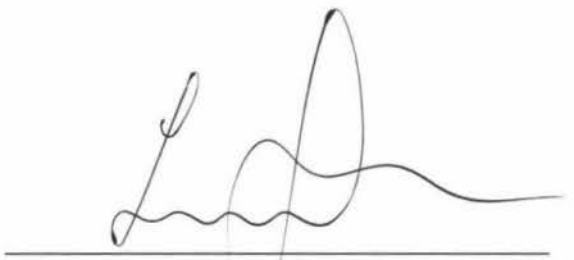
# AIRCRAFT ACCIDENT INVESTIGATION

## Human Factors & Legal Challenge

by

Lily K.B. Fenn



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# CASES CITED

# LEGISLATION CITED*

* Unless otherwise provided, the legislation cited is Hong Kong legislation.

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# AIRCRAFT ACCIDENT INVESTIGATION

## Human Factors & Legal Challenge

## Abstract

From the case studies on various important aircraft accident investigation reports both in New Zealand and Hong Kong, this study suggests that they are deficient and inadequate in a number of ways. As a consequence they may be challenged either on merit or procedure, or both.

In this study, various analytical human factors tools are examined and considered in relation to their potential contribution to challenging the *merits* of investigative reports. In addition, the legal aspects of these reports are also examined to determine how extant legislation and common law could be applied to challenge the reports on the basis of *law* and *procedure*.

It is demonstrated in the analysis how aircraft accident investigation and the reports that are compiled can be challenged on different fronts. Procedural irregularities, such as inadequate opportunity given to those adversely affected to be heard; acting beyond the terms of reference of a public inquiry; or the lack of independence of the investigation itself, may give rise to a cause of action to have the report quashed completely or partially. Those whose reputation is adversely affected may challenge the findings and conclusions in the Board of Review by calling independent experts to attend the hearing to challenge the opinion given by the Chief Inspector. Parties to Court proceedings may seek discovery or disclosure of the records or information collected in the investigation and ask the

Court to rule on the causation of the accident in personal injury cases.

Among the different channels or methods of investigation, the Chief Inspector's reports are most vulnerable to challenge given the legal position in Hong Kong and the lack of statutory non-disclosure protection of the records, information and evidence gathered, and the compellability of the Inspectors to give evidence in Court.

Aircraft accident investigation reports may, at best, be used or taken as a piece of evidence setting out the factual information of the accident, and as an expert opinion of the probable cause thereof in subsequent civil proceedings in establishing the causation of the accident and liability in common law negligence in personal injury or fatal accident cases. Those reports are by no means conclusive or binding on the parties or the Court in civil proceedings, and issue estoppel does not arise.

# CHAPTER I

# INTRODUCTION

## [A] THE CRASH ON MOUNT EREBUS, ANTARCTICA (1979)

On the morning of the 28th November 1979, a DC10 Series 30 aircraft, operated by Air New Zealand Limited with nationality and registration marks ZK-NZP, took off from Auckland. The aircraft, designated as Flight TE901 and scenic passenger in nature, crashed on the slopes of Mount Erebus, Antarctica during its course. The crash resulted in the total loss of the aircraft and the death of all persons, believed to have numbered 257, on board.

A Royal Commission was established by the New Zealand Government and the Honourable Justice Peter Thomas Mahon appointed to inquire into the report of the accident prepared by the Chief Inspector of Air Accidents of the New Zealand Civil Aviation Authority.

A disaster/accident can be looked at from different perspectives. The objective of the investigation is to learn how to identify and eradicate those contributing factors, whether they be apparent or latent. The Chief Inspector's report in the Erebus case reflected the then (1979) orthodox trend of investigation which took a narrow approach to identifying active defects (as opposed to the latent defects) as the primary cause(s) of the accident. The Chief Inspector's report identified the active errors of the flight crew in descending below the minimum safety altitude as the primary causal factor of the accident. This conclusion cannot be criticised as being wrong when

the investigation was conducted about twenty-eight years ago and where front-line personnel were usually the focus of investigation.

Mr. Justice Mahon, however, took a much wider and broader approach in the investigative exercise. Rather than looking for errors directly related to the actions of individuals, he went much further and deeper by delving into the organizational failures and systems defects. This approach was new to accident investigators.

From the Mahon inquiry, a number of latent organizational failures were identified as probable contributing causes of the accident:

a) Although evidence does not show any lack of management commitment to safety on the part of the airline operator, the evidence, does suggest that this commitment was not successfully carried through into practice. The most obvious example is that although it was widely known within the airline that low altitude flying of previous flights had violated what was supposed to be the minimum safety altitude, no censure was taken by the company on any of the flight operations reports of these flight procedures. This sent a wrong message to the flight crew of the disaster flight that this was permitted by flight operation to satisfy passenger curiosity and expectations to see the features on McMurdo Sound where Scott and Shackleton established their expeditions for their conquest of the South Pole.

b) There were obscure or blurred organizational safety responsibilities. The flight operation managers knew the flight crew's descents to low altitudes in previous flights, but considered taking action in relation to

such violations of operational procedures was not their individual responsibilities.

c) The physical and perceptual nature of the sector whiteout phenomenon was not understood by those planning and approving the series of Antarctic flights.

d) Familiarization flights for captains flying this route was initially in place to allow two captains to fly together. The one with experience on this route would brief the one without such experience. However, this practice of rostering two captains was subsequently discontinued. This decision reduced the operation's Antarctic Flights safety margin.

e) The change of the navigational coordinates entered in the aircraft's flight computer by the airline operator's navigation section within a few hours of departure was not communicated to the flight crew. This suggested a failure of the company's procedures and communication with crews.

f) Inadequate control and supervision at management level was best illustrated by the lack of control surrounding descending to low altitudes which was clearly a breach of Civil Aviation rules.

g) There was inadequate training and briefing to flight crew on production and safety goals. Some of the major omissions and mistakes have already been discussed, such as incomplete information regarding the whiteout phenomenon, ambiguous information about what were effectively the permitted minimum safety altitudes; misleading information about the intended navigation route of the flight and ambiguous information about the nature and very limited extent of air

traffic services provided by the McMurdo air traffic control.

h) Finally, there were regulatory failures of the New Zealand Civil Aviation Authority ("NZCAA") in diligently applying and enforcing existing regulations. According to the Report, the Antarctic operation had been scrutinized and approved by the NZCAA at the very outset, as there was a failure to notice the incomplete information provided to flight crews, and another error in approving a route which passes directly over an active volcano. As the airline flight operations evolved, they progressively deviated from those procedures which had been components of the original agreement. These deviations included, the discontinuation of the captains' familiarization flights; change of navigation routes; reduction from McMurdo air traffic control assistance; descents below the minimum safety altitudes for publicized low-altitude sight-seeing tours. The NZCAA did not require the Company to inform it of any changes in its flight operations procedures nor did the authority take any corrective actions when it became aware that deviations in procedures were taking place. This passive altitude and reactive (as opposed to active) role taken for violations of intended restrictions is an example of the types of latent organizational failures which led to the accident.

A number of lessons have been learned from the Erebus disaster. First, it is the primary duty of an airlines directors and senior management to understand their obligations. The same is true of senior regulatory management. For both organizations the most important obligation they

have is to ensure the safe operation of flights within a safe regulatory system.

It was held by the House of Lords in Wilsons & Clyde Coal Co. Ltd. v. English[1] in 1938 that it is the obligation of the airline operator, the entrepreneur, who is responsible for employing staff, training them, and setting up the operation, to devise, lay down and maintain a safe system.

Secondly, in order to ensure the safe operation of flights, a safe system must be established, understood and implemented by the operator within the regulatory system.

Thirdly, a safe system requires an understanding of the underlying human factors which contribute to organizational safety and how these components can be brought together into a seamless whole.

In the Erebus disaster, failures were found within both the airline's operations and the New Zealand Civil Aviation Authority in respect of those fundamentals. The lessons learnt from Erebus are not confined to aviation, but may also apply to safety in all organizations and the community at large. The ICAO Human Factors Digest No.10 (Circular 247-AN/148) takes the view that the Report by Justice Mahon was probably ten years ahead of its time. Had the safety community grasped the message from Antarctica and applied its lessons, the Union Carbide disaster in Bophal (with thousands of deaths by poisoning), Chernobyl nuclear reactor disaster, and many other major high technology systems catastrophes may not have happened. The Mahon Report is now widely accepted as a milestone in systems safety.

[1] Wilsons & Clyde Coal Co. Ltd. v. English [1938] A.C. 57; [1937] 3 All ER 628

Notwithstanding the visionary nature of the Report it has been critically challenged in the way in which it went beyond the traditional judicial role in accident investigations.

In paragraph 377 of the Mahon's Report ("the Report"), the following was stated:

> "*No judicial officer ever wishes to be compelled to say that he has listened to evidence which is false. He always prefers to say, as I hope the hundreds of judgments which I have written will illustrate, that he cannot accept the relevant explanation, or that he prefers a contrary version set out in the evidence. But in this case, the palpably false sections of evidence which I heard could not have been the result of mistake, or faulty recollection. They originated, I am compelled to say, in a pre-determined plan of deception. They were very clearly part of an attempt to conceal a series of disastrous administrative blunders and so, in regard to the particular items of evidence to which I have referred, I am forced reluctantly to say that I had to listen to an orchestrated litany of lies.* "

It was held by the New Zealand Court of Appeal[2] that in making the allegations stated in this paragraph of the terms "*a pre-determined plan of deception*" and "*an orchestrated litany of lies*" were statements in excess of jurisdiction and contrary to natural justice. The conspiracy postulated in the statement was evidently intended to include the chief executive of the

[2] Re Erebus Royal Commission: Air New Zealand Ltd. v. Mahon (No.2) [1981], 1 NZLR 618 (CA; NZ)

airline, the executive pilots and members of the navigation section as participants. In order to provide substantial justice to the company and the positions identified in the Report, paragraph 377 and the adverse cost order made by the Judge were quashed on the grounds that the statements were made without jurisdiction (the ambit of the inquiry is limited by the terms of the instruction of appointment of the Commission) and contrary to natural justice.

The Privy Council[3] subsequently upheld the decision of the Court of Appeal and dismissed Justice Mahon's appeal.

In Hong Kong, aircraft accident investigations are conducted by the inspectors of the Civil Aviation Department ("CAD") with reports being compiled and made public. Regulation 4 of the Hong Kong Civil Aviation (Investigation of Accidents) Regulations, Cap.448, provides that "The fundamental purpose of investigating accidents under these regulations shall be to determine the circumstances and causes of the accident with a view to the preservation of life and the avoidance of accidents in the future; it is not the purpose to apportion blame or liability."

Under Regulation 17, where it appears to the Chief Executive that it is expedient in the public interest to hold a public inquiry into the circumstances and causes of an accident to which these regulations apply or into any particular matter relating to the avoidance of such accidents in the future, the Chief Executive may appoint a commission of inquiry for that

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3 Re Erebus Royal Commission: Air New Zealand Ltd. v. Mahon [1983] New Zealand Law Reports, 662 (PC)

purpose. The Commission shall be comprised of:

(a) a District Judge or Magistrate; and

(b) not less than two assessors, each of whom shall possess an aeronautical or aeronautical engineering qualification or some other special skill or knowledge which is relevant to the conduct of the inquiry.

In the case where any person's reputation, or the reputation of a person on whose behalf representations have been made in the CAD Inspector's investigation is likely to be adversely affected by the findings and conclusions in the report, those individuals may demand a review by a Board of Review, which shall consist of:

(a) a magistrate, a legal officer within the meaning of the Legal Officers Ordinance, or a barrister, or solicitor of not less than five years practice, who shall be the chairman of the board; and

(b) one or more assessors, each of whom shall possess aeronautical or aeronautical engineering qualifications or some other special skill or knowledge which is relevant to the conduct of the review.

The Hong Kong legislation reflects the lessons of the Erebus inquiry. A one person court of inquiry is potentially too prone to reflect the views of a single individual. The Hong Kong legislation recognizes that the chairperson should be assisted by those with aeronautical or aeronautical engineering qualification and expertise.

Any report of the CAD or public inquiry which seeks to apportion blame or liability can run the risk of being reviewed by the Board of Review or

quashed by the Court. The judiciary's role in aviation has changed since the Erebus inquiry, but the *spirit* of inquiry still remains, namely, to determine the circumstances and causes of the accident with a view to avoid accidents in the future.

## [B] INTERNATIONAL LAW AND ISSUES PERTINENT TO THE HONG KONG JURISDICTION

To understand the subject, one cannot ignore the central international text, the Convention on International Civil Aviation 1944, which is commonly known as "*the Chicago Convention*", to which the United Kingdom and China were included amongst the original signatories to the Convention. As such, these two countries were also original members of the International Civil Aviation Organization ("ICAO"). The preamble to the treaty recites that the state parties have agreed on certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner. One of the ways in which safety and order in the air are to be promoted is through the adoption by the institutions of ICAO and the state members of international standards and procedures, a matter regulated by Chapter VI of the Convention and especially by *Article 37*:

> **"Adoption of international standards and procedures**
>
> Each contracting State *undertakes to collaborate in securing the highest practicable degree of uniformity in regulations, standards, procedures, and organisation* in relation to aircraft, personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation.

To this end the International Civil Aviation Organisation shall adopt and amend from time to time, as may be necessary, international standards and recommended practices and procedures dealing with:

(a) communications systems and air navigation aids, including ground marking;

(b) characteristics of airports and landing areas;

(c) rules of the air and air traffic control practices;

(d) licensing of operating and mechanical personnel;

(e) airworthiness of aircraft;

(f) registration and identification of aircraft;

(g) collection and exchange of meteorological information;

(h) log books;

(i) aeronautical maps and charts;

(j) customs and immigration procedures;

(k) aircraft in distress and *investigation of accidents*;

and such other matters concerned with the safety, regularity, and efficiency of air navigation as may from time to time appear appropriate." (Emphasis added.)

*Article 26* provided for the investigation of accidents, which, however adopts a lesser standard of obligation than those stated in the general provisions of *Article 37*:

**"Investigation of accidents**

In the event of an accident to an aircraft of a contracting State occurring in the territory of another contracting State, and involving

death or serious injury, or indicating serious technical defect in the aircraft or air navigation facilities, the State in which the accident occurs will institute an inquiry into the circumstances of the accident, in accordance, *so far as its laws permit, with the procedure which may be recommended* by the International Civil Aviation Organisation. The State in which the aircraft is registered shall be given the opportunity to appoint observers to be present at the inquiry and the State holding the inquiry shall communicate the report and findings in the matter to that State." (Emphasis added)

The lawmaking provisions are to be read not only with Article 37, but also with *Article 38*, which permits *departures* from international standards and procedures:

**"Departures from international standards and procedures**

Any State which finds it impracticable to comply in all respects with any such international standard or procedure, or to bring its own regulations or practices into full accord with any international standard or procedure after amendment of the latter, or which deems it necessary to adopt regulations or practices differing in any particular respect from those established by an international standard, shall give immediate notification to the International Civil Aviation Organisation of the differences between its own practice and that established by the international standard. In the case of amendments to international standards, any State which does not make the appropriate amendments to its own regulations or practices shall give notice to the Council

> within 60 days of the adoption of the amendment to the international standard, or indicate the action which it proposes to take. In any such case, the Council shall make immediate notification to all other States of the difference which exists between one or more features of an international standard and the corresponding national practice of that State."

Those international standards and recommended practices ("SARPS") are designated as Annexes to the Chicago Convention (as stated in Article 54 of the Convention). Article 54 also entrusts the adoption and amendment of those Annexes to the Council of the ICAO. Article 90(a) further prescribes that, for the adoption of those Annexes, the calling of a special meeting of the Council for that purpose, as well as a two-third vote of the council, is required. The adopted Annexes must then be submitted by the Council to each contracting State. Any such Annex shall become effective within three months after its submission to the contracting States or at the end of such longer period of time as the Council may prescribe, unless in the meantime a majority of the contracting States register their disapproval with the Council.

This function of the ICAO is described as quasi-legislative rather than legislative in that these international standards are *not* binding on member States against their will.

With some exceptions[1] to be discussed below, the contracting States have no legal obligation to implement or to comply with the provisions of a duly promulgated Annex or amendment thereto, unless they find it "practicable" to do so. This is supported both by the language of the Chicago Convention as well as by the practice of the ICAO.

Several Articles of the Convention indicate that different exercises of the power under Article 37 will have different binding effect. Such differences are expected given the diversity of the matters covered by the Convention. *Article 12*, regulating the crucial matter of "Rules of the Air" provides a contrast with Article 37 and within the Convention itself:

> **"Rules of the Air**
>
> Each contracting State undertakes to adopt measures to insure that every aircraft flying over or manoeuvring within its territory and that every aircraft carrying its nationality mark, wherever such aircraft may be, shall comply with the rules and regulations relating to the flight and manoeuvre of aircraft there in force. Each contracting State undertakes to keep its own regulations in these respect *uniform, to the greatest possible extent*, with those established from time to time under this Convention. *Over the high seas*, the rules in force *shall be those* established under this Convention. Each contracting State undertakes to insure the prosecution of all persons violating the regulations applicable." (Emphasis added)

[1] The most important exceptions are those laid down in Article 12, concerning the rules of the air over the high seas, and Articles 33 and 34 concerning the recognition of certificates and licences and format of log books.

As can be seen from the wording of Article 12, the rules for flight over the high seas, adopted under Article 37, are to apply without change, no government discretion is contemplated. However, by contrast, the rules of the air applicable to other flights will require further action by the contracting States which have some flexibility in giving effect to the standards established under the Convention.

Lord Atkin of the Privy Council in Attorney-General for Canada v. Attorney-General for Ontario[2] (a case on appeal from Canada) said that it was well established that while the making of a treaty is an Executive act, the performance of its obligation, if they entail alteration of the existing domestic law, required legislative action. The stipulation of a treaty duly ratified by the Executive does not, by virtue of the treaty alone, have the force of law.

Likewise, the Court of Appeal of New Zealand held in New Zealand Air Line Pilot's Association Inc. v. Attorney-General[3] in 1997 that the Chicago Convention, to which New Zealand is a party, as a whole does not form part of the law of New Zealand. And Annex 13 to the Chicago Convention which deals with air accident investigation is not part of New Zealand law.

Hong Kong was a colony of the United Kingdom which is a contracting State of the Chicago Convention. The Convention applied to Hong Kong through the United Kingdom before the change of sovereignty on the 1st July 1997. China is also a contracting State of the Convention. From the 1st

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[2] Attorney-General for Canada v. Attorney-General for Ontario [1937] AC326 at 347
[3] New Zealand Air Line Pilots' Association Inc. v. Attorney-General [1997] 3 NZLR 269

July 1997, the Convention applies to the Hong Kong Special Administration Region through the People's Republic of China. Section 2A(1) of the Civil Aviation Ordinance, Cap.448 of the Laws of Hong Kong, specifically provides that the Chief Executive in Council may by order make such provision as appears to the Chief Executive in Council to be necessary or expedient for carrying out the Chicago Convention, any Annex thereto relating to international standards and recommended practices (being an Annex adopted in accordance with the Convention) and any amendment of the Convention or any such Annex made in accordance with the Convention, and generally for regulatory air navigation, provided that such provision deals only with the routine business and technical management of civil aviation including the:

(i) management of aerodromes;

(ii) provision of air traffic services within the flight information region of Hong Kong; and

(iii) discharge of other responsibilities allocated to Hong Kong under the regional air navigation procedures of the ICAO.

In this research, it has to be borne in mind the legal effect of the Chicago Convention and its relevant Annexes, to what extent the relevant provisions are adopted and enacted in the legislation of Hong Kong, and the decisions of the Courts in other Commonwealth jurisdictions as persuasive authorities, albert not binding on the Hong Kong Courts.

## [C] SUBJECTS AND METHODS

This research has been designed to test the hypothesis: "To what extent

would Aircraft Accident Investigation Reports be (1) sustainable to legal challenge, and (2) utilised in civil legal proceedings in Hong Kong."

The study is intended to provide guidance to lawyers practising in Hong Kong, be they acting for the airlines, pilots, victims or their personal representatives, aircraft manufacturers, Airport Authority or other government departments, to tackle and understand aircraft accident investigation, to identify human failures or human factors in the causation with the view to prevent a similar accident in the future.

However, no matter how meticulous and thorough the investigation reports may be, they are not immune from being challenged in the legal system. The research will go on to ascertain the legal requirements and procedures in Hong Kong for the preparation of the investigation reports, a person or company's *locus standi*, the legal procedures and channels available to challenge the findings and conclusions of the reports prepared by the Hong Kong Civil Aviation Department. This study should provide guidance to aircraft accident investigators in ensuring that their work should take due consideration of the legal requirements, and hopefully assist them to prepare better reports which let them know in advance the legal challenges they may face in Court.

The CAD's draft report on the China Airlines CI642 accident at Hong Kong International Airport in 1999 was challenged by the airlines and the co-pilot in the Board of Review in Hong Kong. The airline and co-pilot sought to review five Findings and two Causal Factors concluded in the CAD report.

Application for review was allowed in part in respect of one finding and one causal factor. The remaining issues for challenge were refused by the Board of Review.

To challenge the investigation reports, one must first understand the tools which may be useful in analyzing human factor issues which may lie at the heart of the event. One of these tools is the Human Factors Analysis and Classification System ("HFACS") developed by Wiegmann and Shappell to identify the holes in the Swiss Cheese model first developed by James Reasons. These 'holes' are found at four probable levels of failure, namely, (a) Unsafe Acts, (b) Preconditions for Unsafe Acts, (c) Unsafe Supervision, and (d) Organizational Influences. Another method is that developed by Oliver Sträter called the Incident Decomposition method.

This Research encompasses the study of Aircraft Accident Investigation Reports prepared by the Hong Kong Civil Aviation Department, reports of the Board of Review[4] and decided cases in Hong Kong, the United Kingdom and other Commonwealth jurisdictions. The legal challenge on the findings of the Royal Commission of Enquiry into the air crash on Mount Erebus, Antarctica, in the Court of Appeal of New Zealand and finally in the Privy Council of the United Kingdom, and the Board of Review decision on some of the Findings and Causal Factors of the CAD draft Report will be studied and analysed in detail.

Insofar as possible, the research will attempt to generalise from the aviation

[4] Board of Review, Hong Kong (Nov.2004). Report of the Board of Review on the Accident to Boeing MD-11 B-150 at Hong Kong International Airpotr on 22nd August 1999

situations and generate a heuristic template which could be applied to any type of accident/incident investigation.

## [D] IMPORTANCE OF THE STUDY

This study comes twenty years after the tragedy of Hawker Siddeley Trident 2E B-2218 ("Trident") at Hong Kong International Airport (Kai Tek) in 1988. It also reviews the report of the crash of China Airlines CI 642 at Hong Kong (Chap Lap Kok) in 1999. The study will demonstrate how aircraft accident investigation reports may be challenged from human factor and legal perspectives.

The study will unveil the deficiencies and inadequacies of those investigations, and illustrate how vulnerable the investigation reports are in the Hong Kong judicial system when compared with other major jurisdictions in the Commonwealth. The study employs two disciplines, namely, aviation human factors and a comparative analysis of relevant legal provisions in Hong Kong and in major Commonwealth jurisdictions with respect to domestic law, public international law and comparative law. Part of the credibility in the execution of this research is that the researcher is both a qualified lawyer, and a qualified pilot in fixed-wing and rotary-powered aircraft.

The Trident and the CI 642 accidents provide case studies from real life examples of the deficiencies and inadequacies of accident and investigation reports typically prepared by the Civil Aviation Department of Hong Kong.

There are two components to the *methodology* chosen to test the study's

hypothesis. First, human factors methods designed to assess and evaluate deficiencies in the original investigative processes. Secondly, the application of the statutory and judicial controls which may identify irregularities in the investigations' procedures, such as inadequate opportunities given to those adversely affected to be heard, acting beyond the scope of the terms of reference of the inquiry, or the lack of independence in the investigation itself. These tools can assess the probative value of the evidence relied on by the Inspectors (in reaching their conclusions on the probable cause(s) of the accident) by way of discovery of the records and information in their possession custody or control, and compelling the Inspectors to give evidence in public inquiries or civil proceedings so that they may be subject to examination and cross-examination in open Court. The discussions on the human factor analysis tools and the application thereof are in Chapters III and IV, whilst those on statutory and judicial controls are in Chapter VII. The case studies are in Chapters V and VI.

# CHAPTER II

# LITERATURE REVIEW

## [A] AIRCRAFT ACCIDENT INVESTIGATION PROCEDURE IN HONG KONG

In 1990, a paper entitled "Aircraft Accident Investigation Procedure in Hong Kong" was written by Cheonghar Wong, a solicitor in Hong Kong, based on a project prepared as part of the requirements for a Master of Laws degree at the University of Hong Kong. It was prepared before the Civil Aviation Department's ("CAD") report on the Trident accident in 1988 was finalised or released. Wong did not have the benefit of reading the aircraft accident investigation report.

The paper was written seventeen years ago. In between that time and now, the law has changed leaving most parts of the content of this report obsolete. In 1999, China Airlines' CI 642 crashed at the Hong Kong International Airport, and the draft report of the CAD was challenged in the Board of Review. This Board was the first established to review an inquiry into an aviation accident in Hong Kong's legal history. Wong did not have the benefit to cover this report either, let alone the report of the Board of Review on the accident.

The paper did not address any human factor issues in the preparation of investigation report, since in those early days, human factor analysis tools in aviation had yet to be developed by safety experts and scholars. The work

of James Reason and others on human and organizational error had not yet been published.

The scope of the study was wide and the paper, with due respect to the author, scratched the surface of each topic, but without going deep enough to deal with the underlying weakness and problems of the procedure(s) in aircraft accident investigation in Hong Kong.

It was suggested that if this aircraft accident investigation were to be re-visited, the study would be incomplete without addressing human factor issues on the *merits* of the investigation, and evaluating it critically in *law and procedure*. The hypothesis to be tested must address both human factors and the legal aspect to make the study complete. That is the object of the *first part* of the hypothesis for this research.

## [B] USE OF AIRCRAFT ACCIDENT INVESTIGATION EVIDENCE IN NEW ZEALAND

An aircraft accident in New Zealand in 1995 highlighted the investigation of evidence issues. An article by Nathan Gedye (2000), a New Zealander, addressed some of these issues. In the five years since this accident, there has been much controversy and litigation about the use of cockpit voice recordings ("CVRs") and their transcripts. This resulted in legislation which confers substantial protection for accident investigation evidence under the TAIC Amendment Act 1999 ("the Act") which imported the thrust of Paragraph 5.12 of Annex 13 to the Chicago Convention but in a more detailed and extensive form.

The article referred to the 1997 New Zealand Court of Appeal decision in NZ Airline Pilots' Association Inc. v. Attorney-General in which the Court reviewed the constitutional status of the Chicago Convention and concluded that Paragraph 5.12 in Chapter 5 of Annex 13 to the Convention did not form part of New Zealand law, and that international conventions and treaties to which New Zealand is a party do not form part of New Zealand domestic law unless specially imported by Act of Parliament.

It covered the two competing interests, namely, flight safety on the one hand and administration of civil and criminal justice on the other. Parliament finally accepted that the greater contribution to safety was to promote free and open provision of information by generally precluding its use outside the investigation.

The paper went on to discuss investigation evidence which is absolutely protected or privileged, the position of accident investigators as witnesses, specific provisions regarding voice or video recordings, what is not covered by the Act, its impact on litigation, air crew protection, adverse effects on investigations, Paragraph 5.12 of Annex 13 and the level of protection for pilots, particularly in relation to civil and criminal proceedings.

On the basis of the New Zealand evidence, it is interesting to examine the Hong Kong situation regarding the extent aircraft accident investigation reports would be utilised in civil proceedings. This is especially so because Hong Kong did not and does not have to this day legislation similar to that which exists in New Zealand. The *second* part of the hypothesis to be

tested in this study is intended to address this deficiency.

# CHAPTER III

# BEYOND EREBUS :

# HUMAN FACTORS ANALYSIS TOOLS

## [A] HUMAN FACTOR CONCEPTS

James Reason's text *Human Error* (1990) has become a reference point for all human factors practitioners involved in safety. The underlying theme is that " ... in considering the human contribution to systems disasters, it is important to distinguish two types of error: *Active errors*, whose effects are felt almost immediately, and the *latent errors* whose adverse consequences may lie dormant within the system for a long time, only becoming evident when they combine with others to breach the system's defences".

Aviation is very much a human endeavour. The threats to the system come from human beings and the vulnerabilities of the system's defences are also human creations or their errors. The study of Human Factors is thus a multi-disciplinary field encompassing psychology, engineering, physiology, medicine, sociology and anthropology.

Reason's approach to accident causation is based on the assumption that there are fundamental elements of all organizations that must work together harmoniously, if efficient and safe operations are to be in place. These elements comprise a "productive system" as depicted in *Figure 1.* Based on this model, the aviation industry is considered a complex productive system whose "product" is the safe conduct of flight operations.

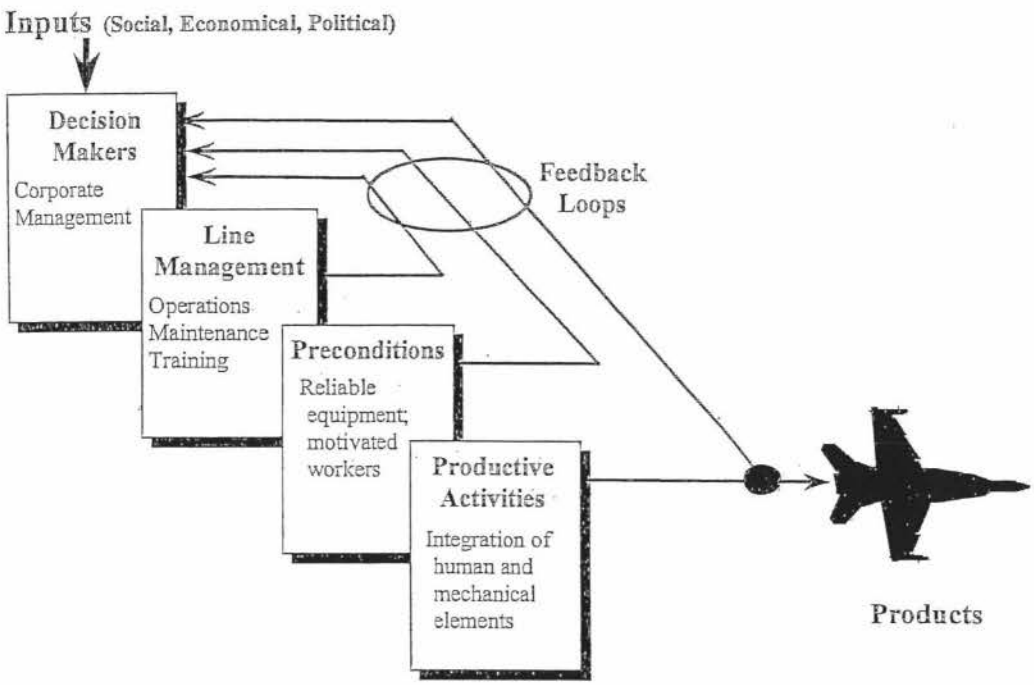


**Figure 1 Components of a productive system (Source: Adapted from Reasons (1990))**

Before productive activities can successfully take place, certain "preconditions" need to exist, such as reliable equipments with good maintenance, well trained and professional staff operating under good management and supervision across various departments within the organization, such as flight operations, engineering and maintenance, staff training, and the like.

Such support comes from decision makers responsible for setting goals and managing available financial and human resources. They have to make decisions based on social, economical and political demands or pressure from outside to deliver safe, on-time and cost-effective operations, and to deal with feedback from managers and other staff within the organization.

Accidents occur when there are breakdowns in the interactions among the components involved in the production process. According to Reason, these failures can be depicted as "holes" within the different defence layers of the system, thereby ruining the entire productive process. The image of the Swiss cheese best illustrates Reason's theory, and thus most commonly known as the "Swiss cheese" model of accident causation in *Figure 2*.

An accident investigator must analyse all aspects and levels of the system to ascertain and understand fully the different possible causes of an accident by working backwards in time from the accident to identify the *unsafe acts* that ultimately led to the accident, such as aircrew/pilot errors. These are the *active failures* or actions of aircrew *directly* linked to the accident. In the

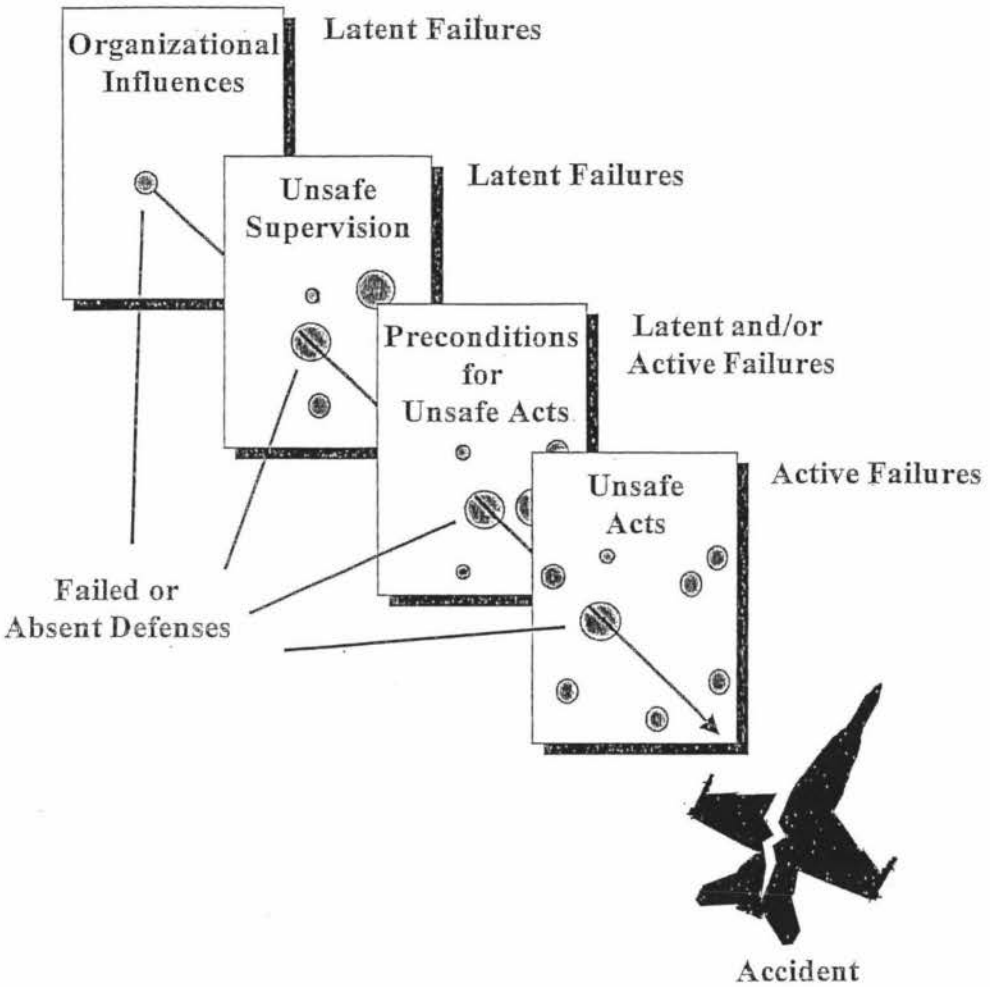


**Figure 2** **The "Swiss cheese" model of accident causation (Source: Adapted from Reasons (1990))**

"Swiss cheese" model, these are the "holes" or failed defences in the last cheese layer representing the last unsafe acts committed by aircrew/pilot.

This "Swiss cheese" model is particularly useful in accident investigation since it guides the investigators to address and investigate latent failures within the causal sequence of events. Such latent failures may not be obvious and may lie dormant and undetected for long periods of time until one day they adversely affect the unwary and unsuspecting aircrew. Consequently, even investigators may overlook and fail to identify them.

Reason goes three more levels higher to observe human failure, namely, *preconditions for unsafe acts*, *unsafe supervision* and *organizational influences*. The preconditions for unsafe acts involves conditions such as mental fatigue or improper communication and co-ordination practices owing to poor crew resource management ("CRM"). If a fatigued pilot fails to communicate and coordinate his or her activities with others external to the aircraft, such as air traffic control, aircraft maintenance engineers, and the like, poor decisions are made and thus mistakes result.

## [B] HUMAN FACTORS ANALYSIS AND CLASSIFICATION SYSTEM ("HFACS")

The limitation of Reason's "Swiss cheese" model is that it fails to identify the exact nature of the "holes" in the cheese layers. It is primarily descriptive but not analytical. It has been criticized for being too academic, not designed for safety practitioners/professionals. For the model to be systematically and effectively applied as an analysis tool, the "holes in the

cheese" need to be clearly defined and identified. To make recommendations for future prevention, investigators are required to know exactly what these system failures or "holes" are, so that they can be identified and spotted in the investigation.

The Human Factors Analysis and Classification System ("HFACS") was specifically developed by Shappell and Wiegmann to defined the latent and active failures implicated in Reason's "Swiss Cheese" model, so that it can be used as a practical accident investigation and analysis tool (Shappell and Wiegmann, 1997; 1998; 1999; 2000; 2001)

*(1) UNSAFE ACTS OF OPERATORS*

For this level of failure, it can be classified into two categories, namely, *errors* and *violations* (Reason, 1990). Errors refer to the mental or physical activities of individuals that fail to achieve their intended outcome, whilst violations, on the other hand, refer to the willful disregard for the rules and regulations that govern the safety of flight.

The categories of errors and violations were further divided (Reason, 1990; Rasmussen, 1982), to include three basic error types, namely, *skilled-based, decision* and *perceptual errors,* and two forms of violations, namely, *routine* and *exceptional*, as depicted in *Figure 3.*

a) *Skilled-based errors*

Such errors in aviation involve commonly known "stick-and-rudder" basic flight skills used by aircrew without significant conscious thought or simply conditioned reflex actions in flying. Commonly found examples include poor flying

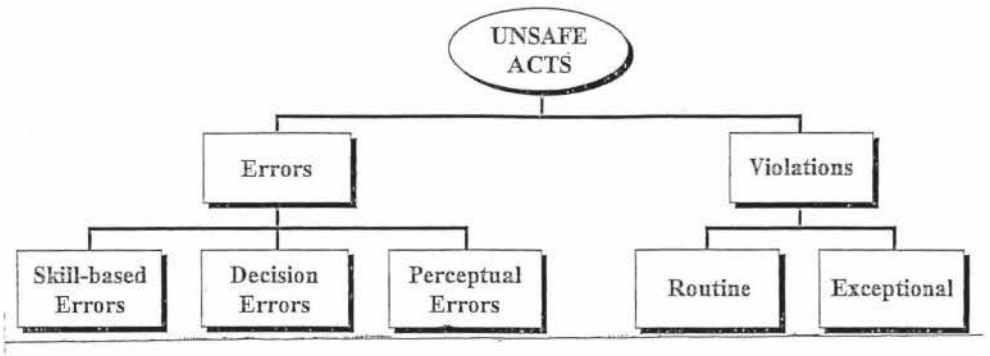


**Figure 3 Categories of Unsafe Acts Committed by Aircrews (Source: Shappell and Wiegmann, 2003)**

technique or airmanship, inadvertent or unintended application or use of fight controls, over-reliance on automation, failure to see and be seen to avoid collision, breakdown in visual scanning of windscreen or the instruments, omitted step(s) in executing procedure on the checklist, failure to prioritize pilot attention (as a pilot should aviate, navigate, and finally, communicate), task overload as well as external or internal distractions.

b) *Decision errors*

Decisions errors refer to situations where intentional behaviour that proceeds as planned, but errors occur because the plan itself proves to be inadequate or inappropriate in the circumstances. These may be honest mistakes of the actions or inactions of individuals without the appropriate knowledge, experience or expertise. Obvious examples of such unsafe acts of operators/aircrew include inappropriate maneuvers/procedures, inadequate knowledge of procedures, systems or items on the checklists, performing jobs which exceed one's ability, knowledge or expertise, incorrect or over response to emergency and selection of wrong options.

*c) Perceptual errors*

Perceptual errors refer to the pilot's erroneous response to the illusion or disorientation. Perceptual errors occur when the pilot's sensory input is degraded or becomes abnormal. Common perceptual errors are due to visual illusion, spatial disorientation or vertigo, misjudged distance, altitude, airspeed or clearance,

blackout or whiteout.

d) *Routine Violations*

Violations can be divided into two categories, namely, routine violations and exceptional violations.

Routine violations are habitual by nature and often tolerated by governing authority (Reason, 1990). For example, a pilot may routinely flies in marginal weather when authorized for visual flight rules ("VFR") only. At times, the situation may fall below the weather minima *en route*. This shows a person's behaviour pattern in flying.

e) *Exceptional Violations*

Unlike routine violations, exceptional violations come as isolated events which depart from the rules. This does not mean it is condoned by management or reflects that individual's behaviour pattern. Such violations are only occasional in exceptional circumstances. They are neither typical or the individual nor condoned by the authority.

*(2) PRECONDITIONS FOR UNSAFE ACTS*

If the accident investigators only scratch on the surface for unsafe acts without going deeper into the reasons behind such unsafe acts in the first place, it is equivalent to focusing on only the symptoms without understanding the root of the illness causing them.

The process of analyzing the preconditions of unsafe acts involves the investigation of the *Conditions of the Operator*, *Environmental Factors*

and *Personnel Factors*.

a) *Conditions of Operators*

There are three conditions of operators with potentially dangerous factors that have a direct impact on performance. They are *Adverse Mental States*, *Adverse Physiological States*, and *Physical/Mental Limitations*.

The most common *adverse mental states* are loss of situational awareness, stress, complacency/over-confidence, task saturation, mental fatigue, distraction, channelled attention, drowsiness/air sickness and lack of vigilance during flight.

Some of the most common *adverse physiological states* are hypoxia due to insufficient oxygen, medical illnesses (such as heart diseases), physical fatigue, intoxication/alcoholism, motion sickness and effects of medication affecting the body.

In aviation, some of the common *physical/mental limitations* are lack of aptitude or cognizance to fly, incompatible physical capabilities in being either too short or too tall, inadequate experience to cope with complex situations, information overload, insufficient reaction time expected of a quick response/rapid processing, human visual limitations, human audio limitations, and inability to deal with high-G environment.

b) *Personnel Factors*

There are a number of personnel factors which create preconditions for unsafe acts.

They may be divided into two categories, namely, *Crew Resource Management* ("CRM") and *Personal Readiness*.

Good communication and team coordination are essential for aviation safety. CRM is the cornerstone of aviation in multi-crew operations. Poor CRM training would lead to fatalities.

Poor CRM would result in lack of leadership by the captain, failure to conduct adequate briefing before take-off, lack of teamwork during flight, failure to conduct adequate debriefing after landing, lack of assertiveness, poor communication/coordination within the aircraft, low power-distance between the captain and his/her sub-ordinates, cultural mis-match among members of the team, poor communication between aircraft, air traffic control, ground engineers, and confusion and poor decision-making in the cockpit.

When as pilot goes to work, he/she is expected to be both physically and mentally fit to fly and perform one's duties. *Personal readiness* is crucial in such a demanding job. Violations usually include failure to manage fatigue for omission to adhere to crew rest requirements, failing to undertake adequate training, self medication without realizing the side effects, over-exertion while off duty, poor dietary habits, lack of appropriate physical exercises, and under influence of alcohol.

All the above violations would adversely affect on the standard of job performance.

c) *Environmental Factors*

Environmental factors can be classified into two general categories,

namely, the *physical environment* and the *technological environment*.

The term physical environment refers to both operational environment and the ambient environment. They include weather conditions, altitude (resulting in reduction of oxygen and thus hypoxia), terrain, thunder and lightning, lighting, vibration, high-G environment in aerobatic flights (causing restriction of blood flow to brain, and thus blurred vision, blackout, greyout or even unconsciousness), toxins in the cockpit, and ice causing whiteout (for example in Antarctica or Alaska).

*Technological environment* encompasses a variety of elements, such as, poor design of equipment and controls, unsatisfactory checklist layout, display/interface characteristics, imperfect automation, under-trust and disuse of automation.

In the recent years, traditional aircraft design is now surpassed by the more complex glass-cockpit with the hope that errors may be reduced. However, the new designs produce some new problems, such as, false alarms which led to the turning off of the same, and resulting in the under-trust or disuse of automation, even though it is well known that aided performance is safer than unaided performance.

*(3) UNSAFE SUPERVISION*

The supervisors of an organization inevitably influence the condition of the aircrew and the environment in which they operate. Wiegmann and Shappell have identified four categories of unsafe supervision,

namely, *Inadequate Supervision, Planned Inappropriate Operations, Failure to Correct Problem*, and *Supervisory Violations*.

a) *Inadequate Supervision*

A supervisor is expected to provide leadership, guidance, advice, training, oversight, incentive, assistance and the like to ensure those working under him/her can get the job done efficiently and safely. In the context of aviation, suitable and adequate CRM training is essential. And thus, proper supervision that such opportunity was offered to each member of the crew to enhance coordinate skill and ability to tackle emergencies is part and parcel of the risk management.

Examples of inadequate supervision may include, failure to provide oversight or guidance, failure to provide suitable or adequate training to those working under him, failure to provide update information, technical knowledge, data or publications, failure to provide suitable practice and procedure for the job, failure to allow adequate rest in the roster system, failure to track qualifications/performance, failure to implement organizational policy, failure to assert authority, engaging untrained/over-tasked/unqualified supervisors, lack of supervisory situational awareness and lack of accountability to the management.

b) *Planned Inappropriate Operations*

Scheduling of aircrew in different flights is part of the routine work

of supervisors. Mismatch of aircrew in the cockpit has accounted for a number of tragedies.

As the result of globalization, commercial airlines have to engage for employment pilots from different parts of the world to cope with the expansion of their fleet. For multi-national crew coming from different cultures can present a very real problem on the flight deck. As such, the aviation industry is exposed to the full range of cultures on a daily basis, which ultimately affects the way it functions, and in particular, impinges on the issue of safety.

Crew Resource Management highlights primarily three main aspects of behaviour that are vital to safe flight deck operation, namely, *command, control* and *communication*. The need for effective command and control dictates that communication gradients should not be perfectly flat, otherwise there will be no leader, and yet the need for open communication requires the communication gradient not being too steep, otherwise it may delay, or even prevent, the effective flow of information which may be time or safety critical, especially in an emergency.

In the CRM training, just like any training programme, it must meet the need of the organisation/company. An imported Western programme, however successful in its home country, may not be suitable when the cultural makeup of the organisation and the country is not addressed. It is necessary to identify the cultural similarities and from there, one may build relationship and trust and take into account the relevant cultural differences. From such

a recognition of the differences, one can further ascertain the strengths and weaknesses so that one may modify and adapt the training curriculum for each organization, taking into account their organizational and national cultures to enhance safety, promote, efficiency of teamwork and avoid cultural mismatch.

Common planned inappropriate operations include cultural mismatch of aircrew, failure to provide suitable CRM programme, failure to adequate briefing, excessive allocation of workload and toleration of risk outweighing benefit.

c) *Failure to Correct Problem*

The third category of unsafe supervision is the supervisor's failure to correct known problems.

If the supervisor knew that a pilot was incapable of flying safely, but yet continued to allow the pilot to fly and failed to correct his behaviour or poor flying habits through remedial training, or temporary suspension of his flight status, is in effect fostering an unsafe atmosphere, and, at the same time, promoting directly or indirectly the violation of rules or discipline. Typical examples of this category include failure to correct inappropriate behaviour, failure to identify risky behaviour/habits, failure to rectify such safety hazards, failure to report the management unsafe tendencies of staff and failure to initiate measures to enforce safety standards.

d) *Supervisory Violations*

Supervisory violations are instances where existing rules and

regulations are wilfully disregarded or ignored by supervisors. Such practices do exist, although relatively rare in the real world. They include authorising unqualified aircrew for flight, wilful disregard of authority by supervisors, failure to observe and enforce rules and regulations, authorising flight by aircrew not current on type, enduring violated procedures, allowing inadequate documentation of job by subordinates, accepting forged documentation and failure to keep the management informed of the unsatisfactory operations.

*(4) ORGANIZATIONAL INFLUENCES*

The decision of the upper level management would directly affect the supervisory practices and attitudes below. This is most often where the most elusive latent failures are cultured and lurking in the system. They would not be noticed easily by accident investigators. It revolves around issues in relation to *Resource Management*, *Organizational Climate*, and *Organizational Processes*.

a) *Resource Management*

Corporate decisions at top managerial level control the allocation and management of all the assets of the organizations, such as, human resources, financial resources, facilities, equipments, and the like. The management has to strike a balance between two conflicting objectives of the operation:

(i) a safe operation; and

(ii) a cost-effective, reliable and on-time operation.

If the organization has plentiful financial resources, it is not

difficult to achieve a balance. However, difficulties start to surface when there is an economic downturn. Excessive cost-cutting would sacrifice staff training, have reduced funding for new equipment, lack of quality replacement parts for existing aircraft and supporting equipments or instruments. Factors that would adversely affect safety include selection of less qualified staff, reduction of manpower, reduction of staff training, omission of background checks on staff recruited, excessive cost-cutting, lack of required funding, selection of aircraft with less advanced models with poorer cockpit designs, purchase of inferior equipments and failure to correct known engineering or design flaws in the fleet.

b) *Organizational Climate*

Organizational climate can be considered as the working atmosphere within the organization. An organization's climate can be reflected in its *structure* in terms of the chain-of-command, delegation of authority, communication channels, and formal accountability for actions.

The *policies* adopted by a company are the official guidelines directing the decisions of the management, such as those for hiring and firing, promotion, retention, sick leave, control on use of drugs and alcohol, internal review of incidents/accident, and the like, to the day to day operation of the organization.

"Unwritten policies", however, is exactly what the investigation is required to find out about the organization, which would most

likely bring investigators clues to the accident.

Corporate *culture* is also an important variable related to organizational climate.

Hofstede (1980) defines culture as "the collective programming of the mind which distinguishes the members of one state from another, ... and culture is to a human collectivity what personality is to an individual."

Robert Moran (1987) said that culture "distinguishes people in one locality from another, that it exists not only between countries, but also within countries, between regions, social classes, generations, sexes, occupations and organisations. Culture influences and conditions the way a person *perceives* reality, selects certain aspects of reality and gives them meaning. Culture includes a value system which affects our *priorities* and therefore the *decisions* we make".

Within an organization, it is the senior management who plays the key role in shaping the organizational culture by influencing the management practices that are noted and followed by its workforce, and in particular, the perception and importance of safety and its enhancement in commercial airlines. Organizational culture varies in each organization/company.

Reason (1993) defines corporate culture as "... the set of unwritten rules that govern acceptable behaviour within and outside the organization. It emanates from the strategic apex of the company and colours all of its activities."

Mitroff and Kilman (1984) define organizational culture as "... a set of shared philosophies, ideologies, values, beliefs, expectations, attitudes, assumptions, and norms".

Jackson (1960) states that "cultural norms refer to the set of unwritten rules that guide behaviour", which is rather close to Reason's definition.

c) *Organizational Process*

This category refers to corporate decisions, rule and regulations that govern the day to day activities within an organization, which include establishment and use of standard operating procedures, operational timeframe/pace, incentives to staff, application of quotas, setting of schedules, keeping track of performance standards, clarity of defined objectives, instructions on procedures, maintaining checks and balances (oversight) between the workforce and management, establishment of risk management programmes and management of resources, climate and the said processes for monitoring a safe work environment.

*(5) CONCLUSION*

Reason's "Swiss cheese" model provides a general comprehensive theory of human errors and accident causation, whilst the HFACS was designed to define the "holes in the Swiss cheese" and to facilitate the application of this model to accident investigation and analysis by accident investigators in a real world. HFACS is summarized in *Figure 4*.

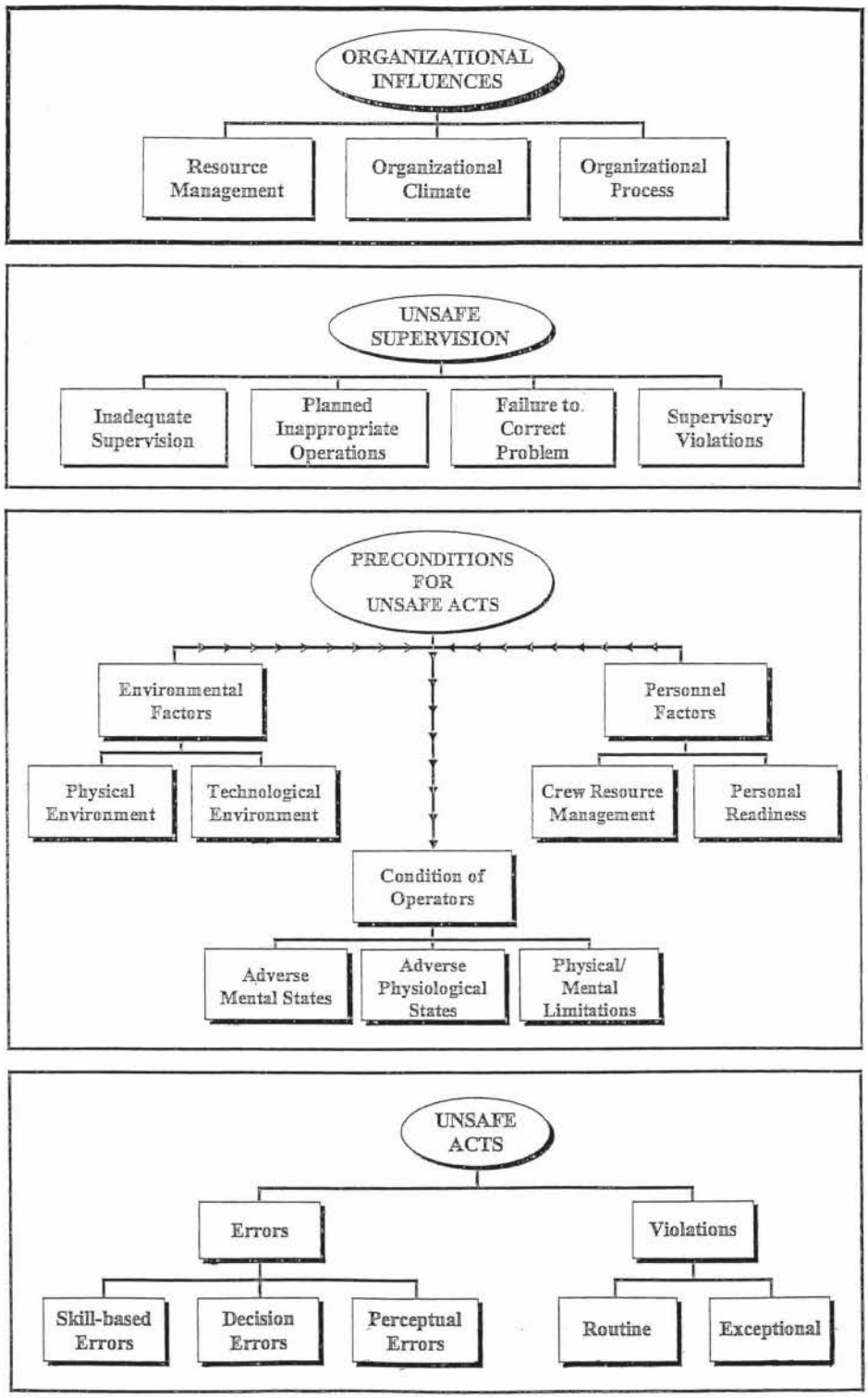


**Figure 4 The Human Factors Analysis and Classification System (HFACS)**
**(Source: Shappell and Wiegmann, 2003)**

In the latter part of this study, it will be demonstrated how HFACS can be used and applied to investigation and analyse aviation accidents, or even a hotel burglary within its safe deposit room as a result of the failures of the security system at different levels.

## [C] INCIDENT DECOMPOSITION

In Oliver Sträter and Van Damme model, they laid more emphasis on the safety of technical systems and developed an Incident/Event Decomposition method for the analysis of human factors in the Air Traffic Management ("ATM") environment. According to Sträter, human errors begin to exist in any design stage, from conceptual development and prototyping, design, validation to implementation of the system.

Going beyond the operational level of the staff at the frontline using the technical system, one must look at other levels to ascertain where the latent failure lies.

a) *Operational level*

This is what Reason called "active errors". The staff on this level actual operates the technical system and directly deals with it. The operational staff are not necessarily responsible for the errors generated.

b) *Maintenance level*

The staff who maintain the technical system may induce errors which hide in the system, not being apparent, for some time. This is what Reason referred to as latent errors.

c) *Design level*

Errors in design can be serious, they may remain latent in the system and not easily corrected without invoking substantial costs.

d) *Organizational level*

The staff on this level are employed either at supervisory or managerial levels and organise and arrange tasks at the operational level. They may be the decision-makers in control of the resources and in the position to influence safety and effectiveness.

e) *Regulator's level*

The people who regulate the use of the system. There may be extensive regulations adopted by the regulator, who may be government departments, setting the requirements to assure the systems and the staff involved required to meet the safety operation standards, for example, the licensing of Air Traffic Controllers. The regulations may introduce certain errors leading to unnecessary burdens on the frontline operators, and thus indirectly causing their active errors.

f) *Event decomposition illustrated*

In the Air Traffic Management system as shown in *Figure 5*, the event decomposition shows the information flow and communication within an event. It reflects the dependencies between different persons involved, either as persons initiating the event (be that a latent or active error) or those involved for potential recovery actions. In the situation outlined in *Figure 5*, a maintenance person has wrongly updated software versions for the Flight Data Processing ("FDP") system. The air traffic radar controller in co-ordination with the tactical controller

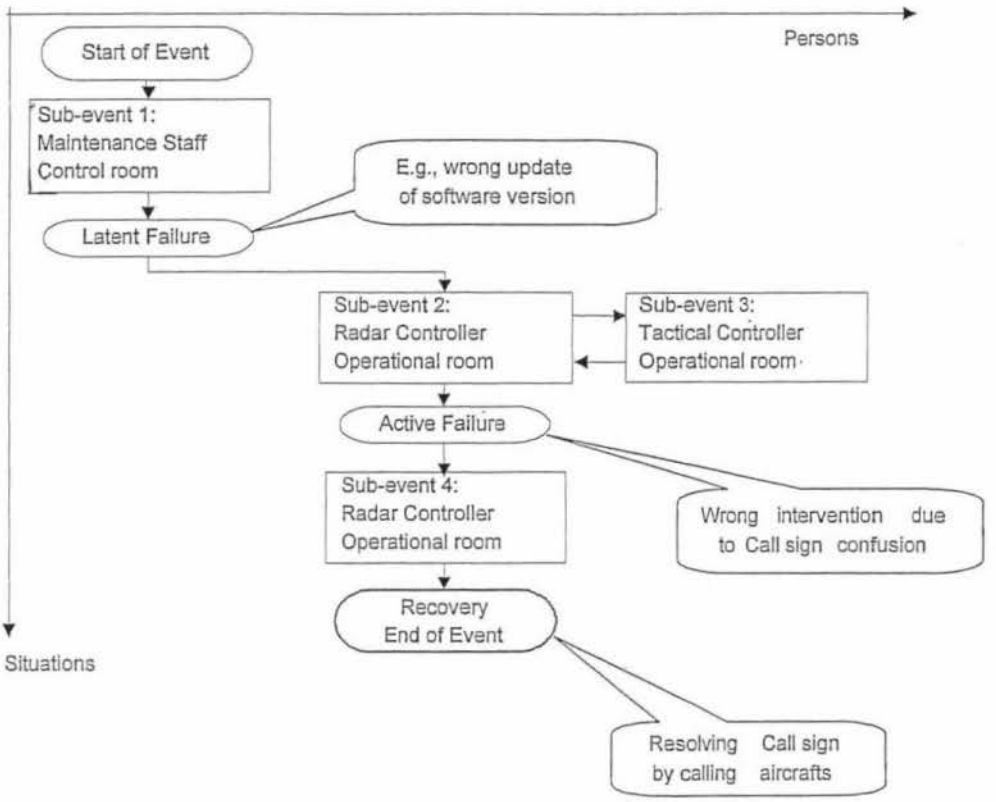


**Figure 5 Event decomposition**
**(Source: Sträter, 1997)**

performs his or her normal activities/duties and is not being able to identify or detect the latent failure in the system. An event causes the latent failure to turn into an active failure such as in making the wrong intervention due to a callsign confusion. Finally the radar controller realises the problem and successfully resolves the callsign problem by calling the different aircraft involved in the callsign confusion and rectifies the mistake.

## [D] HEURISTIC TEMPLATE APPLICABLE TO ACCIDENT / INCIDENT INVESTIGATION

Aviation is not the only industry in the search for deeper roots to accident causality. Recognised merits of the approaches to human errors discussed above can be found in reports of well-known tragedies in different parts of the world.

Although the different types of errors are not exhaustive, depending very much on the nature of the incident/accident, to a certain extent a heuristic template, can be generalised from the aviation situations giving the questions an accident investigator should look at in any type of accident/incident investigation, albeit certain elements/factors are more relevant than the rest. Appendix A is an attempt to provide a checklist for the accident investigator which may serve as a heuristic template applicable to most, if not all, accident/incident investigations.

# CHAPTER IV

# APPLICATION OF ANALYSIS TOOLS

## [A] INTRODUCTION

In the previous chapter, the analysis tools of Reason, Shappell, Wiegmann, Sträter and Van Damme and how they may be generalised for application in accident/incident investigations have been studied.

In this chapter, it will be illustrated how the analytical tools may be applied to an investigation in a burglary, which took place in the safe deposit room of a hotel in Hong Kong, for the purpose of ascertaining the active and latent errors in the security system of the hotel.

## [B] FACTUAL BACKGROUND

Mr. X was a gemstone dealer from abroad for a jewellery fair held in Hong Kong between the 17th and 21st September. He stayed at a hotel ("the Hotel") and deposited his gemstones into three separate safe deposit boxes numbered 1, 2 and 3 at the Hotel's Front Desk. During the Fair, Mr. X removed all his gemstones from the Hotel's safe deposit boxes to the store room of the Fair venue. Upon conclusion of the Fair on the 21st September, Mr. X packed all his unsold gemstones from his booth and re-deposited them into the Hotel's safe deposit box number 1 at 18:00 hours kept in the safe deposit room of the Hotel. The safe deposit room was at all material times under the control of the Hotel.

At 17:00 hours on the following day (22nd September), a Front Desk staff

found that safe deposit box number 1 was prized open. A report was then made to the management of the Hotel.

The tape of the closed-circuit television ("CCTV") revealed that an unknown male ("WP1") entered the safe deposited room between 21:10 and 21:14 on the 21st September. He squatted in front of safe deposit box 1 and finally took away the inner metal box containing the contents from the safe deposit box 1.

The police took over the investigation on the 23rd September. Further enquiry revealed that an in-house guest ("WP2") had last used a safe deposit box at 21:07 hours on the 21st September, and then he, together with four accomplices engaged all Front Desk staff for inquiry during the period of offence. WP2 was suspected to have kept the access door to the safe deposit room open after use to allow WP1 to enter. WP2 then proceeded to distract the Front Desk staff with his accomplices to enable WP1 to break open safe deposit box 1 and steal its contents. WP2 then varnished without checking out with the Hotel.

The safe deposit room was situated behind the Front Desk staff with a wall separating the Front Desk and the safe deposit room. The Front Desk staff may have access thereto through a door at one end.

The individual safe deposit boxes were housed in built-in metal cabinets mounted against the wall of the safe deposit room.

At the other end of the safe deposit room, there were two separate counters

at which customers deposited and withdrew contents of their safe deposit boxes in the presence of the staff of the Front Desk. There was no security bar or separation over the counter to stop customers from jumping over the two counters into the safe deposit room. There was a door behind each counter leading to the Hotel lobby. Each door was operated by a door opening switch button under the said counters by the Front Desk staff.

Safety professionals, investigators and lawyers were engaged to ascertain the causation of breakdown of the security system of the Hotel which resulted in the burglary.

## [C] HUMAN FACTORS ANALYSIS USING ANALYSIS TOOLS

There are many ways to conduct an analysis, however, it is usually best to begin as investigators do at the scene, and work backwards in time from the incident/accident, and conduct the analysis systematically.

The hindsight being, what the Front Desk staff should have done was to leave at least one person at the safe deposit room, and to keep the access door to the safe deposit room closed at all times save and except for authorised entry and exits.

### *(1) UNSAFE ACTS OF OPERATORS*

The unsafe acts of the frontline personnel of the Hotel include the negligence of the Front Desk staff in failing, to keep at least one person at the safe deposit room on guard, failing to keep the access doors to the safe deposit room closed at all times, save and except for authorised entries and exists. Such failure may be routine or exceptional. He

also failed to prioritize their work properly so as to avoid diversion of all their attention to customer enquiries, and to keep an eye on the television screen connected to the closed-circuit video camera on the activities of the safe deposit room.

Besides the Front Desk staff, it is necessary to investigate whether any security guard was guarding the two access doors to the two counters of the safe deposit room. If he was on duty, he had failed to keep the two access doors closed at all times after departure of customers from the safe deposit counters, stop people who were not authorised by the Front Desk staff to gain entry to the safe deposit counters through the said two access doors and keep vigilance during the night shift.

*(2) PRECONDITIONS FOR UNSAFE ACTS*

It is quite obvious here that there were adverse mental states among the Front Desk staff on the day of incident.

There was loss of situational awareness that there was at least a customer using the safe deposit box service and customers at the Front Desk making enquiries at the same time.

Distraction of attention by the thieves and their accomplices is commonly used in burglary. Task saturation was also one of the problems. It was not disclosed exactly how many employees were on duty at the Front Desk, since they were entrusted with the operation of the safe deposit room and Front Desk customer services, it appeared that they were over-saturated with multi-tasks, channelized attention to customer enquiries and forgetting about the safe deposit box operation completely at the material time resulted in the lack of vigilance over the

safe deposit room activities.

There was a lack of teamwork co-ordination. If certain member(s) of the team at the Front Desk had to answer enquiries of customers, at least one of the members should keep watch over the safe deposit room and those using safe deposit box services. There might be lack of briefing before commencement of work, or lack of leadership within the team, or simply no one was leading the team. Members of the team might perhaps do whatever they chose to do without an understood division of labour as a result of poor human resource management.

The lighting of the safe deposit room requires investigation. If it is too dim, it would make surveillance through the video camera difficult. The Front Desk staff might not be able to see clearly on the television screen as to what was happening in the safe deposit room.

Whether there was an alarm system in place in the safe deposit room is an item of inquiry. If it was installed, was it switched on at the material time? If not, why not? Was the security guard properly trained? Did the guard fully understand his/her role? These questions are required to be answered and the explanation would reveal the underlying problems.

*(3) UNSAFE SUPERVISION*

A burglary could have occurred within the Hotel's safe deposit room and remained undetected for almost twenty hours after the incident is alarming. It reflects serious latent errors within the system at the supervisory and managerial levels. It can be seen that the latent errors lie in at least the following areas or aspects: (a) failing to provide

adequate or suitable training to the Front Desk staff on how to prioritize their work, failing to brief and direct the Front Desk staff that at least one person should keep watch in the safe deposit room, and in particular, while the safe deposit services were being used by customer; (b) failing to arrange sufficient numbers of security guard(s) to guard the two access doors leading to the safe deposit counters; (c) failing to convey to the management that it was a security hazard for not installing any partition or security bars over the two counters of the safe deposit room for prevention of unauthorized person(s) from jumping over the safe deposit counters directly into the safe deposit room; (d) failing to devise a system which could only allow authorized entry through the two access doors to the safe deposit counters; (e) if a security alarm system was in place in the safe deposit room; (f) failing to oversee the proper use and/or maintenance of it; (g) if no security alarm system was in place, failing to convey to the management that such a system should be installed in the safe deposit room and failing to provide or arrange sufficient manpower to handle both safe deposit service and Front Desk enquiry service concurrently.

*(4) ORGANIZATIONAL INFLUENCES*

At the managerial level, managers' and directors' liability cannot be exonerated either. It is quite obvious that their policies and/or decisions carried quite a number of latent errors or failures which nurtured the conditions for such burglary.

In this analysis, the first matter to be addressed is whether it was a

correct decision to provide security deposit service to the Hotel's customers in the first place. A lot of matters had to be carefully considered before that decision was made. That begged the following questions:

- Had any qualified architect been consulted to advise on the structure and design of a safety deposit room in the Hotel?
- What were the security measures to be incorporated at the design stage?
- What were the materials to be used in the construction of the same?
- Had any security alarm system expert been consulted on the design of such system for the safe deposit room?
- What were the special features or characteristics of such an alarm system? Did they serve the Hotel's purpose?
- Would the suitable system be too costly for the Hotel, and a result, an inferior system chosen?
- Who was maintaining the security alarm system?
- Were the engineers qualified and equipped with the required technical knowledge, experience and expertise to do the maintenance on both the hardware and software?
- Did the Hotel have financial resources to budget for the construction of such a safe deposit room, the installation and maintenance of such alarm system?
- If not, what had been compromised?
- Did the Hotel have a standard risk management policy for

acceptance of valuables for storage in its safe deposit boxes?

- Were there any standard procedures formulated for the storage of valuables for customers?
- Were standard instructions given to the supervisors and frontline personnel?
- Were there any procedures for internal review of incidents/accidents within the Hotel?
- Did the management keep track of the performance record of the supervisors and frontline personnel?
- What were their guidelines for hiring, firing and promotion?
- What were the "unwritten policies" perceived by the staff of the management?

## [D] CONCLUSION

If the burglary is analysed along the lines discussed above systematically, the clues to unearth the true causation of the incident would soon surface. The draftsman of the Statement of Claim on the Particulars of Negligence, and causation of the incident/accident would certainly find the job easier and would not have to rely on the doctrine of *res ipsa locquitur*[1] so often.

[1] For the plaintiff to discharge the burden of proof, it is usually necessary for the plaintiff to prove specific acts or omissions on the part of the defendant which will qualify as negligent conduct. Sometimes, however, the circumstances are such that the Court will be prepared to draw an inference of negligence against the defendant without hearing detailed evidence of what he did or did not do. The principal requirement is that the mere fact of the accident having happened should tell its own story and raise the inference of negligence so as to establish a prima facie case against the defendant. The story must be clear and unambiguous.

# CHAPTER V

# CASE STUDY on

# WHY CHINA AIRLINES' CI 642 CRASHED

# at HONG KONG INTERNATIONAL AIRPORT (1999)

## [A] INTRODUCTION

It can be seen in subsequent chapters, error is the result of an alignment of conditions and occurrences, each of which is necessary, but none alone sufficient to cause the error. That alignment of factors creates error-provoking conditions affecting the context in which an incident/accident occurs.

In this chapter, the accident to Boeing MD-11 B150 at the Hong Kong International Airport on the 22nd August 1999 (China Airline's flight CI 642) ("the Accident") which was scheduled to operate from Bangkok to Taipei with an intermediate stop in Hong Kong will be studied. As a result of the Accident, three passengers died and two hundred and nineteen persons (including passengers and crew members) were admitted to hospital, with fifty suffering from serious injuries and the remainder sustaining minor injuries.

The study will focus on the *active errors* and *latent organizational failures* of this accident basing on the Report of the Board of Review (November 2004) made pursuant to Civil Aviation (Investigation of Accidents) Regulations, Cap.448 of the Laws of Hong Kong, and the Report of the Civil Aviation

Department of Hong Kong (Accident Investigation Division) Aircraft Accident Report 1/2004 (December 2004), and on that basis, recommendations will be proposed for China Airlines and other organizations concerned.

## [B] AIRCRAFT ACCIDENT INVESTIGATION IN HONG KONG

In Hong Kong, aircraft accident investigation is conducted by the inspectors of the Civil Aviation Department ("CAD") with reports being compiled and made public. Regulation 4 of the Hong Kong Civil Aviation (Investigation of Accidents) Regulations, Cap.448 ("the Regulations") provides that "The fundamental purpose of investigating accidents under these regulations shall be to determine the circumstances and causes of the accident with a view to the preservation life and the avoidance of accidents in the future; it is not the purpose to apportion blame or liability."

Under Regulation 17, where it appears to the Chief Executive that it is expedient in the public interest to hold a public inquiry into the circumstances and causes of an accident to which these regulations apply or into any particular matter relating to the avoidance of such accidents in the future, he may appoint a commission of inquiry for that purpose, which shall consist of: (a) a District Judge or magistrate; and (b) not less than two assessors, each of whom shall possess an aeronautical or aeronautical engineering qualification or some other special skill or knowledge which is relevant to the conduct of the inquiry.

In the case where any person's reputation, or the reputation of the person on

whose behalf representations have been made in the CAD Inspector's investigation, is likely to be adversely affected by the findings and conclusions in the report, he may demand a review by a Board of Review, which shall consists of:

(a) a magistrate, a legal officer within the meaning of the Legal Officers Ordinance, or a barrister, or solicitor of not less than five years practice, who shall be the chairman of the board; and

(b) one or more assessors, each of whom shall possess aeronautical or aeronautical engineering qualifications or some other special skill or knowledge which is relevant to the conduct of the review.

The Inspector of CAD compiled a draft report on the Accident which sets out, *inter alia*, an analysis of the relevant facts and the Inspector's conclusions as to the causes and probable contributory causes of the Accident.

Pursuant to Regulation 11(1) of the Regulations, a notice enclosing the said draft report was served on the following interested parties:

- National Transportation Safety Board ("NTSB");
- Boeing Commercial Airplane Group (as manufacturer) ("Boeing");
- China Airlines (as airline operator);
- Hong Kong Observatory ("HKO");
- Hong Kong Airport Authority ("HKAA");
- Captain Gerardo LETTICH, commander of CI642;
- Captain LIU Cheng Hsi, co-pilot of CI642.

The Regulations provide that the subject matter of review by the Board of Review can only be in relation to "*the findings and conclusion*" which may

likely affect the reputation of the applicants adversely. The *locus standi* of those entitled to serve a notice of review is further restricted, according to Regulation 11(1), to interested parties such as the commander, operator, or "*any person whose reputation is, in the Inspector's opinion, likely to be adversely affected by the report of CAD.*"

Both China Airlines and the then co-pilot Captain LIU Cheng Hsi of CI642 (collectively as "CAL") respectively served a Notice of Review on the Director-General of Civil Aviation. The Board of Review ("the Board") also directed that in addition to CAL, the following parties be granted leave to participate in the review hearing:

- Captain Gerardo LETTICH ("the Commander");
- HKAA;
- HKO; and
- Boeing.

Therefore, there are two reports, one prepared by the Board of Review dated November 2004, and the CAD's final report dated December 2004, on the Accident.

## [C] THE ACCIDENT (FACTUAL HISTORY OF THE FLIGHT)

China Airline's flight CI642 was schedule to operate from Bangkok to Taipei with an intermediate stop in Hong Kong. The crew was aware of the Severe Tropical Storm ("STS") '*Sam*' approaching Hong Kong and the possibility that it would be in the vicinity of Hong Kong at about the scheduled time of arrival on the following evening. Weather information provided at the preflight briefing for the return flight indicated the

continuing presence of STS 'Sam' with its associated strong winds and heavy precipitation. The flight departed from Bangkok on schedule with three hundred passengers and fifteen crew on board, with an estimated time of arrival (ETA) of 1038 hour in Hong Kong. The Commander had elected to carry sufficient fuel to permit a variety of options on arrival: to hold; to make an approach; or to divert to another city. If an immediate approach was attempted, the aircraft would be close to its Maximum Landing Weight ("MLW") involving, in consequence, a relatively high speed for the approach and landing.

Throughout the initial stages of the flight and during the cruise, the Commander was aware of the crosswind component to be expected in Hong Kong and reviewed the value of wind direction and speed which would bring it within the company's crosswind limit, as applicable to wet runways, of *24 knots*.

In the latter stage of the cruise, the crew obtained information weather information 'Whisky' from the Automatic Terminal Information Service ("ATIS") timed at 0940 hour., which gave a mean surface wind of 320° degree ( ° ) / 30 knots, maximum 45 knots in heavy rain, and a warning to expect significant wind shear and severe turbulence on the approach. Although this gave a crosswind component of 26 knots, which was in excess of the company's wet runway limit of 24 knots, the Commander was monitoring the gradual change in wind direction as the storm progressed, which indicated that the wind direction would possibly shift sufficiently to reduce the said component and thus permit a landing as scheduled. Hong

Kong Area Radar Control issued a descent clearance to the aircraft at 1014 hours and, following receipt of ATIS information one minute later. A mean surface wind was at 300° at 35 knots, descent commenced at 1017 hours.

The approach briefing was initiated by the Commander just after commencing descent. The briefing was given for an Instrument Landing System ("ILS") approach to Runway 25 *Right* ("RW25R") at Hong Kong International Airport ("HKIA"). However, the active runway, as confirmed by ATIS was RW25 *Left*. Despite the inclusion in the ATIS broadcasts of severe turbulence and possible windshear warnings, no mentioned was made in the briefing of the Commander's intentions relating to these significant weather phenomena nor for any course of action in the event that a landing could not be made, other than a cursory reference to the published missed approach procedure.

The descent otherwise continued uneventfully and a routine handover was made at 1025 hour to Hong Kong Approach Control which instituted radar vectoring for an ILS approach to what the crew still believed was RW 25R. At 1036 hour, after having been vectored through the RW 25L localiser for spacing, CI642 was given a heading of 230° to intercept the localiser from the right and cleared for ILS to RW 25L. The co-pilot acknowledged the clearance for ILS 25L but queried the RVR (runway visual ranges); these were passed by the controller, the lowest being 1300 m at the touchdown point. The commander then quickly re-briefed the minimums and go-around procedure for RW 25L.

At 1038 hour, about 14 nautical miles (nm) to touchdown, the aircraft was transferred to Hong Kong Tower and told to continue the approach. At 1041 hour, the crew were given a visibility at touchdown of 1600m and touchdown wind of 320° at 25 kt gusting 33 kt, and cleared to land.

The crew of flight CI642 followed China Airline's standard procedure during the approach. Using the autoflight modes of the aircraft, involving full use of autopilot and autothrottle systems, the flight progressed along the ILS approach until 700 ft where the crew became visual with the runway and approach lights of RW 25L. Shortly after this point the commander disconnected the autopilot and flew the aircraft manually, leaving the autothrottle system engaged to control the aircraft's speed.

After autopilot disconnect, the aircraft continued to track the runway centerline but descended and stabilized slightly low (one dot) on the glideslope. Despite the gustiness of the wind, the flight continued relatively normally for the conditions until approximately 250 ft above the ground at which point the co-pilot noticed a significant decrease in indicated airspeed. Thrust was applied as the co-pilot called 'Speed' and, as a consequence, the indicated airspeed rose to a peak of 175 kt. In response to his speed in excess of the target approach speed, thrust was reduced and, in the process of accomplishing this, the aircraft passed the point (50 ft Radio Altitude ("RA") at which the autothrottle system commands the thrust to idle for landing.

Coincidentally with this, the speed decreased from 175 kt and the rate of

descent began to increase in excess of the previous 750-800 feet per minute (fpm). Although an attempt was made to flare the aircraft, the *high rate of descent was not arrested*, resulting in an *extremely hard impact* with the runway in a slightly right wing down attitude (less than 4°), prior to the normal touchdown zone. The right main wheels contacted the runway first, followed by the underside of the right engine cowling. The right main landing gear collapsed outward, causing damage to the right wing assembly, resulting in its failure. As the right wing separated, spilled fuel was ignited and the aircraft rolled inverted and came to rest upside-down alongside the runway facing in the direction of the approach.

The cockpit crew were disorientated by the inverted position of the aircraft and found difficulty in locating the engine controls to carry out engine shut down drills. After extricating themselves, they went through the cockpit door into the cabin and exited the aircraft through L1 door and began helping passengers from the aircraft through a hole in the fuselage. Airport fire and rescue services were quickly on the scene, extinguishing the fuel fire and evacuating the passengers through the available aircraft exits and ruptures in the fuselage.

As a result of the Accident, two passengers were found dead on arrival at hospital, and six crew members and forty-five passengers were seriously injured. One of the seriously injured passengers died five days later in hospital. Six crew members were seriously injured and nine sustained minor injuries.

## [D] FLIGHT CREW HISTORIES

It is worth noting the background of the Commander and the co-pilot at this point for the analysis and recommendations to the airline for future accident prevention and ways to enhance systemic safety.

The Commander joined China Airlines in May 1997 as a MD-11 line captain following his retirement from a major European national airline, where he had been an instructor pilot on MD-11 aircraft. He had a total of 2,300 hours as Commander on the MD-11 aircraft.

Following a simulator course and an abridged line training course, the Commander was cleared to fly the MD-11 as a fully qualified line captain. After two years in this capacity, he underwent a simulator training course to qualify as a line instructor on the MD-11 and satisfactorily completed this training at the end May 1999. Throughout his periodic sessions of training and checking, only minor comments were made on his ability and he was generally awarded an 'average' grading. Earlier in August 1999, the Commander underwent annual training in Cockpit Resource Management (CRM).

The co-pilot joined China Airlines as an *ab initio* entrant in May 1989. Following three years of training in the United States, he graduated as a commercial pilot and commenced a training course with China Airlines as a co-pilot on B737 aircraft. This was successfully completed in September 1992. In November 1994, he commenced a transition course on the MD-11 at the manufacturer's facility in Long Beach, California and qualified as a

co-pilot in March 1995. More recently, in November 1998, he qualified as an in-flight relief captain enabling him to act as relief Commander whilst in the cruise on long haul flights.

The co-pilot's ability was classed as 'average' throughout his career with China Airlines, with no adverse comments on his training records. Approximately one month prior to the accident, the co-pilot also underwent annual CRM training.

Both pilots underwent windshear training in the course of recurrent simulator training/checking.

## [E] ANALYSIS

The CAD Inspector combined eye witness reports, recorded data, crew interviews and wreckage analysis to reconstruct the process which led to the accident. Factors which may have contributed to the Accident are identified.

1) In the analysis, CAD considers that there are human factors aspects in the late and sporadic crew briefings for the approach, including reference to the wrong runway, albeit they are not considered to have contributed directly to the Accident.

2) On the final approach, the Commander disconnected the autopilot to fly the aircraft manually but kept the Autothrottle System ("ATS") engaged, in accordance with normal MD11 operating philosophy. The Commander also used the basic crosswind approach technique described in the MD11 Standard Operational Procedure ("SOP").

The Commander's crosswind approach technique is therefore not considered to be contributory to the Accident by the CAD Inspector.

However, the aircraft's loss of 20 kt indicated airspeed below 50 feet Radio Altitude, consequent upon a loss of headwind component due to the varying wind conditions and the early retardation of the thrust levers, would have resulted in a significant decrease in lift at a critical stage of the approach; this could only be compensated for by a marked increase in pitch attitude, thrust, or a combination of both. The recommended change in pitch attitude of 2° in the MD11 SOP was NOT sufficient to successfully flare the aircraft from its increasingly high rate of descent.

3) The weather conditions associated with STS 'Sam' made approaches to HKIA difficult during the afternoon and early evening of 22nd August 1999. Strong turbulence, possible windshear and heavy rain all added operating flight crew workload. In consequence, of *twenty-six approaches* flown in the period of 3.75 hours up to the accident, *ten* resulted in *go-arounds* as a result of the weather conditions. The CAD considered the prevalent weather conditions are possible contributing factors to the Accident.

4) The Approach Briefing was closely examined by the Inspector. The "Preparation for Descent Procedure" crew briefing was not initiated until just after descent was commenced. It should have started at the end of the cruise phase of the flight while workload was low.

The briefing by the Commander became disjointed, inaccurate and incomplete owing to increasing workload arising from a combination of factors including observance of descent constraint, radio communications and weather avoidance. Items referring to alternate airport, transition level, minimum safe altitude ("MSA"), field elevation, and aircraft go-around procedure (as opposed to the ATC missed approach procedure) were not included in the briefing.

CAD concluded that the inadequate approach briefing did not make a direct contribution to the accident, but did *reflect negatively* on the Commander's attitude towards *cockpit resource management*.

5) The control of power on the approach was carefully scrutinised by the Inspector. The Commander determined that the final approach speed should be 170 kt. He elected to retain the use of the Autothrottle System ("ATS") throughout the approach. As a response to the increase in speed to 175 kt at about 120 ft above ground level, the ATS had begun to retard the thrust, the throttles reaching the idle position by about 70 ft, so that the aircraft entered the flare with *power already at, or near flight idle*.

Therefore, the *Commander's failure to override the ATS and apply power* was a contributory factor to the aircraft's *high rate of descent at touchdown*, and thus to the Accident.

6) Regarding the *cockpit resource management*, the Inspector considered that there were three aspects of crew performance prior to

or during the approach which require comment, although they did not contribute directly on to the Accident. These were:

(a) the delay in completing the approach briefing;

(b) the co-pilot's provision of inaccurate information to the Commander during the approach; and

(c) the control of power on the approach.

In relation to Item (a), thorough planning and briefing is the key to a safe, unhurried, professional approach. It is normal airline practice to complete the approach briefing late in the cruise phase of the flight while crew activity is at a comparatively low level. Delaying the briefing into what might become a very busy descent negates the aims of the operational manual, and put undue pressure on the crew members prior to the commencement of a very demanding approach.

For Item (b), on two occasions, the pilot-not-flying, namely, the co-pilot, provided incorrect information to the Commander and unnecessarily added pressure to him as both the handling pilot and the aircraft commander. On the *first occasion*, ATIS provided information regarding the runway in use was RW 25L, but the co-pilot advised the Commander that the runway in use was RW 25R. This mistaken impression was maintained for some fifteen minutes of the descent and intermediate approach, and was only corrected when ATC radar vectored the aircraft for an ILS approach to RW 25L, which led to another hasty re-brief for the approach. On the

*second occasion*, the aircraft was at about 2,000 feet on the approach when the commander queried if the co-pilot was ready for a go-around and correctly quoted the initial go-around altitude as "*2000*'. To this, the co-pilot interjected '*actually 4500*', but the Commander insisted, correctly, '*2000 until 3 mile*', with which the co-pilot then concurred. These inaccurate interjections by the co-pilot detracted from the aim of a well coordinated crew performance, and came so soon (within one month) after he had completed CRM training, may have arisen from a misplaced interpretation of the role of the monitoring pilot.

In addition, after the co-pilot's call regarding the decreasing indicated air speed (IAS) (at approximately 250 ft above the ground), his attention was fixed *outside the cockpit* rather than continuing to monitor the flight instruments on an *instrument approach* to check the rate of descent and the air speed near the ground.

For Item (c), regarding the control of power on the approach, the Commander should be ready to intervene, or override manually the automated systems on the flight deck. The autothrottle system in the MD11 is a 'full-time' system capable of automatically controlling a variety of parameters of the flight's progress from the initiation of the take-off roll until 50 ft Radio Altitude on final approach, after which it remains armed but normally inactive unless the 'go-around' switch is pressed to discontinue an approach. The pilot may disconnect the system by simply pressing a button on the outside of

no.1 or no.3 thrust lever, or by selecting reverse thrust after landing. He may also intervene and adjust the thrust temporarily in flight by manually moving the thrust levers.

Whilst the operations manuals are not explicit regarding use of the autothrottle system, full time use of the system is known to have been encouraged by the manufacturer in the operation of MD11 aircraft, and also in that of its predecessor, the DC10. As in other areas of automation on the flight deck, this may encourage *over-reliance on the automated system*, to the point where the pilot may no longer be aware of the need to *intervene* when the system is either not coping with the operating conditions affecting the aircraft, or the operational situation is outside the system's design parameters. One of the pilots did intervene by advancing the thrust levers when the speed fell to 157 kt just below 250 ft; however, more critically, the Commander did not react to override the early retardation of the thrust levers and apply thrust to counteract the increasing rate of descent in the flare.

## [F] CAUSAL FACTORS OF THE ACCIDENT

The Inspector of the CAD concluded in his report that the causal factors of the Accident are probably the following:

1) The cause of the Accident was the Commander's inability to arrest the high rate of descent existing at 50 ft radio altitude.

2) Probable contributory causes to the high rate of descent were:

    (i) The Commander's failure to appreciate the combination

of a reducing airspeed, increasing rate of descent, and with the thrust decreasing to flight idle.

(ii) The Commander's failure to apply power to counteract the high rate of descent prior to touchdown.

(iii) Probable variations in wind direction and speed below 50 ft RA may have resulted in a momentary loss of headwind component and, in combination with the early retardation of the thrust levers, and at a weight only just below the maximum landing weight, led to a 20 kt loss in indicated airspeed just prior to touchdown.

3) A possible contributory cause may have been reduction in peripheral vision as the aircraft entered the area of the landing flare, resulting in the Commander not appreciating the high rate of descent prior to touchdown.

The Board of Review confirmed causal factors (1) and (2) (i), (ii), but rejected causal factor 2 (iii) as a possible significant contributing cause to the high rate of descent. And for causal factor (2) (i), the Board of Review took the view that it would be more comprehensive if it had also described the failure to mitigate the situation at the late stage of approach by considering other options available, such as *go-around.* The use of the term "*crew*" rather than "*Commander*" in the said paragraph would have been more appropriate.

In other words, the Board of Review attributed a possible causal factor of the

Accident to the *flight crew's (Commander and co-pilot) failure* to appreciate the combination of a reducing airspeed, increasing rate of descent, and with the thrust decreasing to flight idle, and the flight crew's failure to consider a go-around.

In causal factor (2) (ii), the Board of Review took the view that it could also have been expanded to describe the possible reasons behind the error judgment such as CRM issues, turbulence, crosswind technique and the auto-throttle override. The Board of Review was of the opinion that the Commander's crosswind technique was incorrectly dismissed as a factor in the CAD report.

## [G] RECOMMENDATIONS

In every accident, just as the one under study, usually there are active errors on the face of it and certain latent organizational failures, which were aligned and interacting together, leading to the accident concerned. In this regard, one shall go beyond the recommendations made by the CAD, but go deeper into the root of the problem and make recommendations for China Airlines and other organizations involved.

1) CRM Training

   a) China Airlines should review the syllabus of its CRM training course to ensure that contributions made by the monitoring pilot (co-pilot in this situation) in operational situations are both accurate and appropriate.

   b) The Commander is European, while the co-pilot is Taiwanese, in the CRM training, we have to take into account the underlying *cultural*

*assumptions* at the flight deck and design a suitable training strategy which would enhance safety and reduce cultural mismatch. In Hofstede's work, it showed that countries such as Taiwan, Hong Kong, Singapore and Malaysia, exhibit a high "Power-Distance". Social inequality is readily accepted. Leaders are expected to be decisive and subordinates are expected to know their place.

In the twenty two countries in the data collected in the University of Texas Aerospace Crew Research Project (Merritt, 1993, 1997; Helmreich and Wilhelm, 1997), the correlation between the Power Distance score for Hofstede's study and the Power Distance score for the pilots were + 0.77. Pilots in every country perceived that they work for a more autocratic or directive leadership (indicative of high power distance) than other occupational groups reported in Hofstede's earlier study.

CRM training highlights primarily three main aspects of behaviour that are vital to safe flight deck operation, namely, *command, control* and *communication.*

In China Airlines' CRM training, open communication would effectively improve flow information which may be time and/or safety critical especially in an emergency or a demanding approach to land. In the training, the monitoring pilot's role to provide correct information to assist the Commander should be re-enforced. However, on the other hand, it is also the duty of the co-pilot to challenge the Commander when things are not right and he should

be encouraged to express disagreement. In the Accident, the co-pilot was doing neither, he provided wrong information to the Commander on two occasions and increased his workload on a busy descent, and did not even suggest a go-around.

c) The Commander should be reminded in the training of the need for an early and complete approach brief during the last part of the cruise phase, rather than at the beginning of the descent when the workload would be comparatively higher.

d) In the MD11 training syllabuses, the crew monitoring the automated systems on the flight deck should be trained to be ready to intervene or override it manually, whenever necessary, such as the auto-throttle system on short final approach.

e) Regarding the techniques of crosswind landings, although the CAD report did not consider the Commander's crosswind landing technique a contributing factor to the accident. However, the Board of Review, after hearing the evidence of various experts, came to a different conclusion stating that the Commander's crosswind technique was probably a contributory factor. Therefore, in the regular CRM training, emphasis should be put on improving such landing skills. China Airlines should consider introducing a "Flight Instructor Guide" giving advice to training staff on techniques to be followed during crosswind landings.

f) China Airlines should re-emphasize to flight crews the need on instrument approaches, to continue to monitor the flight instruments in the final stages of the approach as prescribed in Flight Operations

Manual, rather than looking out of the cockpit window.

g) During CRM trainings, the flight crew should be encouraged to make decisions early at the appropriate time whether to go-around or divert to another aerodrome before the situation gets out of hand. The co-pilot should, as the monitoring pilot, advise the Commander decisively when they should go-around rather than taking the risk of landing while the option is still open to them.

h) Although neither the CAD report nor the report of the Board of Review touched upon the English proficiency of the two flight crews of the Accident. China Airline should consider the incorporation of English proficiency training in their CRM course for flight crew members whose native language is not English. The co-pilot in the Accident provided wrong information on two occasions, which may have a correlation with his English standard which led to the misinterpretation of what he heard from the radio (ATIS) and what he perceived from the Standard Operational Procedure regarding the altitude for a go-around.

2) Boeing's Standard Operational Procedure

Boeing should, with the assistance of China Airlines, amend their recommended procedures in the MD11 Standard Operational Procedure ("SOP") to include procedures for approaches and landings in more demanding and severe weather conditions.

3) Hong Kong Observatory ("HKO")

With reference to local wind effects, it is recommended that HKO should provide more and better information regarding the character of airflow in

the vicinity of the touchdown zone of RW25L, RW25R, RW07R and RW07L in conditions of STS, for the purpose of giving more detailed understanding of the wind conditions for all the four runways. Such knowledge is crucial to air traffic safety, particularly in inclement conditions similar to the situation of the Accident. I would, therefore, urge the HKO and the HKAA to work together to identify the most appropriate locations for installation of *more anemometers* for such purpose.

4) Hong Kong Airport Authority ("HKAA")

In none of the reports prepared by the CAD and the Board of Review was it ever mentioned or discussed a further probable layer of defence for the prevention of a similar accident at the Hong Kong International Airport, namely, the *closure of the runways* during STS coupled with severe wind conditions for a short period of time. The HKAA should establish a *warning system* to monitor closely the *crosswind component(s)* for the most favourable runway(s) in use during STS and keep statistics of the *number of go-arounds* for each period of, say, thirty minutes. If both the crosswind component(s) and the number of go-arounds are high within any thirty minute period a warning system should advise those in charge to have the runways closed until such time as the wind conditions have improved. After the installation of more anemometers to detect the wind conditions as recommended above, the HKO and HKAA should work closely with the airlines which are the most frequent users of the Hong Kong International Airport to design a warning system as a defence

to specify the conditions under which the runways must be closed to prevent any similar accidents.

Although any closure of the runways would have a short term impact on the revenue of the HKAA, the airlines and cause some inconvenience to users, it would at least assist the airlines and the pilot-in-command to decide whether to divert to another aerodrome or simply cancel the flight. It is risky to leave it entirely to the commander to make that important decision with so many lives at stake. In aviation, safety is always the top priority, and safety cannot be compromised at the expense of fiscal considerations or short term inconvenience.

5) Civil Aviation Authority ("CAD")

Regarding the recommendation to the HKAA on the conditions under which the runways must be closed, the CAD should, after consultation with HKAA, HKO and the commercial airlines who are the frequent users of the Hong Kong International Airport, consider the introduction of regulatory measures in relation to aircraft landings and closure of runways during STS, and in particular, with high crosswind component(s).

## [H] CONCLUSION

The investigation and review took more than five years to produce the two reports, one by the CAD and the other by the Board of Review after hearing and considering further evidence from the experts at the open court review hearing, all the efforts put into the investigations and the benefits gained from them proved to be worthwhile. The recommendations made to the

airline, the aircraft manufacturer, HKO, HKAA and the CAD will hopefully formulate a more coherent plan for regulators, service providers and operators at all levels to prevent similar accidents at our international airport during severe tropical storms which adversely affect Hong Kong from time to time during the summer and autumn.

# CHAPTER VI

# CASE STUDY on

# WHAT HAPPENDED TO HAWKER SIDDELEY TRIDENT 2E B-2218 AT HONG KONG INTERNATIONAL AIRPORT (1988)

## [A] INTRODUCTION

Human Factors analysis has only started to developed in the early 1990's. Before then, accident investigators were focusing on the unsafe acts and circumstances causing the incidents/accidents. In this chapter, the report[1] on the accident of the Hawker-Siddeley Trident 2E B-2218 ("the Trident") of the Civil Aviation Administration of China ("CAAC") at the Hong Kong International Airport at Kai Tak on the 31st August 1988 at 01:19 hours (UTC) in the morning of Hong Kong time will be studied. (All time quoted herein is based on Universal Time Co-ordinate at Greenwich).

The analysis tools back in the late 1980's were less sophisticated. With the benefit of the analysis tools discussed in the previous chapters, this accident will be revisited, and insofar as possible, additional analysis for probable contributing causal factors will be made.

## [B] THE ACCIDENT (FACTUAL HISTORY OF THE FLIGHT)

Scheduled passenger flight CCA301 of CAAC departed Guangzhou from the

[1] Civil Aviation Department Hong Kong (June 1990). *Report on the accident to Hawker Siddeley Trident 2E B-2218 at Hong Kong International Airport on 31 August 1988* (Aircraft Accident Report 1/90)

People's Republic of China ("PRC") at 00:33 hours on the 31st August 1988 for Hong Kong International Airport with callsign "China 301". The flight deck crew comprised two Captains, a Flight Engineer, a Navigator, a qualified Radio Operator and a Radio Operator under training.

The Caption designated as the aircraft commander occupied the right control seat and acted as non-handling pilot, whilst the other Captain acted as handling pilot operated from the left control seat.

In the passenger cabin, there were three cabin attendants (female) and two security officers (male). There were seventy-eight passengers on board. The planned flight time to Hong Kong International Airport was thirty minutes and cruising altitude was 10,000 feet.

At 00:43 hours, China 301, whilst still in the Guangzhou Flight Information Region ("FIR"), contacted Hong Kong Approach Control on 119.1 MHz, gave its position as SHILONG NDB at 10,000 feet and confirmed receipt of Hong Kong Automatic Terminal Information Service ("HKATIS") "Delta". This was acknowledged by the approach controller with instructions to call twenty miles before RUMET, the reporting point on A461 marking the Guangzhou/Hong Kong FIR boundary. At 00:45 hours, China 301 contacted Hong Kong Approach again and advised of its intention to deviate twelve miles left of track to avoid cumulonimbus. The deviation was approved and shortly afterwards, China 301 was told of weather returns showing on the approach radar in the letdown area associated with the runway 13 Instrument Guidance System ("IGS"). An Instrument Landing

System ("ILS") approach to runway 31, monitored by Precision Approach Radar ("PAR") was offered and the following weather passed:

"... the surface wind is between 090 to 140 degrees at 10 knots ... heavy shower over the airfield ... the visibility on *runway 31* is *5000* meters on the IGS is *3000* metres ... advise. "

China 301 elected to make an ILS approach. The time was 00:48 hours. The ensuing radar sequencing to the ILS took considerably longer than normal, mainly due to weather avoidance at the request of the aircraft and in part to ATC accommodating departing traffic on *runway 13*.

At 01:17 hours, China 301 was heading 270 degrees at 5000 feet, approaching *runway 31* centreline from the east. To facilitate a departure from *runway 13*, it was the controller's intention to take the aircraft through the centreline before initiating a right turn onto the localiser. At 01:09 hours, the aircraft was told to turn *right* onto a heading of 360 degrees to intercept the localiser, however, a *left* turn was requested by the pilot to avoid cumulonimbus. This was approved and at 01:12 hours, China 301 was at 4,500 feet, heading 360 degrees to intercept the localiser, and cleared for an ILS approach. The latest weather was then broadcast:

"... wind 120 to 150 degrees ... 5 to 10 knots ... runway surface wet ... visibility 4500 metres in rain ..."

China 301 acknowledged the weather broadcast and confirmed, however, its intention to use *runway 31*, rather than runway 13 then in use.

At 01:14 hours, when the aircraft was established on the localiser, it was again cleared for an ILS approach and informed that approach would be monitored by PAR. This was acknowledged and after a frequency change to 119.5 MHz, mutual contact with Hong Kong Precision was confirmed at 01:15 hour, at which time the aircraft was approximately ten to twelve nautical miles from touchdown. Although the precision radar controller could see from his adjacent approach radar that China 301 was maintaining the localiser centreline, he was unable to gain radar contact on the PAR due to rain clutter. He immediately advised China 301 that there was no precision radar contact, he passed the surface wind (090 degrees 07 knots), and cleared the aircraft to land.

The last recorded transmission from China 301 was the acknowledgment of this clearance at 01:16:59 hours.

The aircraft's right outboard trailing edge wing flap struck the innermost approach light which is situated twenty one feet above mean sea level ("MSL") and twelve meters before the runway promontory. Almost simultaneously, the right main landing gear tyres struck the runway promontory just below the sloping lip of the sea wall and three of the four tyres on the axle burst. The complete right main landing gear with its support structure, sections of the upper and lower wing skins and the inboard wing flap and flap tracks were then torn from the wing.

The left main gear touched down on the paved surface approximately two meters from the sea wall, the aircraft then bounced and continued to track

just to the right of the runway centreline until it contacted the ground again approximately 600m down the runway. From this point, it started to yaw to the right, departed from the runway and slid sideways across the grass towards the parallel taxiway. The yaw continued, past the direction of travel, until the aircraft was sliding almost completely sideways. As it traversed the grassed runway strip, the left main and nose landing gears collapsed.

The aircraft continued until it crossed the parallel taxiway, slid over the sea wall and fell off the runway promontory into Kowloon Bay. When it came to a halt, it was resting in a slightly nose high attitude, heading East-north-east, with the rear extremity of the fuselage supported on a ledge of stone blocks at the base of the sea wall. It had travelled 1,485m from the point of first impact with the runway promontory.

The main part of the fuselage remained above the water, but the rear of the passenger cabin was partially submerged. The flight compartment (cockpit) and the front portion of the forward passenger cabin remained attached to the fuselage only by control cables and secondary structure and drooped steeply down into the water with the nose resting on the sea bed. At the rear of the aircraft, the centre engine detached from the airframe and a fire started in the centre engine intake duct. A thin layer of fuel spread over the surrounding water.

At 01:19 hours, the duty officer at the Airport Fire Services substation saw the landing aircraft pass by in an unusual attitude on the runway and pressed

the crash alarm. As a result, it took less than a minute for the rescue services to arrive on the scene.

Fire in the centre engine intake duct was soon extinguished and the wreck secured by lines to the shore. Passengers escaped from the aircraft through the forward right overwing emergency exit and the mishaps passenger door. Some stood on the wing in the heavy rain and waited to be rescued, others jumped into the water and a few were able to scramble ashore. Forty-one of those rescued were taken on board the fire services rescue launch and five on to junks that happened to be in the vicinity. The remainder were rescued on to the runway promontory by the land rescue crews.

The two security officers and one cabin attendant were seated in the first two rows of the front passenger cabin and were cut off from the rest of the passenger compartment by the break in the fuselage. They were unable to help in the evacuation and left the wreck themselves.

The remaining two cabin attendants were seated at the midships passenger door. One was rendered unconscious and later rescued from the water by emergency services personnel. The other opened the midships passenger door and directed the evacuation of the passengers. Those suffering from injuries were taken directly to the Queen Elizabeth Hospital for treatment. One passenger later died in hospital from his injuries.

Attempts were made by divers to enter the submerged flight deck but these were hampered by the very poor visibility in the polluted water, the strong current and by wreckage blocking the entrance to the flight deck. When

entry was finally gained, approximately seventy-five minutes after the accident occurred, all flight deck crew-members were found drowned.

As a result of the crash, six flight deck crew members and one passenger died, two cabin crew and two passengers were seriously injured, one cabin crew and ten passengers sustained minor injuries. The remaining sixty-seven persons on board managed to walk away unhurt. The aircraft itself was damaged beyond economic repair and was thus a total loss.

## [C] FLIGHT CREW HISTORIES

It may be worth noting the background of the two Flight Crews, one as Commander and the other as Captain, of the flight for the analysis and recommendations to the airline for accident prevention in the future.

The Commander (in right control seat) is male, aged thirty-eight years, Chinese Pilot Licence holder, with 8,419 hours total flying time of which 4,101 hours on type (of which 2,750 hours were as pilot-in-commander and 514 hours as Training Captain). In the last thirty days preceding the accident, he has flown seventy-six hours and was off duty for twenty-four hours prior to the flight.

The Captain (in left control seat as handling pilot) is male, aged twenty-five years, Chinese Pilot Licence holder, with 3,143 hours total flying time of which 2,613 hours on type (of which 1,063 hours were as pilot-in-command). In the last thirty days preceding the accident, he has flown seventy-seven hours and had been on duty for five hours in the previous twenty-four hours.

No information was disclosed in the CAD Aircraft Accident Report 1/90 regarding the training offered by CAAC to the two flight crews, such as CRM courses, simulator training courses, or wind shear training in the course of the recurrent simulator training/checking.

## [D] ANALYSIS

The CAD inspector combined eye witness reports, recorded data, aerodrome information, meteorological information and record, Air Traffic Control data and information, and wreckage analysis to reconstruct the process which led to the accident.

The difficulties of the investigation involved the lack of evidence from the flight crews and those in the cockpit as none of them survived.

1) The aircraft crashed at 01:19 hours in heavy rain, with Runway Visual Range(s) ("RVR") of 1,000m, and the investigation was concerned to determine whether sufficient advice and information was given, or made available, to the commander of China 301, to enable him to form a reasonable assessment of the landing conditions at Hong Kong International Airport.
2) International Civil Aviation Organization's ("ICAO") Annex 11 to the Convention on International Civil Aviation: Air Traffic Services provides, *inter alia*, that the objectives of air traffic services shall be to provide advice and information useful for the safe and efficient conduct of flight. These objectives are also included in Air Traffic Control Instructions ("ATCI") Nr.2 in the Manual of Air Traffic Control ("MATC").
3) ICAO Document 4444 – Rules of the Air and Air Traffic Services –

specifies in greater detail than Annex 11 the actual procedures to be applied by air traffic services and includes the following under the heading of Information for Arriving Aircraft:

"At the commencement of final approach, the following information shall be transmitted to aircraft:

(a) significant changes in the mean surface wind direction and speed;

(b) the latest information, if any, on wind shear and/or turbulence in the final approach area;

(c) the current visibility representative of the direction of approach and landing or, when provided, the current runway visual range value(s) and the trend, if practicable, supplemented by slant visual range value(s), if provided.

During final approach, the following information shall be transmitted without delay:

(a) the sudden occurrence of hazards (e.g. unauthorized traffic on the runway);

(b) significant variations in the current surface wind, expressed in terms of minimum and maximum values;

(c) significant changes in runway surface conditions;

(d) changes in the operational status of required visual or non-visual aids;

(e) changes in observed RVR value(s), in accordance with the reported scale in use, or changes in the visibility representative of the direction of approach and landing.

4) The flight took place at the relatively low cruising altitude of 10000 feet and whilst still in the Guangzhou FIR the first deviation due to weather was made. After entering the Hong Kong FIR China 301 made several requests to change, or to maintain, heading to avoid weather. No radar recording facilities were available at HKIA and the investigation was based on Universal Flight Data Recorder ("UFDR") data, the Radiotelephone ("RTF") transcript and controller recollection.

5) On first contact with HK approach, China 301 acknowledged receipt of HKATIS Information "DELTA". AT 01:00 hours, ATIS changed to Information "ECHO". The change in weather between the two broadcast was not particularly significant.

6) At 01:12:41 hours, the approach controller broadcast the weather passed to him by the Control Co-ordinator ("COO"), which comprised *some* of the information contained in HKATIS Information "FOXTROT" only, namely:

   "Wind 120-150/5-10 knots, runway surface wet, visibility 4,500 meters in rain".

   However, the approach controller was NOT aware that a meteorological warning had been added to Information FOXTROT, namely, "expect significant windshear and moderate to severe turbulence in the vincinity of cumulonimbus ..." and therefore he did NOT relay this information to China 301.

7) At 01:13 hours, ATIS information was updated to FOXTROT. The update was NOT brought to the attention of the approaching China 301 by the approach controller.

8) During the ILS approach, the touchdown zone RVR Runway 31 fell sharply from above 2,000m to 1,000m at the time of the accident, but no RVRs were passed to China 301.

9) In summary and in sequence, only the following surface weather conditions are known to have been received by China 301:

| | | | |
|---|---|---|---|
| 00:35-00:43 | hr | - | ATIS Information Delta:<br>090-150 / 10 kt<br>1/8 at 500 ft 3/8 at 1800 ft<br>Visibility 5000m in rain; tempo 3,000m |
| 00:47:52 | hr | - | from HK approach control:<br>090-140 / 10 kt<br>Heavy Shower<br>Visibility 5000m on RW31; 3,000m on the IGS |
| 01:12:41 | hr | - | from HK approach control:<br>120-150 / 5-10 kt<br>Runway surface wet<br>Visibility 4,500m in rain |
| 01:16:46 | hr | - | from the PAR controller together with landing clearance:<br>Surface wind 090 / 07 kt |

10) At 01:16 hours, when China 301 commenced its final approach, the visibility was estimated by the Air Movement Controller ("AMC") in the control tower (a certified meteorological observer) to be approximately 3,000m, and although this was passed to, and acknowledged by, the PAR controller, it was NOT passed on by him to China 301. The reason for this could not be determined.

11) In the report, CAD tried to explain for the PAR controller that when he received the visibility over the intercom, the PAR controller was

engrossed in attempting to gain radar contact with China 301. However, the workload was not unduly high and this alone seems an unlikely reason for an experienced controller failing to pass important information on to the aircraft. It may be that the phrasing of the message by the AMC, with the inclusion of a doubt about the RVR readings, could have led a mind preoccupied with PAR controls into subconsciously disregarding it. The report quoted the AMC's words: "Visibility is around three thousand meters – I don't know what's wrong with the RVR".

12) CAAC's aerodrome operating minima for an ILS approach to Runway 31 on visibility was 1,600m. The CAD report goes on to explain that although the reduction in visibility from 4,500m to 3,000m was not made known to China 301, it is unlikely, being well above the company minimum, that had it been passed to the aircraft, it would not have caused the pilot to discontinue the approach.

13) In CAD's analysis, they took the view that although a knowledge of the fall in visibility would have given the pilot a better idea of the visual picture to expect when he broke cloud, the fact that he was not told of it is not considered to have had any bearing upon the outcome of the approach. CAD was of the opinion when weather conditions are such that no approach ban is imposed by company or national requirements, and none existed in this case, the pilot is responsible for evaluating the adequacy of his visual reference at Decision Height regardless of the visibility passed by Air Traffic Control ("ATC"). Based on this appraisal, CAD took the view that it is for the pilot to choose then the

most appropriate course of action.

14) Approximate ten to fifteen minutes before the accident occurred the AMC on duty in the tower noticed that the north RVR reading on the digital display was showing "- 000" with sensible (but unrecollected) readings displayed for the centre and south sites. In such circumstances, controllers are instructed to consider the system unserviceable and to report the fault to the Airport Meteorological Office ("AMO"). And at 01:12 hours, this was done. And there, the matter rested. There was no requirement in the Air Traffic Controller Information ("ATCI") to inform approaching aircraft that RVR's are temporarily unavailable, and China 301 was NOT informed.

15) Soon after reporting the fault, the centre and south readings also fell to "- 000" and stayed there for a short while. The centre and south readings then began to display again but the north reading stayed at "- 000". Still uncertain of the integrity of the centre and south displays, the AMC did not pass the readings to the PAR controller, but did say to him, "... I don't know what's wrong with the RVR".

16) The decision by the AMC to disregard the RVR readings, in the circumstances, is considered by CAD to have been correct. It was subsequently determined that the values displayed for the south and centre sites were, in fact, valid.

17) The computer print-out of the south site (Runway 31 touchdown zone) RVR showed that it fell briefly below 1,500m from 00:43:16 hours to 00:44:28 hours, and that the next RVR reading below 1,500 meters recorded for south site occurred at 01:17:57 hours. Two minutes later

(at 01:19:55 hours) it was back up to 1,500m, having bottomed out at 1,000m at 01:18:36 hours. These recorded readings were not necessarily the same as those that would be shown at the same time on the displays in ATC, and in any case, no RVR was passed to the approach aircraft. The readings do serve to show the order of the values at the time of the accident and the rapidity with which they were changing.

18) CAD took the view that hypothetically had the RVR display been considered serviceable and values passed to China 301, the commander would have been required, with the aircraft at or above decision height (405 feet), by Hong Kong legislation (but not his company regulations), to have carried out a missed approach when the touchdown zone (south) RVR fell below his company minima of 1,500m. At or below decision height, provided there was adequate visual reference, the approach would be continued. The crash occurred shortly after 01:19 hours and Universal Flight Data Recorder ("UFDR") trace shows that the aircraft approached decision height *twenty-five seconds earlier*. Given that the earliest the display in ATC could have registered a RVR reading of less than 1,500m was 01:19:57 hours, and with the system's 15 second display up-date interval, it could have been as late as 01:18:12 hours, it is unlikely that in any event, the RVR would or could, have been passed to the aircraft in time to affect the commander's decision to continue the approach.

19) No RVR was available during the period that China 301 was approaching HKIA, but this information was not passed to the aircraft. CAD thought it is unlikely, even if it had been passed, that it would have caused the

commander to discontinue the approach. And if the RVR had been available, given the timing of the deterioration of the value to below 1,500m, the possibility of it being passed to the accident aircraft in time to influence events was extremely remote.

20) From the foregoing, CAD concluded that sufficient advice and information was available to the commander of China 301 to enable him to assess the general weather conditions affecting HKIA.

21) China 301 was not advised of the deterioration in visibility whilst on the approach, that RVR was temporarily unavailable, and that the ATIS Information had changed from ECHO to FOXTROT, or of the possibility of significant windshear in the vicinity of cumulonimbus in the approach. There arose doubt as to whether the level of information and advice provided by ATC in this instance fully met the objectives of ICAO Annex 11 and Document 4444 issued by it.

However, CAD concluded whilst this may or may not be the case, none of these items of information, either singly or taken in conjunction, were considered to have been of such weight that knowledge of them would have caused the commander to abandon the approach. And whilst knowledge of them would have aided the commander in the planning of the approach, CAD did not consider the lack of knowledge of them contributed to cause the accident.

22) There was some wind shear at the time of the accident, and there was a tailwind of nine knots in the lowest two hundred feet. There was probably some downward motion of air in the heavier rain, but no more than a few knots and CAD concluded the same was not of sufficient

magnitude to cause the accident. The low level windshear warning system at HKIA was serviceable throughout the accident period and did not record any significant windshear until three minutes after the accident.

23) The reconstruction of final approach path of China 301 shows two significant excursions above the glideslope. Both pilots of China 301 held the rank of Captain. The Captain occupying the right control seat was the more experienced Training Captain and the designated aircraft commander. The Captain occupying the left control seat was the handling pilot with the commander acting as non-handling pilot. No pilot training or checking was scheduled to take place on the flight. When both pilots are qualified as Captain, it can lead to uncertainties and hesitation in the decision making process, and it is possible that a crew so constituted may not interact in the same manner as a crew composed of a Captain and a First Officer.

24) CAAC procedures dictate that when two Captains occupy the control seats, the Captain who is the handling pilot decides at Decision Height whether he has adequate visual reference to continue the approach. However, his decision is subject to the overriding authority of the commander. In this case, as the approach was continued past the Decision Height, it was assumed that both the handling pilot and the commander considered the visual reference, although obviously limited, to have been sufficient to safely complete the approach and landing.

25) It is standing practice in CAAC for the flight path to be monitored by the non-handling pilot. The purpose is to detect deviations from the normal,

to bring them to the attention of the handling pilot, and to intervene if the deviation becomes unsafe. In this case, the handling pilot was flying alongside another Captain of higher status and greater experience. He may have been waiting for some intervention from him before taking the decision to discontinue the approach. On the other hand, the commander, out of deference for the other Captain, may well have hesitated to intervene.

## [E] FINDINGS

In the conclusions of the CAD report, the CAD made the following findings in their investigation:

(i) The aircraft commander was properly licensed and qualified to command the flight.

(ii) The captain and flight crew were properly licensed and qualified to carry out their duties.

(iii) Post mortem examination of both pilots revealed no preexisting disease or other medical condition that could have contributed to the accident.

(iv) The aircraft was being flown by the pilot in the left control seat.

(v) The cabin attendants were properly qualified and medically fit to carry out their duties.

(vi) The aircraft was correctly loaded and there were sufficient fuel reserves on board.

(vii) The aircraft was properly maintained.

(viii) With the exception of the partially clogged spray heads of the rain

repellant system, there was no evidence of any defects or malfunctions in the aircraft, its engines or equipment that could have caused or contributed to the accident.

(ix) From the meteorological information available to him the commander should have been able to assess the general weather conditions affecting HKIA.

(x) The approach was not monitored by precision approach radar because the PAR controller was unable to gain radar contact with the aircraft due to heavy precipitation masking the return.

(xi) China 301 was not advised of the change of ATIS Information from ECHO to FOXTROT, nor of the warning to expect significant windshear in the vicinity of cumulonimbus. Had this information been passed to the aircraft it is unlikely to have influenced the course of events.

(xii) The aircraft was not informed by the PAR controller of significant change in the meteorological visibility during the approach. Whilst this omission deprived the commander of the knowledge that the visibility was falling, it is unlikely to have influenced his continuance of the approach.

(xiii) RVR readings were not available to the aircraft whilst on the approach due to the equipment displays in ATC being considered unserviceable. Approaching aircraft were not advised that RVR was temporarily unavailable.

(xiv) The final approach became progressively unstable from 850 ft.

(xv) The possibility that windshear contributed to destablise the approach

cannot be ruled out.

(xvi) During the final part of the approach the aircraft descended below the normal approach path with no apparent remedial action being taken.

(xvii) The aircraft suddenly encountered visibility in the order of 400-500m in heavy rain in the late stages of the final approach.

(xviii) The heavy rain on the forward windshields adversely affected the pilot's ability to maintain visual reference, and may have caused them difficulty in estimating the height of the aircraft above the runway, or the distance to it, or both.

(xix) The accident was survivable.

(xx) The flight deck crew were not wearing shoulder harness.

(xxi) A sixth crew member in the flight compartment sat on a small metal stool that was not secured in any way.

(xxii) There were no passenger safety leaflets on the aircraft, and no attempt was made to ensure that the passengers were familiar with the use of the seat belts and the location and use of the emergency exists.

(xxiii) The approach and departure paths at HKIA are substantially over water but no passenger lifejackets were carried on the aircraft.

(xxiv) The cabin attendants did not ensure that the passengers had fastened their seat belts for landing.

(xxv) One cabin attendant did not fasten her seat belt for landing.

## [F] CAUSAL FACTORS OF THE ACCIDENT

Most disappointingly, the CAD came to the conclusion that there was insufficient evidence to determine the cause of the accident.

It appears probable that, having converted to visual references at some point prior to Decision Height, the commander elected to continue the approach despite the fact that heavy rain had caused a sudden marked deterioration in the visual references in the final stages.

There was no conclusive evidence that the aircraft encountered significant windshear on the approach, but given the meteorological conditions that existed at the time it cannot be ruled out, and therefore windshear may have been a contributory factor in destabilizing the approach.

## [G] RECOMMENDATIONS OF CIVIL AVIATION DEPARTMENT

The CAD made the following safety recommendations notwithstanding their failure to determine the causation of the accident:

(i) Friction fastening passenger seat belts should be replaced by a type with a metal-to-metal latching device.

(ii) Passenger seat belts should be fitted so that the means of closure operates in the natural sense and the release operates from left to right.

(iii) Passenger safety briefing leaflets should be provided.

(iv) Cabin attendant take-off and landing positions on Trident aircraft operated by CAAC should be reviewed.

(v) Flight deck crew should be required to wear shoulder harness for take-off and landing.

(vi) When the number of flight deck crew members carried exceeds the number of flight deck crew seats available, the additional flight crew

member should use a spare cabin attendant seat or a passenger seat, for take-off and landing and in turbulence.

(vii) The flight deck stool should be securely stowed outside the flight compartment for take-off, landing, in turbulence and when not in use.

(viii) Radar recording facilities should be available at terminal control areas handling significant volumes of international traffic.

(ix) A state-of-the-art low level windshear alert and warning system should be installed at HKIA.

(x) Air traffic management at HKIA should review the practices, procedure and instructions relating to the provision by air traffic services of advice and information to arriving aircraft.

(xi) The limitations of use of the PAR at HKIA in conditions of heavy precipitation should be notified in the AIP.

(xii) All aircraft engaged on international commercial air transport should be fitted with a cockpit voice recorder.

(xiii) All aircraft engaged on international commercial air transport should be fitted with a flight data recorder capable of recording the parameters required to determine the flight path, attitude, engine power and the configuration of lift and drag devices.

(xiv) Operators of flights to and from HKIA should provide lifejackets on the aircraft for the passengers and crew.

These recommendations are addressed to the regulatory authority of the People's Republic of China having responsibility for the matters with which the recommendation is concerned. It is for that authority to decide whether and what action is taken.

CAD states in the postscript of their report that since completion of their report, information has been received from the Civil Aviation Administration of China that Safety Recommendations (i), (iii), (iv), (v), (vi) and (vii) have been implemented.

The Civil Aviation Department, Hong Kong, have stated in their final report that action has been taken with respect to Safety Recommendations (viii), (ix), (x) and (xi) and that Hong Kong commercial air transport operators had already complied with Recommendations (xii), (xiii) and (xiv).

## [H] CAUSAL FACTORS REVISITED

The difficulties CAD faced in the investigation is the lack of cockpit voice recorder for recording the conversation between the flight crews from which clues may be drawn as to what happened during the flight, and most importantly, on final approach. From the cockpit voice recorder, the investigator may know what difficulties the pilots were facing, how they distributed, co-ordinated and shared the work. The Flight Data Recorder ("FDR"), which is more commonly known as the "Black Box", only recorded four parameters against time, namely, altitude, airspeed, magnetic heading and normal acceleration. The replayed data was unreliable in that the heading parameter was excessively noisy and lacked normal resolution. The FDR only recorded data whilst the aircraft was in flight. The recorder started when the aircraft became airborne and stopped on initial contact with the ground. A more useful system would have provided information on pitch, roll, flap position and engine thrust.

However, with the information and evidence CAD had acquired, one may still apply the analysis tools discussed in previous chapters to analyse the probable causation of the accident from different perspectives.

From the factual history, the unsafe acts of the operators include at least the following:

1) The controlling pilot's failure to request information he required for a decision whether to abandon the approach, namely, the RVR, whether there would be significant change of weather, the runway in use, and confirmation with PAR controller to establish radar contact.
2) Failing to consider the option of going-around when the pilots were provided only with limited meteorological and terminal information for landing.
3) Failing to take remedial actions to bring the aircraft back to glidepath on final approach.
4) Failing to choose the more favourable runway, namely, runway 13 with head-wind of 9 knots for landing, but rather, a tailwind landing which made the landing even more difficult in bad weather conditions, windshear and turbulence.
5) The failure of the ATC in providing accurate RVR data or the fact that the same was not serviceable, probable significant windshear, the favourable runway in use being runway 13 (as opposed to runway 31), most importantly, a prompt warning of rapid deterioration of visibility and the fact that there was a failure to establish radar control with PAR controller to help the pilots make the appropriate decision on final approach.

The pre-conditions for the unsafe acts in this accident included a number of personnel and environmental factors. The personnel factors may probably be the result of poor training or unsatisfactory cockpit/crew resource management, such as:

1) Low power-distance between the two captains. It was not clear between them who was the leader and who was the follower, and who might override whom under what circumstances. At critical movements, both pilots appeared to be indecisive in whether to abandon the approach and to go-around. They simply let the aircraft fly them without taking decisive positive steps to do the right thing at the right time. There is obviously a poor co-ordination of work within the cockpit, and a lack of assertiveness by the commander who was more experienced to intervene.
2) Inadequate ATC personnel training. The quality of ATC personnel training should be reviewed. The co-ordination of work among the various controllers was questionable. The failure of the AMC in declaring the RVR readings unavailable, so that the pilots might be put on guard in time, reflects he was indecisive and failed to appreciate how important those readings were to help the pilots assess the situation and make their decision promptly in such bad weather conditions.

The environmental factors discussed at great length above have already covered both the physical and technological environments unsafe for the landing in question.

At supervisory level, CAAC had an obligation to provide regular CRM

training to their flight crew. However, nothing was mentioned in the CAD report in this regard. From the performance of the flight crew, it could be inferred that inadequate training was provided by the airlines.

The CAD report did not even question whether it was safe for CAAC to set its aerodrome operating minima on visibility for an ILS approach to Runway 31 on visibility as low as 1,600m. It appears that CAAC did not have any guidelines for pilots regarding visibility minima in the absence of PAR contacts and/or RVR data. This was a latent failure on the part of the supervisors of the airline to make such provisions.

The CAD report was also evasive on the issue whether the supervisors of the relevant controllers at the frontline had provided adequate and suitable emergency training to the controllers on a regular basis, and in particular, in the event some of the instruments or equipment they were monitoring failed, what immediate steps they were obliged to take, what communication and co-ordination among their team members should be. These issues need be canvassed and addressed in detail, but the CAD chose to keep silent in their report on the question of causation, and did not consider this latent failure a probable contributing cause of the accident. In the report, CAD only very subtly mentioned in one of their safety recommendations that "air traffic management at HKIA should review the practices, procedures and instructions relating to the provision by air traffic services of advice and information to arriving aircraft".

## [I] MATTERS FOR FURTHER DISCUSSION

The CAD on the one hand, was /is the service provider of air traffic services at the Hong Kong International Airport, and on the other, the Chief Inspector of aircraft accidents under the Hong Kong Civil Aviation (Investigation of Accidents) Regulations, Cap.448 subsidiary legislation B ("the Regulations") was/is CAD staff. This investigation was concerned to determine whether sufficient advice and information was given, or made available to the commander of China 301 to enable him to form a reasonable assessment of the landing conditions at HKIA.

From the face of it, the air traffic control services provided by CAD are exactly the subject of investigation. The CAD was in fact investigating their department to establish causation of the accident. It would occur to any reasonable person that there would be a real risk of bias, a clear conflict of interest and a breach of the rule of natural justice.

One would doubt whether it was appropriate for the Chief Inspector of Accidents of the Accidents Investigation Division of the CAD to carry out or conduct the investigation single handedly, rather than having an *independent* Commission of Inquiry appointed to hold a public inquiry into the circumstances and causes of the accident to which the Regulations apply, or into any particular matter relating to the avoidance of such accident in the future.

In the following chapter, it will be discussed under what circumstances and in what ways aircraft accident investigation itself and/or the report(s) so

prepared may be challenged in Court or otherwise.

# CHAPTER VII

# STATUTORY AND JUDICIAL CONTROL OF AIRCRAFT ACCIDENT INVESTIGATION

## [A] INTRODUCTION

Aircraft accident investigation is regulated under various legislations and is also subject to judicial control by the Courts.

The Convention on International Civil Aviation in 1944 ("Chicago Convention") provides that in the event of an accident to an aircraft of a contracting state occurring in the territory of another contracting state, and involving death or serious injury or indicating serious technical defect or air navigation facilities, the state in which the accident occurs, must institute an inquiry into the circumstances of the accident, in accordance, so far as its laws permit, with the procedure which may be recommended by the International Civil Aviation Organization ("ICAO").

ICAO adopts and amends, from time to time as necessary, international standards and recommended practices and procedures dealing with various matters, including but not limited to investigation of accidents. The Council of ICAO adopted Annex 13 on Aircraft Accidents Inquiry in 1951. It sets out the recommended procedures to be adopted in air accidents.

Under Article 38 of the Chicago Convention, contracting States must immediately notify ICAO of any differences between their standards and practices and those provided for under the Chicago Convention, including

the amendments thereof, and ICAO shall immediately notify all other contracting states of such differences.

Annex 13 to the Chicago Convention provides detailed international standards and recommended practices to be adopted by contracting States in dealing with an accident or serious incident occurring in the territory of another contracting state. The States in which the aircraft is registered, operated, designed or manufactured are to be given the opportunity to appoint accredited representatives to be present at any accident inquiry conducted by the States in which the aircraft accident or serious incident occurs. Such representatives are entitled to participate in all aspects of the investigation, subject to the control of the accident inspector, by visiting the scene of the accident, examining the wreckage, questioning witnesses and making submissions in the investigation.

Both the United Kingdom and the People's Republic of China are contracting States to the Chicago Convention and the local legislation of Hong Kong was made with ICAO standards and recommended practices in mind. However, in the event of conflict or inconsistency, Hong Kong's local legislation prevails.

## [B] LEGISLATION

Under Section 2A(1)(a) of the Civil Aviation Ordinance, Cap.448, the Chief Executive has general powers to carry out the provisions of any Annex to the Chicago Convention in relation to international standards and recommended practices and any amendments thereof. The Chief Executive is empowered

by the Civil Aviation Ordinance Section 3(1) to make regulations providing for the investigation of any accident arising out of or in the course of air navigation, which either occurs in or over Hong Kong or occurs else where to aircraft registered in Hong Kong. The Hong Kong Civil Aviation (Investigation of Accidents) Regulations, Cap.448 Subsidiary legislation B ("the Regulations") were enacted and took effect on the 21st October 1983.

## [C] DEFINITION OF "ACCIDENT"

In Regulation 2 of the Regulations, the term "accident" includes an incident and a reportable accident. Whilst "incident" means any fortuitous or unexpected event, not being a reportable accident, by which the safety of an aircraft or any person is threatened.

"Reportable accident" means an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and such time as all persons have disembarked therefrom, in which:

(a) any person suffers death or serious injury while in or upon the aircraft or by direct contact with any part of the aircraft (including any part which has become detached from the aircraft) or by direct exposure to jet blast, except when the death or serious injury is from natural causes, is self-inflicted or is inflicted by other persons or when the death or serious injury is suffered by a stowaway hiding outside the areas normally available in flight to the passengers and members of the crew of the aircraft; or

(b) the aircraft incurs damage or structural failure, other than –

(i) engine failure or damage, when the damage is limited to the engine, its cowling or accessories;

(ii) damage limited to propellers, wing tips, antennae, tyres, brakes, fairings, small dents or punctured holes in the aircraft skin,

which adversely affects its structural strength, performance or flight characteristics and which would normally require major repair or replacement of the affected component; or

(c) the aircraft is missing or is completely inaccessible.

The Regulations are applicable to "death" or "serious injury" in or upon the aircraft. The term "serious injury" means an injury which is sustained by a person in a reportable accident and which –

(a) requires his/her stay in hospital for more than 48 hours commencing within 7 days from the date on which the injury was received; or

(b) results in a fracture of any bone (except simple fractures of fingers, toes or nose); or

(c) involves lacerations which cause nerve, muscle or tendon damage or severe haemorrhage; or

(d) involves injury to any internal organ; or

(e) involves second or third degree burns or any burns affecting more than 5 percent of the body surface,

and "seriously injured" shall be constructed accordingly.

Under regulation 5 of the Regulations, the commander of the accident

aircraft, failing whom the operator thereof, and, in the case of an accident on or adjacent to an aerodrome, the aerodrome authority shall forthwith give notice to the Chief Inspector and the Commissioner of Police of the accident and of the place where it occurred.

## [D] INSPECTOR'S INVESTIGATION

For the purpose of carrying out investigation into the circumstances and causes of the aircraft accident, the Chief Executive shall appoint a suitably qualified person to be Chief Inspector[1], and such number of Inspectors. The Director-General of Civil Aviation may appoint persons to assist, and seek such advice or assistance as he may deem necessary in making the investigation.

The Chief Inspector shall decide whether an investigation of the accident is necessary and should be held. If the decision is in the affirmative, public notice[2] that an investigation by an Inspector ("Inspector's investigation") is taking place shall be given as the Chief inspector thinks fit, and the Chief inspector shall invite any persons who desire to make representations to do so in writing within a certain time frame in the notice. The Inspector's investigation shall be held in private, which means the evidence is not heard in a public hearing.

### 1) *Powers of Inspectors*

An Inspector shall have power[3] to summon witnesses, take statements from them and require them to sign a declaration of the truth of the

[1] Regulation 8 of the Regulations
[2] Ibid. Regulation 10
[3] Ibid. Regulation 9

statement made by him; to summon any persons as he thinks fit to answer questions, furnish information, produce relevant books, papers, documents and articles and to retain them until completion of the investigation; to examine any aircraft involved or require any aircraft or any part or equipment thereof to be preserved unaltered pending investigation; to examine, remove, test, take measures for preservation of or otherwise deal with the aircraft; to enter and inspect any place, building or aircraft for the investigation provided that the premises are not being used as a dwelling; and to take such measures for the preservation of evidence as he considers appropriate.

For the purpose of preserving the wreckage of the aircraft[4], no person, other than an person authorized by the Director-General of Civil Aviation, shall have access to the aircraft involved. Neither the aircraft nor its contents may be removed or interfered except for the purposes of extricating persons or animals, removing mails, valuables, dangerous goods, preventing destruction by fire or other cause, preventing danger or obstruction to the public, air navigation or to other transport or for removing any other property from the aircraft with the approval of the Inspector, and bringing the wreckage to a place of safety (if in water).

2) *Structure of the Investigation*

The structure of the investigation is primarily divided into four major aspects, namely, Factual Information, Analysis of the Accident, Conclusions (which include the Inspectors' findings and probable causal

[4] Ibid. Regulation 7

factors) and Recommendations.

(i) *Factual Information*

Collection and preservation of evidence may take months or even years to complete. It involves collecting physical evidence, taking testimony and data collection from different sources.

1.1 *History of the Flight*

The factual information can be divided into various parts, to start off with, is certainly the history of the flight, point of departure and intended destination, the route, time elements, number of passengers on board, date, place and time of the accident, flight number, type of aircraft involved and what happened at take-off, during flight or upon landing as the case may be.

1.2 *Injuries to Persons*

The Inspector shall ascertain how many people on board and on the ground are killed, have sustained injuries and the extent of such injuries.

1.3 *Damage to Aircraft*

The extent of damage to the aircraft would be recorded, measured and assessed by engineers assisting the investigation.

1.4 *Other damage*

Besides the aircraft, there may be damages on the ground, such as damage to the runway, taxiway, grass, lights, lamp-posts, signs, other aircraft, vehicles, and the like. The

Inspector has to record such damages as well.

1.5 *Personnel Information*

The age, sex, pilot licence, type rating, medical certificate, date of last proficiency check, date of last line check, date of last emergency drills check (if applicable), flying experience and qualifications, duty time before accident, training history and past performance records of the flight crew shall be studied. It is important, as it has a significant bearing on the legality of the flight itself.

The medical history and qualifications of cabin crew (if any), record of safety and emergency procedure training records would be checked as well.

1.6 *Aircraft information*

The particulars of the aircraft, including the model, manufacturer, registered owner, operator, registration number, name of operator, date of manufacture, relevant weights, certificate of airworthiness, certificate of registration, total flying hours, maintenance history, maintenance log books and the relevant last checks shall be studied to ascertain the possibility of engineering problem being one of the contributing cause to the accident.

Weight and balance of the aircraft will also be checked to ascertain whether it is within the envelope prescribed in the flight manual. Aircraft overload or out of balance along a particular axis of the aircraft may render the aircraft out of

control.

For advanced aircraft, they may be equipped with automatic flight system, windshear alert and guidance system, longitudinal stability augmentation system, rain clearance wipe system and even radio altitude voice warnings. All these systems would be checked by the Inspector to ascertain whether there were any malfunctions before the accident and whether they have any bearing on the causation of the same.

1.7 *Meteorological information*

Data would be collected by the Inspector on meteorological conditions prior to and at the time of the accident. Various kinds of sensors are planted at different location in Hong Kong to collect meteorological information. The study would include the forecasts and observations issued by the Hong Kong Observatory's ("HKO") Airport Meteorological Office ("AMO") at Hong Kong International Airport ("HKIA"), general weather conditions, actual weather conditions at or around the site of accident, the Automatic Terminal Information Service ("ATIS") weather broadcast contents, runway visual range measurements, surface wind measurements, cloud base measurements, rainful measurements, local wind effects, windshear and turbulence, and any significant weather conditions and changes.

1.8 *Aids to navigation*

The Inspector would also check whether all the relevant

navigational aids were serviceable during the period of the accident flight.

1.9 *Communications*

Radio failure or difficulties in transmission or reception on the relevant frequencies would also be an aspect to be investigated. The transcript of communications exchanged between the aircraft and Air Traffic Control ("ATC") would be obtained and correlated with Cockpit Voice Recordings ("CVR"), if so installed, to ascertain whether there was any problem on communication or the breakdown thereof which might contribute to the accident.

1.10 *Aerodrome information*

The investigation would also encompass the aerodrome at which the accident took place, as the case may be. The various facilities offered and made available to the accident aircraft, such as, the physical characteristics of runways and taxiway, lighting aids, air traffic services, meteorological services provided and airport fire services for evacuation, search and rescue, and the like.

1.11 *Flight recorders*

All flight recording equipment would be recovered from the wreckage by the Inspector's team as soon as practicable after the accident. The equipment would usually comprise a Digital Flight Data Recorder ("DFDR"), Cockpit Voice Recorder ("CVR") and a Quick Access Recorder ("QAR"), if

so installed. The data retrieved from the equipment would be interpreted, calculated and analysed by experts to ascertain the take off or landing configuration, airspeed variation, mean pitch, throttle position, rate of descent, deviation from Instrument Landing System ("ILS") glide slope, engine thrust, relevant pitch attitude, angles of attack variations, elevator angles, roll angle variation, and the like.

1.12 *Wreckage and impact information*

After the accident, survey photographs would be taken to record the final position of the main wreckage, the wreckage parts, skid marks and adjacent landscape areas. Based on the information from these photographs, a wreckage plot would be produced on a survey map.

1.13 *Medical and pathological information*

The extent of injury of the passengers and crew members would be classified. The causes of death of the fatalities, if any, would be studied and ascertained.

1.14 *Fire*

Fire may or may not follow the crash. The effectiveness and efficiency in fire fighting would be studied as it has an impact on the survival aspect of those on board, or even those on the ground directly affected or in the vicinity.

1.15 *Survival aspects*

The investigation would look into the extent of damage to the cockpit and the cabin and assess the flight attendants'

performance in the evacuation of passengers. The efficiency of the search and rescue operation would be studied and assess the survivability of the accident.

1.16 *Tests and analysis*

The Engineering Group of the investigation team would conduct tests and analysis on the wreckage parts for various kinds of analysis and evaluation, such as metallurgical and non-volatile memory data analysis, visual inspection, dimensional inspection, macroscopic examination, hardness test, tensile test, conductivity test, scanning electron microscope analysis, chemical analysis, structural failure sequence analysis, and the like.

1.17 *Eyewitness accounts*

The eyewitnesses' evidence on the accident would usually provide clues to the Inspector on what actually transpired. They include people on the ground, passengers, cabin crew and flight crew.

Regulation 9 of the Regulations empowers the Inspector to take statements from all such persons as he thinks fit and to require any such person to make and sign a declaration of the truth of the statement made by him. The Inspector also has power by summons under his hand to call before him and examine all such persons as he thinks fit and to require such persons to answer any questions or furnish any information.

In the investigation of the accident of China Airlines CI 642

which occurred on the 22nd August 1999, both pilots were interviewed on a preliminary basis by members of the investigation team about four hours after the accident. The basis of the interview was to allow the pilots to provide their recollection of the aircraft's descent and final approach while it was still fresh in their memory, and with minimal involvement by the investigators. Arrangements were made to interview both pilots again on a more structured basis two days later. On arrival, the commander was accompanied by members of the Hong Kong Aircrew Officers Association and one of their nominated lawyers. He declined to be interviewed except in the presence of one of these representatives. The interview was therefore deferred whilst this was being considered, during which time, on or about 26th August 1999, four days after the accident, the commander left Hong Kong. This action was taken by the commander without reference to the accident investigators or to China Airlines, his employer.

All further attempts to interview the commander were frustrated. However, he did answer certain queries put to him by telefax on the 4th September 1999, and later forwarded a prepared statement dated the 2nd February 2000 concerning his recollection of the final approach and landing. The contents of the latter were not entirely consistent with statements previously made either by himself or his co-pilot.

The co-pilot was further interviewed as planned on the 24th August 1999 and again on the 2nd September 1999.

It is not mentioned in the report whether the Inspector had issued summons under his hand to call the commander before him for examination and to require him to answer questions or furnish information on the final approach and landing. However, even if he did, there is no provision in the Regulations for legal sanction against any person served with the summons for non-attendance of the interview, failure to produce oneself for examination or failure to provide documents that such a person is required to produce.

This is an obvious pitfall in the Regulations. The non-attendance or lack of co-operation by the commander would make it difficult for the Inspector to resolve any conflict of evidence, likely to delay the investigation and render part of the evidence unavailable to establish the true causation of the accident.

At the open hearing of the Board of Review initiated by China Airlines and the co-pilot of the accident, the commander did not attend, either in person or by way of representation, nonetheless, he raised certain factual issues for the Board's consideration during the review hearing. Since the commander's reputation could be adversely affected by the findings and conclusions in the CAD report, he was treated as a party and accorded the same right as other parties to the

review proceedings. It was therefore ordered by the Board of Review that he would be entitled to attend the hearing, adduce evidence, make submissions, examine and cross-examine witnesses pursuant to Regulation 14(2) of the Regulations if he so wished.

(ii) *Analysis of the Accident*

The combined information of eyewitness reports, flight crew interviews, cabin crew interviews and wreckage analysis and test reports would enable the Inspector, in most occasions, to reconstruct the process which led to the accident. The reconstruction draws upon all the available evidence to define what happened and the order in which significant events occurred. Relevant aspects of serviceability of the aircraft, weather, design of the aircraft, the facilities of the airport, air traffic control services, performance of the flight crew and the human factors would be examined and analysed in detail. Throughout the analysis section, factors which may have contributed to the accident would be identified, and where applicable, safety recommendations would be made at the end of the accident investigation report.

(iii) *Conclusions*

The conclusions of the investigation would include the findings of the Inspector based on evidence of probative value and then deduce and formulate the probable causal factors of the accident. If there is insufficient evidence to determine the cause of the accident, the Inspector must say so in his report.

(iv) *Recommendations*

Finally, the Inspector would make safety recommendations for the preservation of life and the avoidance of similar accidents in the future. The recommendations would be addressed to regulatory authorities or concerned parties having the responsibility for the matters with which the particular recommendation is made. It is for that authority or party to decide whether and what steps or actions should be taken.

## [E] INVESTIGATION REPORT CHALLENGED

### *(1) Opportunity to be Heard*

After all the necessary investigations have been completed, the Chief Inspector, or such other Inspector as may be authorized by the Director-General of Civil Aviation, would compile the first draft of his report on the accident. Under Regulation 11, the Inspector has to serve notice upon the operator, the commander of the aircraft, and any other person whose reputation is, in the Inspector's opinion, likely to be adversely affected by the report. If any of the foregoing be a deceased individual, upon such person(s) as appear to the Inspector, to represent best the interest of the deceased in the matter.

The notice shall include particulars of any proposed analysis of facts and conclusions as to the cause(s) of the accident which may affect the person on whom or in respect of whom the notice is served. Representations may be made by those served with the notice in writing

and serve on the Inspector within twenty-eight days. Extension of time may be granted under Regulation 21.

So this is the *first opportunity* to challenge the analysis, findings and probable causes arrived at by the Inspector. Expert reports, witness statements, the analysis of the evidence and submissions may be made to the Inspector, who is obliged to consider them and decide whether any part(s) of the draft report have to be amended or revised.

Regulation 11 is an attempt to provide fairness to the operator, commander of the aircraft, and those whose reputation may be adversely affected, an opportunity to be heard. As it is one of the cardinal principles in the rules of natural justice that *no man shall be condemned unheard* (*audi alteram partem*).

In the conduct of the investigation, the standard of prove adopted by the Inspector may be different from those applied in a Court of law. The witnesses are not usually on oath, they may only be required to verify that the contents of the minutes of the interview are correct, but not required to make any statutory declaration under the Oaths and Declarations Ordinance (Cap.11) which carries criminal sanction under Section 36 of the Crimes Ordinance (Cap.200) if the witness knowingly and wilfully provides a statement which is false in a material particular. On conviction, he is liable to imprisonment for two years and to a fine.

It is unknown as to how hearsay evidence is dealt with, and how the Inspector reconciles or resolves conflicting evidence as there is no

opportunity for cross-examination of witnesses, and whether the so called "evidence" the Inspector relies on has probative value.

More importantly, there is no guarantee that the rules of natural justice are complied with in the exercise. Anyone aggrieved by the report on the ground that his reputation is adversely affected by it, but not provided an opportunity to be heard for answering the allegations made against him, may apply to the High Court to have that part of the report quashed and set aside on the ground that the failure to do so is contrary to natural justice[5]. If the challenged findings were made contrary to natural justice, it would be possible for the Court to make a declaration that the findings in question are invalid or made in circumstances involving unfairness and breaches of the rule of natural justice. Fairness[6] is not necessarily confined to procedural matters. It can have a wider range. Remedies in this field are discretionary and the law is not inflexible. If a party seeks to show not only that he/she did not have an adequate hearing but also that the evidence on which he/she was condemned was insubstantial, the Court is not compelled to shut its eyes to the state of the evidence in deciding whether, looking at the whole case in perspective, he has been treated fairly.

*(2) Lack of Independence*

The Civil Aviation Department ("CAD") of Hong Kong is a department of the Government of the Hong Kong Special Administrative Region. The department performs three primary functions, namely, serving as

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[5] Re Erebus Commission; Air New Zealand Ltd. v. Mahon [1981]1 NZLR 618
[6] Ibid, at 629

the *regulator* of civil aviation for carrying out the Chicago Convention and Annex thereto relating to international standards and recommended practices, provision of *air traffic services* within the flight information region of Hong Kong and the discharge of other responsibilities allocated to Hong Kong under the regional air navigation procedures of ICAO, such as *aircraft accident investigations*.

As discussed in Chapter VI above, if an aircraft accident touches upon the inadequacy of air traffic services provided by CAD as a service provider, or the negligence of the staff of the Air Traffic Control division, there would be a gross conflict of interests if the CAD undertakes the role of the Inspector or investigators of the aircraft accident investigation. It is in breach of a cardinal principle in natural justice that *no man shall be a judge in his own cause* (*nemo judex in causa sua*). It is, therefore, not surprising that the Inspector of the accident of China 301, which crashed at Hong Kong International Airport on 31st August 1988, came to the conclusion that there was insufficient evidence to determine the cause of the accident. The Director of Civil Aviation was in effect asking the Deputy Chief Inspector of Accidents of CAD to investigate its own colleagues in the Air Traffic Control division of CAD.

In the United Kingdom ("U.K."), the Air Accidents Investigation Branch ("AAIB"), is an *independent* part of the Department for Transport. It is not part of the Civil Aviation Authority ("CAA"). It is responsible for the investigation of civil aircraft accidents and serious incidents within the U.K. It also assists in U.K. military accidents and

investigations abroad. The Chief Inspector of Air Accident reports directly to the Secretary of State.

In *New Zealand*, the Transport Accident Investigation Commission ("TAIC") is to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in future, rather than to ascribe blame to any person. TAIC is the New Zealand Crown Entity responsible for the *independent* investigation of significant aviation, rail and marine accidents and incidents.

In *Australia*, the Australian Transport Safety Bureau ("ATSB"), is an operationally *independent* body that investigates, analyses and reports on transport safety. It operates within the Australian Government Department of Transport and Regional Services. The ATSB undertakes *independent* investigations and analyses of safety data. It retains a clear organizational separation from transport regulators, such as, the Civil Aviation Safety Authority, the Australian Maritime Safety Authority, the air traffic service provider Airservices Australia, Rail Authorities, and other parties that may be the subject of investigation.

In *Canada*, the Canadian Transportation Accident Investigation and Safety Board ("CTAISB") is a body corporate and is for all purposes, an agent of Her Majesty Queen Elizabeth the Second, with an object to advance transportation safety by conducting *independent* investigations, including, when necessary, public inquiries, into selected transportation occurrences in order to make findings as to their causes and contributory factors, identifying safety deficiencies as evidenced by transportation occurrences, making recommendations designed to

eliminate or reduce any such safety deficiencies, and reporting publicly on its investigations and on the findings in relation thereto. In making its findings as to the causes and contributing factors, it is not the function of the CTAISB to assign fault or determine civil or criminal liability, but the Board shall not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from its findings.

In this regard, Hong Kong lags behind the major Commonwealth countries as Hong Kong does not have any independent organisation to undertake transport accident investigations to avoid any possible conflict of interest.

If the clock is put back to September 1988 or the year 1989, CAAC (as owner and operator of "China 301") and the personal representatives of the flight crew might apply to the Court of First Instance of the Supreme Court (now known as the High Court) for an order of prohibition[7] directed to the Chief Inspector of CAD to restrain or prohibit this public authority from acting in breach of the rules of natural justice, as the investigation was concerned to determine whether sufficient advice and information was given, or made available, to the commander of China 301, to enable him to form a reasonable assessment of the landing conditions at Hong Kong International Airport. The CAD, being the service provider of air traffic services, obviously cannot act as the judge of its own cause. Under regulation 8 of the Regulations, the Chief Inspector shall determine whether or not an investigation shall be

[7] Para.10.103. Halsbury's Laws of Hong Kong Vol.1(1) 2003 Reissue

carried out into any accident to which the Regulations apply. The prohibition order is to forbid any such determination [8] in the circumstances.

The order of prohibition is obtainable on an application for judicial review. Judicial review is concerned with reviewing not the merits of the decision in respect of which the application for judicial review is made, but the decision-making process itself[9]. Judicial review is, however, a discretionary remedy. As to the practice and procedure on applications for judicial review, reference may be made to Order 53 of the Rules of the High Court, which is the subsidiary legislation of the High Court Ordinance, Cap.4.

## [F] APPLICATION FOR REVIEW BY BOARD OF REVIEW

After taking into account any representations made by those served with the notice of the draft report of the Inspector, the Inspector may reconsider the contents of the draft and revise the same. The final draft of the report will be submitted to the Director-General of Civil Aviation under Regulation 10(6) of the Regulations. A copy of the report made to the Director-General shall be served by the Chief Inspector on any person who has been served with a notice previously under Regulation 11(1). Any such person may, at any time before the expiry of twenty-one days from the date of service of the final report, serve on the Director-General of Civil Aviation written notice ("notice of review") that he wishes those findings and conclusions in the

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[8] R v. GLC, ex parte Blackburn [1976] WLR 550 at 559, CA (Eng.)
[9] Chief Constable of the North Wales Police v. Evans [1982]3 All ER 141 at 153-154, HL per Lord Brightman

report from which it appears that his reputation, or the reputation of the person on whose behalf representations have been made under Regulation 11(3), is likely to be adversely affected, to be reviewed by the Board of Review. This is a further opportunity to challenge the report of the Inspector's investigation.

The notice of review shall specify the *findings* and *conclusions* that should be reviewed by the Board of Review, and shall state concisely the *grounds* on which the same are challenged, and there shall be appended to the notice, a copy of any representations made previously.

Where a notice of review has been served, the Director-General shall inform the Chief Executive, who shall thereupon appoint a Board of Review, which shall consist of:

(a) a magistrate, legal officer or a barrister or solicitor of not less than five years' practice, who shall be the Chairman of the Board; and

(b) one or more assessors, each of whom shall possess aeronautical or aeronautical engineering qualifications or some other special skill or knowledge which is relevant to the conduct of the Review.

All those served with a notice under Regulation 11(1) shall be served with the notice of review. The person requesting the review[10] shall, and any person, who in the opinion of the Board may be directly affected by the Review, may be granted leave to appear and, have the right to give evidence, produce witness and examine any other witness giving evidence at the

[10] Regulation 14 of the Regulations

review. The Inspector who made the report shall be entitled to be heard by the Board.

Where new and important evidence is given at the Review, which was not given at the Inspector's investigation, the Board may, on an application by the Chief Inspector, discontinue the Review, and the Chief Inspector shall thereupon cause the investigation to be re-opened.

Upon completion of the Review, the Board shall make a report to the Chief Executive containing a summary of the proceedings at the hearing, and either *confirming or rejecting*, in whole or in part, those findings and conclusions of the Inspector under review, together with *reasons* therefor.

Pursuant to regulation 15, the Chief Executive shall, unless in his opinion there are good reasons to the contrary, cause the Inspector's report, and the report of the Board of Review, to be made public, wholly or in part in such manner as he thinks fit. However, the Inspector's report shall not be published before the expiry of the time for service of a notice of review, or until the Board has made a report to the Chief Executive, as the case may be.

The Inspector's investigation or the review may be re-opened if after the completion of the investigation, or the Review, new and important evidence has been discovered, or if for any reason, there is ground for suspecting that a miscarriage of justice has occurred.

The jurisdiction of the Board of Review is very narrow and limited; it may only review the findings and conclusions which adversely affect the

reputation of the person in respect of whom the notice of review was served. The Board may discontinue the Review at any time if the Board is satisfied that any of the findings and conclusions under review do not adversely affect the reputation of such person.

## [G] PUBLIC INQUIRIES

The Regulations also provide for public inquiries[11] to be held into the circumstances and causes of air accidents, or into any particular matter relating to the avoidance of such accidents in the future, where it appears to the Chief Executive that it is expedient in the public interest.

The Chief Executive may appoint a *commission of inquiry* for that purpose. In such case, the Inspector's investigation relating to the accident, or to the particular matter, shall be discontinued except for the purpose of rendering assistance to the commission and the Secretary for Justice as is in his power.

The commission shall consist of:

(a) a District Judge or magistrate; and

(b) not less than two assessors, each of whom shall possess an aeronautical or aeronautical engineering qualification or some other special skill or knowledge which is relevant to the conduct of the inquiry.

However, there is no provision or guidelines on the circumstances in which it is expedient in the public interest for the Chief Executive to appoint a commission of inquiry. Since the enactment of the Regulations in 1983, no public inquiry on air accidents has ever been held in Hong Kong. It is thus

[11] Ibid. Regulation 17

proposed that whenever there is a potential conflict of interest for the CAD to make an Inspector's investigation into an accident which involves, or is likely to involve, the air traffic services provided by the CAD as a service provider and/or the CAD as a regulator of civil aviation, it would be expedient in the public interest for the Chief Executive to exercise his discretion to appoint a commission of inquiry under regulation 17 of the Regulations. The lack of independence and potential breach of the rules of natural justice or fairness in the process of making the investigation should be compelling reasons for the appointment of an independent commission of inquiry to take the matter out of the hands of the CAD.

These proceedings shall be held in public unless it is in the interest of justice or in the public interest to do otherwise.

Preparation and presentation of the case shall be conducted by the Secretary for Justice, who is required to serve upon the owner, operator, hirer and commander of any aircraft involved in the accident and on any other person, who in his opinion, ought to be served, with the notice of the date, time, place and nature of the inquiry. They shall be deemed to be parties to the proceedings. Any other people may make application to the commission for leave to appear and be a party to the proceedings. A preliminary meeting may be held to give directions and make preliminary or interlocutory orders as to the procedure.

The commission may[12] enter and inspect, authorize any person to enter and

[12] Ibid. Regulation 17(8)

inspect, any place, building or aircraft for the purposes of the inquiry, to summon the attendance of witnesses, to call, examine and require such persons to answer questions, furnish information or produce books, papers, documents and articles which are relevant, to administer oath to such witnesses, permit witnesses to make affirmation, and have all the powers of a *magistrate*.

The powers of a magistrate are set out in the Magistrates Ordinance, Cap.227. The most relevant powers of the magistrate applicable to public inquiries in the current context are provided in Sections 21 and 22 of the Magistrates Ordinances in relation to witnesses and powers to order production of documents. The commission of inquiry may step into the shoes of the magistrate to do the following:

a) If it is made to appear to the commission, by any credible person, that any person within Hong Kong is likely to give material evidence, the commission shall issue his summons to such person, requiring him to be and appear at such time and place as specified in the summons before the commission to testify what he knows concerning the matter.

b) If any person so summoned refuses or neglects to appear as required by the summons and no just excuse is offered for such refusal or neglect, then after proof upon oath that the summons was served on such person, either personally or by leaving the same for him with some person at his last or most usual place of abode, it shall be lawful for the commission to issue a *warrant* to bring and have such person at a time and place to therein mentioned before the commission: (a) to testify as aforesaid; and

(b) to show cause why he should not be punished for his refusal or neglect so to appear. The commission may, unless satisfied that there is reasonable cause for his refusal or neglect to appear as required by the summons, impose a fine of not exceeding $5,000 and order him to be imprisoned for a period not exceeding twelve months.

c) If the commission is satisfied, by evidence upon oath, that it is probable that such person will not attend to give evidence without being compelled to do so, then, instead of issuing a summons, it shall be lawful for the commission to issue a warrant in the first instance.

d) If any person, having come before the commission, shall refuse to be sworn, or having been sworn, shall, without just excuse, refuse to answer such questions as shall be put to him concerning the matter, the commission may, by warrant under their hands and seal, order him to be imprisoned for twelve months unless he in the meantime shall consent to be sworn and to answer questions, or the commission may impose a fine not exceeding $5,000.

The powers contained in Section 21 shall be deemed to include[13] the power to summon and require a witness to produce to the commission books, plans, papers, documents, articles, goods and things likely to be material evidence on the hearing of accident. And the provisions relating to the neglect or refusal of witness, without just excuse, to attend to give evidence, or to be sworn, or to give evidence, shall apply accordingly.

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[13] Section 22 of Magistrates Ordinance, Cap.227

The proceedings on the public inquiry[14] shall commence with an opening speech by or on behalf of the Secretary for Justice, followed with brief speeches by or on behalf of other parties thereto. Witnesses produced by the Secretary for Justice shall be examined, cross-examined by the parties, and then re-examined by the Secretary for Justice.

After the evidence produced on behalf of the Secretary for Justice has been concluded, each party to the proceedings shall be entitled to address the commission and produce or recall witnesses, who shall be examined, cross-examined and re-examined. Further witnesses may be produced by the Secretary for Justice, who would be cross-examined and re-examined.

After all the evidence has been concluded, the parties may then address the commission on the evidence. The Secretary for Justice may finally address the commission upon the whole case.

Upon completion of the inquiry, the commission shall make a report to the Chief Executive stating the *facts* relating to the accident, and the opinion of the commission, touching the *cause(s)* of the accident, or on the particular matter referred to the commission, and adding any *recommendations* with a view to the preservation of life and the avoidance of accidents in the future. Each assessor of the commission shall[15] either sign the report with or without reservations, or state his dissent therefrom with reasons, such reservations, dissent and reasons shall be forwarded to the Chief Executive with the report. The Chief Executive shall, unless in his opinion there are

[14] Regulation 18 of the Regulations
[15] Ibid. Regulation 18(6)

good reasons to the contrary, cause such report and reservations, or dissent with reasons, to be made public, wholly or in part, in such manner as he thinks fit.

After the completion of the inquiry, if new and important evidence has been discovered, or if for other reason there is, in his opinion, ground for suspecting that there is a miscarriage of justice, the Chief Executive may direct the inquiry to be reheard either generally or as to any part thereof, either by the commission in the first instance, or by some other qualified persons appointed by him to be held.

## [H] CHALLENGE TO PUBLIC INQUIRY

### *(1) Jurisdiction*

The term of reference of the commission appointed would define the scope of the inquiry and thus the jurisdiction of the commission. Under Regulation 17, the commission may hold a public inquiry into the *circumstances* and *causes* of the accident, or into any *particular matter* relating to the avoidance of such accidents in the future. The term of reference must clearly define what exactly is that "particular matter". The commission may not act in excess or beyond its jurisdiction.

In Re Erebus Royal Commission[16], a Royal Commission was appointed to inquire into "the cause and circumstances of the crash" and Mr. Justice Mahon, a Judge of the High Court, was appointed sole

[16]Re-Erebus Royal Commission; Air New Zealand Ltd. v. Mahon (No.2) [1981]1NZLR 618 (CA; NZ)

Commissioner. In his report, he disagreed with the Inspector of the accident and found that "... the single dominant and effective cause of the disaster was the mistake made by those airline officials who programmed the aircraft to fly directly at Mt. Erebus and omitted to tell the aircrew". The Commissioner exonerated the flight crew from any error contributing to the disaster.

The Commissioner also made findings of misconduct against certain airline officials. He referred to "the stance" of the airline at the inquiry before him and in Paragraph 377 of the report, he stated that there had been "a pre-determined plan of deception" and "an orchestrated litany of lies".

The airline, its chief executive, and the airline's technical flight manager brought judicial review proceedings seeking orders quashing the Commissioner's decisions recorded in specified paragraphs that certain employees were guilty of serious misconduct and grave improprieties in relation to the collection and preservation of certain documents and articles relating to the flights and/or their conduct at the public hearings convened by the Commissioner.

The Court of Appeal in New Zealand held that in making the allegations stated in Paragraph 377 of the report of "a pre-determined plan of deception" and "an orchestrated litany of lies", the Commissioner had acted, *inter alia*, in excess of jurisdiction. The Commissioner appealed to the Judicial Committee of the Privy Council.

The Privy Council[17] upheld the decision of the Court of Appeal and held, inter alia, that making a finding of this gravity was *collateral but not essential* to his decisions on any of those matters on which his terms of reference required him to report. The accusations contained in Paragraph 377 against the management of the airline must be treated as conclusions that he was not entitled to reach. The test must be what is reasonably incidental to the valid terms of reference. The question of excess of jurisdiction turns on whether the findings are reasonably incidental to an inquiry into the causes and circumstances of the crash. The Courts have a duty to see that the Commission keep within their terms of reference. The Commissioner's appeal was therefore dismissed.

In general, the remedies of certiorari and prohibition have much in common. Certiorari is concerned with decisions in the past, prohibition is concerned with those in the future. In R v. Electricity Comrs, ex parte London Electricity Joint Committee Co. (1920) Ltd.[18], Lord Atkins in the Court of Appeal said, "I can see no difference in principle between certiorari and prohibition, except that the latter may be invoked at an earlier stage. If the proceedings establish that the body complained of is exceeding its jurisdiction by entertaining matters which would result in its final decision being subject to being brought up and quashed on certiorari, I think that prohibition will lie to restrain

[17] Re Erebus Royal Commission; Air New Zealand Ltd. v. Mahon [1983] NZLR 662 (PC)
[18] [1924] 1 KB 171 at 206, CA (Eng.)

it from so exceeding its jurisdiction".

A commission of inquiry is performing a judicial function, both their proceedings and decisions are thus subject to judicial review, and if the Court deems appropriate, to have their proceedings restrained and their decisions quashed by the issue of orders of prohibition and/or certiorari. The orders will be directed to the commission. Moreover, a declaration may be awarded at the same time that the act or decision is null and void[19].

*(2) Bias*

Justice must not only be done, but must also be seen to be done. It is generally unnecessary to establish actual bias, it is enough to establish that there is a real likelihood, in the sense of a real possibility or danger, of bias on the part of the judge or assessor(s) in the commission of inquiry. The alternative test of whether a reasonable person acquainted with the outward appearance of the situation would have reasonable grounds for suspecting bias is now replaced by the "real danger of bias" test[20]. The court may set aside a determination if justice has not been manifestly seen to be done.

In the New Zealand High Court decision of Whale Watch Kaikoura Ltd. v. Transport Accident Investigation Commission[21], it was held that the principle of judicial review did not empower the Court to revisit the findings and conclusions of the commission or determine their merits

[19] As in Ridge v. Baldwin [1964] AC40, HL
[20] R v. Gough [1993] AC 646 (HL)
[21] [1997] 3 NZLR 55

where there had not been any allegation as to excessive jurisdiction or bias on the part of the commission. Therefore, the merits of those findings and recommendations are not amenable to review by the Court. The principles of the New Zealand Court of Appeal in Re Erebus Royal Commission[22] were applied.

[22] [1981] 1 NZLR 618 (CA; NZ)

# CHAPTER VIII

# EFFECT OF REPORTS AND FINDINGS ON SUBSEQUENT CIVIL PROCEEDINGS

## [A] CONCLUSIVENESS OF FINDINGS IN THE REPORTS

The fundamental purpose of investigating accidents under the Regulations is to determine the *circumstances* and *causes* of the accident with a view to preservation of life and the avoidance of accidents in the future; it is *not* the purpose to apportion blame or liability[1].

It is clear that the focus of the investigation is not on the issue of liability or apportionment of blame or liability in the accident. One may at most be a party to the Board of Review hearing or to the public inquiry proceedings. There is no plaintiff or defendant in such proceedings, although the question of liability or who should be blamed may be *inferred* from the findings and probable cause(s) of the accident.

The Inspector's investigation is conducted in camera, the public and the persons interested in the outcome are kept in the dark as to the standard of proof applied by the Inspector, the methods of eliciting evidence from the witnesses, whether statements are given on oath or by way of statutory declaration or not, how hearsay evidence is rejected or accepted, in what way the Inspector resolves or reconciles conflicting evidence, how much weight is given to which piece of evidence and the reasons behind, whether the rules

[1] Regulation 4 of the Regulations

of natural justice have been complied with and whether there is any bias or favouritism involved.

Given all these unknown factors, the findings and cause(s) inferred or deduced can at most amount to "probable cause(s)" of the accident.

Since the accident investigation is not for the purpose of apportioning blame or establishing liability, either civil or criminal, it may well proceed in parallel with inquiries which can lead to legal proceedings. For personal injury claims for common law negligence, the time limit is only three years[2] under the Limitation Ordinance, Cap.347 of the Laws of Hong Kong. A Writ of Summons has to be issued to reserve the Plaintiff causes of action within the statutory time limit, and on many occasions, even before the Inspector's investigation report is released to the public, including the Plaintiff, who is either the victim or the victim's personal representative, as the case may be.

In establishing negligence, the Plaintiff has to prove four elements, namely, (1) the Defendant owed the Plaintiff a duty of care, (2) the Defendant was in breach of that duty, (3) as a result, the Plaintiff suffered loss and damage, and (4) the loss and damage was *caused* by the Plaintiff's breach of duty.

So in both the Inspector's investigation and in the civil proceedings, both have to find out the causation of the accident. Since the burden of proof rests on the Plaintiff, it is natural for him or his lawyers to gather as much relevant evidence as possible to prove his case in Court, they would include:

[2] Sections 27, 28 and 29 of Limitation Ordinance

a) all statements taken from persons by the investigation authorities in the course of their investigation or otherwise;

b) all communications between persons having been involved in the operation of the aircraft;

c) medical or private information regarding the pilot(s) involved in the accident;

d) cockpit voice recordings ("CVR") and transcripts from such recordings;

e) digital flight data recorder ("DFDR"); and

f) opinions expressed in the analysis of information, including flight recorder information.

Annex 13 to the Chicago Convention entitled "Aircraft Accident and Incident Investigation" provides international standards and recommended practices on such investigation. In Chapter 5, Paragraphs 5.12 and 5.12.1 stipulate as follows:

**"Non-disclosure of records**

5.12 The State conducting the investigation of an accident or incident shall not make the following records available for purposes other than accident or incident investigation, unless the appropriate authority for the administration of justice in that State determines that their disclosure outweighs the adverse domestic and international impact such action may have on that or any future investigations:

a) all statements taken from persons by the investigation authorities in the course of their investigation;

b) all communications between persons having been involved in the operation of the aircraft;

c) medical or private information regarding persons involved in the accident or incident;

d) cockpit voice recordings and transcripts from such recordings; and

e) opinions expressed in the analysis of information, including flight recorder information.

5.12.1 These records shall be included in the final report or its appendices only when pertinent to the analysis of the accident or incident. Parts of the records not relevant to the analysis shall not be disclosed.

*Note – Information contained in the records listed above, which includes information given voluntarily by persons interviewed during the investigation of an accident or incident, could be utilized inappropriately for subsequent disciplinary, civil, administrative and criminal proceedings. If such information is distributed, it may, in the future, no longer be openly disclosed to investigator. Lack of access to such information would impede the investigation process and seriously affect flight safety.*"

The rationale contained in the Note is that if the evidence is used for disciplinary, civil or criminal proceedings, it will deter future voluntary provision of it. Greater contribution to safety is to promote free and open provision of information by generally precluding its use outside the

investigation.

However, the people seeking the information argued for a broader public interest involving the administration of civil and criminal justice, accountability of pilots and airlines, and the need for all relevant evidence to be made available in those contexts. Protective legislation would make it harder for victims or dependents to get compensation. It is ultimately in the interests of safety to have full transparency and accountability.

In New Zealand, the TAIC Amendment Act 1999 ("the Act") substantially protects and constrains the use of CVR evidence and other investigation material, and aligns New Zealand domestic law with Paragraph 5.12 of Chapter 5 of Annex 13. In relation to criminal proceedings, it confers even more protection than the Chicago Convention.

The Act came into effect on the 9th September 1999. The general theme of the Act is to protect various types of evidence and records, both from disclosure and from admissibility in any proceedings.

Section 14B of the Act prohibits the disclosure (other than by TAIC itself) and also admissibility in any proceedings, of the material or information summarised as follows:

a) statements or submissions made to TAIC in the course of an investigation;
b) recordings of interviews by a person engaged in an investigation or a transcript thereof;
c) notes or opinions of investigators generated in the course of an

investigation;

d) investigation information provided in confidence by TAIC to any other person.

It is similar to Paragraph 5.12 of Annex 13 and based on the theory and desire to encourage free and frank disclosure of information to TAIC.

In addition to the protection of the said records, Section 14O also protects the TAIC investigators. It provides that no person engaged in an investigation by the TAIC is a compellable witness in any proceedings to which TAIC is not a party. It applies to the investigator's *opinion* concerning any aspect of the investigation and "any matter included in the analysis, findings or recommendations." It appears that it would leave admissible all evidence from investigator recorded under the "Factual Information" section of his report, and is likely to limit the investigator's admissible evidence to direct physical observations and photographs.

In relation to CVRs and transcripts thereof, Section 14C of the Act lays down a *prima facie* prohibition against the disclosure or admissibility of such recordings, but this may be lifted by an order of the High Court in *civil* proceedings (but never criminal proceedings). Sections 14E and 14F of the Act allow any party or prospective party to civil proceedings to apply for disclosure. The test is virtually the same as that contained in Paragraph 5.12 of Annex 13. It provides as follows:

> " ... *if the Court determines, on the balance of probabilities, that the interests of justice in the disclosure of the record outweigh the adverse*

*domestic and international impact the disclosure may have on the investigation to which the record relates, or any future investigation into an accident, or an incident."*

The application has to be heard in chambers (that is, in camera), and the Court's report on the proceedings and outcome is restricted. Neither Chapter 5 of the Annex 13, nor the Act, cover Digital Flight Data Recorders ("DFDR"). It provides generally of the acts or omissions of the flight crew, such as, adherence to flight profiles, flight manuals and procedures, speeds, configurations, control inputs, and the like. These could be vital evidence in Court proceedings. Surprisingly, the information gathered from DFDR does not enjoy equivalent protection as the CVRs, witness statements and communications referred to in Paragraph 5.12 of Annex 13.

In this regard, in New Zealand, it is difficult for the Plaintiff to challenge the findings and conclusion of the investigator through the backdoor. In negligence claims in civil proceedings, it would be an uphill task for the Plaintiff to persuade the High Court to come to a conclusion which may be totally or substantially different from that of the investigator's report as very limited evidence may be discovered from the investigator or otherwise. It would certainly undermines the chance of success of the Plaintiff if the conclusion of the report was unfavourable to him.

In the United Kingdom, the situation is more flexible and left in the hands of the High Court in both civil and criminal jurisdiction for the disclosure of the relevant records referred to in sub-paragraphs (a) to (e) of Paragraph 5.12 of

Annex 13. Regulation 18 of the Civil Aviation (Investigation of Air etc.) Regulations 1996 (SI 1996/2798) provides as follows:

**"Disclosure of relevant records**

*18. (1) Subject to paragraphs (2) and (4) to (6) below no relevant record shall be made available by the Secretary of State to any person for purposes other than accident or incident investigation.*

*(2) Nothing in paragraph (1) above shall preclude the Secretary of State making a relevant record available to any person where*

*(a) in a case where that person is a party to or otherwise entitled to appear at judicial proceedings the relevant court has ordered that the relevant record shall be made available to him for the purpose of those proceedings; or*

*(b) in any other circumstances, the relevant court has ordered that the relevant record shall be made available to him for the purpose of those circumstances.*

*(3) In this regulation*

*"Judicial proceedings" includes any proceedings before any court, tribunal or person having by law power to hear, receive and examine evidence on oath;*

*"relevant court" in the case of judicial proceedings or an application for disclosure made in England and Wales means the High Court, in the case of judicial proceedings or an application for disclosure made in Scotland means the Court*

*of Session and in the case of judicial proceedings or an application for disclosure made in Northern Ireland means the High Court;*

*"relevant record" means any item in the possession, custody or power of the Secretary of State which is of a kind referred to in sub-paragraphs (a) to (e) of paragraph 5.12 of the Annex; and*

*"Secretary of State" includes any officer of his.*

*(4) Subject to paragraph (6) below no order shall be made under paragraph (2) above unless the relevant court is satisfied that the interests of justice in the judicial proceedings or circumstances in question outweigh any adverse domestic and international impact which disclosure may have on the investigation into the accident or incident to which the record relates or any future accident or incident investigation undertaken in the United Kingdom.*

*(5) A relevant record or part thereof shall not be treated as having been made available contrary to paragraph (1) above in any case where that record or part is included in the final report (or the appendices to the final report) of the accident or incident.*

*(6) The provisions of this regulation shall be without prejudice to any rule of law which authorises or requires the withholding of any relevant record or part thereof on the ground that the disclosure of it would be injurious to the public interest."*

In Hong Kong, there are no provisions in the Evidence Ordinance, Cap.8 of the Laws of Hong Kong, the Civil Aviation Ordinance, Cap.448, or the Regulations giving effect to Paragraph 5.12 of Annex 13 in relation to the non-disclosure of evidence collected by the Chief Inspector or Inspectors of CAD, the evidence given at the Board of Review hearing or even at the Public Inquiries conducted under the Regulations.

Although not binding on the Hong Kong Courts, the Privy Council decision in Attorney-General for Canada v. Attorney General for Ontario[3] and the New Zealand Court of Appeal decision in New Zealand Air Line Pilots' Association v. Attorney-General[4] are persuasive authorities on the issue whether the Chicago Convention and Annex 13 form part of the law of Hong Kong. Section 2A of the Civil Aviation Ordinance makes it clear that the Chief Executive in Council may by order make such provision as appears to the Chief Executive in Council to be necessary or expedient for carrying out the Chicago Convention, any Annex thereto relating to international standards and recommended and any amendment of the Convention or any such Annex made in accordance with the Convention.

In other words, before an Order in Council is made by the Chief Executive to adopt Paragraph 5.12 of Annex 13, it is NOT part of the law of Hong Kong. Alternatively, through an act of the Legislative Council, statutory provisions may be made in support of the appropriate provisions of Annex 13 and make them part of the Hong Kong legislation. In the absence of such statutory

[3] [1937] AC 326
[4] [1997] 3 NZLR 269

protection, all the CVRs and its transcripts, DFDRs, witness statements of the persons interviewed by the Inspectors, communications between persons having been involved in the operation of the aircraft, opinions expressed in the analysis of information, including all flight recorder information may become the subject matters of specific discovery in civil proceedings. The medical and private personal data or information regarding persons involved in the accident or incident are protected under the Personal Data (Privacy) Ordinance, Cap.486, from disclosure.

The Plaintiff may invoke Section 42 of the High Court Ordinance, Cap.4. In any proceedings in which a claim in respect of personal injuries to a person or in respect of a person's death is made, the Court of First Instance shall have power to order a person who is not a party to the proceedings and who appears to the Court of First Instance to be likely to have or to have had in his possession, custody or power any documents which are relevant to an issue arising out of that claim to *disclose* whether those documents are in his possession, custody and power, and to *produce* such of those documents as are in his possession, custody or power to the applicant or, on such conditions as may be specified in the order.

Public interest immunity may be a ground for objecting to the making of such an order. Such application may be made and served on the Chief Inspector of the CAD, who would be represented by the Secretary for Justice to deal with the matter.

In civil Court proceedings in Hong Kong for the establishment of liability of

the defendant(s), the Inspector of the accident may be called and is compellable to give evidence and be subject to examination and cross-examination. He may certainly refer to his report, which is admissible in Hong Kong, but how much weight is given to it is a matter for the trial judge. The trial judge may come to a completely or substantially different decision on the causation of the accident on balance of probability, after taking all the relevant evidence into consideration and assessing the probative value thereof.

## [B] WHETHER THERE IS ISSUE ESTOPPEL

In Speeklink Vanguard v. The European Gateway[5], two cross-channel ferries, the Speeklink Vanguard owned by the Plaintiffs and the European Gateway owned by the defendants, collided in December 1982 in the approaches to the port of Harwich. The Secretary of State for Transport in the United Kingdom ordered an inquiry into the collision by a court of formal investigation. The investigation was held and the court concluded that whilst the collision was caused by wrongful acts of both captains, the preponderant blame fell on the captain of the defendants' vessel.

The plaintiffs issued a writ in the Admiralty Court to recover damages from the defendants for the damage arising out of the collision. The plaintiffs based their pleadings on the findings of the court of formal investigation, asking for judgment against the defendants for eighty percent of the damages sustained.

[5] [1987] Q.B.206; [1986] 3 All E.R.554

The defendants served their defence and counterclaim denying liability and asked for judgment in their favour. In their reply and defence to counterclaim, the plaintiffs pleaded that the defendants were precluded from *re-opening the findings* of the court of formal investigation, by the doctrine of issue estoppel or abuse of the process of the court.

It was held by the Admiralty Court, *inter alia*, that:

- The Secretary of State formulated the questions to be determined by the court of formal investigation;
- The Secretary of State decided on whom notice of the investigation should be served and then becoming parties to the proceedings;
- The *purposes* of such inquiry were: (1) to assist in the preservation of a reasonable standard of safety of life and property at sea, (2) to determine why a casualty occurred, and (3) whether the casualty was caused by the wrongful act or default of any person and, if so, whether the court should impose penalties on those at fault;
- The first purpose/function is purely investigative as opposed to the third function which is adjudicative;
- None of the purposes of the inquiry was to determine civil liability as between contending ship owners;
- The court of formal investigation is *not a court of competent jurisdiction* to determine civil liability between the parties;
- For issue estoppel to arise, three requirements have to be satisfied:
  (i) The judgment in the earlier action must be that of a court of competent jurisdiction, and its decision is final and conclusive on

the merits;

(ii) The parties (or privies) in the earlier action relied on as creating an estoppel must be the same; and

(iii) The issue in the later action, in which estoppel is raised as bar, must be the same issue as that decided by the judgment in the earlier action.

- Therefore, *no issue estoppel arises* and that the *findings* of the court of formal investigation would *not* be *conclusive*.

The classic formulation for issue estoppel is found in the words of Lord Keith in Arnold v. Natwest Bank PLC [1991] 2 A.C. 93 at 105 where he said:

> *"Issue estoppel may arise where a particular issue forming a necessary ingredient in a cause of action has been litigated and decided and in subsequent proceedings between the same parties involving a different cause of action to which the same issue is relevant, one of the parties seeks to re-open the issue".*

In Hong Kong, since the fundamental purpose of aircraft accident investigations is not intended to apportion blame or liability, but to determine the circumstances and causes of the accident, the findings, causal factors and conclusions published in any report, either of the Inspector, a Board of Review or a commission of inquiry, are thus *not* determinative, conclusive or binding on the parties or the Courts in subsequent civil proceedings.

In Section 7 of the Commissions of Inquiry Ordinance, Cap.86, it is expressly provided that evidence given by any person before a commission

of inquiry so appointed shall *not* be *admissible* by or against him in any civil or criminal proceedings except for the determination of perjury. It is further provided in Section 12(2) that all evidence given before a Commission shall be absolutely privileged, and no witness giving such evidence shall be liable to any suit or other civil proceeding in respect thereof. However, there is no similar provisions in the Regulations for aircraft accident investigation. It is not clear whether the omission is inadvertent or intentional.

In this regard, the position in Australia and Canada is clear. Section 27 of the Transport Safety Investigation Act 2003 in Australia provides that the final report in relation to the accident investigation is *not admissible* in any civil or criminal proceedings save and except a coronial inquiry. In Canada, Section 7(1) of the Canadian Transportation Accident Investigation and Safety Board Act 1989, c.3 expressly stipulates that the findings of the Board are *not binding* on the parties to any legal, disciplinary or other proceedings.

Therefore, it appears that in Hong Kong, common law principles may be relied upon to determine whether there is any issue estoppel between the parties to subsequent civil proceedings as discussed above.

# CHAPTER IX

## [A] DISCUSSION ON RESULTS AND CONCLUSION

The hypothesis to be tested in this study is: "To what extent would Aircraft Accident Investigation Reports be (1) sustainable to legal challenge, and (2) utilised in civil legal proceedings in Hong Kong."

As demonstrated in the above analysis, the investigation reports can be challenged on different fronts. Procedural irregularities, such as inadequate opportunity given to those adversely affected to be heard, acting beyond the term of reference in public inquiries, or the lack of independence of the investigation itself may give arise to a cause of action to have it quashed completely or partly.

Those whose reputation is adversely affected may challenge the findings and conclusions in the Board of Review. They are usually the operator(s), the pilot(s) or manufacturer(s) of the aircraft. They may instruct independent experts to attend the hearing to challenge the opinions given by the CAD's experts upon which the Inspector's findings and conclusions are based.

Either subsequent to the release of the investigation report to the public, or running parallel with the investigation itself, the records in the possession, custody and power of the Inspector of CAD are subject to Court orders for specific discovery. The Inspector is compellable to give evidence in the High Court in personal injury cases. Without any statutory provisions for the protection of the records from disclosure, the very limited ground of

public interest immunity in opposing the Plaintiff's application for discovery of documents is grossly inadequate from the CAD's perspective. The High Court may rule on the causation of the accident even before the CAD has finalised its report. Therefore, the two may come to different conclusions on the causation of the accident based on the balance of probability. The Inspector of CAD may not have any legal training, as has been discussed above. How the Inspector deals with, accepts or rejects evidence is kept completely in the dark. However, the High Court weighs the evidence judicially in open Court, which provides a more transparent, reliable and credible result than the CAD's report.

The results of Public Inquiries are by no means immune from challenge if the Commission's inquiry exceeds its term of reference, or if there is a real possibility or danger of bias on the part of the judge or assessor(s) in the Commission of Inquiry.

Among the different channels or methods of investigation, the Inspector's report is most vulnerable to legal challenge, given the current legal position in Hong Kong for the lack of statutory non-disclosure protection of the records, information and evidence gathered, and the compellability of the Inspectors to give evidence in Court.

In the circumstances, the aircraft accident investigation reports may, at best, be used or taken as a piece of evidence setting out the factual information about the accident, and as an expert opinion of the CAD in subsequent civil proceedings in establishing causation of the accident and liability in common

law negligence in personal injury or fatal accident cases. Those investigation reports are by no means conclusive or binding on the parties or the Court in civil proceedings, and issue estoppel does not arise.

## [B] RECOMMENDATIONS FOR REFORM

In relation to eyewitness accounts mentioned in Part D of Chapter VII above, Regulation 9 of the Regulations empowers the Inspector to take statements from all such persons as he think fit and to require any such person to make and sign a declaration of the truth of the statement made by him. The Inspector also has power by summons under his hand to call before him and examine all such persons as he thinks fit and to require such person to answer any questions or furnish any information.

However, there is no provision in the Regulations for legal sanction against any person served with the summons for non-attendance of the interview, failure to produce oneself for examination or failure to provide documents such persons is required to produce.

It is recommended that the position should be brought in line with the legal sanction under Regulation 17 of the Regulations, Sections 21 and 22 of the Magistrates Ordinance, Cap.227 to make it a criminal offence that unless the Court is satisfied that there is any reasonable cause for a person's refusal or neglect to appear as required by the summons, a fine of not exceeding $5,000 or imprisonment for a period not exceeding twelve months should be imposed.

If any person, having come before the Inspector, shall refuse to be sworn, or

having been sworn, shall, without just excuse, refuse to answer such questions as shall be put to him/her concerning the matters to be investigated, it should likewise be made a criminal offence attracting a sentence of imprisonment for not more than twelve months, or a fine not exceeding $5,000.

In Part E of Chapter VII, the lack of independence of the Civil Aviation Department of Hong Kong has been canvassed. The department performs three primary functions, namely, serving as the *regulator* of civil aviation, being the *air traffic service provider* and as *aircraft accident investigator*, as opposed to the counterparts in the United Kingdom, New Zealand, Australia and Canada, which all have an operationally *independent* body to investigate, analyse and report on aviation safety and accidents.

To avoid the embarrassing conflict of interest situation in the Trident accident which touched upon the adequacy of air traffic control services being provided at the material time by the Civil Aviation Department of Hong Kong, it is recommended that an independent government body should be formed for the independent investigation of significant aviation accidents in order to make findings as to the circumstances of the accidents, their causes and contributory factors, identify safety deficiencies as evidenced by the occurrences, to make recommendations to eliminate or reduce any such safety deficiencies, and report publicly on its investigations and on the findings in relation thereto. The accident investigative function should be completely separated from the air traffic service providing function of the CAD to make the accident investigation totally independent and free of bias.

This is particularly important if the negligence of air traffic controllers is one of the probable contributing factors of the accident. In summary, the recommendations for reform cover the following areas:

(1) The introduction of legal sanction against people failing to attend interviews after being served with a summons to attend before the Inspectors for examination or production of relevant documents.

(2) The formation of an independent government body for the independent investigation of significant aviation accidents to find out the causation and contributory factors of the accident, to identify safety deficiencies and make recommendations for prevention.

## [C] MATTERS FOR FUTURE STUDIES AND CONSIDERATION

In Hong Kong, before an Order in Council is made by the Chief Executive under Section 2A of the Civil Aviation Ordinance, Cap.448, or an enactment being made by the Legislative Council, Paragraph 5.12 of Annex 13 in relation to the non-disclosure of evidence collected is not part of Hong Kong law and there is a vacuum in the Hong Kong legislation in this regard.

It is therefore, for the Legal Reform Commission to consider whether Paragraph 5.12 of Annex 13 should be adopted in Hong Kong in this entirety or with modification. New Zealand has gone even beyond Paragraph 5.12 to protect the various records from disclosure in civil and/or criminal proceedings by virtue of her TAIC Amendment Act, 1999. However, in the United Kingdom, the non-disclosure of relevant record protection is subject to qualification. It is trying to strike a balance between the two arguments that free flow of information should be encouraged to enhance aviation

safety on the one hand, and the need to have access to such information or records for administration of justice in Court proceedings on the other.

Hence, what stance Hong Kong should take is a question for future studies and consideration, since it would directly affect how the accident investigation reports and the records and information so collected may be utilised in civil proceedings in Hong Kong.

# APPENDIX

## APPENDIX A

HEURISTIC TEMPLATE FOR ACCIDENT/INCIDENT INVESTIGATION:

a) PROBABLE UNSAFE ACTS OF OPERATORS

Q1: Does the operator have the required qualifications to operate the machine?

Q2: Was his licence valid and current at the material time?

Q3: When was the operator last tested?

Q4: To what extent was the machine automatic?

Q5: At the time of the incident/accident, was the operator relying on automation?

Q6: Did the operator keep a close look out?

Q7: Could he be seen at the material time?

Q8: Did the operator follow the steps set out in the checklist in operating the machine?

Q9: Did the operator properly prioritize his attention?

Q10: Was the operator overloaded with task?

Q11: What were the tasks the operator had to handle at the material time?

Q12: Was there any external distraction, and what was it?

Q13: Were there any other distractions?

Q14: Were the maneuvers/procedures applied appropriate in the circumstances?

Q15: Did the operator have adequate knowledge or understanding

of the procedure adopted for the operation of the machine?

Q16: Did the operator have adequate knowledge or understanding of the systems in place, and the items listed on the checklists?

Q17: Did the operator consider himself performing the jobs exceeding his own ability, knowledge or expertise?

Q18: How did the operator respond to the emergency in question?

Q19: Exactly what steps did the operator take at the material time?

Q20: What options were open to the operator?

Q21: What is/are the operator's reason(s) to make the selection?

Q22: Did the operator have any visual illusion at the material time?

Q23: Did the operator suffer from spatial disorientation or vertigo at that time?

Q24: What was the operator's estimation of distance from the point of contact/collision?

Q25: What was the operator's perception of altitude, speed and clearance from the object of contact/collision?

Q26: Did the operator experience any blackout or whiteout?

Q27: Was there any violation of speed limit or weather minima?

Q28: Was it the operator's first time violation?

Q29: Did the operator have propensity for such or similar violation?

b) PROBABLE PRECONDITIONS FOR UNSAFE ACTS

Q30: Did the operator experience stress at the material time?

Q31: What caused such stress, if any?

Q32: Had the operator been operating the machine for a long period of time?

Q33: Was the operator very confident of or held a high esteem of himself?

Q34: Was the operator aware of the situation around him at the material time?

Q35: Was he entrusted with a number of tasks before the accident/incident?

Q36: Had the operator had any complaint(s) of his work conditions before the accident?

Q37: Did the operator have sufficient sleep or rest before the incident/accident?

Q38: Was the operator entrusted with multi-task at the material time?

Q39: Did the operator experience drowsiness/motion sickness?

Q40: Was there sufficient oxygen supply?

Q41: Did the operator have symptoms of hypoxia?

Q42: Did the operator have any kind of physiological illness, such as, heart disease, or diabetes?

Q43: Was the operator physically exhausted?

Q44: Was the operator under the influence of drugs or alcohol?

Q45: What was the operator's drug or alcohol contents in his blood or breath?

Q46: Was the operator taking medication at the material time?

Q47: What medication had the operator taken before the incident/accident?

Q48: What are the effects or side-effects of such medication on the

operator?

Q49: Did the operator have the aptitude or cognizance to operate the machine?

Q50: What test(s) had been administered to the operator beforehand to test his aptitude or cognizance for the job?

Q51: How tall is the operator?

Q52: What is the body weight of the operator?

Q53: For how long had the operator operated such or similar machine?

Q54: Was the operator provided with a lot of information to deal with at the material time?

Q55: What was the reaction time expected of the operator for a response to the situation?

Q56: Was the operator expected to have the other object in collision visual with naked eyes?

Q57: Was the operator expected to hear the other object in collision in the circumstances?

Q58: Was the operator experiencing a high-G environment?

Q59: Did the operator experience greyout or blackout as a result of the drainage of blood away from the brain?

Q60: Did the operator experience any physical discomfort before the accident/incident?

Q61: When did the operator last attend CRM or on-the-job training relevant to his work?

Q62: In a teamwork situation, was there a team leader in the group?

Q63: Was the team leader able to assert leadership on his/her sub-ordinates?

Q64: Was there any, or any adequate, briefing before commencement of the task or de-briefing after work?

Q65: Was there sufficient communication/co-ordination among members of the team?

Q66: What was the power-distance between the team leader and his/her sub-ordinates?

Q67: Did the team members have different cultural background or come from different countries?

Q68: In what way did the operator communicate with the relevant traffic control?

Q69: Was there any sudden breakdown of communication preceding the accident/incident?

Q70: Were the instructions given by the traffic controller ambiguous or misleading?

Q71: Was the operator usually undecisive in making decisions?

Q72: Was the operator undecisive in emergencies?

Q73: How many hours of rest were allowed between shifts for the operator?

Q74: Did the operator adhere to rest requirements?

Q75: Had the operator over exerted himself physically before commencement of work?

Q76: What were the weather conditions at the material time in terms of rainfall, wind direction and strength, visibility, height of

cloud and extent of cover?

Q77: Were there significant weather conditions, such as, thunderstorm, lightning, sand storm, typhoon, tornado and the like?

Q78: Was there any vibration experienced by the operator?

Q79: Was there any toxic gas at the place of work of the operator?

Q80: What was/were the most controversial design(s) of the equipment, instrument and/or controls used by the operator of the accident/incident?

Q81: Were the relevant switches, levers or buttons of the machine in question look alike to the operator?

Q82: What were the display/interface characteristics of the relevant equipment, instrument and/or controls?

Q83: Were those display/interface characteristics likely to cause confusion to the operator?

Q84: Did the operator relied on any automation at the material time?

Q85: Did the automation functioning properly at the material time?

Q86: If not, what were the malfunctions and their impact?

Q87: Were any automation, which was supposed to be switched on, switched off by the operator?

Q88: What was/were the reason(s) for switching it off?

Q89: At the design/development stage, were those malfunctions fully rectified before production?

Q90: If not, to what extent were those defects/malfunctions rectified

or improved?

Q91: What were the results of the relevant tests thereon?

c) UNSAFE SUPERVISION

Q92: Did the supervisor provide any relevant briefing or training to those working under him?

Q93: Did the supervisor provide suitable or adequate guidance to his subordinate on how the job should be done?

Q94: Did the supervisor provide update information, technical knowledge, data or publications as to the operation of the machine to the operator?

Q95: Did the supervisor allow the operator any practice on the machine or practice on the procedures for the job before the accident/incident?

Q96: Did the supervisor allow the operator adequate rest in the shift/roster system?

Q97: Did the supervisor keep track of the operator's training, qualifications and/or performance?

Q98: Was the organization's policy for such operation implemented by the supervisor?

Q99: Was the supervisor sufficiently trained and qualified for the job?

Q100: Was the supervisor aware of the risks involved in such situation?

Q101: To what extent was the supervisor accountable to the management and carry out their orders?

Q102: To what extent did the supervisor participate in the design of the training programme to be provided to the staff working under him?

Q103: Were the staff's concerns reflected and implemented in the training programme?

Q104: If not, why not?

Q105: Was that any shortage of staff for the job?

Q106: Was the operator overloaded with work by the supervisor?

Q107: To what extent did the supervisor tolerate the risk taken by those working under him?

Q108: Did the supervisor allow risk being outweighed by benefit in the situation in question?

Q109: Did the supervisor know the operator's risky behaviour/habits?

Q110: What steps, if any, did the supervisor take to correct the operator's inappropriate/risky behaviour/habits?

Q111: Was the supervisor aware of the safety hazards in question?

Q112: What steps, if any, did the supervisor take to rectify or remore such safety hazards?

Q113: Did the supervisor take initiative to implement safety measures to enforce safety standards?

Q114: If not, why not?

d) ORGANIZATIONAL INFLUENCES

Q115: Was the economy experiencing a downturn or recession at the material time?

Q116: Was relevant staff being reduced to save cost?

Q117: Was staff training reduced to save cost?

Q118: Was the organization suffering a loss in the previous year?

Q119: Did the organization have a tight cash-flow?

Q120: Has the most experienced and high-paid staff being laid off recently?

Q121: Was less qualified and low-paid staff promoted or recruited in substitution of the most experienced for the same position?

Q122: Was there a reduction of manpower in the organization generally?

Q123: Was the relevant machinery upgraded to meet the job requirement?

Q124: Was inferior machinery being used or purchased to replace those out of order?

Q125: Was there sufficient engineering, technical or maintenance support?

Q126: Was engineering or design flaws in question in the machine or the fleet rectified?

Q127: If not, why not?

Q128: What are channels open to the staff to convey their safety concerns to the managerial level?

Q129: What was the morale of the operator and his supervisor in the organization before the incident/accident?

Q130: Did they have any grievance over their job?

Q131: Were past incidents/accidents taken seriously or reviewed

internally by the organization?

Q132: What steps, in terms of company policy, were taken to implement safety measures?

Q133: Were there any "unwritten polices" within the organization which were likely to have a negative impact on the safety culture?

Q134: What was the set of shared philosophies, ideologies, values, beliefs, expectations, attitudes, assumptions, and norms of the organizations as understood or perceived by the operator and supervisors?

Q135: Did the management have defined objectives for the task?

Q136: Had the management established/used standardized operating procedures?

Q137: Was there operational timeframe or schedules set for the staff?

Q138: Were clear instructions given on such procedures?

Q139: What steps had been taken to maintain "check and balance" on oversight of jobs between the workforce and the management of the organization?

Q140: Was there any risk management programme established and put in place?

Q141: What incentives were provided to staff to follow and adhere to the organization's safety policies?

Q142: Was a track record being kept by the organization on the staff's performance standards, and in particular, on their safety records?

Q143: Was safety audit being conducted regularly by external regulator(s)?

Q144: What was the organization's safety record maintained by such regulator(s)?

Q145: Have the regulator's safety recommendations been implemented and checked?

Q146: If not, why not?

The questions are not exhaustive. They, however, provide guidance to accident investigators to think along such directions which may provide clues to the cause(s) of the incident/accident in question. Once problematic areas are identified, further questions have to be asked in order to dig deeper to the root of causation.

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