Safety Regulation Group

Civil Aviation Authority

CAA PAPER 2003/10

Safety Health of Aviation Maintenance Engineering: Project Description

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Executive Summary

In order to measure the effectiveness of various safety initiatives in aviation maintenance, the UK Civil Aviation Authority (CAA) contracted Health and Safety Engineering Consultants (HSEC) Ltd to develop a method of measuring the "safety health" of maintenance organisations. This method should be capable of being consistently applied by different companies, and over time is sensitive enough to measure improvements (or otherwise) likely to have been generated by the introduction of human factors and safety management programmes.

HSEC investigated various options of measuring "safety health" including the possibility of using existing safety culture measurement tools. They rejected the option of using accident and incident data as an indicator of safety health, since (i) there is unlikely to be enough data, (ii) the data could be affected by the level of reporting of incidents, rather than the number of incidents themselves, and (iii) with an infrequent measure such as incidents it is difficult to differentiate how big a part the element of luck is playing versus the contribution of the safety culture that exists. HSEC looked, instead, at indicators known to contribute to the presence or absence of errors, incidents and accidents, such as poor procedures, attitudes towards violating rules, commercial pressures, etc.

HSEC developed a set of questionnaires, based on past research and similar tools in existence, and in conjunction with the CAA and industry. The questions were specific to aircraft maintenance, and could be applied at three different levels within a maintenance organisation: (i) certifying staff, (ii) non-certifying staff, and (iii) management and technical support staff. In addition, three different formats of questionnaire were developed: (i) a generic questionnaire, applicable to everyone, (ii) a questionnaire on organisational factors (such as planning, availability of tools and spares, procedures), and (iii) a job difficulty questionnaire, which concentrates upon problems recently encountered and their likely causes.

This questionnaire was piloted at two organisations, and adapted as a result of feedback. It was then applied at four further companies considered to be fairly representative of UK maintenance (covering both fixed wing aircraft and helicopters, small to large aircraft, and operator-maintained to third party maintained). The results were disidentified and pooled in order to give a benchmark measure. The CAA's intention is to re-apply this questionnaire with the same, or similar companies at a future date in order to measure any improvement (or otherwise) against the benchmark.

A secondary, but nevertheless valuable, objective of this work was to develop a 'user-friendly' computer based version of the questionnaire which could be given out to maintenance organisations, by the CAA, for them to use internally as they wish.

1 Background to the Project

The UK Civil Aviation Authority (CAA) would like to have a means of measuring "safety health" within maintenance organisations in the aviation industry. One specific aim is to determine whether safety initiatives, such as Safety Management Systems (SMS) and Human Factors, will result in measurable safety improvements over time.

This report describes the development of such a measurement tool and its initial application to establish a benchmark "safety health" measure within the aircraft maintenance industry. The second phase would be to reapply the tool at a later date to determine the extent and nature of the change in "safety health" as a result of the various initiatives being undertaken in the industry. This second phase is not part of this current research programme.

1.1 **The objectives of the project were to:**

- Develop a methodology to identify and measure appropriate indicators of "safety health", in particular the effectiveness of human factors and other safety programmes within the UK aircraft maintenance industry;
- Apply the methodology within selected companies to develop a benchmark against which results from further applications of the tool can be compared, for example after the introduction of future human factors training programmes.

An additional objective was to develop a tool incorporating the above methodology, which can be applied easily and quickly within an organisation to obtain a measure of "safety health" and pilot and validate the tool. The intention is to give copies of this tool to UK maintenance organisations for their internal use, allowing them to better measure and monitor their own organisation's "safety health". The title of this tool is the "Safety Health of Maintenance Engineering" (SHoMe) tool. The CAA plans to distribute this tool to industry.

One approach to meeting the objectives was to consider direct indicators, such as incident and accident statistics as a measure of human error in maintenance operations. However it was accepted that use of incidents and accidents as measures, which are relatively infrequent, can be misleading. As such incident/ accident statistics do not necessarily indicate an organisation's susceptibility to human error and other human factors problems, and do not cover errors not resulting in adverse consequences. Measures which address the human factors and organisational issues which have, or could, impact on error likelihood are more useful and these form the basis of this tool.

2 Previous Work

Originally, the measurement tool was to be based around existing questionnaire techniques that were regularly being used by HSEC Ltd on its human factors assignments. These questionnaires and analysis tools are described below:

a) HSEC Human Factors Solutions CD-ROM

This is a computer based questionnaire tool that is directed towards specific workgroups performing specific tasks. A questionnaire is completed by the supervisor of the specific task. Where possible, the workforce also complete a shorter questionnaire. The results automatically generate a report outlining:

i) the strengths and potential human factors weaknesses that could detract from successful completion of this task;

ii) the underlying factors behind each potential weaknesses (taken from the pattern of questionnaire responses); and

iii) a draft action plan specifically targeted for the specific workgroup and task.

Although this tool has been highly effective in other applications, it became apparent during the development of the aviation maintenance "safety health" tool that the 'Human Factors Solution' tool was inappropriate for the needs of this project.

b) Human Factors Reliability Group – Reducing Maintenance Error – published by the HSE

The lead author of this report was co-chair of the sub-group of the 'Human Factors in Reliability Group' (HFRG) that developed the methodology described in HFRG 2000.Improving Maintenance - A Guide to Reducing Human Error, HSE Books, ISBN 0 7176 1818 8.

The incident analysis and questionnaire based methodology addresses the key aspects that can affect general maintenance operations. Although comprehensive, the methodology was developed for general industry and therefore does not specifically address some of the factors that can be specific to aircraft maintenance.

c) Job Difficulty & Organisational Questionnaires

These are two complementary techniques that have been developed by HSEC Ltd for general use in assessments of safety climate. The Organisational Questionnaire identifies those factors that have actually caused the maintenance operator to make errors, confused the maintenance operator, or otherwise adversely affected safety of the plant or equipment. The results tend to complement other indicators of safety climate that could cause future problems. The Job Difficulty Questionnaires seeks to identify which parts of the job are causing the maintainers the most difficulties and hence where remedial actions are likely to be best directed.

3 Methodology

The methodology can be considered to have three parts. Part one is the development of key indicators of 'safety-health' in the aircraft maintenance industry and part two is the development of questionnaires and analysis methods for measuring these in a consistent manner. Part three is the presentation of results.

3.1 Indicators of Safety Health

A key indicator of 'safety-health' is the safety culture of the maintenance organisation. This has been addressed in: 'CAP 712 Safety Management Systems for Commercial Air Transport Operations – A Guide to Implementation prepared by the Air Transport Operations – Safety Management Group'. This guide states that a comprehensive corporate approach to safety requires a positive safety culture – adding that:

"The commitment of a company's top management (those who direct and control the organisation at the highest level) towards safety, safety practices and safety oversight will determine how business is conducted from a safety standpoint. The safety culture of the company underpins the entire safety achievement of the company and is crucial to its success. The ideal safety culture is one that is supportive of the staff and systems of work, recognises that errors will be made and that it is not apportionment of blame that will resolve the problems. Therefore,

the supportive culture will encourage open reporting, seek to learn from its failures and be just in dealing with those involved, Punitive action must not follow automatically from the open acknowledgment of human error. However, it must be made clear that indemnity will not be guaranteed where there has been gross negligence. The front line defence is that operating staff must not accept unsafe behaviour from their peers."

The International Civil Aviation Organisation (ICAO) suggest that positive safety culture is made up from:

- Senior management placing strong emphasis on safety
- Staff understanding the hazards
- Senior managers willing to accept criticism – open views
- Senior managers fostering feedback
- Emphasis on the importance of communications of relevant safety information
- Promotion of realistic and workable rules
- Ensuring staff are well educated and trained – understand consequences of their acts.

The JAA Maintenance Human Factors Working Group (JAA-MHFWG) identified several areas in maintenance which contribute towards a safe organisation and a good safety culture, including:

- accurate and unambiguous data
- a published safety policy
- an internal occurrence reporting and investigation system
- a just culture for reporting incidents and errors
- a procedure for handovers
- taking into account fatigue, when planning work and shifts
- good planning in general
- mechanisms for detecting errors (e.g. duplicate inspections)
- not accepting 'double standards'
- not signing off work without seeing or checking that it has been done

NOTE: The issues identified by the JAA MHFWG were translated into requirements and issued as an amendment to JAR-145 on 1/1/03 (and subsequently incorporated into Part 145 of EASA requirements).

The above comments on safety culture indicators or requirements from the aviation industry are noticeably more prescriptive than others from, say, the nuclear industry. The International Atomic Energy Agency – International Nuclear Safety Advisory Group definition of safety culture is "that assembly of characteristics and attitudes in organisations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance." The CBI describe safety culture of an organisation as "the mix of shared values, attitudes and patterns of behaviour that give the organisation its particular character - put simply it is the way we do things round here".

While safety culture is one key factor, it should be recognised that a positive safety culture is primarily aimed at minimising errors of 'violation' – i.e. intentional deviations

from safe, or approved, rules or procedures. Other forms of errors such as those caused by lapses of attention or distractions and from genuine mistakes are largely not addressed by issues affecting safety culture. This 'safety health' measurement tool therefore needs to address factors within the organisation that could affect all aspects of human error. In particular, it needs to address the issue of dual standards so prevalent in the industry, whereby engineers and technicians are trained to follow procedures on the one hand, and yet sometimes unofficially encouraged to violate procedures in order to get the job done. Perhaps one of the key questions should have been: "Would the company have supported me or penalised me directly or indirectly, if I had refused to sign off a task/aircraft because procedures had not been followed correctly". This specific question was not used, but other statements aimed at detecting the company culture with respect to dual standards were included.

3.2 Inclusion of Key Indicators into the design of a questionnaire and analysis tool

The questionnaire was developed by HSEC in conjunction with industry and the CAA to develop questions that would indicate how a company was performing against the key indicators.

The output of the tool was designed to be 'solution orientated' in that it presents any issues discovered and the potential root problems in such a way that management can readily identify an appropriate set of remedial actions. There are three levels of output in addition to an output that reflects the Boeing Maintenance Error Decision Aid (MEDA) system.

The initial discussions with CAA staff and with the two pilot companies had identified that aircraft safety could be potentially compromised, not only by maintenance staff working directly on the aircraft , but also by staff in other departments such as technical management, planning and technical services . It was therefore necessary for part of the tool to be sufficiently general that it could be applied across all staff.

The basic tool comprises three sections. A general purpose (generic questionnaire) is given to all staff. The certifying and non-certifying engineering staff also complete two further questionnaires that address specific aspects of aircraft maintenance.

Management and technical support staff (including management, quality assurance, training, planning, technical services, technical records, stores and supply chain) only complete one part of the basic tool since the other two sections relate to detailed aspects of 'hands-on' maintenance of aircraft and are therefore not relevant to this group.

The structure of the tool is shown below:

Table 1 Structure of the Tool

Function Type	Generic Questionnaire	Job Difficulty Questionnaire	Organisational Questionnaire
Technical Certifying Staff	Version 1	Standard	Standard
Technical Non-Certifying Staff	Version 2	Standard	Standard
Management and Technical Support Staff	Version 3	Not Applicable	Not Applicable

3.3 Generic Questionnaire

Three versions of this generic questionnaire were developed. Two versions are for the 'hands on' maintenance staff. These are slightly different as those for the certifying staff have additional questions to reflect their added responsibilities. A shorter third version is for the management and technical support staff.

Where applicable, the three versions reflect a common structure. Staff are asked to state whether they agree or disagree with a number of statements using a conventional '5 point' Likert Scale. Appendix 1 presents the issues addressed by each of the three questionnaires along with the outline structure which is not presented in the actual questionnaires (eg individual attitudes, complacency and rule erosion, etc.). Questions that are not relevant to any of the three groups are indicated with 'N/A'.

Copies of the actual generic questionnaires for the three groups of staff are given in Appendices 2, 3 and 4.

3.4 Organisational Questionnaire

The organisational questionnaire forms a key part of the tool. The same organisational questionnaire is given to both certifying and non-certifying staff. This is not applicable to the management and technical support staff.

This part of the tool has been developed to provide a detailed insight into how a large number of 'organisational factors' are likely to negatively impact on maintenance performance. This questionnaire addresses a wide range of factors from those associated with the basic ergonomics of the aircraft and tools and equipment to aspects of the safety culture of the work group and organisation.

Examples of the actual questionnaire are given in Appendices 3 and 4.

3.5 Job Difficulty Questionnaire

The focus of the generic questionnaire and the organisational questionnaire are those factors that generally detract from the reliability and efficiency of the maintenance operation and therefore that could affect safety of the aircraft. With some minor exceptions, it is not possible to determine those parts of the maintenance work where such human factors issues are actually causing difficulties and hence where remedial actions are best directed.

A better indication of where these difficulties occur is obtained from the job difficulty questionnaire, although it cannot be assumed that the main human factors root issues are necessarily the only cause of the difficulties for a specific part of the job.

Copies of the actual questionnaire are given in Appendices 3 and 4.

4 Presentation of Results

The detailed methodology for presenting the results underwent a number of modifications during the course of the project based on feedback received from the pilot study. The results are presented in four different formats:

Level 1 gives a basic overview of core results that reflect whether some of the workforce are not complying with procedures. This is followed by a 'summary score' for each of the 19 basic human factors underlying root issues that may be associated with such non-compliance.

Level 2 repeats the main headings but also gives the breakdown of the underlying problems and 'detailed scores' within each of the human factor issues.

Level 3 repeats the Level 2 presentation but adds the results from the Organisational Questionnaire (i.e. those factors that have actually caused the maintenance operator to make errors). These results are shown in italics and the number is simply the percentage of those respondents who indicated that an issue had "caused them or a colleague to have made a mistake, caused confusion or uncertainty or otherwise affected airworthiness".

The MEDA version essentially reproduces the above results against the same human factors structure adopted in the Boeing MEDA system.

4.1 Presentation of "Root Issues"

The results are presented around a format that is intended to identify which of the following 19 human factors issues are likely to be presenting problems and where additional management attention may be warranted. The 'Potential Root Issues Affecting Reliable Maintenance Performance' are:

- Design & Maintenance Interface
- Provision of Resources
- Training
- Fatigue
- Complacency
- Planning
- Communications
- Commercial Pressures
- Maintenance Procedures: Accuracy, Relevance & Practicality
- Roles & Responsibility
- Management Attitudes
- Safety Commitment of the Engineers/Staff
- Job Pressure
- Working Conditions
- Just Culture/Blame Culture
- Management of Change
- Supervisor Effectiveness
- Competence
- Supervisor Attitudes

It is intended that a different set of management initiatives would be appropriate to address problems associated with each of the above root issues. In this way, the format of the results is intended to assist the organisation to identify any new actions that are indicated to address significant human factor issues that have been identified for any work group.

The methodology uses the results from both the generic questionnaires and the organisational questionnaire to obtain a ranking of root issues in descending order of importance. Within each of the 19 root issues, the methodology presents selected results of the generic questionnaires and organisation questionnaire to provide supporting details of the specific human factor issues that are likely to be associated with each root failure. These are ordered in such a way that those shown first are likely to be more important than those lower down the list.

An example of how the 19 root issues might be displayed, along with more detailed breakdowns within each of the 19 headings is shown in Appendix 5. This comprises:

- The results from the core questionnaire - shown in normal text
- The results from the Organisational Questionnaire - shown inset and in italics

In order to assist an organisation to identify the likely nature and extent of any actual human factors problems, the results are preceded by selected questionnaire scores that reflect actual non-compliance with aircraft maintenance procedures. The results contained within "Evidence of Non-Compliance" should first be studied. However, even if the results show no evidence of non-compliance, it is always possible that unintentional errors of 'slips/lapses/distractions' and 'mistakes' could occur , hence the need to study the results from 19 root issues in addition to the non-compliance results:

A user guide is available which describes the content and scoring methods in greater detail. (The user guide is published as CAA Paper 2003/11.)

4.2 Structure of Results Presentation

The table below represents an example of a level 1 results presentation with fictitious numbers. The higher the score the more problematic the issue is. Examples of all the possible evidence of non compliance and potential root issues that could appear in the results presentation are shown in Appendix 5.

Table 2 Example Results

Evidence of non-compliance	Tech Cert Staff	Tech Cert Eng	Mngmt / Tech Support Staff	Mean Score
EVIDENCE OF NON-COMPLIANCE				49
Completion of job despite the non-availability of equipment/tools	69	67		68
Aircraft released with work not done due to parts shortage	61	69		66
Supervisor condoning unapproved actions to get an aircraft away	68	62		64
Regular non-compliance by the workforce	63	62	55	60
Direct pressure to deviate from procedures	54	49	40	48
Pride on getting aircraft back on time, even if this needs some non-compliance	47			47
Reports of colleagues making errors due to tiredness within last month	38	51	39	43
Direct pressure from the supervisor to deviate from procedures	36	32		34
Supervisor taking risks in releasing aircraft when maintenance incomplete	26	37		32
Self-reports of errors due to tiredness within last month	27	27	34	30

LEVEL 1				
Potential Root Failings Affecting Reliable Maintenance Performance	**Tech Cert Staff**	**Tech Non - Cert Staff**	**Mngmt /Tech Support Staff**	**Mean Score**
DESIGN & MAINTENANCE INTERFACE				68
WORKING CONDITIONS				58
TRAINING				57
PROVISION OF RESOURCES				57
PLANNING				54
COMMERCIAL PRESSURES				52
FATIGUE				52
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SUPERVISOR ATTITUDES				33
MANAGEMENT OF CHANGE				32

5 Pilot Studies

5.1 First Pilot Study

The initial questionnaire was piloted with two maintenance organisations. The specific requirements of the pilot study were to obtain feedback on the following:

- The validity of the questions, and whether they were accurately targeting key safety health issues.
- Practical issues associated with getting staff to complete the questionnaires.

- The ease with which the results could be interpreted.
- The validity of the results as judged by management against known or suspected difficulties.
- The value of the results in terms of assisting with the generation of further initiatives to address any potential problems.

Practical issues associated with getting staff to complete the questionnaire included:

- the method for administrating the questionnaires,

- the time taken to complete the questionnaires,

- the ability to take staff off the job for a period of time.

Staff could be issued with their questionnaire and complete them in their own time and hand them in at the end of the shift. Alternatively, staff could be invited into a room during the shift, told the objectives of the exercise and assured as to the anonymity of results, and asked to complete the questionnaires independently.

Company A agreed to pilot the questionnaire. An initial meeting was held in November 2001 and some changes were made to the questionnaire terminology to reflect their systems. The questionnaires were administered by Company A and returned to HSEC Ltd for analysis in December 2001. Software was developed to analyse the questionnaires and the basic results were returned to Company A around late January 2002.

The interim software was further developed to produce a MEDA compatible results set. The results were then reviewed by HSEC and a summary report was produced for Company A on a strictly confidential basis.

A meeting was held with Company A in February 2002 to discuss the findings. The general findings at this stage in the project were that:

- The initial 'raw output' was difficult to use to get a reliable indication of the root issues.
- The structure of the printouts helped a little.
- The HSEC Ltd summary report was helpful.
- The human factors issues associated with maintenance do not lend themselves to a fully mechanistic approach to interpretation and inevitably some judgement is required.
- The questionnaires for the two sets of engineers were too long and would benefit from being significantly shortened.
- Validation of such questionnaires is difficult, however, the company felt that the summary responses provided a reasonable picture of known issues and there were few areas where any potential concerns were in dispute.

Feedback from the first pilot was generally favourable, however, there was some concern that the questionnaires for the certifying staff and non-certifying staff were too long and that the scoring method may have over-rated one of the many issues. Other scores were generally considered as likely to be accurate. The questionnaires were modified accordingly and piloted with a second company.

5.2 Second Pilot Study

Company B agreed to be the second pilot of the tool. An initial meeting was held on site to describe the project aims and the pilot questionnaire tool. Questionnaires were subsequently issued to Company B who then gave them to staff to complete as and

when they could over the course of a shift. Completed questionnaires were returned to HSEC for analysis.

A summary report was produced by HSEC on a strictly confidential basis in June 2002 and the findings reported to senior management in a subsequent meeting. The basic feedback was again positive and most findings were considered to be a reasonably accurate interpretation of maintenance issues.

5.3 Summary from Two Pilot Surveys

As with the first pilot study, there were indications in the responses that attention may have been falling off towards the end of the longer questionnaires. Some respondents were taking up to 1 hour to complete the certifying staff and non-certifying staff questionnaires.

A shorter questionnaire was required. A number of alternatives were considered. These included dividing the existing questionnaire into two parts with each respondent only being issued with half the questionnaire. This was rejected on the basis that many organisations may have relatively few engineers to complete the questionnaire. This approach would halve the effective number of respondents.

A shorter questionnaire was developed to be applicable to each of the three respondent groups.

A general difficulty with relying on questionnaires is that if (say) 5% of maintenance staff were poor performers that this would be a major concern to a Company. However, when assessing the 'safety health' of a company using a questionnaire, 95% of respondents could be giving very good replies and this would generally be seen to be very favourable.

One way of limiting this effect and helping to better interpret the real 'safety health' of a company would be to review the questionnaire results with any MEDA findings. The latter address those human factors issues that had been associated with incidents, occurrences and maintenance errors. Issues identified by MEDA but not showing as significant in the HSEC tool could indicate an actual problem that has application to a very small group of engineers/staff and which would therefore not show high in the questionnaire scoring.

Structuring the results of the safety health questionnaire in a similar form to MEDA facilitated comparison of results. Many of the human factors issues addressed by the HSEC tool, however, are not included in the MEDA structure, therefore had to be listed separately. If companies are already familiar with MEDA, this form of output may be preferable, as it aids direct comparison.

5.4 Application of the tool to a further four companies

The questionnaires were run within four additional companies with the modifications incorporated. The results of all six were compared and merged. The shortened questionnaires provided a balance between keeping the respondee's interest and providing enough data to form valid indications.

6 Findings

The detailed findings from the six studies are confidential to each company. However it can be concluded that different organisations did have different issues that needed resolution. The spread of issues warranting attention that were highlighted accross the five companies were as follows:

Communications

- communications between shifts
- communications between management and staff

Design Factors

- working with different aircraft where different designs cause confusion
- consistence in design features between different aircraft
- perceived complexity of aircraft design
- possibility of fitting parts incorrectly
- design and availability of work platforms

Job Design

- the shift working systems
- pressure from aircraft operators

Management Style

- trust in management
- the attitudes of management
- the quality and ability of management
- confidence in management's experience and qualifications
- management's willingness to accept criticism
- perceived pressure coming from supervisors and management
- direct pressure from management not to follow rules
- pressure from supervisors to not follow rules and procedures

Planning and Preparation

- planners minimising jobs running over different shifts
- amount of work scheduled in a shift
- realistic expectations of work to be done in a shift
- clarity of roles and responsibilities of different departments

Resources and Equipment

- the general condition and calibration of tools and equipment
- the availability of specialist tools and equipment

Rules & Procedures

- ambiguity in the documentation

Skills and Competence

- training and refresher training not matching job needs

Working Environment

- quality of the personal protective equipment (PPE)
- potential to be exposed to wind, rain etc.
- suitability of tools & equipment for the working conditions
- the workspace in and around aircraft

Most of the above factors are under the control of the maintenance organisation. The exception is where the maintainers were experiencing difficulties due to many aspects of the design of the aircraft maintenance interface and manuals. Such problems are largely beyond the control of the maintenance organisation. Nevertheless, these findings could be passed on to the aircraft manufacturers and those designing and purchasing tools and equipment to better ensure the equipment suits its intended purpose, and that maintenance manuals are more user-friendly.

7 Benchmark Measure

The summary benchmark results are listed in Appendix 6. However, companies are cautioned against complacency if their results are 'better' than the benchmark measures, since a more detailed breakdown of their results may indicate that there are problems in specific areas which are disguised when the results are interpreted at Level 1 only.

8 Conclusions

A tool has been developed that measures the safety health of an aircraft maintenance organisation. It was found that the major technical functions could be broadly categorised into three groups of staff and tailored questionnaires have been developed for each group.

Software has been developed to enable the companies to input their results and obtain three levels of results print outs to suit individual needs. These range effectively from an executive summary (level 1 results) to a detailed working data set (level 3 results). The results can also be printed out in a form comparable with the Boeing MEDA format that some organisations may prefer. Although it should be noted that this tool will detect a wider range of issues than MEDA.

The tool was piloted on a number of companies and the results showed the tool has value in identifying both the underlying strong features and potentially problematic features of such organisations.

The HSEC Safety Health of Maintenance Engineering (SHoMe) tool was informally validated against (i) MEDA data from some of the participating companies and (ii) personal perceptions among some of the senior managers/quality managers of where the company strengths and weaknesses lay with respect to potential for human error. In general, the HSEC tool and MEDA data were reasonably consistent, and the tool provided objective data to confirm the nature and extent of previously suspected problem areas. There were a few areas where the tool failed to highlight issues which were thought to be problematic, and there were a few differences between the pattern of MEDA data and HSEC tool results, but not to the extent of being contradictory. On the whole, participants thought that this was a useful mechanism for measuring the "safety health" of the company, especially when used in conjunction with data from other sources such as MEDA.

The time commitment for the staff to complete the questionnaire is not insignificant at about 30 minutes, however it is hoped that the value of the tool outweighs this time commitment cost. Whilst it is not necessary for all staff to complete the questionnaires, the results have greater validity with more staff contributing to the results.

Organisations should contact the CAA Research Management Department, or osdhfs@srg.caa.co.uk if they would like a free copy of the HSEC SHoMe tool software.

9 Acknowledgments

In addition to staff at the CAA, HSEC Ltd would like to acknowledge the support and assistance of those companies which participated in the study, in particular the individuals within those companies which helped HSEC to develop and apply the tool.

Appendix 1 Generic Questionnaire

This shows the make up of the generic questionnaire, i.e:

Which staff groups get which questions and the headline issues that are being measured together with associated questions.

GENERIC QUESTIONNAIRE	Tech Cert Staff	Tech Non Cert Staff	Mngmnt /Tech Support Staff
Individual Attitudes			
Individual tolerance of people who make errors	✓	✓	✓
People's awareness of their actions on airworthiness and aviation safety	✓	✓	✓
Peer group safety consciousness	✓	✓	✓
Workforce not caring about their jobs - just working for the money	✓	✓	✓
Attitude to making errors - LAE's responsibility to check	✓	✓	N/A
Attitude to making errors - others always check	N/A	✓	✓
Interest in work and job satisfaction	✓	✓	✓
Pride on getting aircraft back on time, even if this needs some non-compliance	✓	N/A	N/A
Complacency & Rule Erosion			
Regular non-compliance by the workforce	✓	✓	✓
Some procedures being there only to protect management's back	✓	✓	✓
Attitudes to risks & making mistakes	✓	✓	✓
Pressure			
Peer pressure from routine violations by workmates	N/A	✓	✓
Direct pressure to deviate from procedures	✓	✓	✓
Management Attitudes			
Demonstrable commitment to safety by managers	✓	✓	✓
Colleagues' perceptions of management's commitment to safety	✓	✓	✓
Visibility of management at work place	✓	✓	✓
Perceptions of management's understanding of actual work practices	✓	✓	✓
Willingness of management to discuss issues with workforce	✓	✓	✓
Supervisor Attitudes			
Direct pressures from the supervisor to deviate from procedures	✓	✓	✓

GENERIC QUESTIONNAIRE	Tech Cert Staff	Tech Non Cert Staff	Mngmnt /Tech Support Staff
Supervisor condoning unapproved actions to get an aircraft away	✓	✓	N/A
Supervisor taking risks in releasing aircraft when the maintenance incomplete	✓	✓	N/A
Perceptions of best jobs going to those who are willing to 'bend' procedures	✓	✓	✓
Supervisor's attitude to workforce's concerns over airworthiness	✓	✓	N/A
Supervisor Effectiveness			
Presence of boss when needed	✓	✓	✓
Effectiveness of boss at maintaining standards	✓	✓	✓
Boss's knowledge on maintenance issues	✓	✓	✓
Working without adequate supervision	✓	✓	✓
Individual Commitment to Continual Improvement			
Colleagues showing commitment to maintaining high standards of safety	✓	✓	✓
Management's commitment to improving safety	✓	✓	✓
Management's priority to safety & commercial improvements	✓	✓	✓
Just Culture/Blame Culture			
Management encouraging reporting of errors	✓	✓	✓
Confidence to report errors	✓	✓	✓
Acceptance of motives behind incident investigations	✓	✓	✓
Willingness to own up if error would impact on airworthiness	✓	✓	✓
Planning			
Jobs planned to give time to do the job properly	✓	✓	✓
Quality Assurance			
The role of the Quality Dept is vital	✓	✓	✓
The Quality Assurance process does not prevent errors	✓	✓	✓
The company pays lip service to quality	✓	✓	✓
Communications			
Communications between management and staff	✓	✓	✓
Managers informing staff of important safety findings	✓	✓	✓
Quality of briefing by others passing on a job	✓	✓	✓
Being given the necessary information before starting a job	✓	✓	✓

GENERIC QUESTIONNAIRE	Tech Cert Staff	Tech Non Cert Staff	Mngmnt /Tech Support Staff
Awareness of the contents of the Company's safety policy	✓	✓	✓
Roles & Responsibility			
Knowledge of job requirements and responsibilities	✓	✓	✓
Knowledge of own accountabilities	✓	✓	✓
Colleagues understanding of their roles and responsibilities	✓	✓	✓
Clarity of inter-department roles and responsibilities	✓	✓	✓
Maintenance Procedures: Accuracy, Relevance & Practicality			
Accuracy of procedures	✓	✓	✓
Provision of information required to do job	✓	✓	✓
Procedures - clarity and ease of understanding	✓	✓	✓
Identification of revisions to procedures	✓	✓	✓
Procedures - practicality and easy of use	✓	✓	✓
Procedures - adoption of 'best practice'	✓	✓	✓
Systems for reporting problems with maintenance manuals and documentation	✓	✓	N/A
Systems for fixing problems with maintenance manuals and documentation	✓	✓	N/A
Provision of Resources			
Systems to ensure specified resources are readily available	✓	✓	✓
Rushing jobs due to staff shortages	✓	✓	✓
Non-certifying staff often have to rush jobs due to staff shortages	✓	N/A	N/A
Delays due to equipment unavailability	✓	✓	✓
Insufficient time given to do a job	✓	✓	✓
Completion of job despite the non-availability of equipment/tools	✓	✓	N/A
Delays due to shortage of spares	✓	✓	N/A
Aircraft released with work not done due to parts shortages	✓	✓	N/A
Commercial Pressures			
Unrealistic deadlines	✓	✓	✓
Rushing jobs due to unrealistic deadlines	✓	✓	✓
Pressure to work additional hours when fatigued	✓	✓	✓
Conflicting commercial & safety demands	✓	✓	✓

GENERIC QUESTIONNAIRE	Tech Cert Staff	Tech Non Cert Staff	Mngmnt /Tech Support Staff
Perceptions of promotions given to those prepared to cut corners	✓	✓	✓
Management of Change			
Individual acceptance of periodic changes to own job	✓	✓	✓
Willing to change to meet Company requirements	✓	✓	✓
Training			
Training meeting needs of the job	✓	✓	✓
Appropriate provision of refresher, or continuation, training	✓	✓	✓
Competence			
Necessary experience/qualifications	✓	✓	✓
Colleagues understanding of hazards & risk associated with maintaining aircraft	✓	✓	N/A
Knowledge of maintenance rules & procedures	✓	✓	N/A
Confidence to deal with unexpected aircraft faults	✓	N/A	N/A
Confidence flying in aircraft released by another certifying engineer after a D check	✓	N/A	N/A
Confidence flying in aircraft on which colleagues had worked after checks	✓	✓	✓
Confidence in manager's experience and/or qualifications to do the job	✓	✓	✓
Fatigue			
Going to work when ill or feeling less than 100%	✓	✓	✓
Self-reports of errors due to tiredness within last month	✓	✓	✓
Reports of colleagues making errors due to tiredness within last month	✓	✓	✓
Frequent working of long hours or large amounts of overtime	✓	✓	✓
Self-report of job being physically tiring	✓	✓	N/A
Working Conditions			
Working conditions making effective working difficult	✓	✓	✓
Design & Maintenance Interface			
Problems with the design of tools	✓	✓	N/A
Problems with the design of aircraft to facilitate maintenance	✓	✓	N/A

Appendix 2 Questionnaire Set for Management and Technical Support Staff

This questionnaire survey has been specifically developed for use in the aircraft maintenance industry to help assess the impact of any safety initiatives on the general 'safety health' of a company.

This questionnaire is anonymous so please answer the following questions as honestly as you can. It will not be possible to identify the responses of any individual.

To help us gain the most from the results please also complete the following two pages which provides information on the nature of your job and your experience.

Thank you for your assistance.

Job Details

Date	
Location:	

Your Job:

Tick all those which apply – (Multiple Entries)

Management/management support staff:

• management	
• quality assurance	
• training	
• planning	
• technical services	
• technical records	
• supply chain	

Technicians/maintenance personnel

• certifying staff/supervisor	
• non certifying staff/mechanic	
• contractor	

The number of years you have worked in aircraft maintenance engineering	
The number of years with this Company	
The number of years in your current job/position , or with current responsibilities	

The shifts you work:

Permanent days	
Permanent nights	
Rotating shifts	

Approx number of hours you work in typical week

<40	
40-50	
50-60	
60-70	
>70	

Please tick if you have worked on any of the following aircraft in the past month:

Only worked on components off the aircraft	

{* this table is modified to include a full list of aircraft that are maintained by the company}

*		*	
*		*	
*		*	
*		*	
*		*	

Others: _____

_____

_____

Generic Questionnaire

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
Management and staff communicate well with each other					
Managers always let us know of important safety findings					
I am always properly briefed by those giving me a job					
Before I start a job I'm always given the necessary information					
I am fully aware of the contents of the Company's safety policy					
I know exactly what I am expected to do and my responsibilities					
I know those parts of my job where I can be held accountable					
I sometimes think my colleagues are confused over their exact roles and responsibilities					
There is often confusion between departments over some of their exact roles and responsibilities					
The procedures I use are accurate & complete					
The company provides me with all the information I need to do my job					
The procedures I use are clear and easy to understand					
I can easily identify where procedures have been revised					
The procedures I use are practical and easy to use					
The procedures I use always adopt 'best practice'					
We have systems in place to ensure that all the resources I need are readily available					
I often have to rush jobs due to staff shortages					
Jobs are often delayed due to vital equipment being missing or in the wrong place					
I am often not given enough time to do the job					
Some deadlines are unrealistic					
We often have to rush jobs due to unrealistic deadlines					
There was pressure placed upon me to work additional hours when I feel that I am not at my best					
There are conflicting commercial & safety demands					
People who are prepared to cut corners seem to always get promoted					
I accept that changes to my job are necessary from time to time					

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
I am always willing to change the way I work to fit in with the Company requirements					
The training I receive is appropriate for the job I do					
Appropriate refresher, or continuation, training is regularly provided					
I have the necessary experience/qualifications for the work I do					
I would be confident flying in an aircraft we have just worked on after a maintenance check					
I am confident our managers have the necessary experience/ qualifications for the work they do					
I sometimes go to work when I am ill or feel less than 100%					
During the last month I have made an error in my work due to tiredness					
During the last month some of my colleagues have made errors in their work due to tiredness					
I often have to work long hours or a large amount of overtime					
My working conditions often make it difficult for me to do my work properly					
Anyone who makes an error deserves to be disciplined					
My colleagues fully understand the implications of their actions on airworthiness and aviation safety					
All the people I work with are very safety conscious					
Some people I work with don't care about the job anymore - they just do it for the money					
I find my work boring and unsatisfying					
It doesn't really matter if I make the odd mistake as my work is always checked					
Some procedures are often not fully followed by some people					
Some procedures are only there to protect management's back					
The real risks from us making mistakes are quite small					
My colleagues often do not follow some procedures					
I experience some pressure from my workmates to do things differently to the procedures					
Management regularly demonstrate their strong commitment to safety					
All my colleagues think management are strongly committed to safety					

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
We never see anyone in management where I work					
The management have no idea of what really goes on					
Management are happy to discuss any of our concerns					
Some supervisors sometimes pressure people not to follow procedures					
Some supervisors give the best jobs to those who are willing to 'bend' procedures					
My immediate boss is always there when I need him/her					
My immediate boss is effective at maintaining safety standards					
My immediate boss is very knowledgeable on job related issues					
I often have to complete work without adequate supervision					
My colleagues show a commitment to maintaining high standards of safety					
Management continue to seek new ways of improving safety performance					
Management devote sufficient effort to improve safety performance in comparison to commercial improvements					
Management encourage us to report our errors					
If I report an error, I am confident I would be treated in a fair manner					
Management investigate incidents to understand weakness in safety procedures, not to discipline the person					
I have no problems telling others when I make a mistake					
Jobs are often planned allowing insufficient time to do the job properly					
The role of the Quality Dept is vital					
The Quality Assurance process does not prevent errors.					
The company pays lip service to quality					

Thank you for completing these questionnaires

Please add any further comments you may wish to make

Appendix 3 Questionnaire for Technical Certifying Staff

@* INSERT COMPANY NAME *

SAFETY HEALTH INDICATORS IN AIRCRAFT MAINTENANCE

This questionnaire survey has been specifically developed for use in the aircraft maintenance industry to help assess the impact of any safety initiatives on the general 'safety health' of a company.

This questionnaire is anonymous so please answer the following questions as honestly as you can. It will not be possible to identify the responses of any individual.

To help us gain the most from the results please also complete the following two pages which provides information on the nature of your job and your experience.

Thank you for your assistance.

Job Details

Date	
Location:	

Your Job:

Tick all those which apply – (Multiple Entries)

Management/management support staff:

• management	
• quality assurance	
• training	
• planning	
• technical services	
• technical records	
• supply chain	

Technicians/maintenance personnel

• certifying staff/supervisor	
• non certifying staff/mechanic	
• contractor	

The number of years you have worked in aircraft maintenance engineering	
The number of years with this Company	
The number of years in your current job/position , or with current responsibilities	

The shifts you work:

Permanent days	
Permanent nights	
Rotating shifts	

Approx number of hours you work in typical week

<40	
40-50	
50-60	
60-70	
>70	

Please tick if you have worked on any of the following aircraft in the past month:

Only worked on components off the aircraft	

{* this table is modified to include a full list of aircraft that are maintained by the company)

*		*	
*		*	
*		*	
*		*	
*		*	

Others: _____

_____

_____

Generic Questionnaire

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
Management and staff communicate well with each other					
Managers always let us know of important safety findings					
I am always properly briefed by those passing on a job to me					
Before I start a job I'm always given the necessary information					
I am fully aware of the contents of the Company's safety policy					
I know exactly what I am expected to do and my responsibilities					
I know those parts of my job where I can be held accountable					
I sometimes think my colleagues are confused over their exact roles and responsibilities					
There is often confusion between departments over some of their exact roles and responsibilities					
The procedures I use are accurate & complete					
The company provides me with all the information I need to do my job					
The procedures I use are clear and easy to understand					
I can easily identify where procedures have been revised					
The procedures I use are practical and easy to use					
The procedures I use always adopt 'best practice'					
We have a good system for reporting problems with maintenance manuals and documentation					
We have a good system for fixing problems with maintenance manuals and documentation					
We have systems in place to ensure that the resources specified in the procedures are readily available					
I often have to rush jobs due to staff shortages					
Non-certifying staff often have to rush jobs due to staff shortages					
Jobs are often delayed due to vital equipment being missing or in the wrong place					
I am often not given enough time to do the job					

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
We usually manage to complete a job despite the non-availability of the specified equipment/tools					
Jobs are often delayed due to a shortage of spares					
Aircraft are sometimes released even if some work can't be done due to parts shortages					
Some deadlines were unrealistic					
We often had to rush jobs due to unrealistic deadlines					
There was pressure placed upon me to work additional hours when I felt that I was not at my best					
There were conflicting commercial & safety demands					
People who are prepared to cut corners seem to always get promoted					
I accept that changes to my job are necessary from time to time					
I am always willing to make changes in the way I work to fit in with the Company requirements					
The training I receive is appropriate for the job I do					
Appropriate refresher, or continuation, training is regularly provided					
I am confident that I have the necessary experience/ qualifications for the work I do					
I am confident that all my colleagues understand the hazards & risk associated with maintaining aircraft					
I have a good knowledge of maintenance rules & procedures					
I am confident that I can deal with unexpected aircraft faults					
I would be confident flying in an aircraft which my colleagues had released to service after a D check					
I would be confident flying in an aircraft on which my colleagues had worked after a maintenance check					
I am confident our managers have the necessary experience and/or qualifications for the work they do					
I sometimes go to work when I am ill or feel less than 100%					
During the last month I have made an error in my work due to tiredness					
During the last month some of my colleagues have made errors in their work due to tiredness					

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
I often have to work long hours or a large amount of overtime					
My job can sometimes be physically tiring					
My working conditions often make it difficult for me to do my work properly					
Some tools could be better designed					
The aircraft could be better designed to allow maintenance					
Anyone who makes an error deserves to be disciplined					
My colleagues fully understand the implications of their actions on airworthiness and aviation safety					
The non-certifying staff are safety conscious					
Some non-certifying staff don't care about the job anymore - they just do it for the money					
It is the responsibility of the LAE to check that no one has made any errors - that's what he's paid for					
I find my work boring and unsatisfying					
I pride myself on getting an aircraft back to service on time, even if I occasionally compromise on small details					
Some of the non-certifying staff often do not follow certain maintenance procedures					
Some of the procedures are only there to protect management's back					
The real risks from us making mistakes are quite small					
I experience some pressure to do things differently to the procedures					
Management regularly demonstrate their strong commitment to safety					
All of my colleagues think management are strongly committed to safety					
We never see anyone in management where I work					
The management have no idea of what really goes on					
Management are happy to discuss any of our concerns					
My immediate boss sometimes pressures me not to follow maintenance procedures					
My immediate boss would approve of my actions if I did not follow procedures in order to get an aircraft away					

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
My immediate boss sometimes take risks in releasing aircraft when the maintenance has not been properly undertaken					
My immediate boss tends to give the best jobs to those who are willing to 'bend' procedures to get aircraft away earlier					
My immediate boss always take seriously any concerns I have over airworthiness					
My immediate boss is always there when I need him/her					
My immediate boss is effective at maintaining standards					
My immediate boss is very knowledgeable on maintenance issues					
I often have to complete work without adequate supervision					
My colleagues show a commitment to maintaining high standards of safety					
Management continue to seek new ways of improving safety performance					
Management devote sufficient effort to improve safety performance in comparison to commercial improvements					
Management encourage us to report our errors					
If I report an error, I am confident I would be treated in a fair manner					
Management investigate incidents to understand weakness in safety procedures, not to discipline the person					
If I made an error which I didn't think would impact on airworthiness I would own up and not release the aircraft					
Jobs are often planned allowing insufficient time to do the job properly					
The role of the Quality Dept is vital					
The Quality Assurance process does not prevent errors.					
The company pays lip service to quality					

Job Difficulties Questionnaire

This part of the tool is intended to identify any specific aspect of your job which is causing you particular difficulty.

You will probably have been involved in a range of tasks and therefore the first stage is to read down the list on the next page and identify those job elements that you have been involved with over the last month (or so). All others are then ignored.

Please place a 'tick' in column 'A' for those activities which YOU ACTUALLY DID over the past month or so. Then ONLY FOR THOSE PARTS TICKED, indicate in columns 'B', 'C' or 'D' the level of difficulty you generally experienced performing these jobs.

For example, if in the last month you were involved in any aspect of 'planning' then you would place a tick in column 'A' on the first row, and:

- if planning your work gave no problems - tick 'B'
- if planning your work gave some problems - tick 'C'
- if planning your work gave you major problems - tick 'D'

However, if your work did not include planning then leave column 'A' blank and move on to the next issue.

JOB DIFFICULTY QUESTIONNAIRE	**A** Was this part of your Jobs?	**B** No problems	**C** Some problems	**D** Major problems
PLANNING: e.g. • Planning your work for each shift • Working to a plan developed by somebody else • Checking work previously done by other people	Y / N			
PREPARATION: e.g. • Obtaining parts/tools/equipment - for planned tasks • Obtaining parts/tools/equipment - unplanned tasks • De-panelling/removing parts for access to work areas	Y / N			
INSPECTION: e.g. • Determining the appropriate inspection standards • Physically carrying out inspections • Raising rectification and defect reports	Y / N			
ROUTINE WORK: e.g. • Routine servicing, cleaning and lubrication • Making component changes • Using specialist tools/equipment • Using facilities for working at height	Y / N			

JOB DIFFICULTY QUESTIONNAIRE	**A** Was this part of your Jobs?	**B** No problems	**C** Some problems	**D** Major problems
CHECKS & FUNCTIONAL TESTING: e.g. • Daily routine checks • Checking new parts • Arranging & performing tests to be undertaken • Checking work of non-certifying staff • Housekeeping following completion of job • Checking completed repairs	Y / N			
NON – ROUTINE WORK: e.g. • Diagnosing faults • Carrying out modifications or service bulletins • Carrying out defect rectification	Y / N			
USING MAINTENANCE DATA/MANUALS: e.g. • Using maintenance data • Using work cards • Using maintenance manual • Using company maintenance procedures • Using service bulletins/airworthiness directives • Using "in house" written modifications & inspection documents • Using computer based maintenance information	Y / N			
UPDATING DOCUMENTATION & SYSTEMS: e.g. • Ensuring all work is completed before sign off • Informing others of work completed & sign off • Updating records, data bases etc.	Y / N			

Organisational Questionnaire

Please read the following list and put a tick against anything which, during the last 6 months or so, has: • caused you or a colleague to make a mistake or • caused you or a colleague confusion or uncertainty over a job(s) or • otherwise affected airworthiness	
The type of documentation you have to use given your working conditions	
The ease with which general written procedures can be understood	
The amount of jargon and ambiguity contained in the procedures	
The ease with which service instructions can be understood	
The ease with which service bulletins can be understood	
The ease with which diagrams and pictures can be understood	
The general design and layout of written procedures	
Ambiguity as a result of different layouts of different types of forms you use	
The standard of legibility of printed and written material	
System for implementing temporary revisions to Maintenance Manuals	
Absence of temporary revisions to the Maintenance Manual concerning known problems	
The effectiveness of the temporary revisions to Maintenance Manuals (MMTR)	
Previously encountered problems were not highlighted	
Distractions and interruptions while you are working	
The general space in and around the aircraft	
Noisy working environments	
Exposure to airborne contaminants	
The temperatures you have to work in	
The general amount of lighting in and around the aircraft	
The presence of glare or dazzling light sources near to your work area	
The potential to be exposed to wind/rain/moisture when working	
The quality and suitability of any protective equipment you use/wear	
The standard of housekeeping adopted by other engineers/technicians	
Systems for prioritising jobs	
The ability of planners to minimise jobs running over other shifts	
The clarity of jobs to which you are assigned	
The system for informing you of any updates to procedures	
The staffing levels allocated to each job	
The financial resource made available to each job	
The general availability of conventional tools & equipment	
The general availability of specialist tools & equipment	

Effectiveness of preparation of tools, parts and data	
The ease with which you obtain necessary spare parts	
The shift systems adopted by your company	
The amount of work scheduled to be completed in your shift	
Any general time pressure to meet deadlines	
Any pressure put on you from the aircraft operators	
Any pressure put on you from your supervisor or management	
The amount of work your immediate boss expects you to achieve in a shift	
Access for inspection & testing	
Access for fitting parts and repairs including space to use tools	
The level of complexity of the aircraft design	
Differences in designs between different aircraft which could cause confusion	
The standard of the labelling of parts	
The legibility of labels under all weather conditions	
Design features which allow/prevent parts being fitted incorrectly	
The postures you need to adopt to conduct the maintenance work	
The suitability of the tools & equipment for the jobs & working conditions	
The general condition & calibration of the tools & equipment you use	
The design of the tools & equipment you use	
The ease with which tools can be used	
The availability of 'quiet room' facilities to allow discussions with your colleagues	
The availability and suitability of personal storage space	
The general design and layout of your hanger/work area	
The manoeuvrability of equipment and access devices	
The ease with which you communicate with other engineers in your team	
The effectiveness of communications with other shifts	
The amount of time devoted to formal handover communication with the next shift	
The effectiveness of communications between you and your supervisor	
The effectiveness of communication between flight crews and maintenance crews	
The quality and ability of the supervisors	
The effectiveness of supervisors in enforcing good working practices	
The presence of supervisors who knowingly permit un-approved working practices	
The presence of supervisors who direct you to adopt 'non-approved' practices	
Lack of trust in your immediate boss	
The competency of newly promoted supervisors	
The quality and ability of management	
The amount of responsibility and authority delegated to you by management	
The presence of any managers who direct you to adopt 'non-approved' practices	

Lack of management support in resolving problems	
The willingness of your workmates or supervisor to discuss your problems	
Your willingness to raise any problems you have with your workmates	
Your knowledge of the company processes or company procedures	
Your knowledge of the aircraft systems you recently worked on	
Your knowledge of the detailed maintenance task requirements	
Your ability to retain information 'in your head'	
Your understanding of what could increase the likelihood of you making an error	
How the content of recent training and recurrent training met your own needs	
The planned times between recurrent/refresher training courses	
Your past 'on-the-job' experiences of these jobs	
Your skills in fault isolation and troubleshooting	
Your skills in testing	
Your skills in fitting parts/making adjustments	
Your skills in using computer based maintenance manuals	
Your ability to correctly use the tools and equipment	
The amount of recent opportunity you have had to practice these skills	
Your ability to deal with very complex tasks	
The numbers of skills you need to posses to do your work	
Your ability to avoid or deal with personal conflicts with others	
Your ability to assert yourself and not allow others to compromise your own standards	
Your strength and/or body size	
Your eyesight and colour vision	
Your ability to maintain good levels of concentration	
Any domestic or other non-work concerns	
Your willingness to be honest with others about any mistakes you may have made	
The clarity of the procedures for reporting safety concerns	
The way management treat individuals who report mistakes or safety concerns	
The extent to which you think senior managers are willing to accept criticism	

Thank you for completing these questionnaires.

Please add any further comments you may wish to make.

Appendix 4 Questionnaire for Non-Certifying Engineers

@* INSERT COMPANY NAME *

SAFETY HEALTH INDICATORS IN AIRCRAFT MAINTENANCE

This questionnaire survey has been specifically developed for use in the aircraft maintenance industry to help assess the impact of any safety initiatives on the general 'safety health' of a company.

This questionnaire is anonymous so please answer the following questions as honestly as you can. It will not be possible to identify the responses of any individual.

To help us gain the most from the results please also complete the following two pages which provides information on the nature of your job and your experience.

Thank you for your assistance.

Job Details

Date	
Location:	

Your Job:

Tick all those which apply – (Multiple Entries)

Management/management support staff:

• management	
• quality assurance	
• training	
• planning	
• technical services	
• technical records	
• supply chain	

Technicians/maintenance personnel

• certifying staff/supervisor	
• non certifying staff/mechanic	
• contractor	

The number of years you have worked in aircraft maintenance engineering	
The number of years with this Company	
The number of years in your current job/position , or with current responsibilities	

The shifts you work:

Permanent days	
Permanent nights	
Rotating shifts	

Approx number of hours you work in typical week

<40	
40-50	
50-60	
60-70	
>70	

Please tick if you have worked on any of the following aircraft in the past month:

Only worked on components off the aircraft	

{* this table is modified to include a full list of aircraft that are maintained by the company)

*		*	
*		*	
*		*	
*		*	
*		*	

Others: _____

_____

_____

Generic Questionnaire

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
Management and staff communicate well with each other					
Managers always let us know of important safety findings					
I am always properly briefed by those giving me a job					
Before I start a job I'm always given the necessary information					
I am fully aware of the contents of the Company's safety policy					
I know exactly what I am expected to do and my responsibilities					
I know those parts of my job where I can be held accountable					
I sometimes think my colleagues are confused over their exact roles and responsibilities					
There is often confusion between departments over some of their exact roles and responsibilities					
The procedures I use are accurate & complete					
The company provides me with all the information I need to do my job					
The procedures I use are clear and easy to understand					
I can easily identify where procedures have been revised					
The procedures I use are practical and easy to use					
The procedures I use always adopt 'best practice'					
We have a good system for reporting problems with maintenance manuals and documentation					
We have a good system for fixing problems with maintenance manuals and documentation					
We have systems in place to ensure that all the resources specified in the procedures are readily available					
I often have to rush jobs due to staff shortages					
Jobs are often delayed due to vital equipment being missing or in the wrong place					
I am often not given enough time to do the job					
We usually manage to complete a job despite the non-availability of the specified equipment/tools					
Jobs are often delayed due to a shortage of spares					

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
Aircraft are sometimes released even if some work can't be done due to parts shortages					
Some deadlines are unrealistic					
We often have to rush jobs due to unrealistic deadlines					
There was pressure placed upon me to work additional hours when I felt that I was not at my best					
There were conflicting commercial & safety demands					
People who are prepared to cut corners seem to always get promoted					
I accept that changes to my job are necessary from time to time					
I am always willing to change the way I work to fit in with the Company requirements					
The training I receive is appropriate for the job I do					
Appropriate refresher, or continuation, training is regularly provided					
I am confident that I have the necessary experience/ qualifications for the work I do					
I am confident that all my colleagues understand the hazards & risks associated with maintaining aircraft					
I have a good knowledge of maintenance rules & procedures					
I would be confident flying in an aircraft on which my colleagues had worked after a maintenance check					
I am confident our managers have the necessary experience/ qualifications for the work they do					
I sometimes go to work when I am ill or feel less than 100%					
During the last month I have made an error in my work due to tiredness					
During the last month some of my colleagues have made errors in their work due to tiredness					
I often have to work long hours or a large amount of overtime					
My job can sometimes be physically tiring					
My working conditions often make it difficult for me to do my work properly					
Some tools could be better designed					
The aircraft could be better designed to allow maintenance					
Anyone who makes an error deserves to be disciplined					

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
My colleagues fully understand the implications of their actions on airworthiness and aviation safety					
All the people I work with are very safety conscious					
People don't care about the job anymore - they just do it for the money					
It is the responsibility of the LAE to check that no one has made any errors - that's what he's paid for					
I find my work boring and unsatisfying					
It doesn't really matter if I make the odd mistake as my work is always checked					
Some procedures are often not fully followed by some people					
Some procedures are only there to protect management's back					
The real risks from us making mistakes are quite small					
My colleagues often do not follow some procedures					
I experience some pressure from my workmates to do things differently to the procedures					
Management regularly demonstrate their strong commitment to safety					
All my colleagues think management are strongly committed to safety					
We never see anyone in management where I work					
The management have no idea of what really goes on					
Management are happy to discuss any of our concerns					
My immediate boss sometimes pressures me not to follow maintenance procedures					
My immediate boss would approve of my actions if I did not follow procedures in order to get an aircraft away					
My immediate boss sometimes take risks in releasing aircraft when the maintenance has not been properly undertaken					
My immediate boss tends to give the best jobs to those who are willing to 'bend' procedures to get aircraft away earlier					
My immediate boss always take seriously any concerns I have over airworthiness					
My immediate boss is always there when I need him/her					
My immediate boss is effective at maintaining safety standards					

Please indicate the extent to which you agree or disagree with the following statements in relation to your work over the last month or so	strongly agree	agree	not sure	disagree	strongly disagree
My immediate boss is very knowledgeable on maintenance issues					
I often have to complete work without adequate supervision					
My colleagues show a commitment to maintaining high standards of safety					
Management continue to seek new ways of improving safety performance					
Management devote sufficient effort to improve safety performance in comparison to commercial improvements					
Management encourage us to report our errors					
If I report an error, I am confident I would be treated in a fair manner					
Management investigate incidents to understand weakness in safety procedures, not to discipline the person					
If I made an error which I didn't think would impact on airworthiness I would own up					
Jobs are often planned allowing insufficient time to do the job properly					
The role of the Quality Dept is vital					
The Quality Assurance process does not prevent errors.					
The company pays lip service to quality					

Job Difficulties Questionnaire

This part of the tool is intended to identify any specific aspect of your job which is causing you particular difficulty.

You will probably have been involved in a range of tasks and therefore the first stage is to read down the list on the next page and identify those job elements that you have been involved with over the last month (or so). All others are then ignored.

Please place a 'tick' in column 'A' for those activities which YOU ACTUALLY DID over the past month or so. Then ONLY FOR THOSE PARTS TICKED, indicate in columns 'B', 'C' or 'D' the level of difficulty you generally experienced performing these jobs.

For example, if in the last month you were involved in any aspect of 'planning' then you would place a tick in column 'A' on the first row, and:

- if planning your work gave no problems - tick 'B'
- if planning your work gave some problems - tick 'C'
- if planning your work gave you major problems - tick 'D'

However, if your work did not include planning then leave column 'A' blank and move on to the next issue.

JOB DIFFICULTY QUESTIONNAIRE	**A** Was this part of your Jobs?	**B** No problems	**C** Some problems	**D** Major problems
PLANNING: e.g. • Planning your work for each shift • Working to a plan developed by somebody else • Checking work previously done by other people	Y / N			
PREPARATION: e.g. • Obtaining parts/tools/equipment - for planned tasks • Obtaining parts/tools/equipment - unplanned tasks • De-panelling/removing parts for access to work areas	Y / N			
INSPECTION: e.g. • Determining the appropriate inspection standards • Physically carrying out inspections • Raising rectification and defect reports	Y / N			
ROUTINE WORK: e.g. • Routine servicing, cleaning and lubrication • Making component changes • Using specialist tools/equipment • Using facilities for working at height	Y / N			

JOB DIFFICULTY QUESTIONNAIRE	**A** Was this part of your Jobs?	**B** No problems	**C** Some problems	**D** Major problems
CHECKS & FUNCTIONAL TESTING: e.g. • Daily routine checks • Checking new parts • Arranging & performing tests to be undertaken • Checking work of non-certifying staff • Housekeeping following completion of job • Checking completed repairs	Y / N			
NON – ROUTINE WORK: e.g. • Diagnosing faults • Carrying out modifications or service bulletins • Carrying out defect rectification	Y / N			
USING MAINTENANCE DATA/MANUALS: e.g. • Using maintenance data • Using work cards • Using maintenance manual • Using company maintenance procedures • Using service bulletins/airworthiness directives • Using "in house" written modifications & inspection documents • Using computer based maintenance information	Y / N			
UPDATING DOCUMENTATION & SYSTEMS: e.g. • Ensuring all work is completed before sign off • Informing others of work completed & sign off • Updating records, data bases etc	Y / N			

Organisational Questionnaire

Please read the following list and put a tick against anything which, during the last 6 months or so, has: • caused you or a colleague to make a mistake or • caused you or a colleague confusion or uncertainty over a job(s) or • otherwise affected airworthiness	
The type of documentation you have to use given your working conditions	
The ease with which general written procedures can be understood	
The amount of jargon and ambiguity contained in the procedures	
The ease with which service instructions can be understood	
The ease with which service bulletins can be understood	
The ease with which diagrams and pictures can be understood	
The general design and layout of written procedures	
Ambiguity as a result of different layouts of different types of forms you use	
The standard of legibility of printed and written material	
System for implementing temporary revisions to Maintenance Manuals	
Absence of temporary revisions to the Maintenance Manual concerning known problems	
The effectiveness of the temporary revisions to Maintenance Manuals (MMTR)	
Previously encountered problems were not highlighted	
Distractions and interruptions while you are working	
The general space in and around the aircraft	
Noisy working environments	
Exposure to airborne contaminants	
The temperatures you have to work in	
The general amount of lighting in and around the aircraft	
The presence of glare or dazzling light sources near to your work area	
The potential to be exposed to wind/rain/moisture when working	
The quality and suitability of any protective equipment you use/wear	
The standard of housekeeping adopted by other engineers/technicians	
Systems for prioritising jobs	
The ability of planners to minimise jobs running over other shifts	
The clarity of jobs to which you are assigned	
The system for informing you of any updates to procedures	
The staffing levels allocated to each job	
The financial resource made available to each job	
The general availability of conventional tools & equipment	
The general availability of specialist tools & equipment	

Effectiveness of preparation of tools, parts and data	
The ease with which you obtain necessary spare parts	
The shift systems adopted by your company	
The amount of work scheduled to be completed in your shift	
Any general time pressure to meet deadlines	
Any pressure put on you from the aircraft operators	
Any pressure put on you from your supervisor or management	
The amount of work your immediate boss expects you to achieve in a shift	
Access for inspection & testing	
Access for fitting parts and repairs including space to use tools	
The level of complexity of the aircraft design	
Differences in designs between different aircraft which could cause confusion	
The standard of the labelling of parts	
The legibility of labels under all weather conditions	
Design features which allow/prevent parts being fitted incorrectly	
The postures you need to adopt to conduct the maintenance work	
The suitability of the tools & equipment for the jobs & working conditions	
The general condition & calibration of the tools & equipment you use	
The design of the tools & equipment you use	
The ease with which tools can be used	
The availability of 'quiet room' facilities to allow discussions with your colleagues	
The availability and suitability of personal storage space	
The general design and layout of your hanger/work area	
The manoeuvrability of equipment and access devices	
The ease with which you communicate with other engineers in your team	
The effectiveness of communications with other shifts	
The amount of time devoted to formal handover communication with the next shift	
The effectiveness of communications between you and your supervisor	
The effectiveness of communication between flight crews and maintenance crews	
The quality and ability of the supervisors	
The effectiveness of supervisors in enforcing good working practices	
The presence of supervisors who knowingly permit un-approved working practices	
The presence of supervisors who direct you to adopt 'non-approved' practices	
Lack of trust in your immediate boss	
The competency of newly promoted supervisors	
The quality and ability of management	
The amount of responsibility and authority delegated to you by management	
The presence of any managers who direct you to adopt 'non-approved' practices	

Lack of management support in resolving problems	
The willingness of your workmates or supervisor to discuss your problems	
Your willingness to raise any problems you have with your workmates	
Your knowledge of the company processes or company procedures	
Your knowledge of the aircraft systems you recently worked on	
Your knowledge of the detailed maintenance task requirements	
Your ability to retain information 'in your head'	
Your understanding of what could increase the likelihood of you making an error	
How the content of recent training and recurrent training met your own needs	
The planned times between recurrent/refresher training courses	
Your past 'on-the-job' experiences of these jobs	
Your skills in fault isolation and troubleshooting	
Your skills in testing	
Your skills in fitting parts/making adjustments	
Your skills in using computer based maintenance manuals	
Your ability to correctly use the tools and equipment	
The amount of recent opportunity you have had to practice these skills	
Your ability to deal with very complex tasks	
The numbers of skills you need to posses to do your work	
Your ability to avoid or deal with personal conflicts with others	
Your ability to assert yourself and not allow others to compromise your own standards	
Your strength and/or body size	
Your eyesight and colour vision	
Your ability to maintain good levels of concentration	
Any domestic or other non-work concerns	
Your willingness to be honest with others about any mistakes you may have made	
The clarity of the procedures for reporting safety concerns	
The way management treat individuals who report mistakes or safety concerns	
The extent to which you think senior managers are willing to accept criticism	

Thank you for completing these questionnaires

Please add any further comments you may wish to make

Appendix 5 Presentation of Results

The table below indicates all the possible evidence of non compliance and potential root issues that can be highlighted by the questionnaires and included in the results report.

EVIDENCE OF NON-COMPLIANCE
Pride on getting aircraft back on time, even if this needs some non-compliance
Regular non-compliance by the workforce
Direct pressure to deviate from procedures
Direct pressure form the supervisor to deviate from procedures
Presence of supervisors who direct you to adopt 'non-approved' practices
Presence of any managers who direct you to adopt 'non-approved' practices
Supervisor condoning unapproved actions to get an aircraft away
The effectiveness of supervisors in enforcing good working practices
Supervisor taking risks in releasing aircraft when the maintenance incomplete
Completion of job despite the non-availability of equipment/tools
Aircraft released with work not done due to parts shortages
Self-reports of errors due to tiredness within last month
Reports of colleagues making errors due to tiredness within last month

MASTER PRESENTATION OF POTENTIAL ROOT ISSUES
A SAFETY COMMITMENT OF THE ENGINEERS/STAFF
Peer group safety consciousness
The willingness of your workmates or supervisor to discuss your problems
Workforce not caring about their jobs - just working for the money
Attitude to making errors - LAE's responsibility to check
Attitude to making errors - others always check
Risk Perception
People's awareness of their actions on airworthiness and aviation safety
Attitudes to risks & making mistakes
Colleagues understanding of hazards & risk associated with maintaining aircraft
[Pride on getting aircraft back on time, even if this needs some non-compliance]
[Willingness to own up if error would impact on airworthiness]
The Quality Assurance process does not prevent errors
Perceived Impracticality of Maintenance Tasks
Some procedures being there only to protect management's back

MASTER PRESENTATION OF POTENTIAL ROOT ISSUES
Job Satisfaction & Participation
[Pride on getting aircraft back on time, even if this needs some non-compliance]
Interest in work and job satisfaction
Other Factors
Regular non-compliance by the workforce
Colleagues showing commitment to maintaining high standards of safety
B COMPLACENCY
Colleagues showing commitment to maintaining high standards of safety
Colleagues commitment to improving safety
Management's commitment to improving safety
Management's priority to safety & commercial improvements
Some procedures being there only to protect management's back
Attitudes to risks & making mistakes
Understanding of what could increase the likelihood of you making an error
The company pays lip service to quality
C JOB PRESSURE
Pressure to work additional hours when fatigued
Your general state of health and well being
Your ability to maintain good levels of concentration
Perceptions of best jobs going to those who are willing to 'bend' procedures
Direct pressures from the supervisor to deviate from procedures
Peer pressure from routine violations by workmates
Your ability to avoid or deal with personal conflicts with others
Direct pressure to deviate from procedures
Presence of supervisors who direct you to adopt 'non-approved' practices
Presence of any managers who direct you to adopt 'non-approved' practices
Ability to assert yourself/not allow others to compromise your standards
[Perceptions of promotions given to those prepared to cut corners]
D MANAGEMENT ATTITUDES
Demonstrable commitment to safety by managers
Presence of any managers who direct you to adopt 'non-approved' practices
Any pressure put on you from your supervisor or management
[Colleagues' perceptions of management's commitment to safety]
Visibility of management at work place
Willingness of management to discuss issues with workforce
How management treat individuals who report mistakes or safety concerns
The extent to which you think senior managers are willing to accept criticism

MASTER PRESENTATION OF POTENTIAL ROOT ISSUES
Management's commitment to improving safety
Lack of management support in resolving problems
Management's priority to safety & commercial improvements
[Perceptions of promotions given to those prepared to cut corners]
E SUPERVISOR ATTITUDES
Direct pressures from the supervisor to deviate from procedures
Presence of supervisors who direct you to adopt 'non-approved' practices
Ability to assert yourself and not allow others to compromise your standards
Any general time pressure to meet deadlines
Any pressure put on you from your supervisor or management
The amount of work your immediate boss expects you to achieve in a shift
Supervisor condoning unapproved actions to get an aircraft away
The effectiveness of supervisors in enforcing good working practices
Presence of supervisors who permit un-approved working practices
Supervisor taking risks in releasing aircraft when the maintenance incomplete
[Perceptions of best jobs going to those who are willing to 'bend' procedures]
Supervisor's attitude to workforce's concerns over airworthiness
How management treat individuals who report mistakes or safety concerns
The extent to which senior managers accept advice and criticism
The willingness of your workmates or supervisor to discuss your problems
Lack of trust in your immediate boss
F SUPERVISOR EFFECTIVENESS
Presence of boss when needed
Working without adequate supervision
Effectiveness of boss at maintaining standards
The quality and ability of the supervisors
The effectiveness of supervisors in enforcing good working practices
Presence of supervisors who permit un-approved working practices
Any pressure put on you from your supervisor or management
The quality and ability of management
The effectiveness of supervisors in enforcing good working practices
Boss's knowledge on maintenance issues
The competence of newly promoted supervisors
[Supervisor condoning unapproved actions to get an aircraft away]
[Supervisor taking risks in releasing aircraft when the maintenance incomplete]

MASTER PRESENTATION OF POTENTIAL ROOT ISSUES
H JUST CULTURE/BLAME CULTURE
Individual tolerance of people who make errors
Willingness of management to discuss issues with workforce
Supervisor's attitude to workforce's concerns over airworthiness
Management encouraging reporting of errors
The clarity of the procedures for reporting safety concerns
The extent to which senior managers accept advice and criticism
Confidence to report errors
How management treat individuals who report mistakes or safety concerns
Lack of trust in your immediate boss
Acceptance of motives behind incident investigations
Willingness to own up if error would impact on airworthiness
The willingness of your workmates or supervisor to discuss your problems
Your willingness to raise any problems you have with your workmates
Willingness to be honest with others about any mistakes you may have made
I PLANNING
Jobs planned to give INSUFFICIENT time to do the job properly
The amount of work scheduled to be completed in your shift
Any general time pressure to meet deadlines
The amount of work your immediate boss expects you to achieve in a shift
Unrealistic deadlines
Rushing jobs due to unrealistic deadlines
[Rushing jobs due to staff shortages]
[Non-certifying staff often have to rush jobs due to staff shortages]
[Delays due to shortage of spares]
Other aspects of planning
Effectiveness of preparation of tools, parts and data
Systems for prioritising jobs
The ability of planners to minimise jobs running over other shifts
The clarity of jobs to which you are assigned
The effectiveness of procedures which inform you of updates
J COMMUNICATIONS
Communications between management and staff
The effectiveness of communications between you and your supervisor
Managers informing staff of important safety findings

MASTER PRESENTATION OF POTENTIAL ROOT ISSUES
Quality of briefing by others passing on a job
The ease with which you communicate with other engineers in your team
The effectiveness of communications with other shifts
Time devoted to formal handover communication with the next shift
Communication between flight crews and maintenance crews
Your willingness to raise any problems you have with your workmates
Being given the necessary information before starting a job
Time devoted to formal handover communication with the next shift
The clarity of jobs to which you are assigned
Awareness of the contents of the Company's safety policy
Others Aspects of Communication
'quiet room' facilities to allow discussions with your colleagues
K ROLES & RESPONSIBILITY
Attitude to making errors - LAE's responsibility to check
Knowledge of job requirements and responsibilities
The clarity of jobs to which you are assigned
The amount of responsibility and authority delegated to you by management
Your knowledge of the company process procedures
Knowledge of own accountabilities
Colleagues understanding of their roles and responsibilities
Clarity of inter-department roles and responsibilities
The role of the Quality Dept is vital
L MAINTENANCE PROCEDURES: ACCURACY, RELEVANCE & PRACTICALITY
Relevance
Some procedures being there only to protect management's back
Accuracy
Accuracy of procedures
Provision of information required to do job
Identification of revisions to procedures
The effectiveness of procedures which inform you of updates
Absence of temporary revisions to the Maintenance Manual concerning known problems
The effectiveness of the temporary revisions to Maintenance Manuals (MMTR)
System for implementing temporary revisions to Maintenance Manuals
Previously encountered problems were not highlighted
Procedures - adoption of 'best practice'
[Systems for reporting problems with maintenance manuals and documentation]
[Systems for fixing problems with maintenance manuals and documentation]

MASTER PRESENTATION OF POTENTIAL ROOT ISSUES
Practicality & Ease of Use
Procedures - clarity and ease of understanding
The ease with which general written procedures can be understood
The amount of jargon and ambiguity contained in the procedures
The ease with which service instructions can be understood
The ease with which service bulletins can be understood
The ease with which diagrams and pictures can be understood
How the design and layout of written presentation helps you refer to them
Ambiguity as a result of different layouts of different types of forms you use
The standard of legibility of printed and written material
Procedures - practicality and easy of use
Practicality of format/documentation for the given working conditions
Your skills in using computer based maintenance manuals
M PROVISION OF RESOURCES
Being given the necessary information before starting a job
[Working without adequate supervision]
System Issues
Systems to ensure specified resources are readily available
Staff Resource
[Rushing jobs due to staff shortages]
Non-certifying staff often have to rush jobs due to staff shortages
The staffing levels allocated to each job
The Quality Dept does not have enough staff to do its job effectively
Equipment Resource
Delays due to equipment unavailability
Completion of job despite the non-availability of equipment/tools
The general availability of conventional tools & equipment
The general availability of specialist tools & equipment
Time Resource
Insufficient time given to do a job
Spares Issue
Delays due to shortage of spares
Aircraft released with work not done due to parts shortages
The ease with which you obtain necessary spare parts
Financial Resources
The financial resource made available to each job

MASTER PRESENTATION OF POTENTIAL ROOT ISSUES
N COMMERCIAL PRESSURES
Unrealistic deadlines
Any general time pressure to meet deadlines
Any pressure put on you from the aircraft operators
Any pressure put on you from your supervisor or management
The amount of work your immediate boss expects you to achieve in a shift
Rushing jobs due to unrealistic deadlines
Conflicting commercial & safety demands
Any pressure put on you from the aircraft operators
Pride on getting aircraft back on time, even if this needs some non-compliance
Supervisor condoning unapproved actions to get an aircraft away
Supervisor taking risks in releasing aircraft when the maintenance incomplete
Management's priority to safety & commercial improvements
Aircraft released with work not done due to parts shortages
O MANAGEMENT OF CHANGE
Individual acceptance of periodic changes to own job
Willing to change to meet Company requirements
P TRAINING
Training meeting needs of the job
Your knowledge of the company process procedures
Your knowledge of the aircraft systems you recently worked on
Your knowledge of the detailed maintenance task requirements
How the content of recent training/recurrent training met your own needs
Appropriate provision of refresher, or continuation, training
The planned times between recurrent/refresher training courses
Your past 'on-the-job' experiences of these jobs
The amount of recent opportunity you have had to practice these skills
Q COMPETENCE
Perceptions of management's understanding of actual work practices
Boss's knowledge on maintenance issues
Confidence in manager's experience and/or qualifications to do the job
Necessary experience/qualifications
Your ability to retain information 'in your head'
Understanding of what could increase the likelihood of you making an error
Your past 'on-the-job' experiences of these jobs
Your skills in fault isolation and troubleshooting
Your skills in testing

MASTER PRESENTATION OF POTENTIAL ROOT ISSUES
Your skills in fitting parts/making adjustments
Your skills in using computer based maintenance manuals
Your ability to correctly use the tools and equipment
The amount of recent opportunity you have had to practice these skills
Your ability to deal with very complex tasks
The numbers of skills you need to posses to do your work
Knowledge of maintenance rules & procedures
Your knowledge of the company process procedures
Your knowledge of the aircraft systems you recently worked on
Your knowledge of the detailed maintenance task requirements
Confidence to deal with unexpected aircraft faults
Confidence flying in aircraft released by another certifying engineer after a D check
Confidence flying in aircraft on which colleagues had worked after checks
R FATIGUE
Pressure to work additional hours when fatigued
Going to work when ill or feeling less than 100%
Any domestic or other non-work concerns
The shift systems adopted by your company
[The noise levels you have to work in]
[The temperatures you have to work in]
Quiet room facilities to allow discussions with your colleagues
Your ability to maintain good levels of concentration
Self-reports of errors due to tiredness within last month
Reports of colleagues making errors due to tiredness within last month
Frequent working of long hours or large amounts of overtime
The shift systems adopted by your company
Self-report of job being physically tiring
The amount of work scheduled to be completed in your shift
[The postures you need to adopt to conduct the maintenance work]
Your strength and/or body size
S WORKING CONDITIONS
Working conditions making effective working difficult
The amount of distractions and interruptions while you are working
The amount of general workspace in and around the aircraft
The noise levels you have to work in
The potential to be exposed to airborne contamination
The temperatures you have to work in

MASTER PRESENTATION OF POTENTIAL ROOT ISSUES
The general amount of lighting in and around the aircraft
The presence of glare or dazzling light sources near to your work area
The potential to be exposed to wind/rain/moisture when working
The quality and suitability of any protective equipment you use/wear
Standard of housekeeping adopted by other engineers/technicians
The legibility of labels under all weather conditions
The suitability of the tools & equipment for the jobs & working conditions
[Your eyesight and colour vision]
T DESIGN & MAINTENANCE INTERFACE
Tools & Equipment
Problems with the design of tools
The suitability of the tools & equipment for the jobs & working conditions
The general condition & calibration of the tools & equipment you use
The design of the tools & equipment you use
The ease with which tools can be used
The manoeuvrability of equipment and access devices
Aircraft Features
Problems with the design of aircraft to facilitate maintenance
Access for inspection & testing
Access for fitting parts and repairs including space to use tools
The level of complexity of the aircraft design
Design differences between different aircraft which could cause confusion
The standard of the labelling of parts
The legibility of labels under all weather conditions
Design features which allow/prevent parts being fitted incorrectly
The postures you need to adopt to conduct the maintenance work
Other aspects of interface
Quiet room facilities to allow discussions with your colleagues
The availability and suitability of personal storage space
The general design and layout of your hanger/work area

Appendix 6 Benchmark Measures

Potential Root Failings Affecting Safe and Reliable Maintenance Performance	Score
DESIGN & MAINTENANCE INTERFACE	68
PROVISION OF RESOURCES	54
TRAINING	53
PLANNING	52
FATIGUE	52
COMMERCIAL PRESSURES	51
WORKING CONDITIONS	50
COMMUNICATIONSI	49
COMPLACENCY	44
MAINTENANCE PROCEDURES: ACCURACY, RELEVANCE & PRACTICALITY	44
RULES AND RESPONSIBILITY	44
MANAGEMENT ATTITUDES	43
SAFETY COMMITMENT OF THE ENGINEERS/STAFF	41
JOB PRESSURE	40
JUST CULTURE/BLAME CULTURE	40
SUPERVISOR EFFECTIVENESS	35
SUPERVISOR ATTITUDES	34
COMPETENCE	33
MANAGEMENT OF CHANGE	32

The higher the score, the greater the likelihood of the root issue resulting in problems. Scores over 65 are worthy of concern, over 55 are worthy of attention, and below 35 may be interpreted as good.