



NLR-TP-98518

NOTECHS:
Non-technical skill evaluation in JAR-FCL

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Abstract

Upon a request from the JAA-Project Advisory Group on Human Factors, NLR, DLR, IMASSA and the University of Aberdeen conducted a study into possible ways to evaluate non-technical skills of multi-pilot aircrew. The request was made in the light of the new requirements in JAR-FCL and JAR-OPS that make such an evaluation mandatory. The project, named NOTECHS, was executed between March 1997 and March 1998, and resulted in a descriptive framework for non-technical skills. The project result includes guidelines on how to use the framework in the check situations referred to in JAR-FCL. The proposed assessment method incorporates safeguards that should prevent misuse or arbitrariness of the evaluation. A formal validation of the proposed method was not possible within the NOTECHS project. The European Union JAR-TEL project will, building on the NOTECHS results, extend its application to JAR-OPS and test the robustness of the method proposed here.



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(15 pages in total)



1. Introduction

This presentation will deal with a proposed method for the evaluation of Non-Technical Skills (NTS) of multi-pilot aircrew. Such an evaluation, mandatory in the new JAR-FCL requirements, may be new in the examination of commercial airline pilots, the topic itself certainly isn't. In every pilot training NTS make their appearance, and this has been so for at least the last two decades. However, the extent to which the topic gets covered will vary largely, and NTS may have passed by a different name: CRM being the most likely option. It is safer to use the abbreviation CRM rather than its full name, since the meaning of the capital "C" keeps changing. I believe the latest fashion is to speak of *Company* Resource Management. It seems very common to associate CRM above anything else with authority differences on the flight deck, while in fact the topic should be interpreted much broader. In the project discussed in this presentation we have considered NTS as those **skills referring to all pilot's attitudes and behaviours in the cockpit not directly related to aircraft control, system management, and Standard Operating Procedures (SOPs)**. The first step towards acceptance of NTS evaluation is to realise that although the name by which these skills are called may have changed, it is not something invented recently by the JAA or by some psychologists.



2. The NOTECHS project

In 1996 the JAA-Project Advisory Group on Human Factors (JAA-PAG) conducted a survey on existing research needs in the different JAA member states. Several times an urgent need was expressed to start research into the way(s) the Non-Technical Skills of flight crew members should be evaluated. This in the light of the (then) forthcoming new JAA rules. Both JAR-FCL and JAR-OPS ask for the assessment of NTS. Unfortunately, clear guidelines on what NTS include and how they should be assessed are not part of the requirements mentioned. Without these guidelines, it is not very likely that the JAA objective to reach harmonisation will be met. Knowing this, the JAA-PAG addressed a request to four research institutes to provide, within one year, background material which could be used by those responsible to write AMC and IEM material on NTS assessment. The four institutes, the Netherlands NLR, German DLR, French IMASSA, and the University of Aberdeen joined forces in the NOTECHS study which was conducted from March 1997 until March 1998. Given the limited time available to come with results, it was clear that it would not be possible to come up with completely new approaches requiring lengthy testing. Therefore, NOTECHS was set up to build on existing knowledge and solutions. Use of operational expertise was guaranteed by the involvement of three pilots, already working on NTS training and/or evaluation issues. To allow completion of the project within the timeframe granted, the NOTECHS consortium decided to focus on background material for JAR-FCL paragraph 1.240, and to postpone a similar exercise for JAR-OPS. Although both documents deal with NTS, the approach taken is so different that the similarities are not apparent at first glance. The main difference is that JAR-FCL uses a more flight-oriented definition of NTS (based on the Multi Crew Co-ordination concept) while JAR-OPS uses a more psychologically oriented definition (based on the definition and concept of CRM). A harmonisation of the two would be welcomed. The final report of NOTECHS contains a comparison of the paragraphs in both documents concerned with NTS or CRM. The result of NOTECHS is primarily directed towards JAR-FCL, but with little modifications it will equally be of use for the implementation of JAR-OPS.

2.1 Review of existing systems

One of the work activities in NOTECHS involved making an inventory of existing solutions to do the NTS evaluation. From this it was concluded that, while NTS are always addressed in pilot training, NTS assessment is nowhere in Europe part of pilot examination. If an assessment is made as part of the airlines training program this will be on a non-jeopardy basis. It is apparent that in the NTS systems evaluated Non-Technical aspects are treated separately from Technical Skills, as is done in the JAR requirements under discussion. However, in the course of the NOTECHS project there was a growing consensus among the team members that it is very difficult, maybe even impossible, to draw a firm line between the two. There is at least a large overlap between Technical and Non-Technical Skills. For that reason the distinction is no longer made in the new evaluation system currently developed by KLM (called SHAPE). In this system all aspects considered in the evaluation of pilots are given equal importance. Because JAR-FCL does make the distinction a full integration of Technical and Non-Technical Skills



was not an option for NOTECHS. As will become clear later on in this presentation NOTECHS has tried to re-establish the natural connection. The review of existing systems resulted in a large amount of different NTS labels and descriptors, each with their own specific meaning, but together covering the whole range of NTS. Another conclusion from the review was that there is hardly any data available on the relation between NTS assessments and the actual pilot NTS performance. British Airways is in the process of setting up a system where safety reports provide input for NTS training. Data from such a system would be very helpful in setting up a method of NTS assessment.

2.2 Components of NTS

Based on the collection of NTS descriptors gathered in the review of (training) systems already in use, a descriptive framework was set up which covers the whole range of NTS. This framework consists of three levels (see also figure 1):

1. Categories
2. Elements
3. Behaviours

The four categories considered are:

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

Anyone familiar with CRM or NTS will immediately spot the absence of *Communication* as one of the main categories. Of course, communication was discussed in NOTECHS, but the conclusion was that communication is not so much a separate skill category as well as a means to be able to perform on each of the other categories. Each category is subdivided into a number of elements (three or four): figure 1 shows the elements for the co-operation category. A description of the whole framework is included as an annex to this presentation. The final report on NOTECHS presents a discourse on each of the categories including the rationale for the breakdown into elements. The categories and elements are formulated to reach a maximum mutual exclusivity, which is only achievable to a certain degree, given the interdependence of the various non-technical skills in flight deck operations. The terminology used reflects everyday language for behaviour, rather than psychological jargon. This resulted for instance in the use of the term *Situation Awareness (SA)*, though one might argue that SA is not so much a skill, but rather the result of some other skill, e.g. Situation Assessment. In this case it was decided to keep the name of the category as it is: every existing system includes Situation Awareness. Moreover, all pilots will easily recognise SA as being one of the important Non-Technical Aspects, what is doubtful for a concept like Situation Assessment. The exact position within the framework and precise naming is not so important as long as the examiners, instructors and pilots who will be confronted with the framework all have the same understanding for each heading, and as long as each critical behaviour is included somewhere in

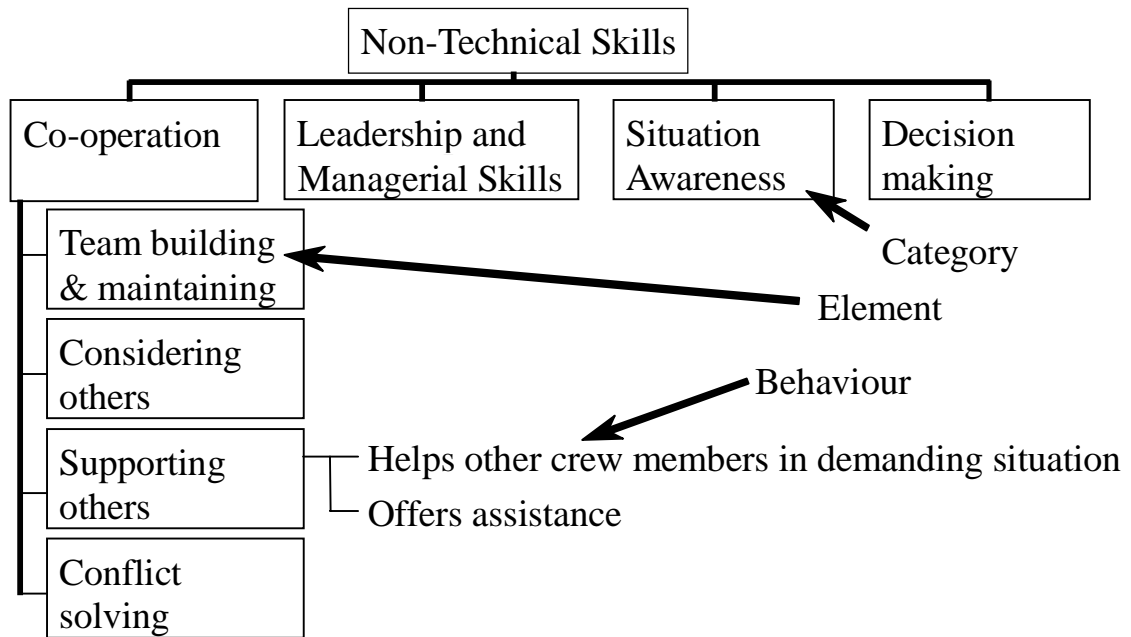


Figure 1 The NOTECHS descriptive framework consists of categories, elements and behaviours.

the framework. The NOTECHS framework provides so-called behaviours for each element that will assist the examiner to describe the observed behaviour in standardised and objective phraseology.

2.3 The five basic NOTECHS principles

The descriptive framework for NTS forms the basis of the NOTECHS evaluation method. The final report presents guidelines for use of this framework based on five principles.

1. Use of a two-point rating scale

JAR-FCL is dealing with the exam situation: the only decision of concern is whether or not the candidate is considered proficient. The outcome of the NTS assessment should just mention whether the observed Non-Technical behaviour was ACCEPTABLE or UNACCEPTABLE: i.e. the evaluation is done using a two-point rating scale. Note that for a training system it can be desirable to subdivide the ACCEPTABLE area, but it may prove difficult to come up with the appropriate anchors. The behaviours given in the NOTECHS final report are formulated in a negative wording. In a small scale study performed for the RLD by one of the pilots participating in NOTECHS, it was found that this was the best option in case of the exam situation. In a training situation it seems more appropriate to formulate the desired behaviour (as well). In the NOTECHS system the examiner monitors for any of the behaviours listed: anything better than the given description can be interpreted as ACCEPTABLE.



2. Need for technical consequences

Non-Technical Skills cannot be rated and cannot provoke a FAILED condition for the whole exam out of the context of a related objective technical consequence leading to compromised flight safety in the short or long term. The primary purpose of the NTS assessment is to help determine reasons behind technical failure. An unacceptable rating on any of the categories in the NOTECHS framework should be considered as an indication of a need for additional training in that specific area. Nothing should restrain the examiner from reporting any observed unacceptable NTS behaviour. The possibilities are rare to spot this behaviour and to take action before it can lead to a difficult situation on the flight deck. If the consequences of an unacceptable rating of behaviour observed under one of the elements are drastic (i.e. FAILED exam), the examiner may hesitate to report this when there are no clear objective indicators in the result of the exercise. In this case it is considered wiser to report the unacceptable NTS behaviour and to take the opportunity to indicate the need for training, but to base the final outcome of the exam on the technical result. NOTECHS proposes to require a (potential) threat to flight safety before an exam can be rated FAILED. Note that it is up to the company and the authority involved to determine what should be considered as potentially endangering for the flight.

3. Explanation required

The rating of NTS behaviour is done at the category level. A negative rating on any of the elements in one category should always lead to an unacceptable rating for the category and hence for the whole NTS group. This seems like a rigid rule, but it should be noted that the need for technical consequences acts as a safeguard against arbitrariness in the assessment. For each category rated unacceptable the examiner must indicate:

- a. the element(s) in that category where the unacceptable behaviour was observed,
- b. the technical area or group where the observed inadequate NTS (potentially) led to safety consequences.

In addition the examiner should give a free-text explanation on each of the categories rated unacceptable, using standard phraseology. The indication of applicable elements as well as the free-text explanation should also be given when there were no problems in the technical area. The outcome of the exam (i.e. PASSED with UNACCEPTABLE NTS) should then be interpreted as a need for additional NTS training. All pilots, instructors and examiners should be made familiar with the terminology, and the examiners should receive a specific training in the use of the evaluation method itself.

4. Repetition required

A leitmotiv of similar behaviour during the check should be observable to conclude that the pilot has problems in this area. It is not the goal of an assessment on NTS to FAIL someone who at one single occasion does not ask the crewmember for options before making a decision. However, if this behaviour is part of a repeating pattern, it should lead to an unacceptable rating on the Decision making category. It is argued that this approach is probably not different from



the current situation in examinations: how many examiners will fail a candidate who is, in a further perfect exercise, at one single moment 120 feet above the designated altitude? The normal rules for a repêchage should apply also in case of a negative NTS rating. If, according to the JAR-paragraph concerned, the nature of the technical failure allows for a second chance, this should be granted, regardless of the rating on NTS.

5. Only observable behaviour

Any evaluation should be based only on observable behaviours. When inferences (interpretation of facts) are required to have access to social or cognitive skills, they should be limited and based on obvious observable facts and behaviours. The evaluation must exclude reference to pilot personality or emotional attitude. The background material for the IEM includes a set of behavioural markers that were designed to support an objective judgement of the trainee, also for less visible elements such as *Outcome review* and *System awareness*.

2.4 Limitations of the project result

The main weakness in the project result is that it is based on a paper-and-pencil study only. There was no possibility to study robustness and validity of the proposed evaluation method. It is for instance unknown, given a certain NTS scenario, what the percentage of agreement on the overall NTS rating among a group of examiners will be. And, more in detail, whether the examiners agreeing on an unacceptable rating all indicate the same element(s) to form the problem area. In a European Union Framework IV project for DG-VII exactly this will be investigated. The JAR-TEL consortium, led by French Sofréavia, started in 1998 with a project building on the outcome of NOTECHS. The NOTECHS partners are involved in JAR-TEL, as are British Airways, AlItalia, Airbus, and the Defense Evaluation and Research Agency (DERA). The planning for the JAR-TEL project includes a field study in which a large group of examiners and instructors is asked to rate NTS behaviour shown in a number of filmed scenarios. The study should reveal a.o. any (company) cultural differences in the assessment of NTS. In addition, JAR-TEL will extend the application of the NOTECHS method, or a derivative, to JAR-OPS.



3. Conclusions

The NOTECHS scope was to address the check situation of JAR-FCL. With little modification the project result should be applicable to JAR-OPS as well. Adoption of a similar method for the AMC and IEM of JAR-OPS may benefit a future harmonisation of JAR-FCL and JAR-OPS in their approach to NTS (or CRM). A plea is made to base the AMC and IEM for JAR-FCL 1.240 on the NOTECHS material, also when the evaluations from JAR-TEL are not yet completed. The main purpose to have NOTECHS, and in fact to have the NTS assessment at all, is to find NTS training needs. The proposed NOTECHS method is capable of doing that, and the safeguards present in the system should rule out misuse of the system or arbitrariness caused by deficiencies in the descriptive framework which forms the heart of the method. It is of course up to those producing the actual AMC and IEM material to decide whether to adopt the complete NOTECHS method or just parts of it. There is no reason to avoid the issue: the *need for technical consequences* will be controversial. It is argued here that removal of this safeguard may be counter-productive as it might raise the threshold to report unacceptable NTS elements. Both JAR-OPS and JAR-FCL distinguish between Technical and Non-Technical Skills. Concluding from the discussions in NOTECHS it is suggested to investigate the desirability and usefulness of a full integration of the two. For the future such a situation where Non-Technical Aspects are treated with equal value as more traditional skills is envisaged, but the aviation community may not be ready for this. The results of the JAR-TEL project should form the next step on the way to acceptance of NTS assessment, but it should also be realised that in fact we are not talking about something new. Any discussion on NTS assessment should therefore be concerned with the method of assessing, not with the fact that the assessment is done. After all, it cannot be denied that appropriate Non-Technical Skills, although maybe called differently, do have a relation with the safety of the flight.



4. References

NOTECHS: The evaluation of non-technical skills of multi-pilot aircrew in relation to the JAR-FCL requirements, edited by J.A.G. van Avermaete and E.A.C. Kruijsen, **NLR Contract Report CR 98443**.



Annex: NOTECHS Descriptive Framework

Nontechnical Skills (NOTECHS) Framework:
Elements and Behaviours for Category - Cooperation

Category:
Cooperation

Elements:

Team Building and Maintaining	Considering Others	Supporting Others	Conflict Solving
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Behaviours:

<ul style="list-style-type: none">- Establishes atmosphere for open communication and participation- Encourages inputs and feedback from others (lower the barriers)- does not compete with others	<ul style="list-style-type: none">- Takes notice of the suggestions of other CM even if s/he does not agree- Takes condition of other CM into account- Gives personal feedback	<ul style="list-style-type: none">- Helps other crew members in demanding situation- Offers assistance	<ul style="list-style-type: none">- Keeps calm in conflicts- Suggests conflict solutions- Concentrates on what is right rather than who is right
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Nontechnical Skills (NOTECHS) Framework:
Elements and Behaviours for Category - Leadership and
Managerial Skills

Category:
Leadership and Managerial Skills

Elements:

Use of Authority/ Assertiveness	Providing and Maintaining Standards	Planning and Coordination	Workload Management
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Behaviours:

<ul style="list-style-type: none">- Advocates own position- Takes initiative to ensure involvement and task completion- Takes command if situation requires- Motivates crew by appreciation and coaches when necessary	<ul style="list-style-type: none">- Ensures SOP compliance- Intervenes if task completion deviates from standards- With crew being consulted deviates from standards if situation requires	<ul style="list-style-type: none">- Encourages crew participation in planning and task completion- Clearly states intentions and goals- With crew being consulted, changes plan if necessary	<ul style="list-style-type: none">- Distributes tasks among the crew; checks and corrects appropriately- Secondary operational tasks are prioritised to retain sufficient resources for primary flight duties- Allocates enough time to complete tasks
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Nontechnical Skills (NOTECHS) Framework:
Elements and Behaviours for Category - Situation Awareness

Category:
Situation Awareness

Elements:

System
Awareness

Environmental
Awareness

Anticipation

Behaviours:

- Monitors and reports changes in systems states
- Acknowledges entries and changes to systems

- Collects information about the environment
- Contacts outside resources when necessary
- Shares information about the environment with others

- Discusses contingency strategies
- Identifies possible/future problems



Nontechnical Skills (NOTECHS) Framework:
Elements and Behaviours for Category - Decision Making



Elements:



Behaviours:

