# Investigation of Human and Organizational Factors

Hobbs, A. (1998). In K.M. Goeters (Ed). *Aviation psychology: A science and a profession*. (pp 257-265). Aldershot, UK: Ashgate.

**Introduction**

It could be said that in complex technological systems such as aviation, accidents do not happen to people, but to entire organisations. There has long been an acknowledgment that system breakdowns or safety occurrences typically reflect not only individual human failings, but also systemic or organisational problems. In recent years there has been a growing awareness that organisational and systemic issues as well as the more traditional human factors, must be considered in an occurrence investigation.

The Reason model of system safety provides a widely understood and accepted framework within which to conduct a systemic investigation. (See Fig1.) While the model is not the only systemic approach to accident analysis, it is rapidly attaining the status of industry standard and its adoption can be recommended for this reason alone. The model has been used to analyse a diverse range of safety occurrences including aviation accidents and incidents, chemical plant mishaps, fires, shipping and rail accidents, and medical misadventure. According to the model, accidents rarely result solely from the actions of system operators. Rather, most accidents are due to a combination of failures originating at all levels of the organisation and from factors outside the organisation.

Reason distinguishes between active failures and latent failures. Active failures are the errors or violations committed by operators, such as pilots or air traffic controllers. Latent failures on the other hand, are the conditions which influence the way operators perform their assigned tasks, or which influence the ability of the system to cope with unexpected behaviour or circumstances. Latent failures can include component failures, such as structural failures or system malfunctions. Latent failures can be present in the system long before the breakdown or accident occurs.

Latent failures which relate to the immediate environment in which an active failure occurred are known as local factors. This category of factors includes workplace morale, operator fatigue and local procedures. Those latent failures which relate to the wider organisation or aviation system are referred to as organisational deficiencies or systemic factors. For the purposes of this document, the terms ‘systemic factor’ and ‘organisational deficiency’ are considered to be interchangeable.

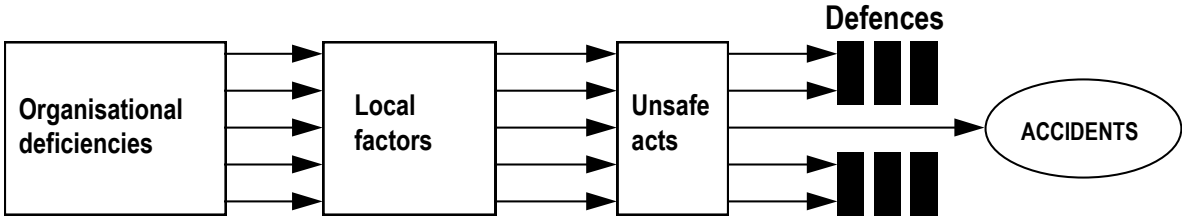


*Figure 1.* Simplified schematic of the Reason model

In a typical accident or system breakdown, local factors set the conditions for an operator to perform an unsafe act. This act then has consequences which are not identified or controlled by the defences or “safety net” built into the system. The local factors and inadequate

defences in turn, are symptoms of wider systemic issues, such as poor communication or inadequate procedures.[1]

## Human Factors Investigations

From the previous discussion, it can be seen that human factors may take the form of local factors or systemic factors. Many issues which have traditionally concerned human factors specialists, such as noise, fatigue, lighting and interpersonal communication fit neatly into the category of local factors. Wider organisational issues on the other hand include the management or system factors which have long been of concern to organisational theorists.

## Purpose of investigating human factors

While it may seem paradoxical, it can be argued that human factors are only of interest insofar as they point us towards system deficiencies. Identifying that a pilot made an error because she was fatigued or that a mechanic left a panel unsecured because he was distracted, may help to explain one accident or incident, but contributes little to improving safety unless a general deficiency can be identified which has the potential to affect the safety of operations in the future.

Putting this another way, if all the information in investigation reports was expressed in the *past tense*, little would be contributed towards the safety of *future* operations. Only when some of the findings of the investigation deal with currently active situations, expressed usually in the *present* tense, does the investigator make a direct contribution to accident prevention.

As a general rule, accident factors which can only be expressed in the past tense tend to be local factors, whereas factors which can be expressed in the present tense tend to be systemic and possess the potential to become the raw materials for future accidents.

## Local vs Systemic Factors

It can be difficult to make a distinction between local and systemic human factors. If the crew of the accident flight made an error because they were not trained to the appropriate level of skill, is lack of training a local factor or a systemic deficiency? In such a case, it would be sensible to consider the lack of skill as a local factor, and the inadequacies in the training system which led to this situation as a system deficiency. In analysing an occurrence, it is generally useful to draw an arbitrary line dividing local and systemic factors. So for example, when considering the performance of air traffic controllers, factors which exist within the control room might be considered to be local, while factors which exist beyond the door of the control centre might be considered to be systemic. Alternatively, the grammatical heuristic described above could be applied, so that factors are described as either problems that *happened* (generally local) or problems that are still *happening* (generally systemic).

[1] For a comprehensive review of the Reason model, refer to ICAO Circular 247-AN/148.

Ultimately, it doesn't really matter what label is applied to a factor, as long as continuing deficiencies are identified

## Establishing a sequence of events

One of the first objectives of a human factors investigation should be to identify the sequence of operational events in time order. The event sequence may be compiled from diverse sources such as cockpit voice recordings, witness reports and interviews with operational personnel.

A typical occurrence will involve more than one event and several of these are likely to be active failures committed by operational personnel.

To be logically consistent, each active failure should be expressed in a subject-verb-object sequence, identifying the person who was involved, the action or omission which they committed and the task or object which this involved. For example: maintenance engineer did not secure access cover.

Once a sequence of events has been established, each active failure can be considered as a separate 'mini-occurrence', with its own local and organisation factors, including failed or absent defences.

## Two stage test of factors: Existence and influence

In attributing factors to explain human actions, it is helpful to apply a two stage test of validity, existence and influence. This test can be applied to local and systemic factors alike.

First, the investigator should be satisfied that the factor was *present* at the time of the active failure. This could involve questions such as: Am I satisfied that the cockpit lighting was dim? Was the person suffering from fatigue? It may only be possible to answer such questions with less than complete certainty.

Second, if the investigator is satisfied that the factor was probably present, it must then be established that the factor *influenced* events on the day. This could involve questions such as: I am satisfied that the pilot was fatigued, but did this contribute to his error?

Only when the investigator is satisfied on the balance of probability, that a factor existed at the time of the event and influenced the outcome of the event, should that factor be considered to have been a contributing factor in the occurrence.

## Investigation of systemic factors

On a large investigation, separate investigators may be assigned to consider the local human factors and the wider systemic human factors which contributed to an occurrence. The following sections relate to the investigation of systemic contributions to an occurrence.

## Relation to other groups

The organisational factors investigator has responsibilities which will overlap with those of other groups in the investigation team. It is important that the organisational investigator maintains a broad awareness of the progress of each group as group leaders may not always recognise the wider systemic or organisational implications of the information they collect.

## Potential problems in a systemic investigation

As occurrence factors become increasingly remote from the immediate time and place of the occurrence, the potential subjectivity of the investigation increases, as do the opportunities for disagreement between those with a stake in the investigation. This is not however, justification for avoiding controversial organisational and systemic issues.

Before commencing work, the organisational investigator must bear in mind that all organisations have weaknesses. Finding such weaknesses during an occurrence investigation does not necessarily help to explain events.

It should also be borne in mind that several organisations may be implicated in an occurrence, each with their own level of involvement. The organisational factors relating to each of these organisations should be considered separately.

In most cultures, there is a strong tendency to search for culpable individuals after an accident and a corresponding reluctance to consider the role of institutions such as companies or government organisations. The organisational investigator must resist such pressures, yet still consider how an effective organisational investigation can be conducted consistent with the national culture.

## Methodology

Since each organisational investigation is unique, it is not desirable to prescribe in detail how each investigation should be conducted.

The method section below describes how the Reason model can be applied to an occurrence investigation. This model provides a useful checklist to ensure that issues are explored and can assist in writing up findings in a form that is consistent with publications such as ICAO Circular 247-AN/148.

The Reason model is not the only possible method or framework which can be used in a systemic investigation. Other methods such as Management Oversight and Risk Tree (MORT) may be useful and the organisational investigator should not feel compelled to limit the investigation to issues covered by one particular model.

## The application of the Reason Model to identify systemic factors

The organisational investigator may partly rely on other groups to identify active failures, local factors and failed or absent defences. As this information becomes available, the

organisational investigator will be in a position to consider the underlying organisational and systemic factors which enabled the situation to develop.

In the event of a large accident, there may be daily briefings which will enable the organisational investigator to become aware of the progress of other groups. It may be appropriate however, for the organisational investigator to arrange for a member of each group to act as a contact and report information which may have a bearing on organisational issues.

In the early stages of the investigation, the organisational investigator may need to attend key interviews conducted by other groups such as ATC or operations. This will ensure that potential organisational issues are not neglected during the interview. As the investigation progresses there may be a need to conduct interviews specifically directed at organisational issues.

In addition to relying on information from sources such as interviews, and documents, the organisational investigator may choose to collect information via additional means such as structured survey interviews or questionnaires.

Potential organisational weaknesses may become apparent as the investigation progresses. Yet these organisational weaknesses may have had no role in the development of the accident. If no evidence subsequently emerges to link these weaknesses with the active failures, local factors and defences of the accident scenario, the organisational investigator should not list these weaknesses among the occurrence factors. It may be appropriate to deal with such findings in an addendum to the report.

In general, it is recommended that the organisational investigator starts by listing the active failures and local factors related to the occurrence and then works outwards to identify the relevant organisational and systemic conditions. Investigators are cautioned against starting at perceived organisational weaknesses and then attempting to link these with the occurrence circumstances.

At the completion of the process, each organisational factor must be linked with at least one active failure, one local factor or one defence. Organisational factors which cannot be so linked fall into the category of uninvolved organisational weaknesses discussed above.

It is important to find supporting evidence of each suggested organisational failure, preferably by looking outside the immediate circumstances of the accident. The identification of organisational factors is described below.

**Potential systemic issues**

In the following section, potential areas of concern are linked to possible questions which could guide an organisational investigator. These areas are by no means the only potential topics to be considered as part of an organisational investigation.

*Corporate goals*
Most organisations operate with goals which conflict from time to time, such as on-time performance and fuel saving. While goal conflicts are a normal aspect of many systems, the manner in which the organisation recognises the conflict and trades goals off with one another may be significant to the occurrence.
The following questions may be useful when considering corporate goals:

> Does the organisation have a formal statement of goals?
> What are the performance expectations of owners (whether shareholders or government)

*Organisational structure*
The ability of the organisation to react to present events and plan for future situations is likely to be influenced by the structure of the organisation. Organisation charts or internal directories can help an investigator to become familiar with the formal structure and systems of the organisation. Potential questions include:

> Do problems stem from the structure of the organisation?
> Are management responsibilities clearly defined?
> What actions by managers and other staff are rewarded?
> What actions are punished?

*Communications*
A primary concern of management to ensure that there is an appropriate exchange of information between individuals in the organisation. A small organisation can often rely on informal communication methods, however larger organisations or those which are geographically distributed will need formal communication channels, to feed information from management outwards, to inform management of operational issues and to enable lessons learnt in one branch of the organisation to be shared with other branches. Some questions to ask are:

> Would the occurrence have been less likely if internal communications were better?
> Do field stations communicate with headquarters?
> Is upper management aware of operational realities.
> Are there adequate systems in place to inform management of key indicators?

*Planning*
Successful organisations recognise that the environment in which they operate is rarely stable and prepare for foreseeable events. Many organisational difficulties such as shortages of staff or equipment may reflect underlying inadequacies in planning. It may be appropriate to consider the following issues:

> Does the organisation operate in a short-term environment?
> Does the organisation have difficulty anticipating events?

*Design of systems and components*
Design issues are included as systemic factors because the design of systems and components is normally an activity remote from day-to-day system operation.

Some systems may not have been "designed" at all, but may have developed over time. Systems which are complex to the extent that their workings are not understood by operators (opaque systems) can be particularly problematic. The following questions may be relevant:

Did the designers receive feedback on the adequacy of the design?
Were there opportunities to modify the design?
Do operators understand fully the systems they use?
If complex technical systems are involved, is there a single person who has a general understanding of system operation?

*Corporate memory*
The expertise of experienced staff can be one of the organisation's most valuable assets. Organisations, like people can suffer from amnesia or can find themselves on a steep learning curve. The following questions may help to explore these issues:

Has there been a recent loss of experienced staff?
Have there been recent mergers or takeovers?
Does the organisation have a well maintained corporate memory?
Are there events remembered in the "folklore" of the organisation which still influence the functioning of the organisation today?
Has the organisation recently entered this particular field of business?

*Procedures*
Formal rules and procedures may be irrelevant, out of date or may fail to reflect operational realities. It may be appropriate to ask such questions as:

Is there a conflict between informal norms and formal procedures?
Would the organisation fail to function if procedures were strictly adhered to?
Do local orders/instructions conflict with organisational orders/instructions.
Are procedures accessible and useable?

*Resources*
Few organisations have the luxury of unlimited resources, however, an organisation which is financially unviable may operate with an unacceptable level of risk. It may be important to ask whether the organisation has the resources to recruit and train staff, maintain equipment and operate responsibly.

*Regulation*
There are many possible regulatory regimes, ranging from *laissez-faire* self regulation to strict government control. Nevertheless, regulations and regulatory authorities have a pervasive influence on aviation organisations. It may be important to know the following:

How frequently do regulators visit the organisation?
Are the regulators capable of administering the regulations?
Do the regulators have available a range of measures (such as sanctions) to encourage compliance?

*Corporate culture*
Corporate culture is an extensive field of study in its own right, and it is not possible to do justice here to the full range of issues which could be considered. Nevertheless, the following issues should be considered:

Does the organisation condone risk taking?
Is safety an important goal of the organisation?
Does the organisation have a history of correcting problems?
Does the organisation have a history of ignoring or covering up problems?

*Safety management*
The following questions may help to identify issues related to the company'

Does the organisation have a safety or quality assurance program?
Is there a safety department? If so, to whom does it report?
Has the organisation recently been the subject of an outside audit?
Has there been a formal hazard analysis of the operation?
Does the organisation have a risk management policy?

**Final considerations**

To be truly effective, investigations must consider the role of systemic factors, yet the investigation of such factors is likely to be heavily reliant on subjective judgement.

One of the most important subjective considerations in an investigation is knowing when to stop. Occurrence factors may be found far removed in time and distance from the occurrence itself and it may be difficult to know how widely the systemic investigation should extend. Such a decision will be influenced by the legal framework within which the investigating authority operates. A useful rule is that when the organisational investigator begins to arrive at circumstances which are beyond the control of managers, the investigation has exceeded reasonable bounds.

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