JAR TEL

Joint Aviation Requirements: Translation and Elaboration of Legislation

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JAR TEL
Consolidation of Results

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Abbreviations and Acronyms

AMC	Acceptable Means of Compliance
ANOVA	Analysis of Variance
AZ	Alitalia
BA	British Airways
BM	Behavioural Marker
CAPT	Captain
CATIII	Category 3 Conditions (Low Visibility)
CRM	Crew Resource Management
DERA	Defence Evaluation and Research Agency
DLR	Deutsches Zentrum für Luft- und Raumfahrt
ECA	European Cockpit Association
FMAQ	Flight Management Attitudes Questionnaire
F/O	First Officer
GPWS	Ground Proximity Warning System
ID	Individualism-Collectivism
IMASSA	Institut de Médicine Aérospatiale du Service de Santé des Armées
IRR	Inter-rater reliability
JAA	Joint Aviation Authorities
JAR FCL	Joint Aviation Requirements (Flight Crew Licensing)
JAR OPS	Joint Aviation Requirements (Operations)
JAA-PAG	Joint Aviation Authorities - Project Advisory Group
JAR TEL	Joint Aviation Requirements:Translation and Elaboration of Legislation
LH	Deutsche Lufthansa
LOSA	Line Oriented Safety Audit (NASA/UT)
MCA	Multiple Correspondence Analysis
NLR	Nationaal Lucht- en Ruimtevaartlaboratorium
NOTECHS	NOn TECHnical Skills (project or method)
NPA	Notice of Proposed Amendment (JAA)
NTS	Non-Technical Skills
PD	Power Distance
SA	Situation Awareness
SC	South central (Europe)
SOFREAVIA	Société Française d'Etudes et de Réalisations d'Equipements Aéronautiques
SOP	Standard Operating Procedure
SP	South peripheral (Europe)
UA	Uncertainty Avoidance
WP	Work package

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Executive Summary

The overall objective of the JAR TEL project (Joint Aviation Requirements: Translation and Elaboration of Legislation) was to support the implementation of those JAR codes that refer to Human Factors. The core activity centred on the experimental validation of a methodology for assessing non-technical skills (NTS) that was proposed in the 1998 NOTECHS[1] report to the European Commission, DGVII (now known as DG TREN). A secondary task was to assist in formulating implementation guidelines in the form of an Acceptable Means of Compliance (AMC) for the relevant JAR OPS paragraphs.

The work was conducted by a consortium, led by Sofréavia, build up around the NOTECHS team with the participation of airlines (BA, Alitalia), Universities (Aberdeen) and research centres (IMASSA, NLR, DLR, DERA (now known as QinetiQ)). The European Cockpit Association (ECA) agreed to support the JAR TEL project, as an observer, by reviewing and commenting the consortium work.

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The first two published JAR TEL work packages (WP1 and WP2) dealt mainly with the cultural aspects of the experiment and proposed a detailed plan for the execution of the validation phase. WP3 reported on the experimental validation of the NOTECHS method. The subsequent WP4 moved the validation process into the operational arena of airline practice in both simulator and line environments. The implementation guidelines required to bring the NOTECHS method into general use were detailed in WP5. A short history of the political background to the negotiations with the interested parties was included in this document. Dissemination of the preliminary results was achieved by way of a forum-style workshop and the report of that activity formed WP6. This WP7 constitutes the Final JAR TEL Report (Consolidation of Results).

A number of hypotheses and associated assumptions were postulated in WP2, against which the validity of the NOTECHS methodology could be tested. In essence the three JAR TEL hypotheses surmised that:

- NOTECHS can be used to evaluate NTS
- NOTECHS is culturally robust
- NOTECHS is practicable

The detailed assumptions aligned with these hypotheses can be found in WP2 but, in summary they assume that the so-called NTS Elements and Categories, as delineated in the NOTECHS framework (see Appendix 1), can be recognised by observing flight crew behaviour and rated with consistency. Sensitivity to variations in NTS proficiency and inclusivity of observable aspects of crew activity are also addressed. Cultural robustness was a fundamental requirement of the validation, as was the practicability and user-friendliness of the method, both in the check situation and as a training/de-briefing tool.

[1] NOTECHS Report to European Commission DGVII (1998)

It will be seen from the published JAR TEL results that these assumptions have been largely confirmed; nevertheless during the progress of the project significant issues not directly related to the original stated aims of JAR TEL began to become apparent to the consortium. It was thus forced to devote a considerable amount of the limited available resources to resolve those conflicts. The centre of focus was a gradual shift away from a purely JAR FCL environment into the JAR OPS arena. This important change had already been signalled during the discussion of the political implications of the project in WP3. The resolution of the key areas of contention is detailed later in this report.

1 Overview of the JAR TEL project

In March 1997 four major European research centres (NLR Amsterdam, DLR Hamburg, IMASSA Brétigny and the University of Aberdeen) conducted a study into the nature and possible evaluation of aircrew non-technical skills (NTS). This undertaking, initiated by the JAA, was called NOTECHS[1] and produced a descriptive framework of behaviours as the first step toward creating a fully validated NTS assessment system. The requirement for such a system under the JAR codes (both JAR OPS and JAR FCL) was clearly not simple to satisfy and further empirical research was called for by the JAA, who recognised the need to develop a method for implementing the new legislation. Thus the wider-based JAR TEL consortium (with the addition of Sofreavia, British Airways, Alitalia and DERA-now renamed QinetiQ) was formed to address the issues raised by NOTECHS and to carry out the research required to validate the proposed method in an operational context.

The main tasks of the JAR TEL project WPs were defined as follows:

- **WP1 – Review and analysis of cultural aspects:** as one of the key aspects of the NOTECHS evaluation is its claimed cultural robustness, a typology of European cultural differences was created to provide a basis for the experimental protocol.
- **WP2 – Development of the experimental protocol:** this protocol defined the scripts and scenarios of the videos to be shown to the instructors at the classroom validation phase
- **WP3 – Experimental sessions:** the production of videos on the basis of the scripts and scenarios defined in WP2, the evaluation of crews who performed in these films by instructors, and the analysis of the results.
- **WP4 – Operational validation of NOTECHS:** this task was defined in order to provide a complementary experimental activity as an operational validation of NOTECHS to provide an additional confirmation of the experimental results (WP3).
- **WP5 – Guidelines for NOTECHS implementation:** on the basis of the tasks above, this document draws up recommendations and guidelines for the operational implementation of NOTECHS by airlines in accordance with the Joint Aviation Requirements.
- **WP6 – Dissemination Workshop:** designed as a forum in which to report on progress to the interested parties.
- **WP7 – The final JAR TEL report and consolidation of results**

Each of the work packages is summarised in the following sections. Full downloadable reports can be found on Sofréavia website: http://www.sofreavia.fr/JAR TEL/index.html

[1] NOTECHS Report to European Commission DGVII (1998)

2 Cultural Differences (WP1)

Along with other actions of the crew, communication behaviour is an important source of information for the examiner or instructor to observe social and infer cognitive skills of the pilots. From what is reported in the relevant literature and is summarised below, it seems very likely that the way in which this information is judged, in relation to positive CRM behaviour and flight safety, will be subject to cultural variation especially for the social skills (Co-operation and Leadership). For example the Leadership Element "use of authority and assertiveness" as well as the Co-operation Element "conflict solving" can be expected to vary along the cultural dimension of power distance (PD). "Providing and maintaining standards" is likely to be related to the uncertainty avoidance (UA) dimension. If the NOTECHS system is to be introduced to the JAA nations as a guideline for the evaluation of non-technical skills, some questions had to be addressed by the JAR TEL partners:

1) Are the Categories and Elements as suggested within NOTECHS accepted as the relevant core requirements for safe CRM behaviour by the JAA nations?
2) Which standards of behaviour, that are universally seen as ‘good’ or ‘poor’ markers of the respective social or cognitive skill, can be defined for the Elements?
3) Will the NOTECHS system contribute to standardisation between examiners and instructors with different national and/or organisational backgrounds and facilitate them in observing and evaluating non-technical skills of aircrews?

Culture and its effects

One of the main difficulties when people start to discuss ‘culture’ is that the term itself is open to broad definition. In the widest sense culture can be described as “the norms, attitudes, values, and practices that members of a nation, organisation, profession, or other group of people share” (FAA HF Team, 1996, p117). Since culture is transmitted through all sorts of interpersonal interactions, it becomes an important factor in Crew Resource Management (CRM) which is based on interactions among crew members. Culture as "the shared way of life of a group of people" (Berry, Portinga, Segall & Dasen, 1992, p1) influences how we communicate with each other, how we delegate and accept orders from others, how we negotiate different opinions, how decisions are made, how risks are evaluated and further issues directly related to crew behaviour.
Professor Helmreich and his research group provided empirical evidence that the cockpit is not a culture-free environment. Besides the national culture they distinguish between professional culture of the pilots, organisational culture, and safety culture.

National culture can be simply determined by a country's territorial boundaries. Individuals whose present nationality and nationality at birth match that of the place in which they are presently living and working are carrying the respective *national* culture.

Professional culture reflects attitudes and values associated with the respective profession. Pilots in most cases do like their job because they love flying. High performance standards and high personal investments are the result of their pride in the profession. On the other hand personal weaknesses such as fatigue, stress, or levels of high workload are often denied.

Organisational culture manifests itself for example in strategies and attitudes of the management towards open communication, the extent of teamwork between different parts of the whole crew (cockpit, cabin, ground etc.), or the qualifications and credibility of multipliers such as check airmen as positive role models. Organisational culture can also have negative influences on crew behaviour if slipping standards or procedural deviations are generally accepted without adequate consequences.

Safety culture can be distinguished from organisational culture as the company's proven commitment to safety or its characteristic trade-off between safety and profitability. Stringent preventive safety programs, a powerful safety department, and published safety bulletins are also seen as aspects of a strong safety culture.

Cultural Clusters in Europe

An *a priori* grouping of European countries was attempted based on the empirical results reported in the literature. Differences in terms of national culture can be described on three general dimensions:

- individualism - collectivism (ID) is the tendency to favour personal choices and achievements over the continuing membership to a specific group to which one is attached,
- power distance (PD) is defined as the extent to which the less powerful members of an organised group expect and accept that power is distributed unequally, and
- uncertainty avoidance (UA) can be defined as the extent to which members of a culture tend to feel threatened by uncertain or ambiguous situations.

All three dimensions are relevant for JAR TEL as they show some relations to crew behaviour.

Cluster 1:
Dimension scores: High ID, low PD, low UA
"Marker" countries: Denmark, Sweden, Norway, (Affinity: Finland)
Geographical region: Scandinavia

Cluster 2:
Dimension scores: High ID, medium PD, low to medium UA
"Marker" countries: Great Britain, Ireland, Switzerland, The Netherlands, (Affinity: Germany)
Geographical region: Northwest Europe

Cluster 3:
Dimension scores: Medium ID, high PD, high UA
"Marker" countries: Italy, France, Belgium, (Affinity: Spain)
Geographical region: South central Europe

Cluster 4:
Dimension scores: Low ID, high PD, high UA
"Marker" countries: Turkey, Greece, Portugal, Ex-Yugoslavia
Geographical region: South peripheral Europe

Cluster 5:
Dimension scores: High ID, high PD (low egalitarian commitment), UA not available
"Marker" countries: Russia, Bulgaria, Romania, Hungary, Poland
Geographical region: East Europe

This culture mapping approach still shows some gaps. Other countries are located between two clusters. They were then added in brackets to the country group to which it shows greatest affinity. Therefore, the typology should be seen as a first suggestion for a classification of cultures in the NOTECHS experiment. In order to cover the different cultures in Europe, care was taken, in the experimentation conducted in WP3, that at least one "marker" country from the five different clusters was represented. Additional variation was provided systematically for characteristics of organisational culture.

Summary of findings:

- *CRM-behaviour varies with national and organisational culture.*
- *National and organisational cultures are therefore likely to influence evaluations of non-technical skills.*
- *Quasi-universal CRM elements do exist and are covered in the NOTECHS system.*
- *Intercultural agreement between examiners is more likely for the general NOTECHS Categories than for behavioural markers.*[2]
- *The JAR TEL experiment could provide evidence of the extent of intercultural agreement for the examples of 'good' and' poor' practice in NOTECHS.*
- *Language skills are a critical factor for cross-cultural differences.*
- *There are two to three stable dimensions according to which cultures can be grouped (ID, PD, UA).*
- *Over the past 20 years a world-wide trend towards increasing individualism can be observed. Pilots in general are more individualistic than the average. Therefore typical collectivist behaviours should not be very common in airline cockpits.*
- *Five European culture clusters can be derived from the available literature.*
- *Ranking of airlines on dimensions of organisational culture is more difficult*
- *It is probably unnecessary to prove cultural robustness of NOTECHS against effects of organisational culture.*
- *Organisational culture should be systematically varied in the JAR TEL experiment to gain more information about the significance of respective influences on CRM-behaviour.*
- *Measures of ID, PD, and UA should be included in JAR TEL study to recheck the proposed cultural classification.*

[2] For further information on the use of Behavioural Markers see Gulf Air NOTECHS section in Appendix 3.

3 Development of an experimental protocol (WP2)

To evaluate the NOTECHS method empirically, a list of hypotheses was composed. The hypotheses were formulated in such a way that testing them to be true or false would make clear if the basic design principles of the NOTECHS framework and method were valid.
The first hypothesis: "The NOTECHS method can be used to evaluate non-technical skills" is directly related to the validity of the method. It postulates that using the framework and method described in WP2 will indeed lead to an evaluation of Non-Technical Skills and not of something else (personality of a pilot, for example). To test the hypothesis to be true, some assumptions underlying the design of the NOTECHS method should be empirically tested. These assumptions are:

- NTS Elements can be recognised by observation of behaviour.
- NTS can be rated at Category level, with clear tendencies for consistent evaluations of behaviour at the underlying Element level.
- The NOTECHS method is sensitive for variations in NTS proficiency.
- The framework of NTS Categories and Elements covers the relevant observable aspects of NTS in multi-pilot aircrew.

The influence of cultural differences on pilot behaviour and attitudes has been widely reported. The main objective of the NOTECHS method is to offer the joint JAA states and companies a method to evaluate NTS with minimal subjectivity and differences in evaluations. Therefore one of the main objectives of the JAR TEL study is to establish the cultural robustness of the method in an empirical evaluation. To investigate the cultural factors that the JAR TEL experiments should control for, an extensive literature review was performed in WP1 of the project. The first result of this literature review was a distinction between two main types of culture that influence views of 'ideal' CRM behaviour. These two types are national and organisational culture. A third set of factors can be found in the different background an experience of the pilots (eg. military fighter/transport, general aviation, check pilot/instructor experience, CRM experience etc.).
The third hypothesis for the empirical evaluation addressed the practicability of the NOTECHS method in three respects:

- during a check flight
- training needs
- usefulness of results

To test the most important hypotheses of the JAR TEL evaluation: *"The NOTECHS method can be used to evaluate non-technical skills"* and *"The NOTECHS method is culturally robust"*, an empirical experimental approach appeared to be the best method. It offered the possibility to control variations between experimental participants and test situations, making a data collection with comparable data sets feasible. The main method for testing the third hypothesis: *"The NOTECHS method is practicable"*, was by means of a questionnaire with multiple-choice closed questions to be filled out after the experimental sessions. The questionnaire would also give additional data for testing the other hypotheses.

4 Experimental sessions (WP3)

The experiment had the following general outline:
A sample of instructor pilots, equally distributed over the cultural clusters and carrier types, received the NOTECHS Training Booklet (see WP3 published report) with the framework and definitions of the NOTECHS method (see appendix 1) before the actual experiment session.
Groups of participants were recruited from each company participating in the experiment, all taking part for one day. After arriving at the appropriate training facility, they received a short introduction to the JAR TEL experiment and filled out two demographic questionnaires. The first questionnaire served to gather data about their background and the second to establish their position on the cultural dimensions' structure (see WP1 Report).
Next the participants received training in the NOTECHS method and instructions for using the method during the experiment.
A total number of eight experimental video scenario ratings were then performed. Full details are available in the published WP3 Report. Each rating sequence consisted of two parts:

- *Screening of the video scenario and concurrent scoring of behaviour of the two pilots at the Element, Category and Final Assessment levels.*
- *Completing the remaining score forms, after the video.*

After all rating sessions were completed the participants filled out an Evaluation Questionnaire, which contained questions about their opinion of the NOTECHS method and the experiment.

Data collection overview

The analysis of the large quantity of data generated from the various phases of WP3 was undertaken mainly by the University of Aberdeen. Certain specific tasks were completed by DLR in Hamburg and IMASSA in Paris. The detailed results were presented in text and tabular forms in Appendix in the WP3 report. The analysis process is addressed in depth in Chapter 3 Experiment Results of the same report.

Benchmarking of video assessments

A set of data was required for the analysis process in order to examine inter-rater accuracy. Three 'benchmarking' sessions were therefore carried out to produce a consensus view of the behaviours presented in the video scenarios, relatively independent of the production team. These data were used during the analysis phase as *Reference Ratings*. Three BA CRM-experienced pilots were briefed using the JAR TEL training material and were then asked to assess the NTS shown in the video. A consensus rating for each of the Elements and Categories was then sought. 'Pass/Fail' judgements were also produced as a common view. A similar but independent process was followed at Lufthansa in Frankfurt under the guidance of DLR using five experienced LH pilots. A consensus was developed on each of the eight JAR TEL scenarios. On the rare occasions where there was a dissenting voice this was recorded on the score form for future reference.

Experimental sessions

The experimental sessions involved 105 instructor pilots from 14 different airlines across Europe. Each of the five clusters was represented by at least two airlines. Their recruitment was part of a difficult logistic process that required more than twelve months to complete. The consortium was extremely fortunate to make contact with a small but enthusiastic network of managers who were willing to commit their highly valuable pilot resources to the JAR TEL programme.

Each session relied on the airlines concerned rostering their instructors to attend and thus remove them from operational duties for that day. It is a remarkable testament to their commitment that a 100% pilot attendance rate was achieved across the fourteen operators.

It was considered important to maintain a consistent briefing for all participants, thus the same facilitator, a BA Training Captain, was used at every session assisted by at least one consortium psychologist. Not surprisingly there was a steep learning curve for all concerned but feedback data both formal and informal seem to confirm a high level of success for the briefings.

There were a number of important briefing issues that were identified by the consortium during the design phase. Where possible they were addressed in the training video presented during the morning session.

Of particular concern were the two following concepts:

Firstly, *Not Observed* as a rating on the score forms required particular elaboration. It was important for the experiment that this was clearly understood as an *absence of a behaviour that was not relevant to a particular situation and therefore not seen* rather than a lack of a particular activity that was considered *desirable but not demonstrated* by the crew member concerned. This latter behaviour should receive a *poor* or *very poor* score.

Secondly, it was also felt necessary to explore with the participants their perceptions on judging the Category of Decision Making. It was felt desirable that the raters should evaluate the *process* involved rather than the outcome of a particular decision.

It was also pointed out that the participants should try where possible to disregard their own company procedures and rules when judging the behaviours in the videos. Where a breach of an SOP was intended to be significant, it would be mentioned by the actors in some direct way.

The overriding importance of the five NOTECHS principles (q.v.) delineated in the NOTECHS Booklet was also re-emphasised by the facilitators.

The use of English as the sole medium for the briefing sessions and the feed back forms was largely maintained except in the case of one airline session where some own language feedback was accepted on the Evaluation Questionnaire and in the Comments boxes on the score form.

The actual rating times for each of the main scenarios were recorded informally as a group value i.e. from the start of scoring until the last participant had completed his score form. They showed a very consistent pattern of timings across the instructor groups for particular scenarios. The overall timings of the experiment sessions proved to be very close to the planned values.

Summary of results

The results in summary are given below.

Regarding Hypothesis 1: The NOTECHS method can be used to evaluate Non-Technical Skills (NTS):

- Assumption 1: NTS Elements can be recognised by observation of behaviour: from the low number of *not observed* scores, this assumption can be confirmed;
- Assumption 2: NTS skills can be rated at Category level, with clear tendencies for consistent evaluations of behaviour at the underlying Element (and Pass/Fail) levels: the hierarchical structure of the rating scale appeared to be consistent;
- Assumption 3: The NOTECHS method is sensitive for variations in NTS proficiency: the results indicate that the NOTECHS method is sensitive to variations in NTS proficiency;
- Assumption 4: The framework of NTS Categories and Elements covers the relevant observable aspects of Non-Technical behaviour in multi-pilot aircrew: the raters stated that they were satisfied with the NOTECHS framework.

Regarding Hypothesis 2: The NOTECHS method is culturally robust with respect to National Culture, Organisational Culture, and experience of raters:

- National Culture: the decomposition of NTS into Categories and Elements as in the NOTECHS system has a high degree of cross-cultural acceptance. Effects of National Culture appear to be only marginal on the five-point scales of the Category level. At the Pass/Fail level the effects are significantly less. Provided that language proficiency of the users is equivalent, the NOTECHS method can be regarded as robust against variations in National Culture;
- Organisational Culture: aspects of Organisational Culture have only a minor influence on ratings with the NOTECHS method. Effects of company size or the regular availability of human factors reports can be discounted;
- Background experience: the only significant difference was that those raters who had previous experience of evaluating NTS were significantly more accurate in rating behaviours at both the Category and Pass/Fail levels than those raters without prior experience of NTS evaluation.

Regarding Hypothesis 3: The NOTECHS method is a practicable method for use during check flights, defining training needs, and is useful for debriefing:

- Check flights: evidence from experimental sessions and evaluation questionnaire suggests the NOTECHS method is practical but this should be confirmed by further operational research (WP4);
- Defining training needs: the training was found to be adequate for the purposes of the experiment, but additional training would be required for NOTECHS to be used operationally.;
- The usefulness of the NOTECHS results for debriefing and training: it would appear that the raters believed that NOTECHS was a valuable and practical method for evaluating NTS.

Experimentation conclusions

From the results of JAR TEL experiment, given in detail elsewhere, it is clear that the NOTECHS method largely fulfils the primary requirements set out in the validation plan:

- NOTECHS can be used to evaluate NTS by observing behaviour and demonstrates an acceptable sensitivity for variations in proficiency.
- NTS skills can be rated using the NOTECHS method with clear tendencies of consistent evaluations.
- NOTECHS has a framework that covers the relevant observable aspects of multi-pilot aircrew behaviours on the flightdeck.
- NOTECHS is, to a great extent, culturally robust with respect to national and organisational cultures as well as the experience levels and backgrounds of instructors.
- Within the limitations of the WP3 experiment, NOTECHS has been found to be practicable and useful by the overwhelming majority of the 105 participating pilots.

Following this preliminary experimental investigation, results to date indicate that NOTECHS is capable of proving itself a valid and reliable method for assessing NTS.

5 Operational validation of NOTECHS (WP4)

The next task of the JAR TEL study (WP4) aimed at validating in more depth the NOTECHS system in simulator checks and actual line operations.

Three limitations however were created by the nature of the experiment:

- The experimental conditions were based on *filmed* scenarios showing simulated flight situations with multi-pilot aircrew demonstrating pre-defined NTS-related behaviour of varying 'quality' ('poor' to 'good' calibration)
- The experimental adaptation of the method used separate score forms for the three rating levels (Category, Element, Final Assessment) in order to prove the sensitivity and the consistency of the NOTECHS framework. This would not be practical in operational use.
- The very short training session clearly suggested that additional training would be required for an operational NOTECHS implementation.

Re-testing in a more operational context was required even though the JAR TEL WP3 experimental sessions and the collected data from the final questionnaire suggested that NOTECHS was indeed practicable, that the training session (a half day) was adequate for the experimental purpose, and that raters believed that NOTECHS was a valuable method for debriefing check flights and improving NTS.

Validation process

Airlines were chosen from those already involved in the experimental sessions where instructors had initially been trained in the NOTECHS method. Alitalia, British Airways, SAS, Air Liberté and Crossair, each provided volunteer instructors. Operational sessions were conducted from the summer to the end of the year 2000.

The operational validation of NOTECHS was carried out using the following method in re-current line or simulator checks in addition to some training flights.

Firstly, the training was aimed at confirming instructors' understanding of the NOTECHS concepts, material and method to avoid any implementation ambiguities, to standardise the training content in order to control variations in applying the method, to calibrate the ratings by reaching an instructor consensus (see Reference Ratings p14) in order to prepare for the operational validation of NOTECHS, and to evaluate and monitor the training effects on NTS evaluation.

Secondly, after this preparation (a full day), instructors were asked to use the NOTECHS score form during their normal duties (line or simulator checks) for several months with JAR TEL assistance as an accompanying support, in order to assess operationally the practicability of the method in such situations and the usability of the results in debriefing.

Lastly, qualitative data were collected through structured interviews with the instructors involved for debriefing on their experience in the use of the method, their feelings as examiners/trainers and feedback on their initial training, to define where possible improvements of the NOTECHS system.

Practicability of the method during a check flight

Although most of the NTS evaluation (51 simulator of 72 sessions i.e. 70%) was made during simulator checks (including routine 'visual recurrency' checks), simulator recurrent training and assessment or simulator conversion courses (final check as Captain in training), the instructors from British Airways as well as from Alitalia tried the method during actual line checks or route training.
In particular, the method was used on the line for a "re-qualification in flight after a four month flight activity interruption".
Also, a NOTECHS evaluation was conducted during a linecheck for a First Officer employed for three months.
However, the NOTECHS method appeared to instructors most valuable in LOS/LOFT sessions.
Both of the airlines used the 5-point scale rating form of NOTECHS and only filled out the rating form once at the end of the check.
Because the aim of this operational validation was to test the practicability of the method by instructors in operational situations, results from the evaluation were not actually used for the purpose of re-training pilots who were not necessarily informed of the experimental nature of the test.
In that context, instructors used the NOTECHS method "as an aid to assessing effective crew behaviour with reference to the outcome of various simulator details, specifically to any threats or potential threats to flight safety". It was also used as a guide for the debriefing structure after instruction or check phase.
For the British Airways instructors[3], the NOTECHS system "is an extension and improvement to the NASA Team Skills" i.e. the existing company system.

Usability of NOTECHS

All the experimental instructors felt comfortable with the NOTECHS methodology: "The more I used the system, the easier I found it" they said.
All of them found that the NOTECHS system was actually good enough for assessing pilots

- The calibration of the scale, 5-points.
- The framework of behaviour with the four Categories and the fifteen Elements.
- The rating at the Category level referring to Elements.
- The principle of overall assessment (one score).
- The simplicity of NOTECHS Rating Form itself.
- The acceptable length of the rating process.
- The clarity of the methodology.
- Its use in simulator checks somewhat better than on line checks to observe and evaluate NTS in various situations and phases of flight.
- The use of NOTECHS to identify inappropriate attitudes towards CRM skills and help in structuring an appropriate debriefing.

[3] As BA system separates strictly training from assessment personnel the experimentation was done with test pilots

Individual assessment

Although most of the instructors (11 participants out 12) thought that NOTECHS was appropriate for giving individual ratings, some difficulties appeared in practising the method:

- The assignment of a Leadership score for the Co-pilot,
- The assignment of a Decision making score for the First Officer in some occasions,
- The distinction between the Captain and the First Officer while observing simultaneously both of them,
- The distinction between the roles within the cockpit and the performance of the crew, as a global safety target,
- The separation of the ability of an individual crew member in some circumstances,
- The assessment by an operating member of the crew which is typically the case in route training.

With greater exposure to the method it is felt that these problems of focus could be overcome.

Summary of results

-Training:

A full working day of training was felt to be the very minimum required time to provide the instructors with the basis of the NOTECHS methodology and calibration (the benchmarking ratings were used as reference). Skill clearly improves with time. The instructors did not need to use the hotline support as they apparently felt confident with NOTECHS.

-'Real-life' operational conditions:

NOTECHS was used for several months by instructors from various companies in their day-to-day working lives.

- It proved to be a usable and efficient tool to assess NTS and support crew debriefing in line checks, simulator checks and training.
- NOTECHS is easy to use in real instructing environments.
- Some potential limitations were identified if used in very early training phases (eg with *ab initio* cadets) where the 'crew' concept may not yet be fully formalised.

Conclusions

From the results of JAR TEL operational validation, as a complement to the experiment, it is clear that the NOTECHS method is a useful and usable tool for the instructors. Careful attention must be paid to their training and reference standard setting.

6 Implementation Guidelines (WP5)

As has been mentioned at the beginning of this report, implementation of the NOTECHS method under JARs has proved more politically difficult than was first anticipated. Thus WP5 found itself in the unfortunate position of becoming the deciding factor in the final JAR TEL publishing process. The contents of this WP are summarised below with some additional material that has emerged subsequent to its publication. The history of the events that led to the emergence of an accepted compromise solution between the JAA and IFALPA representatives is also given here in summary.

The aviation community has put considerable emphasis in the last decade on non-technical skills as one of potential sources of progress towards enhanced safety. The emergence of Crew Resource Management courses is one of the most visible examples of this growing interest.

New mandatory regulations have appeared, requiring the design and development of accompanying tools and methods. This is the case with the new set of CRM regulations included in NPA 16 (modification/creation of JAR OPS 1.940, 1.945, 1.955, and 1.965), calling for an evaluation of flight crews' CRM skills.

An in-depth review of airline practices made in 1997 showed the interest in a common method of evaluation of non-technical skills throughout the JAA countries and JAA operators, minimising cultural and corporate differences, and maximising practicability and effectiveness for airline instructors and examiners.

The European Cockpit Association (ECA) and the JAA have been officially associated with the project as observers.

At the commencement of the NOTECHS project the international pilots' union (IFALPA) had sent written comments to the JAA to emphasise the risks associated with the evaluation of non technical skills, arguing for the potential for faux-pas and abuse through human judgement. This attitude progressively re-oriented the JAA HQ towards a more cautious policy, envisaging the inclusion of NOTECHS into JAR *OPS* for the purpose of compliance with the then new NPA 16 (calling for evaluation of CRM).
Two-thirds of the way into the JAR TEL project, at the end of WP3, the Director of Regulation of the JAA officially confirmed that priority would be given to the compliance with the new requirements on the evaluation of CRM in JAR OPS.

The first results of WPs1, 2 and 3 were presented in a public meeting in Paris in October 2000 (WP6). The meeting was considered by the JAR TEL consortium to be a success. However, the representative of SNPL (Syndicat National des Pilotes de Lignes), speaking on behalf IFALPA, repeated the strong protest against all types of individual evaluation of non technical skills, for any purpose, even in a limited application to JAR OPS.
As a consequence of the complexity of the situation, a meeting was organised with the JAA Ops Director. It was decided to put a series of texts on NOTECHS on the JAA web site, (for JAR OPS committee members' eyes only) and then to briefly introduce the NOTECHS method and evaluation to the OPS Committee. The final discussion and decision were scheduled for September 2001, in Toulouse.

Negotiations with SNPL and IFALPA took place before the final discussion on NOTECHS at the OPS Committee meeting. The parties agreed on NOTECHS as a satisfactory method to assess pilots' CRM skills. **It was accepted that pilots would be debriefed using the NOTECHS method but the results would be kept on anonymous forms, feeding company training databases in order to adapt future training programs according to the strengths and weaknesses observed in NTS performances. New JAA regulatory material (in the form of an AMC) will be soon available describing these different issues.**
In October 2001, during an important aerospace meeting in Dublin, the IFALPA chairman confirmed the acceptability of the new regulatory deal, and ended a series of conflicts that had lasted 4 years.
This hard-won political consensus should open the way to more extensive airline experience in using the NOTECHS method.

In January 2002, the FAA asked the JAA for a minimum harmonisation in the domain of non-technical skills, and at least a clear compatibility. That work is in progress.

The potential threat posed to the success of the project by non-assistance in the instructor groups was partly reduced by inviting representatives of the Human Factors Panel of the European Cockpit Association (ECA) to monitor the experimental work and to comment on the conclusions drawn from the experiments. We have taken the comments of that panel into account in our conclusions and recommendations. It is therefore expected that the JAR TEL initiative will go some way towards engendering a more informed attitude in the field of NTS assessment.

7 Dissemination Workshop (WP6) and Dissemination Perspectives

WP6 covers the proceedings of the JAR TEL Workshop held on October 27, 2000 at the DGAC in Paris. All the JAR TEL partners were present as well as many airlines. Representatives were present of Swissair, SAS, BA, Iberia, TAP, CAA, KLM, DGAC, and the EC. Most of the persons from the airlines were national union representatives. Unfortunately, there was no formal representative from the JAA. Issues arising from this forum have already been alluded to earlier in the WP5 summary.

In the meantime several European airlines have adopted the principles of the NOTECHS system and integrated these principles in their own assessment tools. Usually this is accompanied by modifications of the NOTECHS system, but the basic ideas are still preserved (NOTECHS Compatibility). A review regarding such approaches is given in papers presented to the 25th Conference of the European Association for Aviation Psychology in Warsaw, September 2002 (see www.eaap.net).

One example of using NOTECHS for the evaluation of training needs is documented in a research study which was also funded by the EC (DG TREN). In this study after determining the training needs the NOTECHS methodology was used to assess the effects of the subsequent CRM training in addition to the pre-assessment before the training (Goeters, K.M., *Evaluation of the effects of CRM training by the assessment of non-technical skills under LOFT*, Human Factors and Aerospace Safety 2, 71-86).

NOTECHS has been found useful in other research and training initiatives. The Daimler Benz sponsored GIHRE project has made use of the JAR TEL experience in evaluating pilot proficiency in simulated high stress LOFTs. The ESSAI (DG TREN) research has made use of *effective* and *ineffective* behaviours assessed through NOTECHS-style markers observed in controlled LOFT scenarios.
In other domains interest has been shown in using NOTECHS methodology in evaluating performance. One particularly innovative programme led by G. Fletcher of the University of Aberdeen has successfully completed the initial phase of a study into anaesthetists in operating theatre environments.

8 Conclusions and Recommendations

Since the evaluation of non-technical skills is eventually expected to be incorporated at all levels of pilot training and checking, it is first necessary to train all instructors and examiners in the NOTECHS method. The wider pilot community must then be fully apprised of its application and the safety benefits that will accrue from these evaluations of flightdeck NTS effectiveness. The crews being assessed must be fully conversant with the techniques by which they are to be judged.

NOTECHS uses concepts already included in the JAR FCL theoretical program on human performance and limitations (JAR-FCL 1.125/1.160/1.165-Theoretical knowledge instruction PPL/ATPL). No more purely theoretical knowledge is required although a clear understanding of the use of behavioural markers in observing pilot performance is considered essential.

Most of the initial training effort should be devoted to the specific use of the evaluation grid, the calibration process of judgement and of the debriefing phase. The use of the behavioural markers is at the core of the NOTECHS method and it is strongly recommended that adequate time and effort is dedicated to this phase of the training.

It should be noted that a half-a-day initial video-based presentation of the method was used during the experimental phase. Experience has shown that a structured course involving classroom tuition coupled with practical exercises and subsequent tutored simulator sessions will be necessary to achieve the required levels of inter-rater reliability. Standardisation of judgement and debriefing skills will continue to improve with practice.

Judging behaviour is more liable to accusations of subjectivity than is judging technical activity on the flightdeck. NOTECHS has been specifically designed to minimise those ambiguities and with careful training and supervision by skilled mentors, high levels of consistency have been observed. (see Appendix 3). The question as to whether we should be observing *individual* versus *crew* performance has been raised and needs comment. NOTECHS was designed primarily as a tool for assessing *individuals* but the contribution that he/she makes to the effectiveness (or otherwise) of the crew is observable and thus assessable. The two *social* Categories (Co-operation and Leadership and Managerial Skills) have been shown to be extremely useful platforms for this assessment.

The importance of a clear understanding of the concept and the practice of working with behavioural markers has already been alluded to in this report. The methods used in the training instructors and examiners in this core NOTECHS activity are seen to be crucial if a consistent and effective judgement of performance is to be made. Time spent in this phase of training will not be wasted.

Useful recommendations for the use of behavioural markers have been published in the proceedings of a workshop (July 2001) sponsored by the Daimler Benz Foundation as part of the Group Interaction in High Risk Environments (GIHRE) project. In this document Professors Flin and Helmreich *et al* strongly emphasise the importance of assessor (instructor) training and calibration when working with Behavioural Markers.

The lack of a discrete 'Communications' Category in the NOTECHS framework was the source of a certain amount of discussion during the briefing sessions and elsewhere. The fact that only a very small number actually mentioned this perceived omission on the Evaluation Questionnaire probably indicates that the matter was successfully dealt with at the briefing stage. Further evidence was provided by the operational trials in WP4 and at present the consortium remains open-minded on this issue. It is nevertheless worthy of note that all the s*ocial* skills are dependent on effective communication and the information gathering process and outcome of the *cognitive* skills are similarly anchored in communication. Thus, to evaluate communication as an individual item would not seem to be necessary, but it could be added without violating the principal NOTECHS structure. For example Lufthansa has introduced a NOTECHS compatible assessment system which explicitly also refers to "Communication" as a key category. One is aware that this category is not independent of the others.

The second, perhaps more significant comment centred on the concept of 'Leadership and Managerial skills' in relation to the First Officers' performance. It was felt by some raters that it was difficult to score this Category in situations where there was little opportunity (or indeed requirement) for the Co-pilot to exercise these particular skills. One considered solution was to insert 'and/or' but further experience since the completion of the experiment has shown this to be unnecessary.

An area that appeared to show the need for further training is the rating of the *Decision Making* Category. There is evidence that the raters had some difficulty in assessing this activity. The briefing sessions had touched on the apparent dilemma as to whether the *process* or the *product* was under evaluation here. The received wisdom opted for the former. With experience raters became more confident in this method of assessment.

The role of Situation Awareness is the subject of intensive research throughout the aviation and related industries. It would be prudent to take note of advances in this field when training for the application of NOTECHS, particularly with reference to automation and human-computer interface issues. [The on-going ESSAI project (also sponsored by DGTREN) deals with these and other related issues and has made use of lessons learned from the JAR TEL initiative.]

The NOTECHS method is designed to be a guiding tool to look beyond a failure during recurrent checks or training, and help to diagnose possible underlying deficiencies in NTS competence in relation to technical failings

NOTECHS is not intended to fail additional crewmembers during mandatory checks, or indeed on any other occasion, as compared to the present situation. Lack of non-technical skills alone should not lead to a 'FAILED' assessment out of the context of a related objective technical consequence leading to compromised flight safety in the short or long term.

In the event of a crewmember being assessed as performing badly for any technical reason, NOTECHS can provide useful insights into the human factors' source of the technical failings. Used in this way, the method can provide valuable assistance for debriefing and subsequently orienting tailored retraining, provided that a suitable period of dedicated instructor training has been allocated for calibration and best practice.

It should be remembered that NOTECHS **is**:

- A professional pragmatic tool for instructors and authorised examiners.
- Designed to be used by non-psychologists.
- Designed to use common professional aviation language, with the primary intention of debriefing pilots and communicating both concrete directions for improvements and reinforcing effective behaviour.

NOTECHS **is not**:

- A tool for judging flight crew personality on the basis of instructors' or authorised examiners' personal opinions.
- A tool for introducing 'psychobabble' into the evaluation process.

In view of the outcome of the negotiations mentioned in WP5 (Implementation Guidelines) and the gradual but inexorable shift away from a JAR FCL 'pass/fail' environment towards the JAR OPS-based 'pass/further training required', many of the initial strictures that have been reported in earlier WPs have lost some of their validity during the extended life of the project. The concept of 'failure'-and the implicit negativity attached to the Final Assessment was always likely to be anathema to many dedicated trainers who rightly see their role as one of improving pilots' performance and not as a purely checking function. The NOTECHS method has shown itself to be highly useful to trainers and checkers not only in assessing what (remedial) training might be required after an NTS performance that was judged as unacceptable but also in reinforcing effective pilot behaviours witnessed during a successful NTS demonstration in the simulator or during line operations (see Appendix 3). The possession of such a tool can give the trainer new insights into the workings of an effective *crew* performance viewed through the lens of individual contributions to the outcome.

This apparent refocusing of the practical use of NOTECHS should lead towards raising performance standards on both sides of the training equation. Historically many trainers have felt inadequate to make fine judgements of this nature and have resorted to commenting on the broader concepts of 'airmanship' and 'command potential'. Being provided with a comparatively simple structured method for assessing effective performance can be both a liberating and confidence building activity for both parties during training and checking.

As aircraft technology has rapidly advanced over the last two decades non-technical skills-somewhat paradoxically-have assumed an ever greater relevance in the aviation safety arena. Coupled with the clear need to evaluate the effectiveness of the training regimen initiatives like NOTECHS are potentially of considerable benefit.

It is the considered opinion of the JAR TEL consortium that NOTECHS has an important role to play in the advancement of NTS training and can offer the airline industry an for ongoing evaluation–both academic and operational-of the method and its effective tool in the pursuit of enhanced flight safety. There is nevertheless an urgent need implementation. Professor Helmreich's experience of large-scale trials with the important LOSA initiative re-inforces this view.

Although WP5 originally stated that NOTECHS "inforces this view. is not a research tool," it has shown itself to be very useful in many research applications. The GIHRE and ESSAI projects mentioned earlier have found it helpful in their evaluation of flight crews' simulator performance.

The JAR TEL consortium feels there are potential benefits to be gained from continuing the work begun by the GIHRE partners at their workshop in Zurich 2001 (with Professors Helmreich and Flin) in assessing the complementary nature of the LOSA Behavioural Marker system and that of NOTECHS. It may be possible to apply NOTECHS evaluation techniques in the aftermath of an airline LOSA to help assess the effectiveness of any remedial training that has been undertaken.

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The JAR TEL consortium feelsthere are potential benefits to be gained from continuing the work begun by the GIHRE partners at their workshop in Zurich 2001 (with Professors Helmreich and Flin)in assessing the complementary nature of the LOSA Behavioural Marker system and that of NOTECHS. It may be possible to apply NOTECHS evaluation techniques in the aftermath of an airline LOSA to help assess the effectiveness of any remedial training that has been undertaken.

Flight crew and indeed regulators will hopefully be convinced in the long term of the advantages of being assessed under a standardised set of assessment values and procedures. Used sensitively by well-trained practitioners NOTECHS has the potential to play an effective part in the rapidly evolving world of NTS.

Acknowledgements

The JAR TEL consortium would like to thank all the many participants in this project. Without their enthusiastic commitment to furthering the cause of NTS awareness in the advancement of aviation safety, none of this work would have been possible.

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APPENDIX 1 - NOTECHS

Components of NTS

The review of existing evaluation methods exposed a large number of NTS labels and descriptors, each with their own specific meaning. A NOTECHS framework was therefore created covering the whole range of NTS, based on the descriptors gathered in the review.
This framework consists of four **Categories**:

- Co-operation
- Leadership and managerial skills
- Situation Awareness
- Decision making

Each Category is subdivided into a number of **Elements**. Figure 1 below shows the Elements in the *Co-operation* Category and behavioural examples for one Element. The Categories and Elements are formulated to be mutually exclusive but, given the interdependence of the various non-technical skills required in flight deck operations, this will not always be achievable. The terminology attempts to reflect everyday language for describing behaviour, although the precise naming and positioning of the words within the framework is not that important. The examiners, instructors and aircrew who will be confronted with the framework **must all have the same understanding of the NOTECHS concepts**. Therefore, NOTECHS provides behavioural examples to assist in standardising assessments.

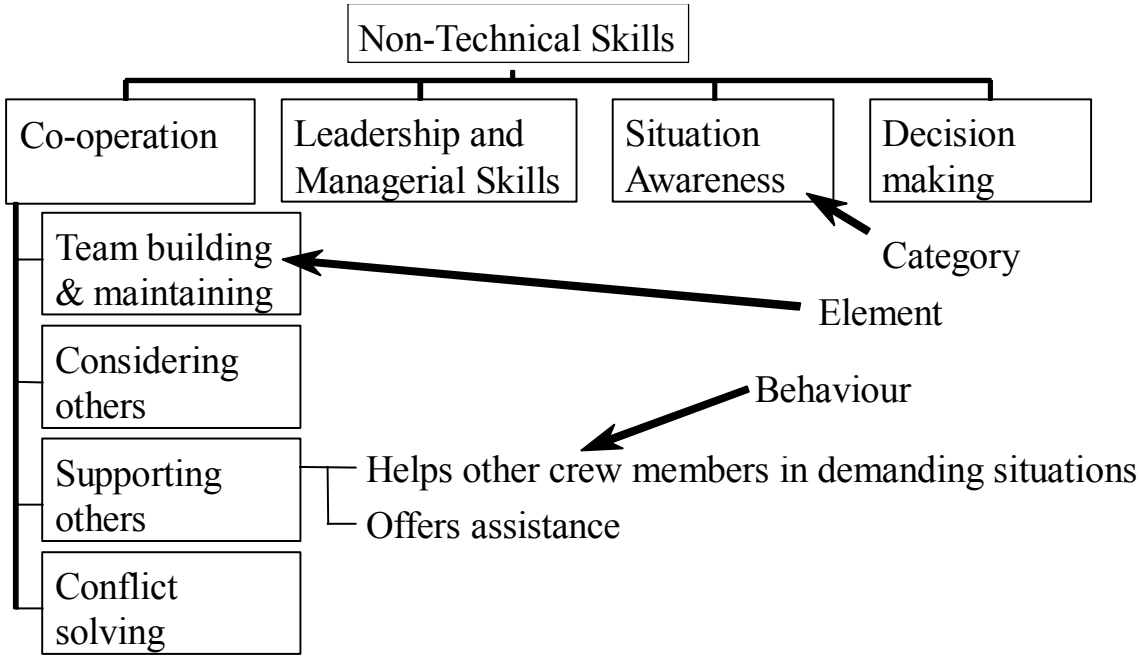

Figure 1. The NOTECHS descriptive framework consists of Categories, Elements and behavioural examples.

CO-OPERATION

Co-operation is the ability to work effectively in a crew.

TEAM-BUILDING AND MAINTAINING

Team-building and maintaining is the ability to establish positive interpersonal relations between crewmembers and their active participation in fulfilling the tasks.

Examples of **poor** practice:	Examples of **good** practice:
Blocks open communication	Establishes atmosphere for open communication and participation
Keeps barriers between crewmembers	Encourages inputs and feedback from others
Competes with others	Does not compete with others

CONSIDERATION OF OTHERS

Consideration of others involves the acceptance of others and understanding their personal condition.

Examples of **poor** practice:	Examples of **good** practice:
Ignores suggestions of other crewmembers	notice of the suggestions of other crewmembers even if s/he does not agree
Does not take account of the condition of other crewmembers	Takes condition of other crewmembers into account
Shows no reaction to other crewmembers problems	Gives appropriate personal feedback

SUPPORT OF OTHERS

Support of others relates to giving help to other crewmembers when they need assistance.

Examples of **poor** practice:	Examples of **good** practice:
Hesitates to help other crewmembers in demanding situations	Helps other crewmembers in demanding situations
Does not offer assistance	Offers assistance

CONFLICT SOLVING

Conflict solving is the articulation of different interpersonal positions and giving suggestions for solutions.

Examples of **poor** practice:	Examples of **good** practice:
Overreacts in interpersonal conflicts, sticks to own position without considering a compromise	Keeps calm in conflicts
Accuses other crewmembers of making errors	Suggests conflict solutions
	Concentrates on what is right rather than who is right

LEADERSHIP AND MANAGERIAL SKILLS

Effective leadership and managerial skills help to achieve joint task completion within a motivated, fully-functioning team through co-ordination and persuasiveness.

USE OF AUTHORITY AND ASSERTIVENESS

The use of authority and assertiveness infers the ability to create a proper challenge and response atmosphere. The given command authority of the Captain should be adequately balanced by assertiveness and crewmember participation. If situation requires, decisive actions are expected.

Examples of **poor** practice:	Examples of **good** practice:
Hinders or withholds crew involvement	Advocates own position
Passive, does not show initiative for decisions, own position not recognisable	Takes initiative to ensure involvement and task completion
Does not show appreciation for the crew, coaches very little or too much	Takes command if situation requires

PROVIDING AND MAINTAINING STANDARDS

Providing and maintaining standards refers to the compliance with essential standards (SOPs and others) for the task completion. Supervision and intervention in case of deviations from standards by other crewmembers is also part of this skill. If situation requires, non-standard procedures might be necessary. Such deviations shall be discussed and announced.

Examples of **poor** practice:	Examples of **good** practice:
Does not comply to SOPs, does not monitor crew for SOP compliance	Ensures SOP compliance
Does not intervene in case of deviations	Intervenes if task completion deviates from standards
Applies non-standard procedures without announcement or consultation of crewmembers	

PLANNING AND CO-ORDINATION

Planning and co-ordination refers to applying an appropriate concept for organised task-sharing and delegation in order to achieve top performance and to avoid workload peaks and dips. Communication of plans and intentions leads to co-ordinated activities within the whole crew.

Examples of **poor** practice:	Examples of **good** practice:
Plans only for self, does not involve crew	Encourages crew participation in planning and task completion
Intentions not stated or confirmed	Clearly states intentions and goals
Changes plan without informing crew or follows plans blindly	Having consulted crew, changes plan if necessary

WORKLOAD MANAGEMENT

Workload management demands clear prioritisation of primary and secondary operational tasks. Based on a sound planning, tasks should be distributed appropriately among the crew. Signs of stress and fatigue should be communicated and taken into account. Available external and internal resources (including automation) should be used to accomplish timely task completion.

Examples of **poor** practice:	Examples of **good** practice:
Flying solo without other crewmembers involved	Allowing secondary operational tasks to interfere with primary flight duties
Inadequate workload planning	Ignoring signs of stress and fatigue

SITUATION AWARENESS

Situation awareness relates to one's ability to accurately perceive what is in the cockpit and outside the aircraft. It is also one's ability to comprehend the meaning of different elements in the environment and the projection of their status in the near future.

AWARENESS OF AIRCRAFT SYSTEMS

The crew needs to be constantly aware of the state of different aircraft systems.

Examples of **poor** practice:	Examples of **good** practice:
Does not ask for updates	Monitors and reports changes in system states
Does not signal awareness of changing systems	Acknowledges entries and changes to systems

AWARENESS OF EXTERNAL ENVIRONMENT

The crew needs to be aware of their environment (position, weather, air traffic, terrain).

Examples of **poor** practice:	Examples of **good** practice:
Collects information about the environment	Contacts outside resources when necessary
Does not enquire about environmental changes	Shares information about the environment with others
Does not comment on relevant environmental factors, or is surprised by them	

AWARENESS OF TIME

The crew needs not only to be aware of the present state of the aircraft systems and environment, but must also be able to predict future states in order to anticipate future events.

Examples of **poor** practice:	Examples of **good** practice:
Does not set priorities with respect to time limits	Discusses contingency strategies
Does not discuss relationship between past events and present / future	
Is surprised by outcomes of past events	

DECISION MAKING

Decision making is the process of reaching a judgement or choosing an option.

PROBLEM DEFINITION AND DIAGNOSIS

Problem definition and diagnosis is the ability to collect the information needed to define a problem and its causal factors.

Examples of **poor** practice:	Examples of **good** practice:
Nature of the problem not stated or failure to diagnose	Gathers information and identifies problem
No discussion of probable causes	Reviews causal factors with other crewmembers

OPTION GENERATION

Option generation refers to the ability of a crewmember to generate multiple responses to a problem.

Examples of **poor** practice:	Examples of **good** practice:
Does not search for information	States alternative courses of action
Does not ask crew for alternatives	Asks crewmembers for options

RISK ASSESSMENT AND OPTION SELECTION

Risk assessment and option selection refer to the ability of a crewmember to successfully assess risks and benefits of different responses to a problem, and to select the best response. Both should be accomplished through discussion with other crewmembers.

Examples of **poor** practice:	Examples of **good** practice:
Inadequate discussion of limiting factors with crew	Considers and shares risks of alternative courses of action
Failing to inform crew of decision path being taken	Talks about possible risks for course of action in terms of crew limitations
	Confirms selected course of action

OUTCOME REVIEW

Outcome review refers to the crewmember's need to check the outcome of a solution against the predefined goal.

Examples of **poor** practice:	Examples of **good** practice:
Fails to check selected outcome against goal	Checks outcome against plan

APPENDIX 2 - Rating form

NON-TECHNICAL SKILLS RATING FORM

(**Draft** -modified for Gulf AIR- **training purposes only**)

Name: Sim / Sector:	A	B	C	D	E	COMMENTS
Co-operation Team-building and maintaining Consideration of others Support of others Conflict solving	Give **one** score for Co-operation					
Leadership and Managerial Skills Use of authority and assertiveness Providing and maintaining standards Planning and co-ordination Workload management	Give **one** score for Leadership and Managerial Skills					
Situation Awareness Awareness of aircraft systems Awareness of external environment Awareness of time	Give **one** score for Situation Awareness					
Decision Making Problem definition and diagnosis Option generation Risk assessment and option selection Outcome review	Give **one** score for Decision Making					

Overall rating

(Pass)	(Further training required)

Comments:
Instructor's name: Date:

APPENDIX 3 - An example of NOTECHS implementation

In the Autumn of 2001 the then Senior Manager Flight Training at Gulf Air in Bahrain, Captain Rick James, approached a British specialist training company On Target Solutions (OTS) with a view to upgrading the existing CRM programme and incorporating the NOTECHS method into the Gulf Air Training Manual in advance of becoming JAR compliant. A small task force of experienced OTS trainers-all either current or recently retired airline trainers, one with particular NOTECHS experience- formulated a three-phase programme designed initially for the 65+ Gulf Air instructors and examiners. The phases consisted of:

1. NTS update and reinforcement of existing knowledge plus an introduction to NOTECHS (including an in-depth study and creation of *culturally*-specific Behavioural Markers).
2. Training in LOFT concepts and facilitated de-briefing skills using NOTECHS
3. Simulator LOFT practice and subsequent full introduction of NOTECHS assessments.

The basic concept of the programme was to provide essential knowledge in the first phase and to concentrate on skills training in the second and third. The Gulf Air instructors and examiners had varying CRM/NTS backgrounds. Most had at some time completed an in-house course that complied with existing regulatory requirements but had little or no experience in structured assessments of NTS performance and limited exposure to simulator LOFT activity. A comprehensive revue of both subjects was thought to be essential. An update of current thinking on Situation Awareness was included as was Threat and Error Management since these two areas were considered highly significant in the overall assessment of NTS performance. Because Behavioural Markers (BM) are at the core of the NOTECHS method, four half-day session were allocated to a comprehensive study of the construction and application of BMs within the specific cultural and organisational ethos of the airline. The suggested NOTECHS BMs were used as a starting point by the course facilitators but a catalogue of perceived **effective** and **ineffective** behaviours was created (under guidance) by the participants and collated later into an airline specific document for later operational use. This technique has much to commend it when sufficient resources are available since the rote learning of prescribed behaviours will clearly not be as effective as material created by the same personnel that will be later carrying out the NTS assessments. This is particularly relevant in an airline like Gulf Air where there are believed to be in excess of 35 nationalities among the pilot group and many more languages spoken. [The great enthusiasm with which the participants approached this stage of the training was a welcome surprise to the OTS team!]

Video scenarios including the original JAR TEL experiment material and other similar simulated behaviours were evaluated under the guidance of the course facilitators. Emphasis was placed on achieving consensus at the Element and Category levels to obviate conceptual misunderstandings.

Use was made of the NOTECHS Reference Ratings (see page 13 of this report) in this context.

As might be expected issues that were familiar from the Experimental Sessions resurfaced and were discussed in depth with the groups (average size 12 pilots/2 OTS facilitators) taking advantage of the extra time available.

The natural historical tendency for trainers and examiners to concentrate on *technical* issues when assessing pilot performance was apparent especially in the early stages of the course and this brought constant reminders of the need to focus on NTS.
The last day introduced basic LOFT concepts. An interesting (and believed) novel plan at Gulf Air is to dedicate annually one 4-hour simulator session to purely NTS issues with minimal technical input. It is hoped that this innovative *non-jeopardy* programme will come into fruition in the near future.

4-day course outline:

Day One
Intro by SFMT Gulf Air + Course Overview
Video Exercise
NOTECHS (Outline)
Threat & Error Management
Situation Awareness (Intro)

Day Two
NOTECHS (Categories and Elements):
Co-operation
Leadership and Managerial Skills

Day Three
NOTECHS (Categories and Elements):
Situation Awareness
Decision Making
Evaluation Exercises

Day Four
LOFT (Intro to Design and Conduct)
Instruction & Facilitation Techniques
Debrief Styles
Exercise
Summary & Course Outro

The second two-day course was designed to build on the knowledge gained in phase one and impart the skills required to *facilitate* a debrief using NOTECHS as the structural base. To achieve this difficult task, small groups of pilots were rostered in the ratio of one facilitator to three participants.

This allowed cost-effective role-play techniques to be utilised in the classroom with minimal equipment requirements. Video scenarios were again used but this time Gulf Air produced in-house material of a very high quality enabling more culturally specific issues to be presented the participants. The ready acceptance of unaccustomed role-play by the Gulf Air pilots was a significant factor in the success of this course. Video cameras were used to review the assessment and facilitation process.

Of particular interest to those considering using NOTECHS for this kind of activity is the approach developed by the OTS team. It was decided to make use of modified Rating Forms largely in the manner of the experiment but then to guide the debrief on established facilitation lines towards only the crucial and possibly trainable issue(s) observed. For example: A Captain's decision to divert is based on false assumptions derived from his lack of Situation Awareness (SA). The temptation to descend into arguments about which airport was actually nearest should be avoided, as probably should SOP considerations and the debrief best 'steered' towards Decision Making processes.
This technique was seen to be highly effective in concentrating the trainer's attention towards the **non-technical** and away from technical minutiae.

[On a personal note: the JAR TEL member involved in this programme found it extremely heartening to see the method working in the real world of active airline training.]

The third and final phase of the programme, implementing the non-jeopardy LOFT concept, is still ongoing and has local regulatory implications that are fortunately outside the OTS remit.