producing recommendations aimed at preventing them. One of the main advantages of flight simulators is the re-creation of the situation facing the flight crew. This can be helpful in developing an understanding of the crew’s actions. Air traffic control and other simulators can be similarly used.
4.3.14 Incident reporting schemes should include “incidents” found in routine simulator training exercises, as an “incident” in a simulator may be just as important for accident prevention as one which occurs in flight.

4.4 HAZARD ELIMINATION OR AVOIDANCE

General

4.4.1 Not all hazards can or will be eliminated. Once hazards have been discovered and defined, the organization responsible for their elimination or avoidance must be informed, usually by means of a safety recommendation or notification. Unless this is done, accident prevention efforts are wasted.

4.4.2 Safety recommendations should be framed in general terms only, as the expertise for solutions will normally not exist within the prevention organization. Also, specific recommendations tend to detract from management’s responsibility for accident prevention. A specific recommendation has the potential of inducing a rejection mentality in the recipient, because it could be considered as implied criticism, or because it was not thought of by him (the so-called “not invented here” syndrome). Finally, a specific recommendation may not be the best way to eliminate the hazard, thus tending to erode the credibility of the originator. In conjunction with the recommendation or notification, there should be, if appropriate, an assessment of the severity of the hazard; whether it forms part of a trend and any additional advice or information which could assist the recipient in taking the required preventive action. Care should be taken, however, that the solution for a particular problem does not introduce new problems.

Information to management

4.4.3 The management activities of administrations, manufacturers and operators are vital parts of the aviation safety process. Since the ultimate responsibility for safety rests with management, it must be supplied with sufficient information and advice on which to make decisions related to the elimination of hazards. For example, operational management should be aware of industry safety trends, especially of operators using the same aircraft types in similar operations.

Feedback to the regulatory process

4.4.4 Most States possess methods of incorporating some of the lessons learned from accident and incident investigations into their various systems of regulatory control. Generally, this is a slow process, due in part to legal and other constraints imposed by changes to legislation. As an example, a series of one type of accident may indicate a weakness in an area of pilot training. Considerable time can elapse before changes to the regulations regarding pilot training procedures can be made. As an interim measure, States could conduct an information programme aimed at highlighting and hopefully avoiding these weaknesses.

4.4.5 Regulations, rules and instructions in themselves do not prevent accidents and unless they are enforced they are of little value. Also, the temptation to address every new hazard or problem with a new regulation, rule or procedure should be recognized and resisted. Although a new regulation may appear to be a simple solution, it is only likely to be effective if it goes to the root of the problem and does not create other difficulties. Finally, the cumulative effect of additional regulations and rules may make it Practically impossible for the aviation community to comply with them all, with the result that they may become counter-productive. Careful analysis is therefore required before regulations or rules are used to correct safety deficiencies.

4.4.6 However, where the airworthiness of aircraft is involved, the response by the regulatory authorities can in most cases be rapid. For example, a failed aircraft part may provide clear evidence of inadequate design or poor quality control. In such cases, airworthiness directives are usually issued promptly to rectify the hazard. In addition, manufacturers, operators and airworthiness authorities have developed effective information exchange systems.

4.4.7 It is unfortunate that there is often an imbalance between the efforts devoted to accident/incident investigation on the one hand and the efforts expended on subsequent hazard elimination on the other. Usually the investigation effort is considerable while the remedial effort is often quite small. Accident or incident
investigations should not be regarded as a means to an end in themselves but rather as the first of several steps towards accident prevention.

4.5 MEASUREMENT OF SAFETY

Accident/incident statistics

4.5.1 It is highly desirable to monitor the effectiveness of accident prevention efforts. There are basically two ways in which this may be accomplished; one is the simple use of numbers of accidents, incidents, fatalities, etc. the other involves accident rates. Valid comparisons can only be based on rate information. For instance, if two types of aircraft are compared and type A flies one million hours in one year resulting in one accident and type B flies five million hours in a year resulting in five accidents, the accident rate based on hours flown is the same for both types (one accident per one million flying hours).

Rates

4.5.2 Rates thus express the numerical proportions of two sets of data and in accident statistics this usually involves numbers of accidents, incidents, injuries or damage as one set and some measure of exposure, such as flying hours, as the other. Generally, rates are best suited to establishing the general measure of safety of an operation, rather than indicating specific prevention measures. For a rate to be valid, the sets of data used must be compatible. For example, long and short haul operators do not fly the same numbers of flights. Their flights are usually of different duration, using aircraft that may have widely varying performance capabilities, and carrying differing numbers of passengers. Therefore, a comparison of the relative safety of these two types of operation will largely depend on whether the exposure base includes numbers of flights, flying hours, miles, passengers or some combination of these.

4.5.3 Statistics must be used with caution. For instance, they may show that pilots in a certain age group or with a certain number of flying hours have the most accidents. Mathematically these figures are correct; however, they imply that the pilots in these groups are "less safe" than pilots in other groups. Before such a determination can be made, it is necessary to determine the total number of pilots in each age group, since the pilot group with the highest number of accidents may also contain the greatest number of pilots. This principle needs to be considered whenever comparisons are made. Many accident statistics are of little value for accident prevention purposes because they provide no valid means of comparison.

4.5.4 When calculating rates, the exposure data used will depend on the purpose of the study. For example, a passenger’s expectation of reaching his destination safely is of concern to him. Thus he is unlikely to be interested about such things as the time he will be at risk, or how many other people on the aircraft are at risk with him. A rate outlining the number of flights per fatal accident therefore provides an appreciation of risk he can relate to.

4.5.5 Traditionally, airline safety statistics have used seat kilometres (or miles) as an exposure base. With the advent of wide-bodied aircraft the number of available seats has increased dramatically. The longer range of such aircraft also means that they spend a greater proportion of each flight in the cruise phase. Most accidents occur during the landing and take-off phases and this is a constant for all flights irrespective of other factors. In addition, any flight that results in an accident can be seen to represent a failure of the safety process, irrespective of how long it has been airborne, how far it has flown, or how many seats it has. Accordingly, when comparing safety levels of airline operations, the rate of accidents to numbers of flights may be a more appropriate yardstick than the use of flight hours or seat/kilometres.

4.5.6 There is also the choice of whether fatal accidents, or individual fatalities are more appropriate for accident statistics than, say, total numbers of accidents (including non-fatal accidents). The criteria for non- fatal accidents vary widely from State to State and caution is necessary if statistics for these types of accident are to be compared.

4.5.7 Aviation safety also concerns those factors that affect accident survivability. Related statistics usually involve the number of fatalities that occur in an otherwise survivable accident and frequently include the presence or absence of fire.
4.5.8 For most general aviation operations, the number of accidents or incidents and an exposure base measured in flight hours are often used. The resulting rate is then an expression of accidents or incidents per 100 000 hours (or 10 000 hours). In special operations involving unique hazards, it may be desirable to use a different exposure base. For example, aerial application operations usually involve many flights per hour. The large number of take-offs and landings substantially increase the likelihood of an accident during these critical phases of flight. For such operations it may be more useful to compare numbers of accidents with numbers of flights.

4.5.9 Most States require aircraft operators to furnish regular reports on various aspects of their operations for planning and other purposes. Some of this information is subsequently forwarded to ICAO. The difficulty in obtaining up-to-date and accurate statistical data on which to base rate calculations is a serious problem in measuring safety.

4.5.10 When considering safety statistics, the current record is often compared against a base period to determine whether there has been an improvement or decline in safety. This analysis method can also provide a useful hazard alerting technique. However, when the numbers of accidents/incidents are comparatively small, slight changes in numbers, for instance from one year to another, can provide an erratic and virtually meaningless result. To overcome this, some form of averaging can be used. For instance, the number of accidents in the subject year can be compared to the average number of accidents in a preceding three or five year period. Alternatively, the number of accidents in the subject year can be added to the number of accidents of the previous two or four years, from which a so-called rolling three or five year average is calculated. Examples of these types of safety statistics are contained in Appendix A.

4.5.11 The use of a five year average will provide a greater “smoothing” effect but it will be less responsive to developments in the aviation system than the shorter period.

**Recording the prevention effort**

4.5.12 An accident prevention organization should continually assess the effectiveness of its work. Records can be kept of the hazards discovered, safety recommendations or notifications issued, the responses received and the numbers of hazards considered eliminated. Such records provide a measure of the effectiveness of the prevention effort and assist in the follow-up of those hazards for which no or an inadequate response was received.

4.5.13 On the one hand, accident prevention requires financial support. On the other hand, part of the financial responsibility of management is to eliminate needless expense. In an effort to save money, the management of an operator with a good safety record may be tempted to assume that further or continued expenditures on accident prevention are not warranted. Records of accident prevention activities may then be used to demonstrate that the good safety record is due in part to past accident prevention efforts and that any attempt to reduce these efforts may lead to increased costs in the long run. Management may need to be reminded that accident prevention expenditures are investments in future safety.
CHAPTER 5
PREVENTION ORGANIZATIONS

5.1 ESTABLISHMENT PRINCIPLES

General

5.1.1 The following general guidelines should be considered when defining the terms of reference and operating methods of an accident prevention organization:

a) it should aim to arouse an awareness and understanding of accident prevention in all sectors of the aviation organization or community;

b) once hazards have been identified and assessed, the prevention organization should notify the appropriate authority and recommend action to eliminate or avoid the hazards;

c) it should keep management informed of safety trends and uncorrected hazards within the organization;

d) the prevention organization’s role is advisory only. It should have no executive function or authority.

5.1.2 Irrespective of the organizational arrangements of the prevention effort, it needs to be emphasized that the objective of accident prevention is the discovery and elimination or avoidance of hazards; thus providing an independent quality control check of the aviation infrastructure.

State administrations

5.1.3 The manner in which a State establishes an accident prevention organization depends largely on the extent of its aviation activities, the availability of resources and its desire to be effective in this area. Some States have established prevention organizations and programmes that are completely independent of the aviation administration. Accident investigation boards, etc. and incident reporting systems are examples. While this procedure requires extra resources, the results are worthwhile as they tend to produce a more objective overview of the total aviation system. This method also removes any suggestion that such programmes are associated with a State’s enforcement activities.

5.1.4 One common method used by States is to establish a prevention organization within the aviation administration which is responsible for all prevention programmes. This method has the advantage of providing good lines of inhouse communication and ready access to specialists in the various aviation fields. However, if this method is chosen, it is essential that the organization report on safety matters direct to the highest level within the administration, so that its safety recommendations are not blocked or diluted in passing through normal administrative channels. One disadvantage of this approach is that the safety organization and its programmes may be associated with the enforcement activities of the administration. This in turn may restrict its sources of hazard information particularly in the human factors area. Such a disadvantage can be minimized, but not entirely eliminated, by legislation, education, confidential incident reporting systems, etc.

5.1.5 In still other States, usually the smaller ones, accident prevention activities will often be undertaken as a secondary duty of a section or individual within the aviation administration. This is the least desirable method of achieving the accident prevention objective. The effectiveness of this method will depend largely on the capability of the person(s) selected for the task, on the availability of resources and on access to the highest level of the aviation administration.

Aircraft operators

5.1.6 The extent and effectiveness of accident prevention activities within commercial aviation organizations are very dependent on management, since management plans, organizes and controls the organization. Establishing
a safety organization for an aircraft operator involves considerations similar to those that apply to State administrations. However, the wide variety in size, complexity of operations and often severe financial constraints have a marked effect on the scope of these activities.

5.1.7 Ideally, a self-contained “prevention unit” will be established with clearly defined access to top management on safety matters. Its basic function is to determine what is occurring within the organization (finding the hazards), monitoring trends in other similar operations, advising management and other staff on accident prevention methods and generally promoting safety. Many large airlines have such a unit. Its function is advisory only. To remain effective, it must avoid any association with blame or punishment.

5.1.8 At the other end of the scale, in a small operation, a pilot or another employee may be assigned the task of bringing accident prevention information and ideas to the attention of others in the organization. This will largely involve the use of material produced by others. In this case the lack of manpower or resources severely hampers accident prevention activities.

5.2 PERSONNEL

5.2.1 Accident prevention activities need to have a person or persons as a focal point and driving force. Throughout this manual the term Accident Prevention Adviser (APA) has been used to describe a person filling such a position. The choice of this term was deliberate. It highlights the primary role of this position which is to act as an adviser to management on methods to improve safety. It also avoids any suggestion of being associated with regulatory or punitive activities — a principle this manual has repeatedly expounded. The use of such a term is of course not obligatory and terms such as Accident Prevention Officer (APO) and Accident Prevention Specialist (APS) may be more suitable in certain circumstances. Existing safety officers or flight safety officers already perform a similar function.

5.2.2 An APA must be able to assess and evaluate the functioning and interrelationship of the many varied activities that make up an aviation operation. This requires an extensive knowledge of aviation. Typically such personnel will have a flight crew or aviation engineering background. In addition to their technical knowledge, they require initiative and an inquisitive and analytical nature to seek out or anticipate aviation hazards. They must also be completely objective and thus have the respect of flight crews and other personnel. Persistence is also desirable to ensure that appropriate action is taken on discovered hazards.

5.2.3 Since they rely heavily on people for their information, APAs should be able to get along with personnel at all levels. Tact and diplomacy prevent conflicts and can foster confidence and respect. This helps to ensure that the most useful insights are obtained. The complexity of some elements of aviation also requires a high level of analytical skill.

5.2.4 While much accident prevention information will become available from established channels such as reporting systems, investigations, etc., a considerable amount will come from informal day-to-day discussions and ad hoc contacts. The APA should therefore be free to move around the organization — probing, questioning and observing. He needs to be readily accessible to anyone wishing to contact him, and should not shut himself in an office and wait for information to come to him. His physical location within the organization is important. If it is remote from the day-to-day operations, communications will inevitably suffer. It will also tend to make his own movement about the organization difficult and will certainly deter others from seeking him out. One of the main sources of safety information within an airline is its flight crews. Therefore, it may be desirable to locate the APA where flight crews can have ready access to him. This is particularly important in relation to human factor elements where the facility to discuss a problem, in confidence if necessary, immediately after a flight may be the deciding factor on whether the information is reported at all.

5.2.5 It is important for an APA to keep in close touch with other safety organizations and operators both formally via committees, professional organizations, etc. and informally. He should collect relevant safety information from all available sources and ensure this is disseminated to appropriate people within his organization.

5.2.6 To summarize, accident prevention programmes require the following broad categories of skills:

a) technical, operational, human factor and administrative expertise to detect and assess hazards and...
formulate recommendations to eliminate them; and

b) effective speaking, writing and other communication skills to encourage the elimination of hazards and to promote safety awareness.

5.3 INVOLVEMENT OF PROFESSIONAL ORGANIZATIONS

5.3.1 Professional organizations such as those of pilots, engineers and air traffic controllers possess a considerable body of specialist knowledge and may have persons trained in accident investigation and prevention. In addition, they usually have an effective communication system within their own group. Because of their intimate knowledge of specific areas of aviation, they can often assist in identifying and eliminating aviation hazards.

5.3.2 While these groups can be of considerable assistance, it should be remembered that they exist in part to further the interests of their members. Care should be taken therefore to differentiate between real safety issues and other issues which may be disguised as safety issues.

5.3.3 Other groups, such as aviation insurers, have a vested interest in accident prevention. They often have detailed statistical data relating to insurance claims and sometimes have staff trained and active in accident prevention.

5.4 SAFETY PROMOTION

Information/motivation

5.4.1 Safety promotion involves the communication of information with the objective of modifying behaviour or eliminating factors known to induce accidents. Traditionally, the emphasis has been on the communication of information. However, as increased human factor insights are gained, it is increasingly apparent that most accidents do not result from a lack of information so much as from deficiencies in attitude and behaviour. These, in turn, can erode the judgement on which decisions are based.

5.4.2 Communications experience teaches that if a message is to be learned and retained, the recipient first has to be positively motivated. Unless this is achieved, much well-intended effort will be wasted. It is also important to realize that propaganda which merely exhorts people to take more care, avoid making errors, etc. is ineffective as it does not provide anything substantial which individuals can relate to. This approach has sometimes been described as the “bumper sticker” approach to safety.

Dissemination methods

5.4.3 All methods of dissemination — the spoken word, the written word, posters, slide-shows, films, etc. — require talent, skill and experience to be effective. Poorly executed dissemination may be worse than none at all, since bad communication tends to have an opposite effect to what is intended and creates a negative reaction in the recipient. Professional input is therefore highly advisable when disseminating information to a critical audience.

5.4.4 Once a decision has been made to disseminate safety information, a number of important factors should be considered. They include:

a) The audience: the message needs to be expressed in a language that reflects the knowledge of the audience. For instance, do not speak down to people or tell them what they already know;

b) The response: what is hoped to be accomplished?

c) The medium: while the printed word may be the easiest and cheapest, it is likely to be the least effective;
d)  *The style of presentation:* this may involve the use of humour, graphics, photography and other attention-getting techniques.

5.4.5  Ideally, a prevention programme will use several different communication methods. The following methods are commonly used for this purpose:

a)  The spoken word: this is the most effective but also the most expensive method. It is time consuming and requires organization to assemble the audience, aids and equipment. Some States employ specialists who routinely visit various organizations, holding lectures and seminars;

b)  The written word: by far the most popular because of speed and economy. However, the explosion of printed material tends to saturate man’s capacity to absorb it all. Printed safety promotion material competes for attention with considerable amounts of other printed material. Professional guidance or assistance is desirable to ensure that the message is conveyed effectively;

c)  Audio-visuals: the combination of sound and visual image significantly increases attention and comprehension. For promotion purposes it has two limitations:

-  expense; and

-  the need for equipment.

Economy can be achieved, however, by mailing the audio-visuals to groups for their own use. In that case the extra money spent on producing the presentation is offset by savings in salaries and travel costs. This mode of safety promotion is of particular value to States which have no full-time APAs. A catalogue of selected audio-visual material available in various States is contained in Appendix F.

d)  *Displays:* when a message is to be shown to a large group which has gathered for some purpose, the display is a good “self-briefing” technique. Imagination and display expertise are required to present not only the message but the image of the accident prevention organization. Its drawbacks are expense and — unless it is manned — a static and somewhat uninteresting appearance. Professional guidance or assistance is needed to ensure the message is conveyed effectively.

5.4.6  When a safety promotion programme is being contemplated, it will be beneficial to seek advice from experienced communicators and knowledgeable representatives of the target groups involved.
6.1 If the air transport accident rate remains static, and the volume of air transport continues to grow, the number of accidents each year will increase. In addition, aircraft size and capacity continue to escalate. Thus each accident will involve, directly or indirectly, more and more people and the associated financial costs will rise proportionately. If the travelling public is to continue to regard air transport as having an acceptable safety record, then the current accident rates must be reduced.

6.2 While the goal of accident prevention is the elimination of all aircraft accidents, the fallibility of human nature makes this goal unobtainable. Increasingly, people involved in aviation are coming to realize that almost all aircraft accidents can be traced to a human failure somewhere and that the failure is often far removed from the direct operation of the aircraft. Accident prevention must therefore include all aspects of human involvement in the operation of aircraft — not just those most visible.

6.3 The present admirable safety record has been largely achieved by dealing with the effects or symptoms of people’s actions. If they were found to be hazardous, new techniques, procedures, rules, etc. were created to eliminate or minimize their effect. If in the future we are to succeed in significantly reducing accident rates, it will be necessary to go well beyond dealing largely with effects. In other words, we must significantly increase the efforts to determine and understand the reasons why people behave, act, or respond in the ways they do. Only then can we hope to effect some fundamental improvements in the safety record.

6.4 Attempting to determine and modify the way in which people act and react is much more difficult than simply dealing with the effects of such actions. Often, the people concerned may not know the reason why they responded or acted as they did. This phenomenon is an area for scientific research and is beyond the scope of a manual such as this. However, one of the purposes of this manual has been to stimulate research and activity in these fields of accident prevention.

6.5 The simple approach to accident prevention presented in this manual is centred on discovering what is really happening in the aviation environment before attempting to correct it. This can best be achieved by establishing the right management environment and the use of effective prevention programmes. It is hoped that, as a bonus, additional insights will be forthcoming which will throw some light on the underlying human factors.

6.6 The Appendices which follow provide examples of how some States and organizations are attempting to achieve this objective.
Appendix A
PRACTICAL APPLICATIONS

I. CONDUCTING A SAFETY SURVEY

1. A safety survey is basically a review of a particular area of aviation operations or facilities. It may be used to confirm that an existing situation is satisfactory, i.e. as a monitoring function, or when problems appear or are suspected. In either case the principles and procedures are the same and they are equally applicable to large or small surveys. In short, a survey is a cost-effective and flexible accident prevention method.

2. The objective of a survey is to identify hazards so that management can take action to eliminate or avoid them.

3. In conducting a survey, some fundamental principles should be considered:
   a) the co-operation of the people involved in the survey is essential. It will be of little value without it;
   b) it must never appear to be a “witch hunt”. The objective is to gain knowledge, and any suggestions of blame or punishment will be counter-productive;
   c) the people interviewed are usually more experienced in their speciality than is the person carrying out the survey and they should be regarded accordingly;
   d) criticism should be avoided because it can destroy the rapport with the person being interviewed;
   e) hearsay and rumour need to be treated with caution — every effort should be made to substantiate all information before it is accepted.

4. When planning the survey, the following points need to be considered:
   a) the purpose of the survey;
   b) selection of those best qualified to perform it;
   c) defining the areas to be examined;
   d) ensuring that the management responsible for the area being surveyed is aware of the intended actions and supports its objectives.

5. The gathering and analysis of the information, development of recommendations and the preparation of the final report of a survey will take time. It is therefore desirable to hold a brief review with those responsible as soon as the survey has been completed. If any conclusions are immediately obvious, they should be discussed informally.

6. It is important that the report on a survey be completed as soon as possible. Recommendations should be practical and within the scope and ability of the organizations concerned. Sensitive issues should not be avoided, but care should be taken to ensure they are presented in a fair, constructive and diplomatic manner.
II. AN EXAMPLE OF ONE STATE’S GUIDELINES FOR THE ESTABLISHMENT OF AN ACCIDENT PREVENTION PROGRAMME BY AN OPERATOR

Introduction

1. Experience indicates that the aviation safety process is neither widely nor well understood — not that most companies are not “safety conscious” and individuals are not dedicated to preventing accidents. Nevertheless, establishing an aviation safety programme calls for more than enthusiasm; it requires familiarity with the process. This often means that an operator needs guidance to establish and support an aviation safety programme.

1.1 Since no two operators are alike, these broad guidelines create the opportunity for innovation and adaptation. Some of the programme elements may be beyond the resources of the small operator. However, most are indispensable if the programme is to succeed.

Management

2. Obviously, management “support” is required to initiate a safety programme, but of greater importance is a genuine and visible commitment to it. Senior management must clearly convey to all persons in the organization their full confidence in the programme and the person or persons involved in running it. Inevitably, safety problems reveal deficiencies in human decision making. Managers may see these failures as opportunities for “weeding out” those they consider to be undesirable employees. In this respect, management should recognize that they could forfeit the benefits of a safety programme if such action is taken. For example, management will be aware that the Accident Prevention Adviser (APA) will be privy to information of a sensitive nature — usually related to an individual. A manager who prides himself on “getting to the bottom of things” could fail to sense the dampening effect such an action has on the vital free interchange of safety information.

2.1 If experience is to be converted to good use, the manager should be sure in his own mind that an event or condition in the company is almost invariably a symptom of a broader problem. For example, a damaged wingtip may indicate a number of possibilities besides carelessness. It may even reflect unfavourably on the quality of management itself, if the incident occurred as the result of external pressures on the pilot caused by tight schedules, long working hours, etc.

The Accident Prevention Adviser (APA)

3. An operator’s safety programme should have a focal point in a person — the APA — who enjoys the confidence of his peers as well as management. He must be persuasive without being dogmatic, skilled at public relations and have the ability to effectively promote such programmes.

3.1 His basic role is as a safety adviser to management. On his appointment, all staff should be advised of his responsibilities, as well as an explicit statement attesting to his position of trust and confidence.

3.2 Some operators send their APAs on training courses aimed at introducing the trainee to aviation safety management concepts and techniques. Although expensive, such training courses need only save a company one minor accident to be cost-effective.

Safety communication

4. The APA should be the focus of any safety proposal, observation, report, etc. These may extend from a general comment about a facility to an incident report submitted anonymously by a pilot who may not wish to incriminate himself or others. Before the APA can make a meaningful safety response, it will be necessary to identify the underlying problems (hazards) revealed by the reported symptoms. Unless the underlying deficiency is corrected the hazard will persist.

4.1 There is another aspect to communication which is not widely understood because it is “silent” communication. This refers to the negative reaction of employees when a manager acts against a person, using sensitive information which the staff suspects has been obtained from the APA. Both the APA and management need to keep in mind that safety communication is exceedingly fragile and can be shattered by one breach of trust. Renewed trust — the foundation of safety communication — can be slow to return.
4.2 The APA should possess good interviewing skills. Too often, a well-meant interview falls flat because of a failure to communicate. In some cases, the APA will encounter a reluctance to convey an opinion or an observation. Putting such a person at ease calls for skill and judgement, based on good training.

**Accommodation and equipment**

5. The aviation safety programme must have a physical presence. The resources apportioned by management have a double impact; they not only facilitate communication but they also demonstrate company support.

5.1 The minimum equipment needed will be a generously sized bulletin board with publication racks. Since many aviation periodicals contain information relating to safety as well as a professional standard of knowledge, they are invaluable adjuncts to the safety programme. It is desirable that the APA use this material in his safety programmes. The item could be pinned to the bulletin board, be copied for broad distribution, or made the subject of a safety briefing. A number of States routinely publish accident investigation reports which are available on subscription.

5.2 Larger companies should make a room available for safety briefings and an office for the APA. As more safety material is being produced in the audio-visual medium of slide/sound and film, equipment to handle these will be a necessity. Slide/sound, films and video recordings are now used extensively for such presentations.

**Aviation safety briefings**

6. These are useful but are often difficult to schedule. However, they are valuable because they maintain a high level of awareness of current safety problems and provide a forum to discuss hazards observed by company pilots. For example, the onset of a new weather season is an excellent opportunity to review related cautionary advice. At this time, typical aircraft accidents can be examined in detail, providing excellent insights for pilots, particularly if they involve aircraft of the same type as that flown by the company.

6.1 Periodic training sessions, during which a detailed examination is made of certain aircraft components such as the engine or instrumentation, are also useful and can be carried out using company resources, such as engineers.

**Surveys**

7. The APA should visit all areas of company operations observing activities with an inquiring mind. This should include the hangar and maintenance operations, as well as places the company flies to on a regular basis. During the survey the APA should ask himself “If this hazard is not corrected, will it contribute to an accident?” Remember, that the hazard by itself may not appear significant, but in conjunction with others, it may initiate a chain of events which results in an accident. Therefore, each hazard should be noted and photographed if necessary, for further consideration and discussion.

**Records**

8. A useful technique of recording hazards is to construct a chart as shown in Figure A-1. The areas of interest are recorded vertically on the left and the number of times the deficiency is observed is recorded horizontally. Using this technique, it will soon become apparent where safety problems lie. It is important to remember that, while obviously of interest because the problem has been identified on a number of occasions, sheer numbers should not deter the APA from analysing hazards which occur less frequently. In other words, the APA should analyse each identified hazard and decide if a single hazard in one area is as important as many hazards noted in another area.

**RECORD OF OBSERVED SAFETY DEFICIENCIES**

<table>
<thead>
<tr>
<th>Operations</th>
<th>January</th>
<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incomplete pre-flight inspections</td>
<td>x</td>
<td>x</td>
<td>xx</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Out-of-date publications</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overloading</td>
<td></td>
<td>x</td>
<td>xxx</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
Cargo not tied down | xx | x |
Deferred unserviceabilities | x |
Rushed turnarounds | x |
Weather briefing not obtained | x | x |

**Training**
Irregular ground school | |
Seasonal briefings | |
Knowledge of safety equipment | x | x |
Proficiency checks | x |
Initial check-out | |

**Maintenance**
Poor tool control | |
Scheduling of inspections | |
Personnel qualifications | x | x |
Quality control | |
Aircraft equipment | |
Uncorrected defects | xx |

**Managerial**
Company policy on medication | x |
Duty times | x |

Figure A-1

**Questionnaires**

9. Another useful technique to gather hazard information is to provide a questionnaire to company employees asking them to identify safety deficiencies. This shows that their input is sought and will provide an idea of the problem areas which should be assessed in depth. Figure A-2 is an example of a safety opinion survey in the form of a questionnaire.
EXAMPLE OF A SAFETY OPINION QUESTIONNAIRE

How good is our safety programme? Here is a chance to express your personal opinion on how you feel towards company safety. Finish each sentence to show what you think of the programme. You may want to give examples to explain your answers. There is no need to sign this survey. Your answers will be combined with those of others to determine the staff’s opinion of our safety programme.

Be frank!

Tell us where the programme has failed; tell us the good points, too! How can we improve safety?

1. Safety training in my department...
2. My knowledge of accident prevention...
3. My boss’s view on safety...
4. The best part of our safety programme is...
5. The co-operation of my work group in achieving safety...
6. Evidence of safety in my work area...
7. Management concern for safety...
8. What hazardous situations or occurrences have you been involved in during the past year?
9. What might cause an accident of any kind in this company?
10. I think we can improve our safety programme by...

Figure A-2

Analysis and corrective action

10. All hazards should be analysed by the APA. A discussion should then be held with the person who has the authority to correct the identified problem. Senior management need not be approached on every item, but, rather, the manager at the lowest level at which the problem can be corrected, should be advised. Having been appraised of the hazard, most managers will take the necessary corrective action. Should the manager not take corrective action and a serious hazard remain, then the APA should be prepared to discuss the matter at a higher level.

Feedback

11. If the APA is to expect other company personnel to actively participate in the safety programme, he must be prepared to provide feedback to them on hazards that have been brought to his attention and the corrective action taken.

Reporting to management
12. At regular intervals, the APA should report to the senior company executive to whom he is safety adviser. This report should:

a) identify all the hazards which have been noted since the previous report;

b) advise the corrective action which has been taken by the responsible managers; and

c) notify those hazards which remain uncorrected. Senior management must then decide whether to take corrective action or leave the hazard uncorrected. (Sometimes problem areas cannot be corrected, but they can be taken into account and circumvented when plans and procedures are devised.)

12.1 Since the senior manager is the person ultimately responsible for safety in the company, he must be kept informed of the status of all hazards. Only then is the safety health of the company likely to improve.

Aviation safety conferences

13. It is unlikely — and certainly undesirable — that an APA will encounter all the safety problems likely to confront his organization. The cross-fertilization of ideas and information possible at workshops or conferences is invaluable to the APA and his programme. He will not only learn of other companies’ safety problems but can measure the quality of his own activities and pick up new ideas and approaches.

Bibliography

14. There are several excellent books which have been published to assist safety managers. Examples are:

Techniques of safety management, Dan Peterson, McGraw-Hill Book Company. Details the elements of a safety programme. Techniques discussed are readily adaptable to aviation companies.

Organizing For Safety, National Air Transportation Associations Inc., 1156 Fifteenth Street, N.W., Washington, D.C. 20005.


Safety Management — A Human Approach, Dan Peterson, Aloray Publisher, Englewood, New Jersey.

Systematic Safety, Walter Tye and E. Lloyd published by CAA, United Kingdom.

III. EXAMPLE OF AN AIRCRAFT MANUFACTURER’S SYSTEM SAFETY PROGRAMME FOR A NEW AIRCRAFT TYPE

Introduction

1. The primary objective of this System Safety Programme is to define those activities deemed necessary to ensure that the aircraft is capable of safely carrying passengers, flight crew and cargo and is safe to handle by ground crews throughout its entire life and operating environment. This document defines the system safety activities during the design, development, manufacture and testing of the aircraft.

1.1 Prior to the release of engineering drawings, the entire aircraft will be subject to a system-by-system Preliminary Hazard Analysis. The distribution and extent of further system safety effort will be based on the outcome of the Preliminary Hazard Analysis.

1.2 The safety programme is based on the following principles:

— everyone involved in the design, development, manufacture, test and operation of the aircraft has an influence on its safety. Therefore, system safety activities shall be co-ordinated with the functions of all other engineering and support disciplines;
— technical, quality, and operational requirements based on safety considerations shall be defined as clearly and completely as practicable in all technical, manufacturing, and purchasing documents and in operation and maintenance manuals;

— identification of hazards to which the aircraft, flight crews, passengers and ground crews may be exposed shall be done as early as practicable in the programme;

— systems shall be designed so that single point failures, which would prevent safe flight, will be eliminated;

— systems shall be designed so that no single point failure or foreseeable combination of failures shall result in an uncontrolled sequential failure in the same system or other systems which would prevent safe termination of the flight;

— design order of precedence to ensure satisfaction of system safety requirements and resolution of hazards shall be as follows:

  — design to eliminate hazards. If hazards cannot be eliminated, control the hazards by design selection;
  
  — if unable to eliminate or control the hazard by design, protective safety features or devices shall be provided;
  
  — when neither design nor safety devices can control the hazard, detection and warning devices shall be provided. These devices shall minimize the possibility of misunderstanding and incorrect action by flight crews;
  
  — if design selection, safety devices and warnings do not control the hazard, control shall be maintained through procedures and crew training;

— human factors shall be a prime consideration in design, development and evaluation of flight and operational procedures and in maintenance planning.

Functions and responsibility

2. A System Safety Manager (SSM) will be appointed. The SSM will draw on experience and data from the various technical disciplines both within and outside the company, to perform the following functions:

   **Primary**

   a) Monitor the performance of safety tasks listed in the system safety programme.

   b) Critique, formally and informally, the design of the aircraft, its systems and sub-systems.

   c) Identify potentially hazardous situations and make recommendations for changes to design.

   d) Document and follow up identified system safety problems.

   **Secondary**

   a) Critique the operational and maintenance procedures and make recommendations for changes to procedures and manuals.

   b) Review suggested and recommended changes to the aircraft design through the Change Review Board (CRB).

   c) Support test, certification and manufacturing programmes.

Safety tasks
3. In carrying out its responsibilities, the safety staff will perform the following tasks:

Critique of design and procedures

3.1 To properly accomplish a critique of the aircraft design and associated procedures, a number of analyses will be performed at various levels. These analyses will result from a study of specifications, designs, drawing board visits, discussions with designers and observation of procedures. The output will be in tabular format, a narrative or fault tree analysis. In general, the tabular and narrative formats will cover an entire system. Conversely, a fault tree analysis (FTA) may be utilized for an in-depth look at a particular hazard and those failures which can precipitate it. Any of these analyses can be qualitative or quantitative depending upon the criticality of the system and the availability of data. The results of these analyses will be an identification of any potentially hazardous condition caused by component performance degradation or failure.

Preliminary Hazard Analysis (PHA)

3.2 This analysis will be done only once on each system as soon as the system is defined. It should be completed before the release of drawings to Manufacturing.

The following systems are to be analysed:

a) propulsion
   — Engine including gear box
   — Propeller
   — Fuel system
b) nacelle
   — Structure/engine installation
   — Plumbing
   — Fire protection/detection/suppression
   — Anti-icing
c) landing gear
   — Installation/doors
   — Operation
d) wheels/brakes
e) electrical power
f) hydraulic
g) environmental control
   — windshield de-ice
   — wing and tail de-ice
   — cabin environment
h) navigation equipment
i) payload systems
   — interior materials
   — galley
   — doors/windows
   — passenger and crew accommodations
   — cargo system
   — fuselage access doors

j) flight deck systems
   — cockpit configuration and flight crew workload
   — visibility
   — flight instruments
   — caution and warning systems

k) flight control systems
   — flight control system
   — automatic flight systems

l) aerodynamics
   — stability and control
   — performance

m) structures

3.3 The Preliminary Hazard Analysis (PHA) will be a general survey of the preliminary design, aimed at defining potential hazards to the aircraft, its passengers, flight crew, and ground crew. The results will form a system-by-system analysis of the entire aircraft and will be the basis of safety requirements and goals and the input to the System Hazard Analysis (SHA) and Sub-system Hazard Analyses (SSHA). The result of the PHA will be reviewed to determine the scope and depth of further analyses.

System/Sub-system Hazard Analyses (SHA and SSHA)

3.4 These analyses will be done throughout the design phase. SHAs are normally comprised of one or more SSHAs. A basic SHA for each system will be completed in time to make positive inputs during the respective system design review. Subsequent refinements to the SHA will be dictated by changes to the system or by discovery of further hazards. This analysis must also evaluate interface problems between different systems.

Operating Hazard Analyses (OHA)

3.5 Operating hazard analyses will verify that the safety requirements and objectives, relating to aircraft operation, maintenance, servicing, testing, crashworthiness, emergency, escape and rescue have been satisfied for all the intended operations of the aircraft. Engineering data, procedures and instructions developed from the design efforts, test programmes and human factors considerations will support this effort. Results of the operating hazard analyses will provide the basis for:
— design changes, where feasible, to eliminate potential hazards or provide safety devices as safeguards;
— the warnings, cautions, special instructions and emergency procedures for operating and maintenance instructions;
— special procedures for servicing, handling and operating.

**Design review**

3.6 The safety staff will participate in preliminary and critical design reviews of the system under review and, where appropriate, report on the results of any special safety analyses or studies which affect the design. The safety staff will also monitor the design review to ensure that the design is compatible with all stated requirements and objectives concerning safety, or that incompatibilities are resolved. Following the design review, the safety staff will review all action items for those with a potential safety impact.

3.7 Informal design review, trade studies and pertinent analyses will be performed to support the aircraft design. This will include drawing board tours to detect potential safety problems before drawings are completed.

**Mock-up and aircraft safety reviews**

3.8 Safety reviews of the mock-up and the first aircraft will be conducted. The main purpose of the review will be to inspect the hardware and to identify any unacceptable conditions in the hardware or its design. This will also provide a check of the thoroughness of the design assurance work and the manufacturing quality. The aircraft safety review will be scheduled on the aircraft just prior to roll-out. The safety review team members will be asked to consider such areas as:

— accessibility and clearance;
— susceptibility to damage by operating, servicing or maintenance personnel;
— considerations of problems known from previous similar designs.

**Flight readiness review**

3.9 Prior to the commencement of taxi tests, a flight readiness review will be conducted to ensure that the aircraft is ready for flight. Emphasis will be placed on ensuring that all recommendations resulting from the final aircraft safety review have been accomplished or dealt with. The review team will be composed of key design and flight test personnel. System safety will report the findings of the review team to the programme director.

**Test programme**

3.10 Support to the flight test programme will consist of two elements:

a) assurance that the aircraft is safe for flight in all aspects of the impending test. This assurance will consist of the safety analyses reports and the results of the flight readiness review;

b) a back-up check of planning in support of the flight including search and rescue, crash and fire protection and if necessary, flight clearance.

**Certification**

3.11 The safety staff will assist the certification programme by providing any data, special safety analyses, criticality determinations or other support required.

**Product support**

3.12 The safety staff will provide assistance to all product support functions. The outputs from the various hazard analyses will provide the basis for cautions or warnings in technical manuals or procedures.
3.13 Ground support equipment, both the hardware and associated procedures, will be reviewed for any safety impact. Recommendations for changes will be submitted as required.

Manufacturing

3.14 System safety support of the manufacturing effort will be limited to informal tours of the workshops and assembly line. All phases of fabrication will be included. These tours will be primarily to maintain familiarity with developing hardware but if discrepancies are noted they will be brought to the attention of manufacturing management.

Safety analysis reports

3.15 The results of safety analyses and studies such as failure analyses, fault tree studies, engine hazard analyses, fire protection studies, etc. will be combined into a single document or safety analysis report. This document will provide an overall look at the safety programme, with emphasis on the potential hazards and risks that have been considered and details of the means employed to eliminate or control them. A preliminary safety analysis report will be prepared one month prior to the flight readiness review so that it may be used to familiarize review team members with the safety aspects of the design. The preliminary reports, by providing an overview of the safety programme, will also highlight any areas that require additional safety studies or efforts. The final safety analysis report will be published prior to the flight readiness review.

Documentation and follow-up of identified system safety problems

3.16 All hazards identified through the various hazard analyses will be documented by the safety staff in a hazard notice (Figure A-3). This form will then be sent to the appropriate engineering group or product support group for action. A copy will be sent to the engineering manager(s). If the effect of the hazard is dangerous or catastrophic, a copy will also be sent to the programme director.

3.17 The hazard notice will be completed to show resolution of the problem and returned to Safety. The completed hazard notices will be filed in the product safety file and the appropriate hazard analysis will be updated to show elimination or control of the hazard.

HAZARD NOTICE

<table>
<thead>
<tr>
<th>Issued by</th>
<th>Date</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category 1</td>
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<td></td>
</tr>
<tr>
<td>Action assigned to</td>
<td>Need date</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-syst/Component</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazard Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Recommendation</td>
<td></td>
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</tr>
<tr>
<td>Corrective Action</td>
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</tr>
<tr>
<td>Approval signature</td>
<td>Date</td>
<td></td>
</tr>
<tr>
<td>Problem Closed</td>
<td>Date</td>
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<tr>
<td>Safety Comments</td>
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</table>
IV. EXAMPLES OF SAFETY STATISTICS

Example 1. General accident statistics
   Example 2. Accident rates
   Example 3. Comparative statistics
Example 4. Graphical presentation of statistical data

Example 1 — General accident statistics
   Example 1 (continued)

Example 2 — Accident rates
   Example 2 (continued)
   Example 2 (continued)

Example 3 — Comparative statistics
   Example 3 (continued)

Example 4 — Graphical representation of statistical data
   Example 4 (continued)

V. EXAMPLES OF ACCIDENT FILING/RECORDING SYSTEMS

1. Examples of index cards
2. Examples of a rim punched index card

Example 1 — Two examples of index cards

Copies can be filed under various headings, such as
aircraft make, type of operation, phase of flight, injury, etc.

Example 2 — Rim punched card

Colour can be used to separate different years.

Example 2 — Rim punched card (reverse)

Needle inserted in applicable hole will allow cards so punched to drop out of a stack of cards.
Appendix B
ACCIDENT PREVENTION TRAINING

I — Example of a training outline for an operator’s Accident Prevention Adviser (APA)

II — Communication skills

— Introduction
— Interviews
— Meetings
— Presentations
— Report writing

I. EXAMPLE OF A TRAINING OUTLINE FOR AN OPERATOR’S ACCIDENT PREVENTION ADVISER (APA)

Objective

The objective of the Accident Prevention Adviser course is to:

a) ensure the candidates have an appreciation and working knowledge of accident prevention concepts and methods;

b) improve their level of communication skills including providing additional training in the written and spoken word;

c) ensure a minimum standard in interviewing techniques.

Candidate selection

The accident prevention training programme consists of two basic parts: 1) the processes of discovering aviation hazards; and 2) the various forms of feedback. The former requires the analytical skills of the investigator, demanding an inquisitive mind, a respect for logic and the determination for sustained effort. The latter requires communication skills to ensure that the recipient will be sufficiently motivated to respond to safety recommendations. This feedback occurs at two levels, the formal governmental or managerial processing of material and the informal, or discussion-type of safety presentation. The accident prevention programme is therefore derived to a considerable extent from skills not normally associated with aviation. For this reason, APA candidates must be carefully selected if the expectations of an accident prevention programme are to be fulfilled.

Description of course content

The course will include:

a) a description of the history and evolution of the accident prevention concept;

b) the philosophy of safety, with examples from various States;

c) an examination of problems and limitations confronting States in their attempts to introduce accident prevention programmes;

d) some of the options available to States depending on their resources and limitations;
e) examples of governmental accident prevention activities;

f) a review of accident prevention facilities available in ICAO and member States;

g) the effective use of training aids, including the operation of audio-visual equipment;

h) the performance of an aviation safety survey;

i) consideration of the risk management concept; and

j) the establishment of a voluntary aircraft incident reporting and processing system.

Proposed lecture programme

Lecture #1 Basic Safety Management

Objectives:
— To outline the background and development of safety management concepts.
— To provide a historical study of the need for safety in aircraft operations.
— To show the organizational approach to an effective safety programme within a company.
— To show how an effective internal safety programme will support company policy and thereby increase efficiency.

This presentation will provide the student with an overview and basic understanding of the complex subject of safety management.

Lecture #2 Accident Prevention Adviser (APA)

Objective
— To outline the duties of an APA. Each duty will be presented and discussed in general terms.

This presentation sets the scene for the course. Following a general discussion the student will receive an in-depth presentation of each duty and its application in the company environment.

Lecture #3 Forming a Safety Committee

Objectives:
— To show the student the importance and effectiveness of a company safety committee.
— The student will be shown the steps necessary to form the committee (from motivating management to holding the first meeting).

On completion of this presentation, the student will have sufficient information to establish a safety committee on his return to his company.

Lecture #4 Safety Promotion (part 1)

Objectives:
— The student will be shown how to establish an internal incident/hazard reporting system.
— The student will be shown how to disseminate information both in the form of government safety publications and those received commercially or from any other source.

— The student will be shown how to design an effective safety notice board and other dissemination techniques.

Lecture #5  Safety Promotion (part 2)

Objective:

— This session will demonstrate the presentation technique for motivating safe procedures and behaviour among company staff.

On completion of part 2, the student will have sufficient information to initiate a safety promotional campaign within his company.

Lecture #6  Adviser to Management

Objectives:

— The student will be shown how to sell safety to management, and how management may use his safety expertise to improve company efficiency and reduce costs.

— To improve techniques in communicating with top management.

This is one of the more important areas that the APA must deal with as his effectiveness is proportional to his credibility as a safety adviser to management.

Lecture #7  Accident Investigation and Reporting

Objectives:

— The student will be given an overview of accident investigation and reporting in the State.

— The student will be shown how he will become involved should an accident occur.

— The student will be shown examples of typical investigations. These will be used to illustrate the steps taken by investigators to determine the factors leading up to the accident.

This session will provide the student with an appreciation of the formal investigation process in the State and how he would function should his company be involved in an accident.

Lecture #8  Developing a Readiness Plan

Objective:

— This will show the student how to develop an internal plan designed to organize a company’s personnel in their response to an accident or incident.

On completion of this presentation, the student will understand the need for a formalized approach to handling an incident or accident.

Lecture #9  Monitoring of Safety Equipment
Objectives:
— To show the student his role as a safety officer regarding company safety equipment.
— To show how to carry out periodic surveys of safety equipment and advise operational managers when new equipment should be purchased.
— To impress upon the student the need for all personnel to be properly instructed in the correct use of all available safety equipment and the most effective types.
— To reinforce the need for adequate safety equipment which is kept in good working order and which staff know how to use properly.

Lecture #10 Dangerous Goods
Objectives:
— To show the student his role as a safety officer regarding company operations which deal with the transportation of dangerous goods.
— To review the current dangerous goods regulations in terms which relate to a small operator.
— To show the student how to respond to an incident or accident involving dangerous goods.

Lecture #11 Survival/Location Equipment
Objectives:
— To show students the current survival/location equipment used in company operations.
— To demonstrate and discuss the types of equipment designed to be used in sparsely settled or other problem areas.

Lecture #12 Organization and Operation of the State Aviation Administration
Objectives:
— To provide an overview of the function and responsibility of the various sections of the aviation administration.
— To show the student how the current reporting and notification systems work.
— To show the student how, as a safety officer, he should communicate hazard information both within the company and to the Aviation Administration.
— To ensure that the student understands the need for a system within the company to handle information received from the State, e.g. Airworthiness Directives, NOTAM, etc.

Emphasis will be placed on the need for a close working relationship between all staff to ensure that factual data related to aviation hazards are conveyed to all concerned.

Lecture #13 The Safety Survey
Objectives:
— To show the student the need for internal surveys and how they can be used as an effective management tool.

— To teach the basic techniques employed in co-ordinating a survey.

Following this presentation the student will have an understanding of the methodology employed in using surveys to discover hazards.

Lecture #14  *How to Hold a Safety Meeting*

Objectives:

— To show the student how to prepare for, and organize an effective meeting.

— To show how to select relevant material and keep it interesting.

— To show the student how to present material in an effective manner.

II.  COMMUNICATION SKILLS

Introduction

1. Techniques and procedures for good communications including interviews, meetings, etc. can be found in published literature. It is beyond the scope of this manual to cover the general subject in detail. It is therefore proposed to review the main points relating to good communications and to amplify those elements which are particularly relevant to aircraft accident prevention.

Interviews

2. The following points should be considered prior to conducting a formal interview:

   *Planning the interview*

   — plan the approach you intend to take

   — avoid interruptions and allow ample time

   — ensure all the relevant facts are available

   — choose the right time and place

   *Conducting the interview*

   — open with a subject in which the interviewee is known to have an interest. Aim to establish a good rapport early

   — explain the objectives of the interview, stressing how these relate to the individual’s responsibilities and what you hope to achieve

   — keep the interviewee at ease — never talk down, interrupt or make fun of him

   — remain friendly but retain firm control of the interview

   — draw out the interviewee and motivate him to ensure you obtain the answers or information you require. Listen attentively and question closely

   — identify any areas likely to need action, develop and plan any action necessary and outline your
proposals clearly
— review the significant points discussed, confirm any actions or agreements reached and ensure these are recorded
— express your appreciation to the interviewee for his contribution

After the interview
a) assess the results; did they achieve what was planned? Is there any need for a further interview?
b) record the results of the interview
c) initiate the action you undertook to do. Credibility can be quickly lost due to inactivity, particularly where safety matters are concerned.

Meetings
3. Properly conducted meetings can provide a catalyst for the development of safety conscious attitudes which are important for preventing accidents. Meetings should be carefully planned and properly presented. In arranging such meetings, consider the following:

Planning for the meeting
— be clear on what you expect to achieve
— prepare an agenda in the optimum order, allowing adequate time for each item. Avoid too long an agenda, about two hours is the maximum attention span. Most meetings should be much shorter
— choose the right time, place and environment

During the meeting
Control the meeting as a group:
— keep speakers to the point
— avoid repeated coverage of old ground
— prevent private discussions
— present agenda items in a positive manner
— keep to the meeting timing
— prepare a concise and accurate record of the proceedings

After the meeting
Assess the results and initiate any required action as discussed under “Interviews”. If there is a likelihood of delay in the implementation of proposed actions ensure that everyone who needs to know is informed.

Presentations
4. These are a particular form of meeting in which the objective is to convey facts or a point of view to an individual or group. Properly performed, a presentation can be an effective method of informing or persuading people. All the points previously mentioned under interviews and meetings are directly relevant and in addition the following points should be considered:
— the people giving the presentation must be fully knowledgeable of the subject and confident in their ability to talk about it. They must be capable of effectively responding to any questions raised;

— the presentation must be prepared to suit the occasion and the audience. One mistake can ruin the whole effect;

— the use of visual aids, e.g. films, slides, etc. can be helpful. If these are used, prepare them thoroughly to ensure they are readily understandable and that all systems operate correctly;

— as a presentation will normally be given to a critical audience, ensure it is well rehearsed and endeavour to anticipate awkward questions which may arise.

4.1 During the presentation, gain interest and attention with a short and concise introduction — make the objectives of the presentation clear and stress any points you wish to convey. If the object is to present a solution to a problem, be sure that the problem and its causes are apparent at the start.

4.2 When presenting technical subjects, as will often occur in accident prevention, the use of notes will be essential; avoid the tendency to read these. If this is done the impact on the audience and hence the purpose of the presentation will be lost.

4.3 Draw the presentation together with a conclusion. If you are “informing”, summarize all the main points. If you are “persuading” you have to both summarize and motivate the audience by clearly reiterating what actions you expect. Do not make the conclusion too long, but on the other hand do not end abruptly. Do not introduce any important new information or ideas at this stage.

Report writing

5. Reports contribute to the accurate transmission of information and serve as a permanent record for later reference. They are an economical means of keeping others informed. Reports will often be read by persons other than the person to whom they were addressed. Such people may have to act on the report but may lack the background information that the addressee had. A report therefore should be complete in itself.

5.1 Since the primary purpose of a report is to inform, it should be written for the benefit of the reader. In other words what does the reader need to know — what can I tell him? The reader needs to know what is expected of him and the report should therefore quickly and clearly answer the following questions:

— What is the subject?
— Why should I (the reader) be interested?
— What briefly is the background?
— What action is recommended?
— Why?

5.2 Not all subjects will necessitate a written report. Perhaps the most important factor in technical writing is to keep the vocabulary simple and clear, so that it can be readily understood by all. Unusual technical words should be used sparingly and their meaning explained.

5.3 The following steps briefly outline the procedure to be followed in drafting a technical report:

— form a clear idea of the purpose of the report and the intended readership;
— define the scope of the report;
— assemble the necessary data and roughly divide, classify and arrange them;
— check all technical details for accuracy;
— decide which facts belong in the report and which would be better in an appendix;
— make a preliminary table of contents;
— draft the report;
— check that the conclusions and recommendations are supported by the facts;
— ensure that the text, tables, illustrations and appendices do not needlessly duplicate each other, but are instead complementary;
— check that the report is properly proportioned and that it emphasizes all the points you wish to make;
— consider a summary sheet or paragraph at the start of the report;
— revise the report as often as is necessary;
— obtain a second opinion on whether the report fulfils your objectives.

5.4 Prior to releasing the report, it could be compared against the following check list to determine if it is likely to meet its objectives:

Problem
— Is the problem clearly and completely stated?
— Is the report limited to a specific and manageable problem?

Factors relating to the problem
— Are the facts genuine, can they be substantiated?
— Are the facts pertinent, acceptable and authoritative?
— Should additional facts be added?
— Are the assumptions logical and acceptable?
— Are sufficient facts, assumptions and criteria included to support the solutions considered in the discussion?
— Are facts clearly distinguished from assumptions or opinions?
— Are sufficient criteria included to adequately test all possible solutions?
— Are all unusual terms defined?

Discussion
— Is the discussion concise?
— Are assumptions and opinions identified in the discussion?
— Is the discussion sufficiently developed to maintain the line of thought?
— Are all possible solutions included?
— Are possible solutions adequately tested?
— Has the best possible solution(s) been clearly identified?
— Have the necessary tables, charts, diagrams, etc. been included as appendices to support the case?
— Are they adequately referenced?
— Is all the material discussed pertinent to the problem?

**Conclusions**
— Will the conclusions completely satisfy the requirements of the problem?
— Do the conclusions briefly state the best solution(s)?
— Does this section contain material which should not be in it, e.g. discussion or new material?

**Recommendations**
— Are the recommendations clearly and logically supported by the information in the report?
— Are these the most suitable, feasible and acceptable courses of action?
— Is the writer prepared to stake his professional reputation on the actions recommended?
— Is sufficient information supplied or referenced to implement the recommendations?

**Writing techniques**
— Is the material well organized and does it follow a logical development?
— Is each paragraph concerned with only one topic or phase of a topic?
— Is there a smooth transition from one paragraph to another?
— Are sentences short, clear and logical?
— Are sentences free of involved and awkward constructions?
— Is the language free of verbiage and jargon?
— Is the report short and concise?
— Does the report catch and hold the reader's interest and not offend anyone?

A report that complies with this check list stands a good chance of achieving its objective.
Appendix C
EXAMPLES OF VOLUNTARY INCIDENT REPORTING SYSTEMS

I. United States — Aviation Safety Reporting System (ASRS)

II. United Kingdom — Confidential Human Factors Incident Reporting System (CHIRP)

I. UNITED STATES — AVIATION SAFETY REPORTING SYSTEM (ASRS)

Brief description

1. The Aviation Safety Reporting System (ASRS) which was introduced in 1975 is administered by the National Aeronautics and Space Administration (NASA) on behalf of the Federal Aviation Administration (FAA).

2. It is a voluntary, confidential system in which a reporter may remain anonymous if so desired. The reporting form is printed on one sheet (Figure C-1). As of January 1984, over 36,000 reports had been recorded in the system.

3. One feature of the system is a follow-up telephone call (call-back) to reporters where additional information is required. Another is the strict anonymity of the reporter. All identifying information is destroyed once the reporter has been called back and no identifying information is entered into the computer. All reports are acknowledged (Figure C-2).

4. Finally, an advisory committee with representatives from the major fields of aviation in the United States oversees the running of the system, including monitoring its effectiveness and the adequacy of measures to ensure reporter confidentiality. This committee is an essential feature in ensuring the continued support of the aviation community.

Information to be reported

5. The ASRS solicits reports from anyone who witnesses or is involved in “an occurrence or situation which he or she believes poses a potential threat to flight safety”. In short, everyone is invited to report all perceived hazards.

System output

6. The information gathered by this system is used to produce the following:

   a) A monthly, one-sheet bulletin called CALLBACK (Figure C-3).

   b) Notifications of discovered hazards by so-called “Alert Bulletins” (Figure C-4). Ninety per cent of these are addressed to the FAA, the remainder to other authorities, such as airport managers, etc.

   c) Quarterly Reports. These reports deal with specific safety problems, such as “Altimeter reading and setting errors”, and “Near midair collisions”. Each report contains a summary of relevant incident reports and the associated Alert Bulletins issued, together with the response from the authorities concerned.

   d) NASA Technical Papers and Contractor Reports. These are more comprehensive research reports on wider safety problems, such as “Dimensions of the information transfer problem”, and “Operational problems experienced by single pilots in instrument meteorological conditions”.

Additional information
AVIATION SAFETY REPORTING PROGRAMME

On 1 May 1975, the Federal Aviation Administration (FAA) implemented an Aviation Safety Reporting Programme. The programme's purpose was to identify deficiencies and discrepancies in the National Air Transportation System; to provide a sound basis for improving the current aviation system and to ensure a better foundation for design recommendations for a future system. The information to be used in the programme was to be submitted voluntarily by pilots, controllers and others using and working in the aviation system.

Because of the perceived risks to potential reporters using the FAA's Aviation Safety Reporting Programme, many aviation organizations initially opposed it. Recognizing these concerns and the need for such a programme to improve safety, the FAA requested NASA's participation as a "third party" to receive, process and analyse the safety reports submitted.

This NASA Fact Sheet describes the design of the Aviation Safety Reporting System (ASRS), its relationship to the FAA Programme, and how NASA operates the ASRS to facilitate the flow of safety information and to protect the identity of individuals who voluntarily submit safety reports.

NASA AVIATION SAFETY REPORTING SYSTEM

Safety reports

The ASRS is designed to collect reports which may provide valuable safety information. The aim is to extract and analyse the safety-related data, and to inform those who can do something about perceived safety problems — hopefully in time to prevent accidents. By collecting and disseminating such data, NASA can also detect trends and situations which may likewise serve to alert the aviation system to developing problems.

The ASRS solicits reports from any person in the national aviation system who witnesses or is involved in an occurrence or situation which he or she believes poses a potential threat to flight safety.

FAA Advisory Circular 00-46B briefly describes the operation of the ASRS and contains an example of a NASA reporting form. Copies of the reporting forms have been distributed to airlines, fixed base operators, ATC facilities, and other organizations. They are also available through FAA Air Carrier and General Aviation District Offices.

While NASA will accept data however they are reported, it urges that an ASRS form be used if at all possible. Individuals submitting reports are further urged to fill out the form as completely as possible, including the identification section, which will be returned to the sender; NASA has found from previous experience that the maximum information from a report is often only realized when an experienced data analyst can talk directly with the person who submitted the report.

NASA analysts will attempt to talk directly with the reporter when it appears useful to do so. This is a major innovative feature of the ASRS and one which NASA believes considerably enhances the effectiveness of the system.

Initial processing of reports

Upon receipt of a safety report, NASA is obligated to screen it for information that relates to a criminal offence or to an aircraft accident. This screening is done by a NASA attorney who is a qualified pilot. In the case of a criminal offence, the report is forwarded to the Department of Justice; in the case of an accident, to the National Transportation Safety Board with a copy to the FAA.

These two exceptions (criminal offences or aircraft accidents) are the only situations in which a report leaves NASA's possession with the identity of the individual revealed. Since there are misconceptions about the meaning of these exceptions, the following definitions are provided:
**Criminal Offences:** A violation of the Federal Statutes, Title 18, U.S.Code. Hijacking, smuggling and sabotage are examples of criminal offences.

**Aircraft Accident:** An occurrence as set forth in the Code of Federal Regulations, 49 CFR 830. Examples of aircraft accidents are those involving mid-air collisions, fatal or serious injury, substantial damage, etc. Aircraft operators are obligated to notify the nearest National Transportation Safety Board field office immediately in the event of an aircraft accident.

NASA does not screen safety reports for violations of Federal Aviation Regulations. To do so would seriously compromise the willingness of pilots and controllers to report conditions or situations which pose a threat to air safety. NASA has been granted an exemption by the FAA and will not notify the FAA of any violation noted during the processing of a report.

NASA examines each safety report in order to identify any situation or condition that poses an immediate or urgent threat to aviation safety. If such a situation or condition is suspected, the safety report is given to a report analyst for priority handling.

**Report analyst**

After initial processing by a NASA employee, safety reports are passed to a NASA contractor for detailed analysis. Each report is assigned to an analyst for processing. Analysts are selected on the basis of expertise in various facets of aviation operations, for example, air traffic control, general aviation or airline operations.

If an analyst believes that additional information would make the report more valuable, or if clarification of certain details is needed, the analyst will attempt to contact the reporter by telephone.

When the analyst decides that the report is as complete as is necessary or when further information cannot be obtained, he or she de-identifies the report by removing the identification strip and obliterating any other identifying information in the body of the report. The identity slip is returned to the reporter as proof of submission of the report to the ASRS program.

The objective is to have most safety reports de-identified within 72 hours of receipt. When the identity slip is returned to the sender by the report analyst, a letter of acknowledgement and another reporting form accompany it.

If a safety report is flagged by NASA for priority handling or if the report analyst considers it to be a correctable hazard, pertinent information is referred promptly to NASA for further processing. NASA's actions in such cases are described in the safety information dissemination section of this fact sheet.

The analyst then prepares the de-identified report for computer entry, makes certain judgements regarding the coding of information in the report, and passes it to a clerk for computer entry. The original de-identified report is filed and subsequently destroyed.

**General data file**

Although some reports may contain information that is obviously critical to aviation safety, many other reports contain information that in isolation does not clearly identify a hazard. Several such reports, however, may help to identify a hazard or show a trend that points the way to a problem.

For this reason the reports must be considered not only for what they contain taken alone, but also for what they contain in relationship to the content of other reports. Such analyses on a large body of data require sophisticated computer programmes. The design of such analytic capability has been a key feature of the ASRS since its inception.

The ASRS computer is searched periodically and automatically for trends. Whenever such trends are detected, they are identified by the computer in such a way that the ASRS staff can interpret their operational significance.

The general data file is designed to prevent a specific occurrence being traced to the person who submitted a
safety report. This feature ensures that the identity of reporters is not revealed.

**Safety information dissemination**

The ASRS exists to serve all members of the aviation community. In addition to research initiated by the ASRS staff, requests are received for special studies of interest to specific organizations or groups. Within the limit of its resources, the ASRS staff designs and conducts such special analyses.

Perhaps the most serious deficiency of many earlier aviation reporting systems was the long time between entry of data and the appearance of useful results. Designers of the ASRS believe that prompt feedback of results to the aviation community is absolutely necessary if the community is to continue to support the system by providing it with data.

Routine reports describing findings and system results are issued quarterly. Special and hazard notification reports are distributed to those with a specific need for the information and such reports are abstracted in the quarterly reports; copies are available on request.

As previously indicated, urgent safety reports may be identified during the initial NASA processing or by the report analysts. The method by which these safety reports are processed is described below.

Upon receipt of a report “flagged” for priority handling by NASA, or as a result of his or her own analysis, the analyst promptly processes the report and makes telephone contact with the reporter to ensure that the information is complete. The analyst then de-identifies the report, prepares a synopsis of the hazard including all pertinent data, and forwards that material, along with an Alert Bulletin recommendation to NASA. Following NASA’s verification that an Alert Bulletin is warranted, the Alert Bulletin is forwarded in writing to the organization which is in the best position to investigate the hazard and make improvements.

The report analyst may query the general data file and add relevant information from other safety reports. The analyst also ensures that the information is entered into the general data file.

**MANAGEMENT OF THE ASRS**

The ASRS is funded jointly by NASA and the FAA, although the latter has no direct role in its management. FAA participates in the programme through representation on an advisory subcommittee.

ASRS management is vested in the life sciences directorate, Ames Research Center, NASA. The senior operating officer for the ASRS is the project manager, human factors in aviation safety. Most of the ASRS functions are performed under a contract for which the project manager is the technical monitor.

The ASRS functions as a part of NASA’s continuing research into human factors in aviation safety. In that role, the ASRS gathers descriptive data while the aviation safety research group performs analytical studies of human performance and behaviour in the operational environment.

An advisory subcommittee has been appointed by the administrator of NASA. The membership is comprised of aviation safety experts who possess backgrounds in general aviation and airline piloting, manufacturing, engineering, air traffic control, consumer interests and airport management. The Department of Defence and FAA are also represented.

The advisory subcommittee advises the programme’s managers on the design and conduct of the ASRS, and advises the Administrator of its views of the programme.

A security group functions within the subcommittee specifically to advise the project manager and the aviation community regarding the confidentiality of the Aviation Safety Reporting System. It examines the system periodically to ensure that confidentiality is protected.
II. UNITED KINGDOM — CONFIDENTIAL HUMAN FACTORS INCIDENT REPORTING SYSTEM (CHIRP)

In spite of the safeguards incorporated in the United Kingdom CAA Mandatory Occurrence Reporting System (MOR) (see Part I, Appendix D) and the considerable efforts to ensure that it is not used to attribute blame, the proportion of true human factor occurrences which are reported remains small. This is a common failing with all such mandatory reporting systems.

Failure to report such occurrences is usually attributed to a reluctance to admit personal error to an employer or to a regulatory authority. In order to encourage the reporting of such incidents, a confidential reporting system, initially for flight crew only, was introduced on a trial basis in December 1982.

In this context, a human factor incident is defined as:

a) a crew member’s action(s) or omission(s) which caused or could have caused a potentially hazardous situation; or

b) the operational environment, i.e. aircraft equipment or operating procedures which could have contributed to an error by a crew member.

In order to ensure complete confidentiality, the scheme is run at the request of the CAA, by the RAF Institute of Aviation Medicine and, in general, is similar to the scheme run by NASA on behalf of the FAA in the United States. (See Part I, Appendix C). A copy of the reporting form is contained in Figure C-5.

Each report forwarded to the system is assessed by the small team running the system. If the report is entirely self-explanatory it is acknowledged by the return to the reporter of the name and address section from the form. No copy of this information is retained. If any aspects require clarification, the reporter is telephoned prior to acknowledgement.

Periodically a news-letter called FEEDBACK is circulated, summarizing the incident reports received and any conclusions drawn. (see Figure C-6). Specific problems or trends are drawn to the attention of the appropriate authorities.

The CAA has agreed that should it receive an incident report from a third party indicating an infringement of the Air Navigation Orders and Regulations, it will not take legal action provided that:

a) the infringement was neither unlawful nor grossly negligent;

b) the person involved had forwarded a completed confidential report within 10 days of the incident occurring;

c) the infringement was directly connected with the human factor incident reported.

This reporting system supplements, but does not replace the CAA Mandatory Occurrence Reporting System which should be used for all reports other than those discussed above. While ensuring that the essential confidentiality is not jeopardized, the CAA maintains close liaison with the team running the system. De-identified reports are passed to the Safety Data and Analysis Unit (SDAU) for CAA follow-up action when
necessary and for recording in the SDAU records for analysis purposes.
Appendix D
EXAMPLES OF MANDATORY INCIDENT REPORTING SYSTEMS

I. United Kingdom — Mandatory Occurrence Reporting System (MOR)

II. Australia — Air Safety Incident Reporting System

I. UNITED KINGDOM — MANDATORY OCCURRENCE REPORTING SYSTEM (MOR)

Brief summary

1. This system was introduced by the Civil Aviation Authority (CAA) in 1976. Legislation requires the reporting of specified occurrences involving public transport aircraft with a maximum take-off mass of over 2,300 kg. The reporting of occurrences to aircraft below this mass limit is voluntary. The reports are confidential and the authority will not disclose the name of the reporter, “unless required to do so by law” or the reporter authorizes disclosure. The CAA will not prosecute unpremeditated or inadvertent infringements except “in a most flagrant case involving dereliction of duty amounting to gross negligence”. Some 5,000 reports are received annually.

System output

2. The information received is used to produce the following routine publications:
   a) Occurrence Digest: A weekly digest containing a selection of the more important public transport occurrences and items of general safety interest.
   b) New Reportable Occurrences: A weekly computer listing of all new occurrences recorded that week. This list also provides acknowledgement of receipt of occurrence reports. The occurrences are grouped under three headings:
      — New occurrences “closed” on receipt by SDAU;
      — New occurrences “open” for CAA follow-up;
      — Old occurrences for which significant new information other than closure has become available.
   c) Occurrence Summary: A monthly computer listing containing occurrences which had been “open” for CAA follow-up and which are now “closed”. The summary is produced in nine groups covering various categories of aircraft, equipment and supporting services.
   d) General Aviation Safety Information (Figure D-1): A monthly safety leaflet with summaries of the more serious general aviation occurrences. Information, comment and advice on remedial or preventative measures are also included.
   e) Analysis of Occurrence Data for Aircraft over 5,700 kg: Issued at six monthly intervals, this document contains a summary of reported occurrences showing the relative extent of problem areas using figures and tables.
   f) Follow-up Action on Accident Reports: These leaflets, issued as required, contain details of the CAA response to any safety recommendations contained in an accident report issued by the Accident Investigation Branch.

UNITED KINGDOM MOR SYSTEM: DESCRIPTION

(Note: The following is a condensation of a description provided by the United Kingdom.)

When the decision was taken to introduce Mandatory Occurrence Reporting, it was also decided that there
should be a completely unified system embracing aircraft defects, incidents and faults in ground facilities and services which affect the safety of aircraft. The term “occurrence” was selected for this unified system, meaning any fault, problem or shortcoming of parts or people.

The requirements and procedures for reporting accidents are the subject of separate legislation. However, to achieve the maximum statistical and analytical benefit from an occurrence recording system, it is considered essential that accidents be included. The term “occurrence” therefore includes accidents.

For similar reasons, incident/accident/defect data from other countries are monitored and some occurrences are extracted and recorded in the system. This relates to occurrences to foreign operated aircraft, or major equipment of United Kingdom design/manufacture; world-wide accidents to aircraft over 5 700 kg, and occurrences to public transport aircraft of non-United Kingdom design/manufacture operating on the United Kingdom register.

The confidence in such a system can be quickly undermined if there is any indication that it is being used to apportion blame rather than to learn lessons. Safeguards are therefore built into the system to ensure that, where appropriate, reporter anonymity is assured.

The number of variables in aircraft operations is so large that it is virtually impossible to provide a list of “reportable” items. A relatively minor problem in one set of circumstances can, when associated with other circumstances, result in a hazardous situation. The CAA approach, therefore, has been to provide guidance and then to rely upon the judgement of the reporter. Examples of occurrences considered reportable follow this description of the structure and operation of the system.

**Reporting responsibility**

The legislation places the responsibility for reporting occurrences upon specified individuals. Reports may be submitted to local CAA area offices or may be sent direct to the Safety Data and Analysis Unit (SDAU), the unit responsible for managing the system. In practice, the majority are sent direct to the SDAU. Local area offices receive a copy of each report and assist in any follow-up.

Because operating organizations are required to have some form of internal reporting system, the CAA encourages reporting through companies. Individual employees then report via the company system to a nominated senior person, e.g. quality manager, operations manager or flight safety officer.

This person is responsible for reporting to the CAA. However, he has the prerogative to “filter out” and not pass to the CAA any reports which he considers fall below the “reportable” level. To safeguard the originator’s intent, he must be advised if his report is not forwarded and has the right to insist that it be passed to CAA. With such systems, the criteria used for “reportable” occurrences within the organization are often set at a lower level than the CAA requirement to provide wider monitoring of the organization’s activities.

Such filtering of reports is considered satisfactory and indeed, essential, to concentrate limited effort where it is needed most. Further, this procedure ensures that the reports which are passed to the CAA are comprehensive and reflect the investigations and actions taken by the reporting organization.

**CAA processing of reports**

The Safety Data and Analysis Unit (SDAU) was established to achieve the objectives of a fully integrated system. This unit is directly responsible to the airworthiness and operations divisions of the CAA. Its technical staff combine both flight crew and engineering experience. Every occurrence report is evaluated by someone from each “speciality”. Figure D-2 is a copy of the reporting form.

The SDAU is the central unit for receipt, processing and storage of occurrence reports. One of its primary tasks is to identify reports requiring CAA follow-up and then to direct them to the most appropriate specialist staff. One of these is selected to be co-ordinator, to take charge of the investigation of the occurrence and co-ordinate the activities of a team which will process the occurrence to closure.

Any report considered to not warrant CAA follow-up is closed by the SDAU on receipt. A weekly listing of these is circulated to the appropriate “specialists” thus providing a “fail safe” back-up for the SDAU decision to close.
Any report considered not justified is closed as “non-reportable”. A periodic listing of all such reports is circulated to advise the originators of the CAA decision and to provide them with an opportunity to question it if required.

**CAA storage of data**

The volume of data involved in this system makes it essential to use a computer to store and retrieve information quickly. The Authority uses a data base system offering on-line and batch processing. All searches (retrievals) of data are done on-line from Visual Display Units (VDUs) available to the analysts. Updating of the records is done on a batch basis for reasons of economy.

One of the primary functions of the system is to provide historical data to the co-ordinator of any occurrence, e.g. details of any similar or possibly similar occurrences. It is also possible to print a standard range of tabulated data or produce tabulations to meet any special requirement or queries as they arise.

The record of each occurrence comprises three main “blocks” of data:

a) “fixed field” identification and progress data;

b) a narrative;

c) a number of keyphrases selected from an extensive lexicon.

The keyphrases, coupled with the “fixed field” data, form the basis from which retrieval of any individual element or combination of elements of the occurrence will be made. The objective is to select keyphrases which show what has gone wrong — malfunctions/problems of parts and people, and also to state other factors which have, or might have, influenced the occurrence.

A comprehensive keyphrase lexicon has been prepared on the basis of the ATA 100 specification. The basic ATA numbering system has been expanded to cover the required operational and human factor areas. Chapter and sub-chapter titles of the lexicon are shown in Figure D-3. Use of the internationally recognized ATA 100 specification ensures that the basic coding has a great deal of compatibility with other storage systems.

**Analysis of data**

This is done in two stages. Firstly, the monitoring of reports as they are received and checking for similar occurrences. The follow-up of “hunches” etc. and when necessary, alerting appropriate specialists. This is a manual task undertaken by analysts in the SDAU, backed up by the unit supervisory staff. In parallel with this activity, there are searches of the data for the preparation of reports on specific subjects, in response to requests from within CAA and outside. The VDUs available to the analysts provide immediate access to the stored data, greatly facilitating this task. Secondly, longer-term analysis and overview of the total data. Computer programmes which will permit a more sophisticated analysis of the data with the aim of identifying and ranking potentially hazardous situations are now being studied and developed. Currently the efforts are directed towards identifying cause and effect relationships in the records to establish specific combinations of these factors. The frequency and rate at which they appear can then be determined.

**EXAMPLES OF OCCURRENCES REQUIRED TO BE REPORTED IN THE UNITED KINGDOM MOR SYSTEM**

It is difficult to precisely define significant hazards required to be reported to the CAA, but, listed below are types of occurrences considered “reportable”. Although covering a wide range of items, this list must not be considered comprehensive. For convenience the list is broadly grouped under the titles of the appropriate sub-paragraph of the Air Navigation (General) Regulations.

**A. Damage to aircraft structure**

a) This refers to damage, in flight or on the ground resulting from either accidental causes or in service deterioration, e.g. cracks, corrosion, permanent deformation, etc.
b) Damage to any primary structure or any damage to secondary structure which did or could have endangered the aircraft.

c) Any damage found as a result of a special mandatory inspection or check (e.g. ADs, etc.).

d) Separation of any part of the aircraft in flight.

Note.— *Substantial damage which occurs between the time any person boards an aircraft with the intention of flight until such time as all persons have disembarked is required to be reported as a Reportable Accident in accordance with the Civil Aviation (Investigation of Accidents) Regulations.*

B. Injury to a person

Any significant injury to any person which directly results from the operation of the aircraft or its equipment but which is not considered to constitute a reportable accident.

*Note.— Serious injury or death to flight crew or passengers which directly results from the operation of the aircraft or its equipment (e.g. abrupt manoeuvres, turbulence, propeller or jet blast) is required to be reported as a Notifiable accident as above.*

C. Impairment of a member of flight crew or ground staff to undertake the functions to which their licence or responsibilities relate

Impairment of any member of the flight deck operating crew, including those which occur prior to departure if it is considered that it could have resulted in incapacitation after take-off.

Impairment of any member of the cabin crew which renders them unable to perform their essential emergency duties.

Impairment of any member of ground staff (e.g. ATC controller, maintenance and engineering staff, etc.) when as a consequence an aircraft was, or could have been, placed in a hazardous situation.

D. The use of any procedure for the purpose of overcoming an emergency

The use in flight or on the ground of any emergency equipment or prescribed emergency procedures.

The use of any non-standard procedure by the flight crew to deal with an emergency.

The declaration of an emergency.

An emergency, forced or precautionary landing.

Failure of emergency equipment or procedures to perform satisfactorily including those being used for training or test purposes.

E. Failure of aircraft systems or any aircraft equipment

This section covers failures or malfunctions which occur in flight, on the ground and during routine maintenance, overhaul and repair. It must be appreciated that a particular failure or malfunction may be considered reportable on one type of aircraft, and not on another.

1) Any loss or significant malfunction of more than one main system, sub-system, set of equipment or major component, for example:

   — engine and thrust reversers
— hydraulic power
— flight control systems
— electrical power
— air systems
— ice protection
— communication systems
— navigation systems and instruments
— warning systems and devices
— brake systems
— wheels/tires on each landing gear

2) Loss or significant malfunction of any system, sub-system, set of equipment or major component when any of the following circumstances apply:
   — exceptional circumstances exist or unforeseen consequences arise
   — standard operating procedures and controls are not satisfactorily accomplished
   — relevant back-up systems, sub-systems or equipment do not perform satisfactorily
   — a hazardous situation arises or might have arisen from the decisions or actions of the crew subsequent to the malfunction or failure
   — loss or significant malfunction of any engine on a multi-engine rotorcraft

3) When any of the following circumstances arise:
   — fire or explosion
   — smoke, toxic, or noxious fumes in the aircraft
   — significant leakage of fuel resulting in major loss or significant fire hazard
   — malfunctions of the fuel jettisoning system which result in inadvertent loss of significant fuel quantity, significant fire hazard or possible hazardous contamination of aircraft equipment.
   — inability to jettison
   — fuel system malfunctions having a significant effect on fuel supply and distribution
   — significant leakage of hydraulic fluids, oil or other fluids which result in a significant fire hazard or possible hazardous contamination of aircraft equipment
   — inability to re-light or re-start an airworthy engine
   — inability to feather or unfeather a propeller
   — inability to shut down an engine or to control power or thrust
   — uncontained failure of engines or other high speed rotating components, e.g. APU, air starters,
— significant overspeed or runaway of engines, propellers, rotors or APU
— significant asymmetry of flaps, slats, spoilers, etc.
— limitation of movement, stiffness, or poor or delayed response in the operation of primary flight control systems or their associated tab and lock systems
— loss or malfunction of any rotorcraft auto stabilizer mode
— total inability to achieve the intended aircraft configuration for any flight phase
— malfunction of any indication systems when the possibility of significantly misleading indications to the crew results
— operation of any primary warning system or devices, unless it is clearly evident to the crew that the indication was false, for example:
  — fire or smoke warning
  — stall warning
  — stall protection
  — door warning
  — ground proximity warning
  — rotor or transmission condition warning, etc.
— any failure, significant malfunction or deterioration of any critical items, systems or equipment found as a result of a mandatory inspection or check
— significant defects or deterioration of systems or components found during routine maintenance/overhaul/repair when it is considered to be of a type not expected as a result of normal service operation
— systems/component failures or significant malfunctions identified by routine testing and inspection procedures whether on the aircraft or in the workshop where there is a likelihood of there being further similar defective items which might not be identified, e.g. by another operator
— failure or malfunction of any item not normally considered as reportable (e.g. furnishings and equipment, water systems, items included in an allowable deficiency or minimum equipment list) where the circumstances of the failure or its association with other failures introduces an element of hazard

F. Any reportable occurrence arising from the control of an aircraft in flight by its flight crew
— Abandoned take-off — at speeds close to or over Vq
— Unintentional significant deviations from intended track or altitude, caused by a procedural, systems or equipment defect
— Discontinued approach from below decision height
— Unintentional contact with the ground, including touching down before the runway threshold
— Over-running the ends or sides of the runway or landing strip
— Serious loss of braking action
— Approach and/or landing on an incorrect runway or airfield
— Loss of control from any cause, e.g. turbulence
— Occurrences of stall or “stick push” operation, other than for training or test purposes.
— Significant inadvertent loss in airspeed
— Reversion to manual operation of powered primary controls, other than for training or test purposes
— Inadvertent or incorrect operation of primary or ancillary controls which resulted in or could have resulted in a significant hazard
— An incident or hazard which arises as a consequence of any deliberate simulation of failure conditions for training, system checks or test purposes

G. Failed or inadequate facilities or services used in connexion with the operation of aircraft

1. Navigation aids/communications
   — Total failure or significant malfunction of any aids to navigation
   — Total failure or significant malfunction of any communications equipment

2. Air Traffic Control Services and General Operational Services
   — Provision of significantly incorrect, inadequate or misleading information from any ground sources, e.g. ATC, ATIS, Meteorological services, maps, charts, manuals, etc.
   — Provision of less than prescribed terrain clearance
   — Provision of incorrect altimeter setting
   — Failure or inadequacy of prescribed let-down procedures
   — Mis-identification of aircraft on radar
   — Incorrect transmission, receipt or interpretation of significant messages
   — Separation between aircraft of less than that prescribed

3. Airfield facilities
   — Failure or significant malfunction of airfield lighting.
   — Major failure or significant deterioration of surfaces of airfield manoeuvring areas
   — Significant spillage of fuel on airfield aprons
   — Errors or inadequacies in the marking of obstructions or hazards on airfield manoeuvring areas
   — Runways or taxiways obstructed by foreign objects
   — Apron blast incidents resulting in significant damage or injury
— Collision between a moving aircraft and any other aircraft, vehicle or other ground object
— Moving aircraft inadvertently leaving the paved surfaces

4. Flight crew interpretation of information and instructions
— Incorrect setting of an SSR code
— Flight at a level or on a route different from that allocated
— Incorrect receipt or interpretation of significant radiotelephone messages

H. Occurrences arising from the loading or carriage of passengers, cargo or fuel
— Loading of incorrect fuel quantities likely to have a significant effect on aircraft endurance, performance, balance or structural strength
— Loading of incorrect type, or contaminated fuel or other essential fluids
— Carriage of dangerous or restricted goods in contravention of appropriate requirements
— Incorrect labelling and packaging of restricted goods
— Incorrect loading of passengers, baggage or cargo, having a significant effect on aircraft mass and balance
— Inadequate securing of cargo containers or significant items of cargo
— Incorrect stowage of baggage or cargo likely to hazard the aircraft, its equipment or occupants or to impede emergency evacuation
— Significant contamination of the aircraft structure, systems or equipment arising from the carriage of baggage or cargo
— Difficulty in controlling intoxicated, violent or armed passengers

I. Any other occurrence which endangers, or which if not corrected would endanger, the safety of an aircraft, its occupants or any other person

As will be appreciated, it is not possible to envisage every kind of occurrence that endangers, or which could endanger, an aircraft or its occupants. Accordingly it is necessary to include any other occurrence affecting flight safety. Some examples of the types of occurrences not listed under other sections are:
— Failure or malfunction of ground equipment used for test/check of aircraft systems and equipment when the required routine inspection and test procedures did not clearly identify the problem
— Repetition at an excessive frequency of a specific type of occurrence which in isolation would not be considered “Reportable”
— Incorrect assembly of parts or components of aircraft or ground equipment where the condition has not been found as a result of inspection and test procedures required for that specific purpose
— A bomb threat
— A hijack
— A lightning strike which results in significant damage to the aircraft, loss or malfunction of any essential services or injury to or impairment of the occupants
Introduction

Australian legislation imposes a mandatory requirement to report all accidents and incidents involving an Australian aircraft or any other aircraft in Australian territory. In this context the regulations define an incident in essentially the same terms as Annex 13. Responsibility is placed equally upon the pilot-in-command, the owner, the operator and the hirer (if any) to ensure that a written notification of an incident is furnished to the Department of Aviation within 48 hours of the occurrence.

In considering the Air Safety Incident Reporting system, it is necessary to place it in proper perspective as only one of several safety performance monitoring systems which the Secretary to the Department of Aviation administers in discharging his statutory responsibilities for the safe, orderly and expeditious operation of civil aircraft in Australia. Other complementary systems include the accident notification and investigation system, the major defect reporting and performance testing system. Additionally, operators are required to establish monitoring systems to ensure that day-to-day safety standards in aircraft operations are met. Operation of the incident system also includes liaison with overseas aviation authorities for the exchange of safety information such as accident/incident investigation reports and findings. Information thus received is carefully examined for its relevance to the Australian aviation environment.

System features

The fundamental purpose of the Air Safety Incident Reporting system is to establish the circumstances, the sequence of events, and the contributory factors leading to any occurrence prejudicial to air safety and to use such data as the basis for an effective accident prevention programme.

Thus, the principal system objectives can be defined as:

- an up-to-date and comprehensive record of every reported Australian air safety incident;
- a record content and structure which facilitates the analysis of trends and correlations relevant to air safety and the prevention of accidents;
- immediate access to records via a flexible and user-oriented system of enquiries and reports designed to meet the Department’s information needs.

A computer-based system is used for the storage and retrieval of both accident and incident data. The system is essentially the same as that used by ICAO and a number of other States in respect of accidents, but it contains additional codes in a number of fields to facilitate the recording of incident information. For example, any of the “standard” types of occurrence may be used for incidents. However, an additional 21 codes are available to cover types of occurrence specific to air safety incidents.

Occurrences to be reported are not defined as such — the system accepts any occurrence or circumstance which anyone considers to be undesirable or hazardous. All such reports are recorded and investigated, although the level of investigation, and the amount and type of data recorded, depend to some extent on the nature of the occurrence. For the more serious types of incident, the system allows for updating of the record as the investigation progresses, from initial notification through an interim report stage to the final report.

There is no exclusive method for notifying an air safety incident. It is considered that the notification process
must be kept simple, so that potential users of the system are not discouraged by complex procedures. Any form of written notification is acceptable, although an incident report form is available and is illustrated in Figure D-4. Use of the report form is encouraged in the interests of standardization and completeness of reporting. In practice the great majority of incidents are reported by means of this form. Reports may be lodged at any departmental unit, either personally or by mail, for forwarding to the appropriate field office of the bureau of air safety investigation.

Regardless of where or how reports are submitted, all are considered. Air safety investigators in the bureau's field offices are responsible for the investigation of the incident, including any necessary follow-up action to obtain elaboration of the report from the originator. Follow-up action, at any stage of the investigation, presents no difficulty because the notification procedures call for the originator of the report to be identified. Anonymous reports, very few in number, are accepted and investigated as far as possible, although such investigations are often inhibited by the inability to obtain follow-up information.

The bureau central office monitors the progress of investigations, reviews the final reports and any associated recommendations, and ensures that all relevant data are entered into the computer system. Recommendations for remedial action do not necessarily await the conclusion of an investigation; they are referred to the appropriate area of the Department as soon as the need to do so is identified. In some cases this might be very soon after the submission of an incident report. In other more involved circumstances, a considerable amount of investigation might be necessary to establish the need for, and the scope of, any necessary recommendations. The bureau's experience is that, while individual investigations in some instances clearly indicate a need for remedial action, this is the exception rather than the rule. A more productive source of information comes from the analysis of groups of occurrences which have one or more significant features in common. The computer-based system allows the extraction and analysis of records meeting certain selection criteria which can be specified from a wide range of data items.

Irrespective of whether a recommendation arises from an individual investigation or from analysis of a large number of occurrences, it is, in the first instance, directed to the area within the Department with the functional responsibility for the relevant aspect of aviation operations. The resultant remedial action may take the form of a procedural amendment, an information circular, a directive or some similar action.

System output

The computer-based records extend back to 1969 and incidents are being added at the rate of some 6,000 per year. A comprehensive system of enquiries and reports provides for the selection and presentation of data in a wide range of formats to serve particular information requirements.

The enquiries/reports suite of programmes is designed to facilitate access to the accident and incident system by users with little knowledge of EDP. A system of account numbers and passwords controls access at various levels, depending on the role and needs of the individual user. The programmes are generally interactive, providing appropriate prompts to the user at the terminal. Those enquiry programmes which produce lengthy interrogations of master files will detach, freeing the terminal for other use.

The basic computer-generated document for information regarding an individual incident is the condensed report, illustrated in Figure D-5. This report is used for both accidents and incidents and comprises selected data items, the factors allocated, supplementary data (additional factor-type information desirable to record but not contributory to the occurrence), and the remarks field. The report also indicates the status of the record — initial, preliminary or final.

To facilitate the examination and analysis of groups of occurrences there is a wide range of statistical reports available from the system. These reports present numerical data in a variety of forms to meet the needs of particular analyses. A typical example is shown in Figure D-6.

As well as providing for the continuous monitoring of safety trends, the system is capable of responding rapidly to ad hoc requests for information. Such requests arise, either from within the bureau or from other areas of the Department, at a rate of about 300 per year. They are dealt with primarily by means of a "standard" enquiry programme in which the selection criteria have been chosen to satisfy the kinds of enquiry most commonly made. The system design also encompasses a "user-written" enquiry to cover the more specialized or complex cases.
Appendix E

EXAMPLES OF SAFETY PROMOTION MATERIAL

Example 1 — General safety information published on a regular basis (Government)
Example 2 — Safety information specific to a special type of operation, e.g. helicopters (Government)
Example 3 — A wall poster
Example 5 — Safety leaflets or brochures addressing specific problem areas (Government)
Example 6

Example 7
Example 8 — Safety bulletins, leaflets and booklets (Airline)
Appendix F

SAFETY PROMOTION MATERIAL AVAILABLE IN STATES

Part 1 — Audio-visual aids
Part 2 — Magazines, periodicals, books or pamphlets
Part 3 — Posters

SAFETY PROMOTION MATERIAL AVAILABLE IN STATES
Part 1 — Audio-visual aids
Note.— Audio-visual aids available from

United Kingdom
Civil Aviation Authority
CAA House
45-59 Kingsway or Chalfont Grove
London WC2B 6TE or Gerrards Cross
United Kingdom
Bucks SL9 8TN

Canada
National Film Board of Canada
3115 Côte de Liesse
Montreal, Quebec
Canada H4N 2N4

Ireland
Department of Transport
Dublin 2

Federal Republic of Germany
Federal Office of Civil Aeronautics
Flughafen, Postfach 3740
D-3300 Braunschweig
Federal Republic of Germany

United States of America (1)
National Audiovisual Centre
National Archives and Records Service
General Services Administration
Order Section/RK
Washington DC 20409
United States

United States of America (2)
General Aviation Manufacturers Association
Suite 801
1400 K Street NW
Washington DC 20005
United States

ICAO
International Civil Aviation Organization
(Attention: Document Sales Unit)
1000 Sherbrooke Street West, Suite 400
Montreal, Quebec
Canada H3A 2R2

Or one of the ICAO Regional Offices

Languages:
E — English
F — French
S — Spanish
G — German

Part 2 — Magazines, periodicals, books or pamphlets

a) Magazines/Periodicals

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<tr>
<th>State</th>
<th>Language</th>
<th>Title</th>
<th>Description</th>
<th>Address Code*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>Spanish</td>
<td>Aircraft Accident Information Bulletin</td>
<td>Contains reports on large scale and unusual accidents in general and commercial aviation. Also includes general articles related to accident prevention as well as detailed accident statistics. Approx. 140 pages.</td>
<td>1</td>
</tr>
<tr>
<td>State</td>
<td>Language 1</td>
<td>Language 2</td>
<td>Title</td>
<td>Description</td>
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</tr>
<tr>
<td>Australia</td>
<td>English</td>
<td></td>
<td>Aviation Safety Diet</td>
<td>A quarterly magazine containing articles based on accident and incident investigations, principally Australian, which have significant safety education value. Also includes a summary of Australian accidents that occurred in the previous quarter. An index for past articles is produced from time to time. Approx. 32 pages.</td>
</tr>
<tr>
<td>Canada</td>
<td>English</td>
<td>French</td>
<td>Aviation Safety Letter</td>
<td>Published six times a year, it contains safety editorials, short articles on safety matters that have come to light through the investigation of accidents and incidents. Approx. 8 pages.</td>
</tr>
<tr>
<td>Canada</td>
<td>English</td>
<td>French</td>
<td>Aviation Safety Vortex</td>
<td>Published monthly. Similar in content to the Aviation Safety Letter but primarily concerned with accidents to rotary winged aircraft.</td>
</tr>
<tr>
<td>Canada</td>
<td>English</td>
<td></td>
<td>Aviation Safety Amateur Builder</td>
<td>Published three times a year in co-operation with the Experimental Aircraft Association of Canada. Contains items of particular interest to aircraft built at home.</td>
</tr>
<tr>
<td>Canada</td>
<td>English/</td>
<td>French</td>
<td>Aviation Safety Maintainer</td>
<td>Published quarterly, it contains material related to the maintenance of aircraft and the prevention of recurrences collected by investigators.</td>
</tr>
<tr>
<td>New Zealand</td>
<td>English</td>
<td></td>
<td>Flight Safety</td>
<td>A quarterly magazine containing a wide range of articles on aviation safety subjects. Includes details of selected New Zealand and overseas accidents. Approx. 22 pages.</td>
</tr>
<tr>
<td>United</td>
<td>English</td>
<td></td>
<td>AiB Bulletin</td>
<td>Brief preliminary facts on all accidents occurring in the United Kingdom.</td>
</tr>
<tr>
<td>Kingdom</td>
<td>English</td>
<td></td>
<td>General Aviation Safety Information leaflets</td>
<td>A monthly safety leaflet with summaries of the more serious general aviation occurrences (see Figure D-1)</td>
</tr>
<tr>
<td>United</td>
<td>English</td>
<td></td>
<td>Occurrence Publications</td>
<td>Various computer generated publications listing occurrences reported to the mandatory occurrence reporting system (see Appendix D-I).</td>
</tr>
<tr>
<td>Kingdom</td>
<td>English</td>
<td></td>
<td>FAA General Aviation News</td>
<td>A bi-monthly safety publication produced by the Department of Transportation/Federal Aviation Administration. Copies of past articles on various subjects are available on request.</td>
</tr>
<tr>
<td>United</td>
<td>English</td>
<td></td>
<td>Approach</td>
<td>A monthly naval aviation safety review. Contains articles on flight operations, commentaries and short features all related to mishap prevention.</td>
</tr>
<tr>
<td>United</td>
<td>English</td>
<td></td>
<td>Flying Safety Magazine</td>
<td>A monthly magazine published by the United States Air Force to promote aircraft accident prevention.</td>
</tr>
<tr>
<td>United</td>
<td>English</td>
<td></td>
<td>Mech.</td>
<td>A quarterly naval publication primarily for aviation maintenance personnel. Contains general maintenance errors and ground handling mishaps.</td>
</tr>
</tbody>
</table>

* See decode at the end of this Appendix.
<table>
<thead>
<tr>
<th>State</th>
<th>Language</th>
<th>Title</th>
<th>No. of Pages</th>
<th>Description</th>
<th>Address Code</th>
</tr>
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<tbody>
<tr>
<td>Argentina</td>
<td>Spanish</td>
<td>Medical Advice for Pilots</td>
<td>73</td>
<td>Based on the book “Medical Handbook for Pilots” published by the United States FAA. Outlines the physical and psychological aspects which affect pilots aimed at preventing accidents</td>
<td>1</td>
</tr>
<tr>
<td>Australia</td>
<td>English</td>
<td>Survey of Accidents to Australian Civil Aircraft</td>
<td>45</td>
<td>An annual statistical survey of Australian accidents in the subject year.</td>
<td>3</td>
</tr>
<tr>
<td>Canada</td>
<td>English/French</td>
<td>Flying this winter</td>
<td>4</td>
<td>Tips on the preparation of the aircraft and other winter flying techniques.</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>English/French</td>
<td>Flying the mountains</td>
<td>4</td>
<td>Highlights some of the hazards to be avoided when flying in mountains.</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>English/French</td>
<td>Living with vortices</td>
<td>4</td>
<td>An explanation of different types of vortices and how to avoid them.</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>English/French</td>
<td>Slinging with safety</td>
<td>4</td>
<td>What causes helicopter sling ing accidents and how they can be avoided.</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>English/French</td>
<td>Pressing the weather</td>
<td>4</td>
<td>Explains how flying into adverse weather is often a problem of attitude and judgement.</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>English/French</td>
<td>Emergency Locator Transmitter</td>
<td>4</td>
<td>Explains what an ELT is, what it does and how to use it.</td>
<td>2</td>
</tr>
<tr>
<td>France</td>
<td>French/German</td>
<td>Information bulletin on aircraft accidents</td>
<td></td>
<td>Published twice a month.</td>
<td>1</td>
</tr>
<tr>
<td>Federal Republic of Germany</td>
<td>German</td>
<td>The fatal decision</td>
<td>8</td>
<td>This pamphlet describes the risks of a VFR flight being continued into bad weather.</td>
<td>1</td>
</tr>
<tr>
<td>Federal Republic of Germany</td>
<td>German/English</td>
<td>Report 3/80</td>
<td>24</td>
<td>Evaluation of general aviation engine failure accidents in aircraft below 5 700 kg MTOM.</td>
<td>1</td>
</tr>
<tr>
<td>New Zealand</td>
<td>English</td>
<td>New Zealand Civil Aircraft Accidents</td>
<td>40</td>
<td>An annual booklet listing brief details of all aircraft accidents occurring in New Zealand during the subject year. Also contains a brief statistical study of these accidents.</td>
<td>1</td>
</tr>
<tr>
<td>Switzerland</td>
<td>French/German</td>
<td>The mountains should not be your grave</td>
<td>8</td>
<td>Drawing pilots’ attention to the dangers of flying in mountains.</td>
<td>2</td>
</tr>
<tr>
<td>Switzerland</td>
<td>French/German</td>
<td>Wake turbulence</td>
<td>15</td>
<td>Outlines the dangers to small aircraft of wake turbulence created by large aircraft.</td>
<td>2</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>English</td>
<td>Accidents to aircraft</td>
<td></td>
<td>An annual publication on the British register</td>
<td>2</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>English</td>
<td>World airline accident summary</td>
<td></td>
<td>A summary of accidents to aeroplanes over 5 700 kg and helicopters over 4 500 kg since 1946. Amendment service.</td>
<td>2</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>Flight sense</td>
<td>5</td>
<td>Emphasizes some of the important areas that require consideration by all pilots prior to flight.</td>
<td>5</td>
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<tr>
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<td>Language</td>
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<td>No. of Pages</td>
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<tr>
<td>United States</td>
<td>English</td>
<td>Density Altitude</td>
<td>5</td>
<td>Discusses factors that affect air density.</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>Weight and balance — an important safety consideration for pilots</td>
<td>5</td>
<td>Describes how aircraft performance and landing characteristics are affected by the gross weight and centre of gravity limits.</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>Some hard facts about soft landings</td>
<td>5</td>
<td>Discusses landing accident causes and their prevention.</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>The safe pilot’s 12 golden rules</td>
<td>3</td>
<td>Provides some guidelines for safe operating practices.</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>Thunderstorms — Don’t flirt — skirt 'em</td>
<td>5</td>
<td>Provides information on thunderstorms and associated weather hazards.</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>Pilot perogatives</td>
<td>5</td>
<td>Discusses ways to develop and enhance flying judgement.</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>Tips on winter flying</td>
<td>10</td>
<td>Provides precautionary measures pertinent to winter flying.</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>Anatomy of a landing — cue by cue</td>
<td>9</td>
<td>Discusses the visual cues essential to good aircraft landings.</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>All about fuel</td>
<td>4</td>
<td>Provides information on aviation fuels and the safety precautions that need to be observed during aircraft fuelling.</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>Proficiency and the private pilot</td>
<td>7</td>
<td>Discusses ways to improve pilot proficiency.</td>
<td>5</td>
</tr>
<tr>
<td>United States</td>
<td>English</td>
<td>The propwatchers guide</td>
<td>4</td>
<td>Provides safety tips to avoid being struck by rotating propellers or rotor blades with boarding or exiting aircraft.</td>
<td>5</td>
</tr>
</tbody>
</table>

In addition, many State civil aviation authorities publish aeronautical information circulars and other publications, some of which are directly relevant to aviation safety and accident prevention.

Many of the larger airlines also publish safety information for the benefit of their company personnel.
<table>
<thead>
<tr>
<th>State</th>
<th>Language</th>
<th>Size</th>
<th>Title/Text</th>
<th>Description</th>
<th>Address Code</th>
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<tr>
<td>Argentina</td>
<td>Spanish</td>
<td>30 x 20 cm</td>
<td>11 Golden Rules for pilots</td>
<td>Recommendations for safety, especially for new pilots</td>
<td>1</td>
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<tr>
<td>Argentina</td>
<td>Spanish</td>
<td>40 x 30 cm</td>
<td></td>
<td>Two humorous colour sketches of aircraft manoeuvres and feats which should not be attempted.</td>
<td>1</td>
</tr>
<tr>
<td>Canada</td>
<td>English/French</td>
<td>25 x 18 cm</td>
<td>&quot;A superior pilot is one who stays out of trouble by using his superior judgement to avoid situations which might require the use of his superior skill.&quot;</td>
<td>Mottoes</td>
<td>2</td>
</tr>
<tr>
<td>Canada</td>
<td>English/French</td>
<td>25 x 18 cm</td>
<td>&quot;Caution isn’t cowardice — nor is carelessness, courage.&quot;</td>
<td>Mottoes</td>
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<td>Canada</td>
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<td>&quot;If you think safety is too costly, try an accident.&quot;</td>
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<td>Canada</td>
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<td>&quot;The walk from A to B could take the rest of your life.&quot;</td>
<td>Propstrikes</td>
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<td>&quot;Make your weather decision while you still have a choice.&quot;</td>
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<td>&quot;The ambulance in the valley&quot; (poem)</td>
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The publications and posters listed in Parts 2 and 3 of this Appendix can be obtained from the following locations:

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<td>The Civil Aviation Authority of the State concerned.</td>
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