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HUMAN FACTORS

Study Report on Factors
Affecting Handovers

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EUROPEAN ORGANISATION
FOR THE SAFETY OF AIR NAVIGATION

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Study Report on Factors Affecting Handovers

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Abstract

Handover/takeover situations are critical moments, when a number of failures (e.g. forgetfulness, communication breakdown, etc.) are most likely to occur and lead to incidents. Although this issue is addressed in a number of Team Resource Management (TRM) training courses, the need to increase Air Traffic Controllers' (ATCOs) awareness, especially during refresher courses, was identified independently by the EUROCONTROL Safety Enhancement Business Division (DAP/SAF), today merged into the new Safety, Security and Human Factors Division (DAP/SSH), and by training experts at the EUROCONTROL's Institute of Air Navigation Services (IANS).

In preparation for the development of this training material, a research study was conducted to identify the factors affecting handovers and takeovers. This document reports the findings of this research.

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Air Traffic Control (ATC)	Air Traffic Controller (ATCO)	

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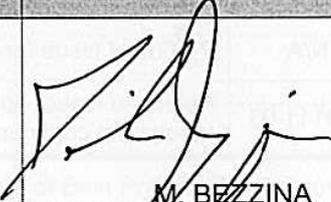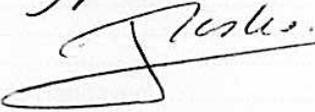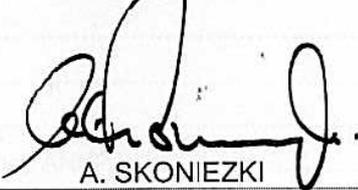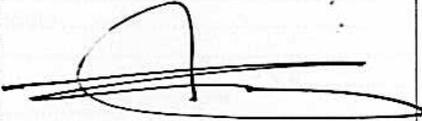
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EXECUTIVE SUMMARY

Handover/takeover situations are critical moments, when a number of failures (e.g. forgetfulness, communication breakdown, etc.) are most likely to occur and lead to incidents. Although this issue is addressed in a number of Team Resource Management (TRM) training courses, the need to increase ATCOs' awareness, especially during refresher courses, was identified independently by the EUROCONTROL Safety Enhancement Business Division (DAP/SAF), today merged into the new Safety, Security and Human Factors Division (DAP/SSH), and by training experts at the EUROCONTROL's Institute of Air Navigation Services (IANS).

In preparation for the development of this training material, a research study was conducted to identify the factors affecting handovers and takeovers. This document reports the findings of this research. It includes the following sections:

- Section 1, 'Introduction', provides some background information and the document objectives;

- Section 2, 'Literature Review', reports on the study performed by the National Air Traffic Services Ltd. UK (NATS) on handovers and the establishment of best practices based on this study;

- Section 3, 'Interviews of Safety Experts' summarises the interviews on handover-related safety hazards conducted with the safety managers of two Air Navigation Services Providers (ANSPs);

- in Section 4, 'Training Material Review', the existing pedagogic material relative to handovers in Europe is reviewed and analysed (prior to the Web-based training on factors dealing with handover/takeover produced by EUROCONTROL in 2006);

- Section 5, 'Identification of the Main Handover-related Safety Issues', provides, based on the information collected during the study, a preliminary list of the main handover-related safety issues that should be addressed to improve handover processes; and

- Section 6, 'Conclusions' highlights the key findings of this preliminary study on handover issues.

- Appendix 1 provides the 'PRAWNS Checklist Recommended by NATS, UK', while

- Appendix 2 gives an 'Example of a Checklist Use in Faro, Portugal'.

- Finally, a list of the 'Abbreviations and Acronyms' used in this document, followed by a list of 'References and Sources', can be found at annex.

It is to be noted that originally this report was not written with the intent of publishing. However at a later stage in the handover/takeover training material development, it was felt that it had an informative value of its own. In this context readers should regard this study report as such – a useful information tool – rather than consider it from an "empirical research" viewpoint.

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1. INTRODUCTION

1.1 Background

Handover/takeover (hereafter only referred to as handover) situations are critical moments, when a number of failures (e.g. forgetfulness, communication breakdown, etc.) are most likely to occur and lead to incidents. Although this issue is addressed in a number of Team Resource Management (TRM) training courses, the need to increase ATCOs' awareness, especially during refresher courses, was identified independently by the EUROCONTROL Safety Enhancement Business Division (DAP/SAF), today merged into the new Safety, Security and Human Factors Division (DAP/SSH), and by training experts at the EUROCONTROL's Institute of Air Navigation Services (IANS).

For this reason, the Handover Project was launched in 2005 to develop a storyboard that will subsequently be used to create a pedagogical tool and its debriefing material.

The project comprised the following four tasks.

- Task 1 consisted of a detailed description of the problem and the identification of the tasks necessary to address the problem;

- Task 2 consisted in collecting information on handover issues both through training experts' experience and a review of the literature on training. The results of this second task are the subject of this document;

- Task 3 focused on the development of pedagogical objectives; and

- Task 4 set up a storyboard for the refresher training course on handover issues.

In preparation for the development of this training material, a research study was conducted to identify the factors affecting handovers and takeovers.

1.2 Objectives

This document summarises the information gathered under Task 2. The aim of this task was to carry out a preliminary analysis of the current knowledge on handover issues.

In order to make this review as meaningful and complete as possible, information was collected from different sources. Three points of view were considered: the literature on handovers [1], the experience of safety experts [2], and the training material already in use [3]. Each viewpoint is summarised below and developed further in this report (see Sections 2 to 4). The outcome

of this threefold approach in the information collection is a solid reference framework on which pedagogical objectives were to be developed.

[1] Literature on handovers: The first source of information consisted of the documents, studies, recommendations and analyses provided by safety groups and training experts. This literature focused on the need to increase awareness of handover-related problems and is a good synthesis of the current views on handover issues. The retained elements consist of a study carried out by the NATS Human Factors Unit, and an incident case provided by the Transportation Safety Board (TSB) of Canada. Existing Standard Operating Practice (SOP) defined by the US Federal Aviation Administration (FAA) was also considered. They do not pretend to cover a complete literature review, but give an insight into the current status of handover issues.

[2] Safety experts' experience: The second source of information was the experience gained by the safety experts. Safety managers and incidents analysts from two ANSPs were interviewed. The material so obtained allowed to consider safety in handovers from an operational viewpoint and gave access to experiences of handover-specific incidents.

The analysis of the information collected in the interviews was important for three reasons:

⇨ Firstly it allowed the identification of issues and practices, be they specific to one ANSP or centre, or common to all ANSPs.

⇨ Secondly this data made it possible to clearly define the specificity of handovers in each operational situation (i.e. area control, approach control, and tower control).

⇨ Thirdly this analysis was an opportunity to identify various organisational aspects (e.g. types of shift change procedures) that may be linked to specific handovers issues.

Overall this analysis aimed at providing a qualitative overview of problems identified as relating to handovers and, in some cases, a first account of the solutions already developed by the ANSPs.

[3] Training material in use: The third source of information was the existing pedagogical material on handovers issues. Training courses (i.e. films, slides and incident case studies) on best practice were reviewed. They provided a basis to define how the controller's awareness can be developed and complemented through a tool dedicated specifically to handovers issues. In particular, Team Resource Management (TRM) material from the French and Portuguese ANSPs was examined.

2. LITERATURE REVIEW

2.1 Introduction

As mentioned previously, this section summarises a literature review on handovers issues. It reports on a thorough HF study led by NATS an incident case where handovers were considered an important causal factor, and the FAA procedures.

2.2 The NATS Study and Development of Best Practice for Handovers

2.2.1 Introduction

A study on handovers processes and improvements was conducted by the Human Factors Unit of NATS in the London Area and Terminal Control Centre (LATCC).

This study was in fact the follow-up of a 1996-97 analysis that had showed a disproportionately high number of errors occurring at the beginning of a shift. The purpose of it was to identify any problem associated with handovers. The study was divided in two phases:

- Phase 1, 'Initial Handover Study', reviewed the handover processes to identify any common features that may be contributing to suboptimal handovers being conducted, while

- Phase 2 aimed at assessing the impact of a checklist called 'PRAWNS', and best-practice handover processes.

The NATS study constitutes a unique example of a thorough analysis combining observations, interviews, videos, and incidents analyses. For this reason, its results are extremely valuable for this preliminary analysis of handovers issues. Furthermore, the NATS study provides an insight into what the pedagogical objectives of future handover training material should be.

2.2.2 Results of Phase 1

The first phase of the NATS study took place in 1999 at LATCC and aimed at examining current working practices. The investigations were conducted following different directions, and using different means such as structured interviews, questionnaires, the analysis of incident reports, video analyses, the observation of real handovers in the operations room, and shadowing techniques.

As the results of the NATS study are extremely rich, only those points that are relevant to the purpose of this document will be reported.

The first significant finding was that controllers did not follow a formal process during handovers. The study reported a large variety of styles amongst controllers. Besides, it appeared that controllers had not received any formal training in handover procedures. Although a procedure was defined in the Manual of Air Traffic Services (MATS), it appeared that this information was not always provided during handovers. On average a handover lasted 25 seconds.

Another interesting finding was the cause and effect relationship between the degree of familiarity with other controllers and the controllers' behaviour. Controllers who were "familiar" to each other (e.g. who had received On-the-Job Training (OJT) from another member of the watch) were found to behave differently from those who were unfamiliar to the watch (e.g. controllers who were not part of the team on the watch and only worked with the team on particular occasions, or controllers who had been trained elsewhere). An example of the impact of familiarity between controllers on their behaviour is the tendency "to stay around for longer and keep involved" noticed with the outgoing controller, and the overall process that is "more social and informal".

It should be remembered that the trigger that initiated this study was a finding according to which many incidents occurred a few minutes after handover. This raised the question of the time needed by an incoming controller to "get the picture" (i.e. to build his/her situational awareness).

From the information collected through the interviews it appeared that controllers thought that their picture acquisition time was two minutes on average. However, the analyses of video recordings show that the majority of senior controllers only got a complete picture after 3.26 minutes on average. The controllers' tendency to underestimate the time needed to settle into their position and be "in the picture", is an important feature to understand handover issues. In fact this suggests that one should not only consider the handover process as a mere delivery of information - however structured and complete - but also focus on the incoming controllers.

Finally the NATS study led to an instructive finding about the moment handovers take place. From the analysis of a set of incidents, it appeared that there was a link between the grouping of sectors and handover issues. The same could be said for splitting sectors. The study states that "if the coordinator is relieved at the same time as a controller, a significant loss of continuity and backup is incurred on the sector overall".

It is interesting to note that these points were also raised in the analysis of incidents carried out by the French Civil Aviation.

2.2.3 Results of Phase 2

As mentioned earlier, a second phase of the NATS study was conducted, where human factors specialists and operational staff at LATCC worked together to define an ideal or best-practice handover process. An important

part of the definition of best practice was the design of a checklist produced by the NATS Human Factors Unit together with one of the LATCC Watches.

The '**PRAWNS**' checklist became a mnemonic for controllers: **P**ressure, **R**unways, **A**irports/**A**djacent sector, **W**eather and **N**on-standard information, **S**trips-to-radar traffic point out. The checklist is provided in <u>Appendix 2</u>.

In order to evaluate whether any improvement had followed the introduction of the new handover process and checklist, the methodology applied to Phase 1 of the study was adopted during Phase 2. Where possible, the same data collection techniques (i.e. observations, questionnaires, interviews, etc.) were used. Phase 2 lasted four months, starting in October 2000.

It should be noted that what was evaluated was the impact of the PRAWNS checklist rather than the process of definition of best practice. However, controllers were briefed on the key points of the whole handover process. Once again, this section only focuses on the results that are relevant to the development of handover-related training material.

Six major differences between Phases 1 and 2 results were identified:

- Firstly, during PRAWNS trials the handover processes became more formalised. The differences in style between controllers decreased significantly.

- Secondly the incoming controller was more active (e.g. asked more questions).

- Furthermore the handover duration increased significantly (from 25 seconds on average without the PRAWNS checklist to 45 seconds on average with PRAWNS).

- From the analysis of incidents it also appeared that the number of serious incidents linked to handover processes decreased during the PRAWNS period. However, a more thorough analysis would require that data were collected over a longer period of time.

- Observations showed a reduction in the number of incomplete ATC plans handed over from one controller to another.

- Finally it was found out that with PRAWNS the incoming controller tended to ask questions and prompt the outgoing controller to provide information using PRAWNS more often. The study states that: "This was particularly the case for trainees who seemed to use PRAWNS as a prompt to get more information prior to taking over. This change would suggest that use of the PRAWNS checklist made the incoming controller more proactive in the handover process".

With only one exception, all watches strongly supported the PRAWNS checklist. Even the only watch that was not strongly in favour still had a slightly higher number of controllers who were in favour rather than against the checklist:

- *Ab initio* students found the use of the checklist particularly helpful.

- Experienced controllers were more balanced in their opinions. A number amongst them stressed that "experienced controllers should be able to carry out handovers and pass on information at the correct level given the situation".

- The approach controllers who were interviewed had mixed opinions about whether or not the PRAWNS checklist was relevant for their position. After several trials of different options, a slight majority was in favour of use in future of the PRAWNS checklist by both approach controllers and terminal area controllers. In such a case, the 'A' in 'PRAWNS' would stand for 'Airports' rather than 'Adjacent sectors'.

2.3   An Example of an Incident Case Linked to Handovers

As part of an incident analysis carried out by the Canadian Transportation Safety Board (TSB) [2] a failure in the handover briefing was clearly identified as one of the main causes of the loss of separation between two aircraft. Again the purpose here is not to investigate incident cases in detail but rather to consider those aspects directly in line with our study:

After 45 minutes of duty a first controller advised his supervisor that he required an immediate break. A second controller was recalled early from his break to take over the position. The first controller left the control room immediately after briefing the second one shortly, but did not inform him of a conflict between two aircraft (one aircraft was flying on an opposite direction level).

The report indicates that: "neither controller referred to the handover checklist, which was available at each control position". The general traffic situation was covered during the handover, but not the particular clearance of one of the two conflicting aircraft. The report adds: "neither controller used the checklist, nor was the habit of doing so".

Interviews conducted with controllers in the course of other TSB investigations revealed that "checklists are seldom if ever used during position handover briefings". However, Section 4 of the unit's briefing checklist includes an item on "traffic information" with "possible/probable separation problems", etc.

The investigation among others concludes that, although a checklist was available on the position, "there are no written requirements mandating controllers to use the available handover checklist. As a result the checklists are only used sporadically, which can lead to information being missed during the many handovers which take place in the course of the day".

The report also concludes that, as a safety action taken, the unit where this incident occurred had reacted by adopting a "mandatory requirement for controllers to complete the briefing checklist when assuming responsibility for a sector".

2.4 Existing Procedures: An Example in Federal Aviation Authority, US

In this last section on the literature review results the handover procedure in FAA will be summarised, as will be an example of a detailed and formalised procedure concerning handovers. Appendix D of the FAA manual describes the "Standard Operating Practice (SOP) for the transfer of position responsibility". The importance of the "position relief process" is emphasised and it is stated that "the contents, methods, and practices for position relief and briefings vary among personnel, and pertinent information is often forgotten or incompletely covered".

The SOP insists on the process and responsibilities rather than on specific items. Reference to a checklist is made, as is the recommendation that it should be specific to each unit. The checklist is defined as: "an ordered list of items to be covered during a position relief". The document also mentions "precautions" and reminds the reader that the specialists involved "should not rush or be influenced to rush".

As many points are very similar to the ones identified by European ANSPs, only the aspects that are specific to the FAA's experience and highlighted in their documentation are summarised below:

- The first point of interest is the insistence on "shared responsibility", which "means that the specialist being relieved is obliged to provide a complete, accurate, briefing and the relieving specialist is obligated to ensure that the briefing takes place and is to his/her total satisfaction".

- A second point concerns the "assumption of position responsibility". Taking responsibility of a position should be clearly expressed. Thus, the relieving specialist needs to "make a statement or otherwise indicate to the specialist being relieved that position responsibility has been assumed". There is also a "signature" process, where the controller signs on when taking the position, which formalises the end of the relief process.

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3.   INTERVIEWS OF SAFETY EXPERTS

3.1   Introduction

A series of interviews were conducted with French and Portuguese safety managers and safety specialists such as incident analysts. The aim was to look at the handover-related problems and any solution from an operational point of view. These interviews provided valuable information as it was delivered by experts who either themselves had been air traffic controllers and in some cases also instructors, or had been analysing incidents for several years and had been responsible for developing solutions to safety issues including handover-related problems.

The following two sections describe how handover issues have been addressed in these ANSPs and the lessons learned by their respective safety specialists.

3.2   French Air Traffic Services

In the French Air Traffic Services the former chief of the incident investigation bureau, who was also the former safety representative in the EUROCONTROL Safety Improvement Sub-Group (SISG), was interviewed.

Failures during handovers are regularly evoked as a possible incident cause when analysing incidents. These failures may concern the time at which a handover take place being not appropriate, or the process itself being flawed, and the information provided not enough. When the TRM course was developed in France, a preliminary analysis of the specificities of safety issues in the French ANSP identified handovers as a critical topic to be addressed (see Section 4.3). Hence, controllers receive awareness on handovers during TRM courses. However, there is still a wide variability concerning the degree of formalisation of handovers amongst units. In general in France handovers are neither bound to procedures nor formalised.

Valuable and complementary information was also provided by the "Bilan sécurité 2004", that is the official safety report in which the information regarding incidents from all French Air Navigation Service units is synthesised. The chapter headed "Causes and lessons learned from the analyses" includes a section on handovers.

The bad quality of handovers can be directly identified as a cause or contributing factor in two reported cases: "It is important to remember that a handover must allow the incoming controller to assimilate the current and arriving traffic thanks to the elements that are transmitted to him/her, and to identify the conflicts that he/her may have to solve. An incomplete handover may provoke an inadequate management of the traffic, which can result in an incident".

There are also other cases where handovers are mentioned as a contributing factor. The following classification is proposed:

➜ Absence of handovers (one case): the standard handover procedure was not followed, during a handover or during the grouping of sectors.

➜ Incomplete application of the handover procedure (four cases): the standard handover procedure was only followed in part.

➜ Inappropriate timing (one case): The moment in which the standard handover procedure was carried out was not appropriate (e.g. the change-over could have been delayed taking into account the conflicts occurring at that moment).

➜ Other cases (two cases): special or unusual situations occurring when the standard handover procedure was being carried out.

> The handover process is also evoked in another section of the report under the heading "Causes in Context and Environment".
> In the subsection on collective factors "Habits of the centre (e.g. to perform quick handovers)", and "habits of the team" (e.g. to perform quick handovers) are listed as relevant.
> Implicitly, this means that in the other cases, the misapplication of the handover procedure was not due to a habit of the centre or of the team, but rather linked to individual factors.

A number of recommendations are provided:

➜ A handover procedure should be precise and should not leave room for doubt on their application.

➜ It is necessary to adopt a precise methodology (e.g. a checklist) in order to ensure good handovers. Rigour is mandated, even when Planning Controller (PCO) and Tactical or Radar Controller (PCR) swap their places.

➜ The control room manager or supervisor must make sure that conditions allow a safe handover (e.g. adequate number and availability of staff, appropriate choice of moment to carry out the handover).

In conclusion, handovers were identified by the French Air Traffic Services safety management as a critical issue. In this documentation the problem has been analysed in terms of the underlying factors that "led" to a handover of information which was either too fast or incomplete. The necessity of a checklist is mentioned, but its development and implementation have been left to the units' responsibility. However, training on handovers is provided during

TRM training courses, in which a section is entirely devoted to handovers' analysis (See Section 4).

3.3   Portuguese Air Traffic Services

In NAV Portugal training is provided on handovers best practices. This has been mandatory since 2000 at all levels of the controller training (i.e. *ab initio*, recurrent training, supervisory and TRM). Handover's best practice is also used during simulations. Usually, during simulations the possibility to start and stop an exercise transforms a continuous process into a situation with a beginning and an end. Safety staff and trainers noticed that the process of handing and taking over was learned only when controllers started working in control centres. The objective of starting the practice of handovers from the beginning of a controller's training aims at making it an integral part of the job of controlling aircraft, and not a kind of "added" obligation to colleagues.

The problems that had been encountered by NAV Portugal in relation to handover issues before the introduction of best-practice training were quite similar to those highlighted by the French civil aviation and the British NATS. To illustrate some of these issues, an air traffic controller accepted to provide account of an incident he had experienced a few years earlier.

When the handover occurred, the controller was in charge of only two aircraft. He had given them their clearances - one of them was supposed to climb to Flight Level (FL) 350. In this quiet traffic context the handover was very relaxed; the two controllers started chatting about football. The incoming controller did not ask questions, maybe because the outgoing controller had been his instructor and was considered a very competent controller. One of the two aircraft changed its trajectory to avoid weather activity, and the other one, which had been cleared to FL350, never reached this level. A few seconds after the incoming controller took over the frequency, he found himself confronted with loss of separation between the two aircraft. He gave an emergency clearance, which resolved the conflict.

The incoming controller's overconfidence in the more senior outgoing controller, together with the informal briefing he received and the relaxed chat the two controllers had during the handover are factors common to a number of other handover-related incidents. About the last factor, Voller (1999) underlies the fact that handovers are "a social event" for the controllers involved.

Following the recognition of handovers being a problem, NAV Portugal safety management identified the need to clearly define best practices. Best practices comprised the whole process of handovers and included a checklist. As stated by the safety manager, "there was no need to reinvent the wheel", and thus the material was developed taking advantage of Sweden ATS and NATS' experiences. Nevertheless, the best-practice material that was developed is an original product of the Portuguese ATS. Careful consideration was also given to the possibility of local development by each unit. Thus, checklists differ slightly in Faro, Funchal and Lisbon. They were the result of

local development that was based on a "centralised" safety management decision and initiative, as well as a common framework to address the handover issues.

Although the best-practice material has the status of a recommendation from the safety department, it is not part of the procedures manual. It has been judged a success, although the way controllers perceive the material differs. Less experienced controllers are more prone to comply with the practices than their more experienced colleagues, who are less convinced by the usefulness of such training. One reason, explained above, is of course that the first ones have been trained with this material from the beginning whereas the latter have been used to work without it for years.

A point was also raised that, generally, younger air traffic controllers nowadays tend to have higher academic degrees and "like to learn". A concern was expressed that the younger generation of controllers appeared to be more safety-conscious than the older generation. This is a commonly held opinion held by safety specialists as older controllers have grown up with the system and feel more confident in their ability to ensure safety. Furthermore, the recruitment process is very selective. After the initial recruitment and one year of *ab initio* training, only very few of the student-controllers are finally selected to become operational air traffic controllers. It was explained that "new controllers are very good, from a theoretical and practical point of view". Their concern for safety is high and is exemplified by the fact that younger controllers ask for the radar and frequency recordings when they have a doubt concerning their controlling performance. This attitude is less common among older controllers. These factors may explain why young controllers are, in general, more compliant to the use of a structured process for handovers.

The result of this training is that over the past two years the number of incidents occurring ten minutes after handovers has dramatically decreased. A new trend of incidents occurring at the end of a shift is appearing. This is probably linked to fatigue and extra busy hours being worked as peak periods become longer.

In spite of the fact that in Portugal handover issues no longer seem to be a critical safety issue, the safety specialists interviewed agreed that it was essential to continue raising awareness of its major importance. Thus, as any other safety issue, it is necessary to refresh ATS professionals on the relevance of handovers.

4.   TRAINING MATERIAL REVIEW

4.1   Scope

This section reviews and analyses the existing pedagogical material where handover issues have been explicitly dealt with.

Two sets of pedagogical materials have been examined:

➔ Team Resource Management (TRM) course material developed by EUROCONTROL;

➔ TRM course material developed by the French and Portuguese civil aviations (Even though this material uses some parts of EUROCONTROL TRM, most of it was developed as original material).

4.2   The Definition of TRM

Training Resource Management (TRM) and Crew Resource Management (CRM) are similar concepts. However, TRM is specific to air traffic control, whereas CRM is specific to pilots working on the flight-deck.

The objectives of a TRM training course are stated as striving "to develop positive attitudes and behaviours towards teamwork skills and human performance in air traffic control." Furthermore, TRM aims "to reduce or minimise the impact of teamwork-related errors within the Air Traffic Management (ATM) system".

4.3   TRM "En-route" Developed by the French ANSP

4.3.1   Contents

The pedagogical material developed by the French ANSP comprises a set of eight modules. Each module contains slides, incident cases, and situations to role play. A number of videos are also included, such as a British Broadcasting Company (BBC) film on the Zagreb accident, which is used as an introduction to the course. Two videos produced by the French Civil Aviation describe the everyday life of an ATC centre, and a disorganised splitting of sectors during an On-the-Job Training (OJT) situation. The whole material is in French. One of the modules focuses on handovers ("la relève" in French), suggesting that this topic was identified as particularly relevant following an audit of safety issues. Other subjects considered on the course are OJT, relations with pilots, and teamwork.

4.3.2 Objectives of the handovers module

The objectives of this module are stated as being the following:

➔ to describe handovers as a crucial part of ATC work;

➔ to remind controllers of the roles of both the outgoing and incoming controllers;

➔ to identify any risks inherent to the handover process (i.e. elements that may disrupt handovers or lead to incidents);

➔ to discuss the means and strategies available to avoid or minimise these risks;

➔ to provide a model of a "safe" handover.

4.3.3 Pedagogical aspects

The module is organised in a set of questions raised by the TRM moderator/instructor, who is supported by slides. Controllers are invited to participate and exchange experiences. For example, at the beginning of the course they are asked to share their experiences of handover issues and to answer questions such as "What are the obstacles to communication during handovers?". The moderator listens to all the answers, synthesises them and comments on what the group can learn from them. A link is always made with the concepts that are used throughout the TRM training course. These concepts are either taken from the psychology literature (e.g. situational awareness, communication, leadership, and error) or coined by the TRM consultant to highlight specific aspects of ATC (e.g. team culture, tightly knit teams, and routines and habits).

4.3.4 Different types of handover

In the material the following different types of handover are identified:

➔ handovers with a shift change,

➔ handovers within one sector (e.g. when the Planning controller becomes the Tactical Controller or when a new Planner arrives),

➔ handovers within the team,

➔ handovers with the splitting or grouping of sectors.

This last case is considered particularly critical, as it may occur under time pressure, and lead to reduced information exchange.

For each type of handover situation participants are invited to think of the specificities raised by handovers. However, the module does not explore in

detail each of these situations; these are mentioned only to suggest the diversity of handovers situations.

The approach used is thus a high level one, focusing more on the aspects in common amongst the different types of handovers.

4.3.5   Roles in handovers process

Handovers were analysed also in terms of the "roles" of both the outgoing and incoming controllers. Here, risks are mainly seen in terms of "obstacles to communication".

The role of the outgoing controller is first and foremost to prepare what is referred to as a "clean" situation. A clean situation is one where handovers take place at an appropriate moment (e.g. in terms of traffic load) and classical strategies are used to easily transmit information regarding the situation to the incoming controller. It is also important that the outgoing controller stays next to the incoming controller for a while, and only leaves only when he/she is certain that the incoming controller really has the traffic situation under control.

The role of the incoming controller is to understand the situation and detect any anomalies (e.g. a forgotten conflict or an error in the traffic representation).

Conditions that increase the likelihood of incidents occurring are also highlighted:

➔ no or little preparation before handovers (the metaphor used is "to clean the desk"),

➔ a reduced amount of information exchanged,

➔ the outgoing controller being "in a hurry to leave",

➔ the incoming controller being "in a hurry to control",

➔ when there is a difficult situation the handover may focus on a problem to the detriment of the whole traffic situation.

Paper strips, which are still in use in French control rooms and in other places in Europe, are considered an important support to communication, as they may compensate for information that the outgoing controllers would forget to pass on. However, this assumes that strips have been properly filled out, in a readable manner, and this may not always be the case.

4.3.6   Familiarity and implicit communication: a case study

A case study based on an incident is also provided. It describes a situation where a handover was made "with a good, old friend". When arriving at his position, the incoming controller notices that there is a conflict, but thinks that "he (i.e. the outgoing controller) must have taken appropriate actions". Due to

the fact that the two controllers are old friends, they communicate in a very implicit way, and the incoming controller does not dare to ask for supplementary information. This incident illustrates one of the risks in handovers: controllers are reluctant to use formal, explicit communications with colleagues that are also good friends. In the French Air Traffic control centres, teams of controllers are very stable. In fact, the same people may work together for years, and thus as well as good colleagues they become close friends, sharing activities outside the operations room. This encourages familiarity between people that does not favour formal interactions, which are often required in ATC.

The objective of this case study is to make controllers aware of risks inherent to stable teams and typical of clans. Clan members favour implicit communication, which has strengths and weaknesses.

Due to the fact that in French air traffic control teams are stable, people may work together for more than ten years. This may result in teams defining their own rules and for this reason the theme of stable teams is particularly critical. Thus, the risks implicit in stable teams are discussed throughout the TRM course

4.3.7 Factors that lead to an incomplete handover process

Even though none of the French TRM training videos specifically focus on handovers, this matter is tackled in two of them.

The first film is called "Splitting sectors" and consists of a case study based on an incident. The event takes place on a sector where OJT is being carried out. Flow management informs the room supervisor that the traffic is going to increase. When the supervisor informs the instructor, her only reaction is to tell the trainee that it is good news. The traffic load starts increasing and the planning controller suggests splitting the sectors. However, the instructor does not listen to him, as she wants to "push" the trainee. In actual fact, she is so concentrated on the trainee's performance that she does not notice the progressive increase in traffic. The room supervisor comes to the position and suggests splitting the sectors, but he is not assertive enough and therefore his suggestion is ignored. Signs of the trainee becoming overloaded are apparent (e.g. strips not being properly integrated on the strip board, trainee's voice becoming tense, etc.). Seeing that the situation is becoming more and more critical, the planning controller announces: "I'm fed up! We are splitting now!" In the meantime the two controllers who are supposed to open the new sector are chatting and do not pay attention. The room supervisor is busy on the phone and thus unable to open a new position immediately. In the end the position is being opened in a hurry and the handover process reduced to a minimum. Very shortly after having begun to control the controllers get a severe incident.

Although the handover issue is not the main focus of the film, it shows a number of possible reasons behind a rushed handover. The film highlights a number of factors (e.g. a training situation, lack of room management

leadership) that may lead to handovers where little or no information is passed onto the incoming controller.

The second film is called "A day in the life". Even though it does not focus on handovers either, it includes a scene which is relevant to handovers. The manner in which the outgoing controller briefs the incoming controller is familiar and vague. Before leaving he says: "It's hell, the military are playing with the cumulus-nimbus (CBs), and zone Z is active. However, the worse is over now, so I leave it to you".

This example was designed to illustrate a situation which can be overcome using appropriate TRM. The objective was to give an example of a handover where the information provided was simply "a snapshot of the outgoing controller's state of mind who, in this case, just had a very hard and busy shift and was in a hurry to leave the position". In this situation the information delivered is closely linked to the emotional state of the controller. His outburst is as much to express his emotions as to deride those (i.e. the military) who have contributed to make his shift a difficult one. The communication is thus not at all directed towards the incoming controller, who is given little support to build his picture. The fact that communication is not only "telling words" is relevant to TRM and very important in the handover process. For communication to be truly effective, it is necessary for the receiver of the communication to be taken into account and for the goal of imparting information to be always kept in mind. In a handover the incoming controller needs to be helped to build a picture of the traffic to ensure continuity of control, in spite of the disruption caused by the handover.

To conclude, those of the key points raised by the films which are relevant to the handover subject are summarised below:

- The first film ("Splitting sectors") shows a number of systemic aspects of a handover which is carried out too fast. The controllers are shown allowing the situation to progressively getting out of control. In the end the only solution is to carry out a fast handover with very little information transfer. This scenario provides a broader view on handovers in order to highlight the importance of contextual factors. The implication is that to understanding handovers it is important to consider factors that are not necessarily close in time to the handover but "upstream", and thus prior to the actual handover moment.

- The second film ("A day in the life") focuses more on factors and attitudes related to the controllers involved. The handover described is not carried out in a rush, but the outgoing controller is tired and in a hurry to leave his position. The focus of this video is to show that "providing information" during handovers must be done considering the needs of the incoming controller.

4.4 TRM Developed by the Portuguese ANSP

Handover issues are addressed at all stages of the controller training in the Portuguese ATS, as explained in Section 3.3, including TRM courses. The issues are covered in a number of activities, including storytelling exercises, role-playing, and matching games.

In the storytelling exercises, controllers are asked to share their negative experiences of handover situations, which are then discussed by the whole group.

With regard to role-playing, the moderator describes an example where a very experienced controller sits down at a position and tells the outgoing controller: "it's ok, you can go". Participants are asked to describe how they would act in such a situation. Everyone's replies are commented by the moderator and discussed by the group.

Finally, a card-matching game is also used in the TRM course to highlight handover issues. Participants are given a dozen pictures showing different steps of a handovers process. Each picture represents a step of the handover process (e.g. a controller showing another controller a flight on the radar screen or both controllers looking at the checklist) and controllers have to be put the pictures in the correct temporal order.

5. IDENTIFICATION OF THE MAIN HANDOVER-RELATED SAFETY ISSUES

Based on the information collected through the interviews and training material summarised in previous sections, the following preliminary list was drawn up. This list includes any of the key issues that should be addressed to improve handovers processes:

➔ Lack of rigour during handovers (lack of information or low quality of the information delivered).

➔ Handovers carried out at an inappropriate moment (e.g. when a conflict is occurring).

➔ Handovers carried out during a critical moment (e.g. grouping or splitting sectors).

➔ Insufficient information exchanged between controllers during a position swap (i.e. a Planning Controller takes the Tactical Controller's place and vice versa) due to incorrect expectations (i.e. the controller believes his/her colleague already has the picture).

➔ A non-standard procedure used just before a handover and not communicated to the incoming controller.

➔ Lack of a sufficient overlap time between the arrival of the incoming controller and the departure of the outgoing controller.

➔ Outgoing controller in a hurry to leave or, incoming controller in a hurry to control.

➔ Implicit communication due to the belief that it is an offence to give too much information to the incoming controller or for the incoming controller to ask too many questions.

➔ Fast handovers due to habit which is either specific to the team or to the centre.

➔ Handover as a social event. The handover is a moment when controllers exchange greetings and may be an opportunity to chat. This feature was highlighted in the NATS study, where in 38% of cases, distraction is mentioned as a contributing factor in incidents.

➔ Differences in handover processes being noticed depending on the relation between the two controllers involved. Thus, for example, controllers within the same team being treated differently from those normally working in a different team.

➔ Difference in level of experience that can lead a younger, or less experienced controller, to "blindly" trust a more experienced colleague who is handing over.

➔ For the same reason, difference in level of experience that can make it harder for a younger controller who is handing over to give too many details to a more experienced controller taking over.

➔ Handover part of the process of building situational awareness and time necessary to "get the picture" often underestimated by controllers.

➔ Risk mitigation: The incoming controller should play an active role in the taking of "responsibility" for the sector.

➔ Risk mitigation: The outgoing controller should stay next to the incoming controller to ensure he/she does not need any additional information or support.

6. CONCLUSIONS

The following points may be stressed upon from this preliminary study on handover issues:

➔ The handover process is a critical moment in ATC, and as such, needs to receive careful attention from operational persons. ATC is a continuous process, but the succession of controllers on working positions introduces a form of discontinuity in the controlling process. Although this fact is acknowledged, it seems it does not receive all the attention it would need, and the choice of concrete practices for handovers are often let to the appreciation of controllers, and thus subject to a wide variability.

➔ The degree of formalisation of practices varies a lot with the different ANSPs, and even with the different units within an ANSP. Even when handover tasks are defined as procedures in a "manual of operations" that give them some "official status", they may be simply not followed by the majority of controllers. This is stressed for example in the report by NAV Canada and in the NATS study. In other ANSPs the handover process is not the object of a defined procedure, and, gradually, a "way of doing things" becomes a kind of implicit rule. For example, the French safety report states as one incident cause: "habit of the centre, or of the team, to have very quick handovers". In this case, practices are transmitted through On-the-Job Training (OJT) to have quick handovers to trainees and this becomes a rule, all the more difficult to change once it is "naturalised[1]" by the student controllers.

➔ Training around handover formalised processes is provided in most cases rather late into the training of an Air Traffic Controller. This is very much linked to the organisation of training, where a young trainee begins to control on simulators before to get on real traffic. Because simulators allow to "stop" and "start" exercises, and because training is very much focused at this moment on the individual performance, handovers are not taken care of from the beginning of a controller's training. They are instead introduced later in the training process, as a kind of "supplement" to what is still considered an individual performance. One noticeable exception identified in our study concerns the NAV Portugal, where student controllers are trained from their first sessions on simulators to simulate also a handover when starting a session and another when finishing with the instructors. In this case handovers become an integral part of the job of an air traffic controller.

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[1] Concept borrowed from anthropology: When a way of doing things is not based on reason, and has never been debated, it acquires a status of something which is on the side of "nature" (in opposition to culture). This habit becomes all the more difficult to change that it is ingrained in our lives, and becomes the only possible imaginable way to do things.

➔ The identification of "handovers" as a possible cause for incidents" must be carefully examined, and maybe refined. It must be first acknowledged that access to the analysis of incidents is still difficult. Incidents databases keep, in most cases, a very little part of the incident whole story, and resume to an elliptic "cause" the richness of complex events. Thus, when a handover is found to be a cause", it would be more interesting to know more precisely how the succession of events turned into an incident. This can only be found when we have access to entire stories of incidents (most often form the controllers themselves) and not form databases. A second point stressed by the NATS study is also very important. When they had found out that many incidents were occurring roughly ten minutes after a shift change, it may be linked to a lack of information provided by the outgoing controller but also to the lack of situational awareness built at this time by the incoming controller. Voller *et al.* [1] explain that most controllers underestimated the time needed to be completely settled in their tasks. Many formalised practices insist on the role of the outgoing controller, in terms of rigour and completeness of information provided, and this is of course a crucial point. But, there is also a need to stress the role of the incoming controller as an active role to build the picture, and also to make controllers more aware of the necessary needed time. The fact to recognise and insist on this needed time should be a good argument for changing attitudes (for example, to encourage outgoing controllers to stay in the surroundings for help a few minutes after the relief). It is also important to keep in mind a systemic view on handovers. Some factors leading to a bad handover process might be found quite far in time: for example, the French TRM film (see Section 4.3) shows all factors that lead to a very messy handover. Examining how handovers are addressed demands moving away from analysing them as isolated factors. It is difficult to set up directly a very formalised and detailed handover procedure in an organisation where procedures are not formalised or considered only as papers … It is equally not probable to observe very quick and lousy handovers where, normally, there is a high degree of formalisation of practices.

APPENDIX 1: THE PRAWNS CHECKLIST RECOMMENDED BY NATS, UK

P	**Pressure** High – Low – Min Stack		**P**	**Pressure** High – Low – Min Stack
R	**Runway(s) in Use**		**R**	**Runway(s) in Use**
A	**Airports** ILS – Gaps – Freqs		**A**	**Adjacent Sectors** Bandboxed – Split - Freqs
W	**Wx** Vis – Avoidance - Winds		**W**	**Wx** Vis – Avoidance - Winds
N	**Non-Standard / Priority Info** NSFs – EATs & Holding NavAids – Danger Areas NODE-L Setup - Other		**N**	**Non-Standard / Priority Info** NSFs – EATs & Holding NavAids – Danger Areas NODE-L Setup - Other
S	**Strips to Display**		**S**	**Strips to Display**

PRAWNS for Approach and PRAWNS for TMA

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APPENDIX 2: EXAMPLE OF A CHECKLIST USE IN FARO, PORTUGAL

1.	**OPERATIONAL INSTRUCTIONS**	DAILY BRIEFING
2.	**AIRSPACE RESERVATIONS**	
3.	**NOTAMs / INOP**	INOPERATIVE EQUIPMENTS
4.	**FREQUENCIES**	SELECTED, including 121.5 and 243.0
5.	**HEADSETS**	OPERATOR, HL, INT and VOLUME

1.	**WIND**	DIRECTION AND SPEED
2.	**RUNWAY**	in USE (confirm with the colleague)
3.	**SELECTOR**	of RUNWAY and WIND indicator
4.	**VISIBILITY**	and CLOUDS
5.	**PAPIS & LIGHTS**	BRIGHTNESS (RWYs and TWYs)

1.	**QNH – RADAR**	and TRANSITION LEVEL
2.	**CONFIGURATION**	COVERAGE, CENTRE and FILTER
3.	**SIDs & STARs**	
4.	**TRAFFIC**	Relevant to the incoming controller
5.	**FLIGH PROGRESS STRIP**	UPDATED FLIGHT PLANNING

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[2] L Voller (born Donohoe) - Donohoe was the name used at the time of the study.
[3] L Glasgow (born Cordiner) - Cordiner was the name used at the time of the study.

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ABBREVIATIONS AND ACRONYMS

For the purposes of this document the following abbreviations and acronyms shall apply:

ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Services
BBC	British Broadcasting Company *(UK)*
CRM	Crew Resource Management
DAP/SAF	Safety Enhancement Business Division *(now merged into the new DAP/SSH)*
DAP/SSH	Safety, Security and Human Factors Division *(EUROCONTROL Headquarters; formerly split into DAP/SAF and DAS/HUM)*
DAS/HUM	Human Factors Management Business Division *(now merged into the new DAP/SSH)*
DGAC	Direction Générale de l'Aviation Civile *(F)*
EAT	Expected Approach Time
EATCHIP	European Air Traffic Control Harmonisation and Integration Programme *(later renamed 'EATMP' and today known as 'EATM')*
EATM(P)	European Air Traffic Management (Programme) *(formerly known as 'EATCHIP')*
FAA	Federal Aviation Administration *(US)*
FL	Flight Level
Freqs	Frequencies
HL	Headset/Loudspeaker *(select the output to the headsets or speakers)*
HRT	Human Resources Team *(EATM)*
IANS	Institute of Air Navigation Services *(EUROCONTROL Luxembourg)*
ILS	Instrument Landing System
INOP	Inoperative

INT	Integrated *(integrate the VCS phones in the headsets)*	
LATCC	London Area and Terminal Control Centre	
MATS	Manual of Air Traffic Services	
NavAid	Navigational Aid	
NODE	NATS Operational Display Equipment *(US)*	
NOTAM	Notice to Airmen	
OJT	On-the-Job Training	
PAPI	Precision Approach Path Indicator	
PRAWNS	Pressure, Runways, Airports/Adjacent sector, Weather and Non-standard information	
RWY	Runway	
SID	Standard Instrument Departure	
SISG	Safety Improvement Sub-Group	
SOP	Standard Operating Practice	
STAR	Standard Instrument Arrival	
TMA	Terminal Control Area	
TRM	Team Resource Management	
TSB	Transportation Safety Board *(CDN)*	
TWY	Taxiway	
Vis	Visibility	
Wx	Weather	