A new human factors risk management program for Qantas

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Like many airlines, Qantas has advanced systems for detecting and managing human risk in flight operations. It is now considered timely for Qantas to extend its human factors risk management systems across all of its operational businesses. A number of options for developing a company wide human factors strategy have been considered. The process included a review of cross industry best practice; stakeholder needs; regulatory requirements; safety management systems and current human factors activities. A new model for human factors risk management is proposed using a safety management framework. This paper will outline some key elements of the model with example applications of the program. Suggestions for successful implementation of human factors programs will also be discussed in relation to the Qantas experience thus far.

Introduction
The drivers for implementing a new Human Factors Strategy were threefold;

- to reduce the human factors contribution to **safety** incidents
- to meet **regulatory requirements** for managing human factors and
- to reduce costs arising from human performance limitations and **add value** through improved human performance

The Qantas Human Factors Strategy provides a framework for applying Human Factors risk management principles in any operational area. The model uses a safety management systems (SMS) approach to manage human performance limitations. The Human Factors Strategy is intended to maximise the benefits of existing practice whilst outlining a common approach for Human Factors management across the Qantas group. Additional benefits are expected to include:

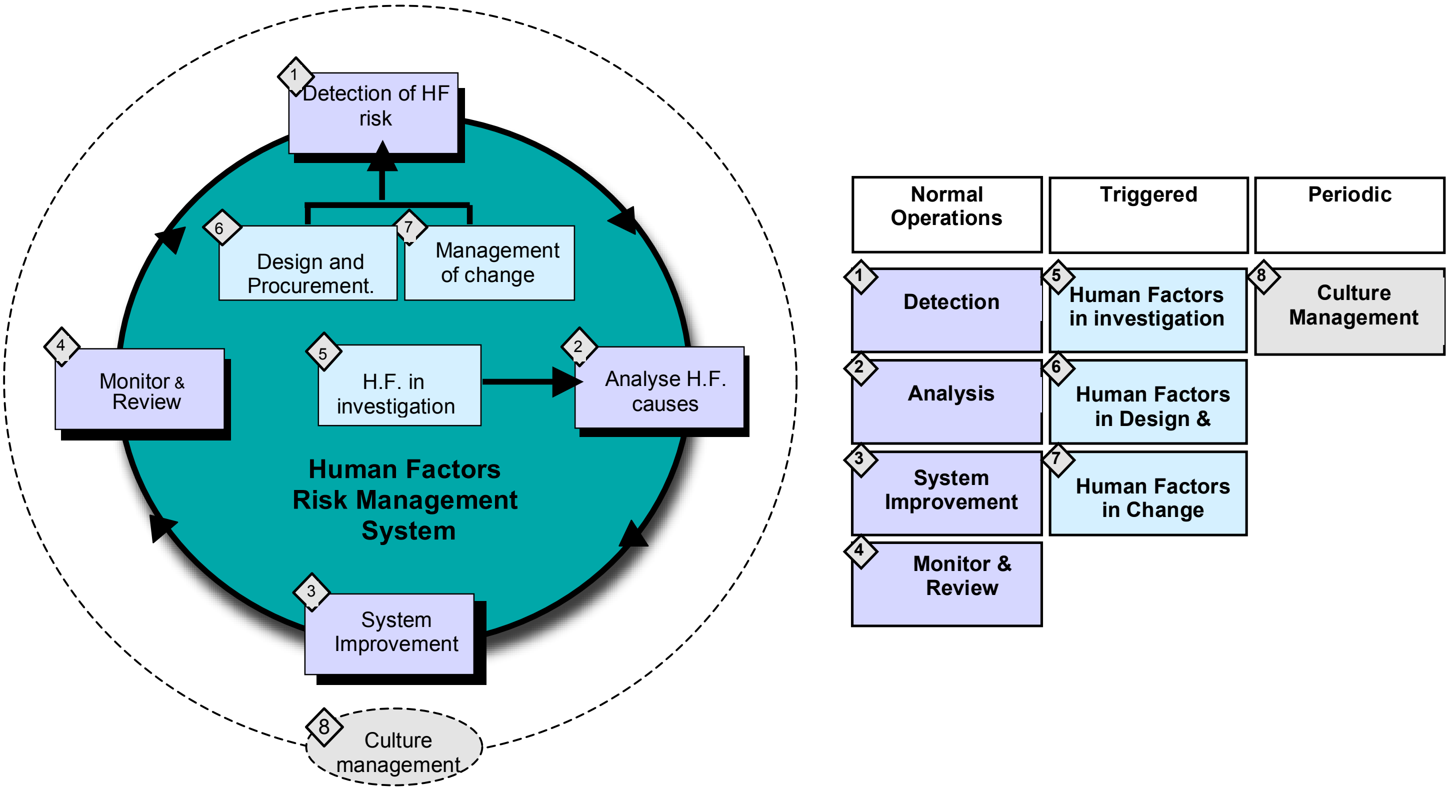
- A vision and strategy for Human Factors risk management across the Group;
- A generic framework, which enables flexible and customised approaches;
- A shared platform for exchanging ideas and best practice;
- A common approach for internal and external monitoring and review and
- A vehicle for continuous Human Factors risk reduction.

The development process
An existing program known as “AIRSAFE” within the Engineering and Maintenance business was found to have many of the tools and processes of good Human Factors risk management. AIRSAFE tools and resources included: a processes for detecting and analysing human risk; Human Factors educational programs; a confidential reporting system; and a Just Culture improvement initiative. The cross industry review suggested that successful Human Factors risk management would be best achieved through a safety management system framework (FAA, 2005; Thameslink, 2000, Davis, 2001; Wright et al, 2003). This allows for the management of human risk (like any risk) to be a continuous process of identifying areas that have the potential to cause harm and implementing system improvements. It was therefore proposed to develop a model which would allow human risk to be considered systemically and which would gain maximum advantage from tools and processes already developed.

A Model for Human Factors Risk Management
The proposed solution is primarily a framework for applying human factors tools and techniques in a coordinated and systemic way. The model has a number of elements concerned with risk management processes as part of normal operations, as well as “triggers” for when particular HF attention is required for example, following an event or incident, the acquisition of new equipment or the need to

manage change. The model also takes into account that human behaviours do not occur within a vacuum, but are influenced by an organisation's safety culture, which should also be subject to periodic measurement, assessment, and improvement. The model can be applied generically across all the operational businesses and has sufficient flexibility to cope with customised tools and processes within each element. Figure 1 provides an overview of the model and its elements:

Figure 1. Human Factors Risk Management Model:



Each element is described in more detail below. The tools discussed are for illustrative purposes only and may vary depending on the nature of the risk or operational context being addressed.

System Elements and Tools

1 Detection

Detection of Human Factors risk allows a business to determine where it is vulnerable to human performance limitations. At its most basic level this can be done through work inspections or by informally by talking to staff about perceived opportunities for human error or violation to occur. Often those with most experience of the task are best placed to provide this information. Detection through reporting by operators should be encouraged through confidential reporting, if necessary, and by establishing a "just culture" (GAIN 2004) where employees feel safe to report errors and near misses. At a more formal level, tools such as Line Operations Safety Audit (LOSA) (Klinect et al 2003) provide detailed analysis of where threats and errors are occurring in flight operations. Similar observation methods could also be employed to detect threats and errors outside the cockpit environment – such as a Ground Operation Safety Audits or GOSA. Human Factors tools and methods can also be incorporated into risk assessment methodologies, so that human risks can be detected, recorded and managed, as with other operational risks during the risk assessment process. Several methods for assessing human factors during risk assessment can be broadly categorised as Human Error Identification techniques and Human Reliability Assessments (Shorrock, Kirwan and Smith 2003; Kirwan, 1994).

2. Analysis

Once the (actual or potential) human errors and violations have been identified, considering their causes helps to identify effective intervention measures. LOSA data can be used to identify causes of error. For example, procedural errors may reflect inadequately designed Standard Operating Procedures. Proficiency errors can indicate the need for more extensive training. Other analysis tools can be employed to help to identify the root causes of human failures through application of error taxonomies. For example the AIRSAFE program in Qantas Engineering uses Boeing's MEDA method (Maintenance Error Decision Aid) for analysing the causes of any maintenance errors. Similar tools can be adapted for a range of operating environments such as REDA (Boeing's Ramp Error Decision Aid) or the application of more generic taxonomies, such as "The Wheel of Misfortune" (O'Hare 2000). The application of a classification system to identify the root causes of error helps to identify a shared understanding of common causes to be addressed.

3. System improvement

Improvement measures should address the causes of human failure in order to prevent reoccurrence. Ideally, risk should be eliminated or systems can be put in place to help operators manage and recover from an error before it becomes an incident. Improvement methods include training such as Crew Resource Management (CRM) (Helmreich 1993), Threat and Error Management (Helmreich, Klinect, & Wilhelm, 1999) as well as technological warning systems such as GPWS and TCAS. When error cannot be prevented or recovered from, the system needs to be protected through improved organisational defences and risk controls, such as crash worthiness, emergency procedures, and protective equipment. Establishing a panel or committee to review the findings of the Analysis and Detection phases is a useful mechanism for developing evaluating potential system improvements.

4. Monitoring and Review

The purpose of Monitoring and Review is to assess the effectiveness of improvement measures and also to affirm the 'health' of the Human Factors risk management system. If similar risks continue to reoccur through the loop, then improvement measures may be inadequate. Similarly, if incident risks were not predicted, detection methods may need review. For flight operations, monitoring systems are usually well advanced with periodic LOSA analysis and data systems such as Flight Operational Quality Assurance (FOQA) programs which involve the collection and analysis of data recorded during flight. Air Safety Incident Reports (ASIR) also provides feedback on how well the system is functioning. Outside the flight deck environment self reporting of error is a good opportunity to get feedback on the system state. Monitoring of Behavioural Markers (Flin &Martin, 2001) can also be used in a range of environments to assess the effectiveness of training programs such as CRM. Monitoring performance and reviewing the data for trends is an important part of continuous improvement and risk reduction.

5. Human Factors in Incident investigation

It is essential that when incidents do occur, the contribution of Human Factors is properly investigated so the organisation can learn and prevent reoccurrence. There are many tools and techniques available for analysing the human contribution of incidents and how best to improve systems to defend against them. Generic tools include for example the Reason Model for accident causation (Reason, 1990, 1997; Maurino et al, 1995). Specialist tools are also available for specific operational environments such as MEDA and REDA (Maintenance/Ramp Error Decision Aid), and Human Factors HFACS the aviation Human Factors Analysis and Classification System (Shappell & Wiegmann, 2000). Specialist toolkits are also available for analysing and preventing non compliance (violations) with rules and procedures (eg Safety Critical Rule Compliance toolkit RSSB). Training in one or more human factors methodology is important for incident investigators to be able to address root causes of human performance limitations.

6. Human Factors in Design and Procurement

Integrating Human Factors at the early stages of design is the most effective way of eliminating or "designing out" Human Factors risk and is now required by FAA regulation. Too often organisations are faced with the challenge of trying to reduce human performance limitations with the equipment and systems that cannot change. It is much more cost effective if Human Factors are properly considered in the design or procurement stage. This means applying well-established Human Factors design principles (eg ISO 13407) and methods such as Human Factors Integration Planning (HFIP) (Eurocontrol, UK Health and Safety Executive). When buying in equipment or contracting out design, it is important that Human Factors criteria are established in the contract and tendering process and used to influence procurement decisions. Areas of application include; commissioning/procuring new products, equipment or technology; engaging contractors or suppliers in new build activities; procuring off- the- shelf products, equipment or technology or changing an existing design.

7. Human Factors in Change Management

Integrating Human Factors into change management ensures the impact of change on the people within a system is properly considered and planned for. By conducting a task analysis of legacy systems and comparing these with task analysis of proposed changes, the human issues can be identified and managed through appropriate controls, before they are introduced. The tools for assessing human factors risk during change are similar to those used in risk assessment (see *detection* above) Areas of application include: engineering system (equipment) changes, organisational (personnel / structure) changes or operational (systems / procedural) changes, as well as changes of a reactive nature (e.g. in response to an incident) or proactive review. Organisational change can also have an impact on human factors risk and safety culture (Gall, 1996). Assessing and planning for the human impact of change can be a critical component to whether change efforts thrive or fail.

8. Culture Management

An organisation's culture (shared norms, values, assumptions, belief systems, behavioural expectations etc) affects the behaviour of individuals and groups within it. The aspects of culture that affect safety behaviours are referred to as an organisation's Safety Culture or Climate. Poor safety cultures have been negatively linked to human performance (Sexton and Klinect, 2001). It is now understood that actively managing safety culture can positively influence behavioural outcomes. (Reason, 1997; Step Change Program, 2006; Atomic Energy Agency, 1991) Safety culture management often involves the following steps: measuring the current culture; identifying cultural influences and levers for change; developing cultural improvement interventions; and periodic monitoring and review. The nature of improvement interventions will vary but might include, for example, Just Culture interventions, Behaviour Based Safety interventions (BBS) (Clancy, 2006) and safety leadership programs.

Application of the model to the existing elements of AIRSAFE

Although it is not yet a 'closed loop' system for managing human risk, AIRSAFE is the most complete example of human risk management currently available within Qantas. Figure 3 demonstrates how the AIRSAFE tools and resources would align with the new system model:

Figure 2. Tools and resources available in the Qantas Engineering AIRSAFE program:

Detection	Inspection of all work by Licensed Aircraft Maintenance Engineer or Production Examiner in workshops to detect error and violations
System Improvement	AIRSAFE HF training, Fatigue Management systems, HF awareness campaign, polices, posters and resources
Monitor & Review	CROSS reporting (confidential reporting of errors). CROSS follow up and data logging. MEDA report trending

HF in investigation	Maintenance Error investigation training Course, MEDA method for Maintenance error investigation, Just Culture assessment tools for culpability investigation
Culture Management	SHO-ME culture survey and software analysis tools. Just Culture Policy. Periodic repeat of culture survey

In order to capitalise on the experiences and awareness of the AIRSAFE tools, the new model has been built on the existing AIRSAFE brand. The "enhanced" AIRSAFE program has been expanded in its scope, with tools and guidance provided to be able to accommodate other areas of the business. The intention is for all segments to apply the model to develop their own processes for each system element - building on existing AIRSAFE or generic methodologies wherever possible.

The application of the model in Qantas

Although the most of the tools and processes have been developed within flight operations and engineering, the elements can apply equally well in any operational context. The example below demonstrates how the human factors strategy might be employed within a ramp environment:

Figure 4. Example of a possible application in the Ramp:

1 Detection	Consider the application of LOSA methodology to Ground operations (GOSA) to detect "threats" and "errors" .Consider integrating HF tools into risk assessments and encourage confidential error reporting.
2 Analysis	Establish working group to analyse GOSA data and identify causes of human failures based on the evidence provided and error taxonomies. Investigate confidential reports for underlying
3 System Improvement	Establish a steering committee to develop Interventions based on the detection and analysis phases. Consider options such as reducing threats and error producing conditions and strengthening
4 Monitor & Review	Repeat the GOSA periodically to monitor the effectiveness of interventions. Review other indicators eg ground damage incidents. Review confidential error reports and incidents for trends
5 HF in investigation	Integrate the Reason model into incident investigation. Consider application of REDA methodology for analysing errors. Consider use of violation toolkits for identifying preventative actions.
6 HF Design and Procurement	Establishing guidelines for considering Human Factors requirements when buying equipment or designing new tasks Conduct user trials when considering equipment procurement
7 HF in Change Management	Considering introducing tools for addressing Human Factors in change management eg task analysis of new and proposed change combined with human risk assessment
8 Culture Management	Consider introducing safety culture assessment and cultural improvement interventions such as behavioural risk management and Just Culture Policies and training

Implementation of the Strategy

Using the model as a starting point the next step was to work closely with the respective business segments, to develop customised approaches for Human Factors management within each element. To maximise efficiencies, tools were utilised from the existing AIRSAFE programs or from human factors tools available in the public domain. Individual approaches are being developed in consultation with each business segment to target their specific business needs. A common repository for tools and resources is being developed through a Human Factors intranet website. Governance of the strategy will be steered through human factors working group with representation from each of the business segments.

Critical Success factors for successful implementation of a Human Factors Strategy
Several issues were identified as critical to the success of the program within Qantas. The first was that the solution needed to be flexible and able to be customised to the very different operational business within the group. (Eg Engineering, Airports, Catering, Flight Operations, etc) The second was that the program had to be able to demonstrate significant return on investment in order to compete with other potential initiatives. The first objective was achieved by developing the generic model elements above and allowing each business segment to develop their own processes. The second objective, to demonstrate the "value" of a human factors program, was supported through a comprehensive business case, estimating the expected return on investment based on previous studies (eg CAA, 2003; Edkins, 2002; Johnston 2006) Equally important for continued commitment and investment, are Key Performance Indicators (KPI's), to demonstrate the impact of the program. KPI's include baseline and performance measurements, error rates, reduction in ground damage or delays attributable to human error for example.
As customised solutions are required, full implementation of the strategy across all of the operational business has only just begun and is expected to take some time. To date, implementation has begun in a few business segments. Early indications suggest that the strategy is beginning to yield benefits in terms of reduced error rates and improved behaviours.

In summary, introducing the Human Factors Strategy at Qantas is giving greater visibility of human performance limitations and is beginning to improve the management of human risk. Whilst it may be some time before conclusive results can be provided in support of the Qantas Human Factors Strategy, the approach is proving to be useful in integrating Human Factors into the business. It is suggested that other organisations may wish to consider adopting a similar safety management approach to the continuous reduction of human risk.

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