

# **Safety Survey Report**

## **Handover-takeover in ATS**

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# Section 1 Acronyms and references

## 1.1 Definitions, acronyms and abbreviation(s)

ACC	Area Control Centre or Area Control
APP	Approach Control Centre or Approach Control
ARAM	ATS-SRO Remedial Action Management
ASD	Advanced Situational Display
ATC	Air Traffic Control
ATCC	Air Traffic Control Center
ATCO	Air Traffic Controller or Air Traffic Control Officer
ATFCM	Air Traffic Flow and Capacity Management
ATS	Air Traffic Services
CANAC	Computer Assisted National Air Traffic Control Center
CPDLC	Controller – Pilot Data Link Communication
CPOH	Controller Position Operator Handbook
CWP	Controller Working Position
DG	Directorate General or Director General
DGO	Directorate General Operations
DSS	Data System Specialist
E-E	EUROCAT-E system (provided by Thales)
FDPS	Flight Data Processing System
FDS	Flight Data Specialist
FIS	Flight Information Service
FISO	Flight Information Service Officer
FMP	Flow Management Position
FPASD	Flight Plan Air Situation Display
GS	Ground Speed
HCI	Human Computer Interface
HMI	Human Machine Interface
HOTO	Handover - Takeover
LVO	Low Visibility Operation
OCA	Operational Competence Assessment or Operational Competence Assessor
ODS	Operator Display System
OJT	On the Job Training or On the Job Trainee
OJTI	On the Job Training Instructor
OLDI	On-line Data Interchange
OPS	Operations
OSU	Operational Safety Unit
MATS	Manual of Air Traffic Services
MTCD	Medium Term Conflict Detection
N/A	Not Applicable or Not Available or Not Assigned
Ntc	Note to Controller
N2Ops	Note to Operations (electronic version of Ntc)
NOTAM	Notice to Airmen
OJT	On the Job Training
OJTI	On the Job Training Instructor
PSSA	Preliminary System Safety Assessment
RI	Runway incursion
SMI	Separation Minima Infringements
SMS	Safety Management System

SMU	Safety Management Unit
SRO	Safety related Occurrence
STCA	Short Term Conflict Alert
TC	Training Centre
TOF	Training Officer
TWR	Tower
VCSB	Voice Communication System Bravo
WP	Working Position

## 1.2 References

{DOC9426}	Textual Title:	Air Traffic Services Planning Manual
	Doc ID:	Doc 9426 – AN/924
	Version:	First (Provisional) Edition
	Date:	1984
	Organization:	ICAO
{ESH}	Textual Title:	Effective Shift Handover – A literature Review
	Author:	Ronny Lardner
	Version:	prepared for the Health and Safety Executive Offshore Safety Division
	Link:	<a href="http://www.hse.gov.uk/research/otopdf/1996/oto96003.pdf">http://www.hse.gov.uk/research/otopdf/1996/oto96003.pdf</a>
	Date:	June 1996
	Organization:	The Keil Center
{FAA}	Textual Title:	ATSB Transport Safety Investigation Report
	Doc ID:	Aviation Occurrence Investigation - 200701982
	Version:	Final
	Date:	2007
	Organization:	Australian Transport Safety Bureau
{HDVR}	Textual Title:	Handover Takeover e-learning
	Doc ID:	ATC-R-HDVR
	Version:	2016
	Date:	
	Organization:	Eurocontrol Training Institute
{HF}	Textual Title:	Study Report on Factors Affecting Handovers
	Doc ID:	07/01/11-03
	Version:	1.0
	Date:	2007-02-09
	Organization:	Eurocontrol
{SAA}	Textual Title:	Hand-over/take-over of operational positions
	Doc ID:	Safety Alert
	Version:	N/A
	Date:	15 Octobre 2004
	Link:	<a href="http://www.skybrary.aero/index.php/Hand-over/take-over_of_operational_positions">http://www.skybrary.aero/index.php/Hand-over/take-over_of_operational_positions</a>
	Organization:	SKYbrary Wiki
{SAS}	Textual Title:	Handover/Takeover of Operational ATC Working Positions/Responses
	Doc ID:	N/A
	Version:	N/A
	Date:	9 September 2011
	Link:	<a href="http://www.skybrary.aero/index.php/Handover/Takeover_of_Operational_ATC_Working_Positions/Responses">http://www.skybrary.aero/index.php/Handover/Takeover_of_Operational_ATC_Working_Positions/Responses</a>
	Organization:	SKYbrary Wiki
{SKB}	Textual Title:	Briefing and Provision of Operational Aeronautical Information to Air Traffic Controllers
	Doc ID:	N/A
	Version:	N/A
	Date:	20 August 2010
	Link:	<a href="http://www.skybrary.aero/index.php/Briefing_and_Provision_of_Operational_Aeronautical_Information_to_Air_Traffic_Controllers">http://www.skybrary.aero/index.php/Briefing_and_Provision_of_Operational_Aeronautical_Information_to_Air_Traffic_Controllers</a>
	Organization:	SKYbrary Wiki

## Section 2 Introduction

### 2.1 Handover/Takeover

#### 2.1.1 Definition

A Handover can be defined as the passing of control authority from one person/group to another person/group.

A position handover can also be defined as “the accurate reliable communication of task-relevant information across shift changes, thereby ensuring continuity of safe and effective working”<sup>1</sup> or as “the requirements needed for the safe transfer of the understanding of the operational situation from one team/person to another team/person”.

The Handover action is complete when the receiving controller acknowledges assumption of control authority. Also called hand-off.<sup>2</sup>

In ATC, a shift handover can be triggered for instance by the end of a given ATCO’s shift, the collapse or de-collapse of sectors, etc.

The aim of a handover is to ensure that the incoming controller has an adequate overview not only of the traffic situation but also the control strategies of the outgoing controller.

#### 2.1.2 Literature review

##### 2.1.2.1 Effective shift handover – Offshore experience & study<sup>3</sup>

The review of communication theory<sup>4</sup> indicates that to ensure effective shift handover communication procedures should:

- give effective shift handover communication a high priority
- pay particular attention to handovers which occur when staff have returned following a lengthy absence from work, during maintenance, during deviations from normal working; and when handovers take place between experienced and inexperienced staff
- specify key information needed by the incoming operator to update their mental model of operational status
- use operator supporting tools (logs, displays, etc.) designed on the basis of the operator’s information needs
- include and develop communication skills in the selection criteria and training for shift-workers.

Individual handovers should:

- be conducted face-to-face
- be two-way, with both participants taking joint responsibility for ensuring accurate communication
- use verbal and written means of communication
- be given as much time as necessary to ensure accurate communication

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<sup>1</sup>{ESH} Lardner, 1996 , p.3

<sup>2</sup> <http://www.thefreedictionary.com/handover>

<sup>3</sup> {ESH} Lardner, 1996, p 6

<sup>4</sup> More information can be found in Appendix A

Several studies performed in the nuclear and offshore industries report an increased rate of accidents at or near shift changeover, with the highest incidence at the commencement of the shift (e.g.: Sellafield Beach Incident, Piper Alpha, etc.).<sup>5</sup> In all cases, a lack of procedures which specified how to conduct an effective shift handover, inaccurate and unreliable carry-forward of information from shift to shift were identified. The implemented solutions to solve those problems proved to be efficient and were based on face-to-face communication with support material (written forms, checklist, etc...) developed with or by the users. Staff involvement was seen as crucial to the success of the implementation.

### 2.1.2.2 Human attention level

Human performance and attention level changes with the time passed at a WP. In the following two examples, research studies show that during the performance of a monotonous task (i.e. attending a lecture or observing video monitoring) attention levels generally decrease. However, attention levels can partially be restored by interruptions in the monotony, breaks, or conscious activity, the latter of which is inherent to an ATCO's work.

#### **Schematic Summary of Student Attention Level in Lectures**

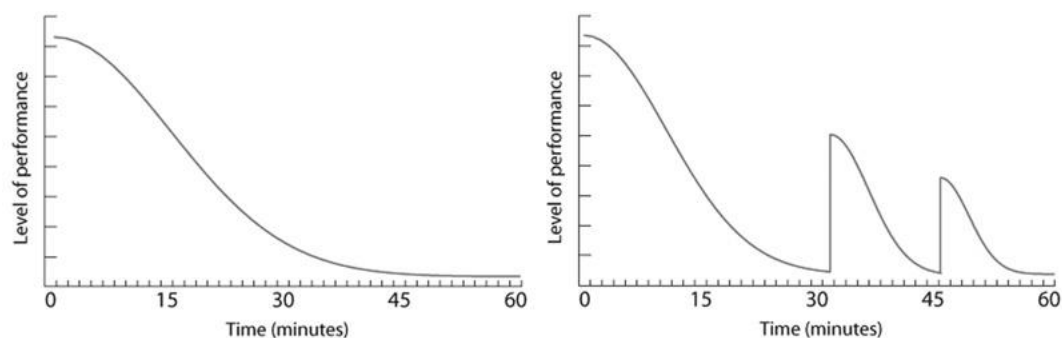


Figure 1: Student Attention Level in Lectures

These two graphs measure students' relative level of performance as the fraction of students paying attention at any time as determined by twelve lecturers over an average of ninety lectures. The level of attention and performance during any lecture shows an almost immediate decline, and at the end of a class period of normal length (sixty minutes) attention is down to a very low level (left-hand graph). Interrupting the lecture for activities, quizzes, or asides helps (right-hand graph), but engagement never returns to what it was at the start of the class. Source: A schematic representation of the conclusions drawn by Johnson, A. H., and F. Percival. 1976. Attention breaks in lectures. *Education in Chemistry* 13:49–50.

#### **Sustained attention of security guard video monitoring operators**

The human brain has limited attention span capabilities. A 1999 study (Green, 1999) found that after 20 minutes, guards watching a video scene will miss up to 95 percent of all activity. Leveraging advancements in video pattern detection, video analytics technology addresses this issue and has comprehensively evolved from being a strictly forensic tool into a powerful proactive solution. Paired with high-definition imaging, HD analytics provides security operators with highly accurate alerts and clear image detail, enhancing their ability to effectively intervene and take action when an incident occurs.

<sup>5</sup> {ESH} Lardner, 1996

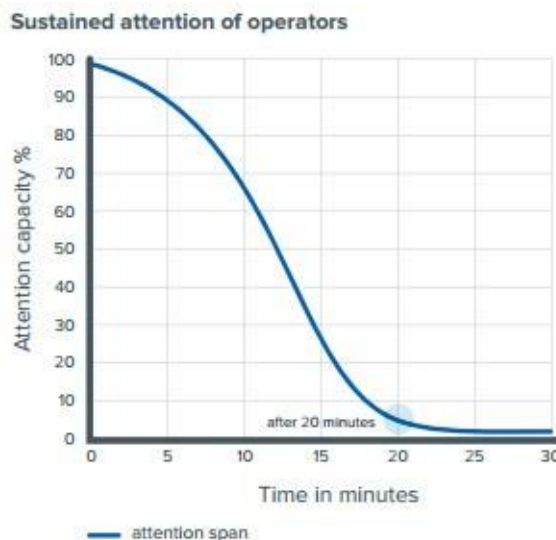


Figure 2: Sustained attention of security guard video monitoring operators

### 2.1.2.3 US Federal Aviation Administration<sup>6</sup>

*“The US Federal Aviation Administration (FAA) undertook an analysis of air traffic controller (ATC) Operational Errors (OE) between 1997 and 2000. That analysis found that 35% of all ATC OE occurred within 20 minutes of a controller assuming control of a position.*

*In response to that error rate, the FAA established a number of initiatives including the need for an appropriate controller overlap period following the completion of the control position’s transfer checklist. During the overlap period, the relieved controller is required to remain at the operational position, and is responsible for monitoring the activities of the new controller to ensure:*

- *the complete transfer of responsibilities between the affected controllers*
- *that the required level of SA is achieved by the oncoming controller”*

### 2.1.2.4 International documentation and recommendations on HOTO

The ICAO DOC 9426 - AIR Traffic Services Planning Manual<sup>7</sup> contains the following statements and recommendations on the transfer of watch:

#### **“1.7 TRANSFER OF WATCH RESPONSIBILITIES**

- 1.7.1 *The hours of operation of ATS units usually require a shift change at least once a day. During such shift changes, a number of actions are to be taken to ensure continuity of operation; this applies particularly to a comprehensive hand-over/take-over procedure. Since the specific actions, which need to be taken at each unit and at each operating position, may vary, they should be specified in unit operating instructions. The time required for handover at shift change will depend on the complexity of the operating position and the traffic situation at the time of the change.*
- 1.7.2 *When a controller is assigned to an operating position, he should normally not hand over responsibility for the performance of the duties associated with this position to any*

<sup>6</sup> See {FAA}

<sup>7</sup> {DOC9426} PART IV, Section 2 ATS Facility Administration and Management, Chapter 1 Functional Management



*other controller unless he is authorized to do so by the supervisor on duty, except as provided in 1.7.6 below.*

- 1.7.3 Before vacating an operating position for any reason while a unit is still in operation, the controller vacating that position should ensure that there is a clear understanding as to who will assume responsibility for that particular operating position and an appropriate hand-over should be effected.*
- 1.7.4 It is essential that all controllers occupying an operating position are in a satisfactory state of health throughout their period of duty. Accordingly, a controller should not assume or retain responsibility for any ATS operating position if his capacity to perform the duties of the position is in any way impaired because of sickness, injury, alcohol, drugs, fatigue, personal worry or his emotional state. A controller who considers that his physical or emotional state is such that his ability to perform his duties satisfactorily may be impaired should notify the supervisor on duty, and that supervisor should make necessary relief arrangements.*
- 1.7.5 Prior to taking over an operating position, a controller should:*
- ensure that he has a full understanding of the air traffic situation including an awareness of clearances issued but not yet acted upon and any developing situation requiring early attention;*
  - familiarize himself with the serviceability of all equipment under his charge and liable to be used during his tour of duty (e.g. radar, radio, approach aids, telephone lines and aerodrome lighting);*
  - obtain all relevant information and familiarize himself with the meteorological situation and trends for his tour of duty and where practicable get a personal briefing from a meteorological office;*
  - ensure he is fully conversant with the latest promulgated orders, instructions, notices and information, particularly with reference to the serviceability of aerodromes and other air navigation facilities;*
  - sign on in the log or at the operating position, as applicable, as having accepted responsibility for the position.*
- 1.7.6 A controller handing over watch to another person should ensure that his successor is provided with full information on the current traffic situation and any matters of significance which have influenced the development of the situation or which may have a bearing on the situation arising during the ensuing tour of duty. When a prevailing traffic situation or other event makes it desirable for a controller to complete all actions before transferring responsibility to another controller, he should remain on duty until such time as these actions have been completed. However, assembly of records or completion of reports associated with any such event should be completed after hand-over is effected but before signing off. In any case it must be ensured that responsibility for manning a position is recorded in an uninterrupted manner.*
- 1.7.7 Should a situation arise at any time whereby a controller considers it prudent to seek advice he should notify the supervisor on duty, or, if not available, the most senior controller. If the situation so warrants, the person called upon should assume responsibility for the operating position and record that fact in the ATS log. Nothing in this paragraph should prevent a supervisor from assuming responsibility for an operating position at any time if, in his judgement, the situation so warrants.”*

Part III § 3.2 of the same document states that the ANSP should designate a briefing room close to the operations room to be used for briefing sessions and for current pre-shift, individual, briefing.

### 2.1.2.5 Eurocontrol documentation

The “Selected Safety Issues for Staffing ATC Operations” document from Eurocontrol defines the following hazards, prevention and mitigation strategies, tools and procedures linked to the HOTO process:

#### **“HAZARDS**

- **Information exchange:** Inadequate exchange of information being passed to the new shift, e.g. incorrect assumptions/expectations.
- **Reliability of information:** Information is distorted during successive handovers. For example, different teams may interpret/apply certain procedures in a different way.
- **Disregard for procedures:** Not following the checklist or procedures.
- **Checklist complacency:** Omitting items on checklist when using checklists routinely.
- **Distraction:** Errors are introduced; vigilance is compromised.
- **Simultaneous handovers same sector:** Everybody on the same sector hands over to someone else at the same time. The result is that everyone is new on the sector.
- **Simultaneous handovers several sectors:** Staff working on several sectors hands over to other staff at the same time. The result is that everyone is new on a number of sectors.

#### **PREVENTION AND MITIGATION STRATEGIES**

##### **PEOPLE**

- **Handover time:** Allow sufficient time for handover.
- **Training:** Handover should be practised during all phases of training including refresher training.
- **Roster design:** Time for position handover should be built into the roster.
- **Availability and preparedness:** Operational staff should make themselves available and prepare for the takeover (e.g. familiarisation with new procedures, environment, weather, expected demand, work plans, etc.) prior to approaching the operational position.
- **Workload and information transfer:** Where available supervisor should be responsible for determining timing. All handover/takeovers should be conducted at a time when doing so will not compromise the information transfer (i.e. during demand troughs). Supervisor may monitor transfers in complex situations.
- **Staff assessment:** Operational staff assessment should include handover process on a regular basis.

##### **EQUIPMENT (TOOLS)**

- **Checklist(s):** Checklist(s) should be available at all operational positions.
- **Handover form / briefing note:** Standardised handover form should be available to describe critical information e.g. weather, facilities, staffing, and equipment status.
- **Reminders:** Consider introducing support tools to provide reminders to the controllers (e.g. bleep).

##### **PROCEDURES**

- **Follow checklist:** As a routine task, operational staff should follow the checklist. A ‘uniform’ way of working for all members having the same endorsement which should reduce the problems where teams have distinctly different ways of working.
- **Handover form:** The handover form should be completed.
- **Signing off/in procedure:** Signing off and signing in procedure should be in use to acknowledge that everything is done.

- **Adjacent operational positions:** Avoid simultaneous handover of adjacent operational positions.
- **Number of handovers:** Where possible minimise the number of handovers (need to compromise between need for regular breaks and need to minimise hazardous activity like a handover/takeover).
- **Sector opening:** Minimise the number of handovers before/after sector opening (e.g. when sectors are collapsed or de-collapsed). All handovers/takeovers should be conducted at a time when doing so will not compromise the information transfer.”

The Eurocontrol study also concluded that the followings elements should be considered:

<b>HANDOVER</b>	
<b>NORMAL OPERATING CONDITIONS + HIGH WORKLOAD</b>	
•	All handovers/takeovers should be conducted at a time when doing so will not compromise the information transfer (i.e. during demand troughs).
•	Consider monitoring the handover/takeover.
•	The length of the handover/takeover will also vary and should take the time required (not necessarily the rostered time).
•	Consider requiring the handing-over controller to remain to answer any queries and verify handover.
•	Train handover situations
<b>DEGRADED OPERATING CONDITIONS + HIGH WORKLOAD</b>	
•	Consider requiring the handing-over controller to remain to answer any queries and verify handover.
•	Handover/takeover should not be done during an emergency or degraded situation (may wish to make a controller swap because of performance management issues). In the case of critical incidents - CISM procedures maybe recommended.
•	All handovers/takeovers should be conducted at a time when doing so will not compromise the information transfer (i.e. during demand troughs).
•	Consider monitoring the handover/takeover.
•	The handover/takeover should take the time required.
<b>NORMAL OPERATING CONDITIONS + LOW WORKLOAD</b>	
•	Where possible minimise the number of handovers.
•	Avoid unnecessary handovers, e.g. smoking breaks.
<b>DEGRADED OPERATING CONDITIONS + LOW WORKLOAD</b>	
•	Handover/takeover of a position should not be done during an emergency or degraded situation until the emergency or degraded situation is stabilised. However, the supervisor may wish to make a controller swap because of performance management issues. In the case of critical incidents - CISM procedures may be recommended.

Figure 3: Eurocontrol Handover recommendation

## 2.1.2.6 Skybrary

### 2.1.2.6.1 Safety Alert<sup>8</sup>

#### Consider before Hand-over

- A hand-over produces a workload of its own. Careful consideration to the timing should be given;
- If it is likely that the sector will be split shortly after the hand-over consider splitting it before the hand-over;
- Simultaneous take-over of all the sector positions (for example both radar and planner) should be avoided;
- Do not shortcut the existing good practice during low vigilance periods;
- The handing-over controller should tidy up the working position prior to the hand-over;

#### During a Hand-over

- Avoid distracting controllers during hand-over;
- Use checklists with the sequence of actions to be performed by both handing-over and taking-over controllers;
- The taking-over controller should ensure that he/she has been able to assimilate all information relevant to a safe hand-over and should accept responsibility only after he/she is completely satisfied that he/she has a total awareness of the situation;
- Use mnemonic reminders within the checklist like "check REST before going to rest":

		Examples
<b>R</b>	Restrictions	Flow restrictions; TSA, Danger, Prohibited and other special status airspace
<b>E</b>	Equipment	Status, maintenance, ground-ground communication, air-ground communications, navigation, surveillance, radar filters, radar source, type of surveillances sources integration if multiple, strip printers, workstations, information systems
<b>S</b>	Situation	Weather ( fog, snow, hail, visibility, low/high pressure, CB, turbulence, CAT, winds, etc.), Staffing, Configurations ( Sectors, Runways, Taxiways, Adjacent sectors, etc.), Strips, Holding
<b>T</b>	Traffic	All under control, expected, military, VIP, Aerial activity, non-compliant with ATM regulations (RVSM, RNAV, 8.33, ACAS, etc.), VFR flights, Clearances and instructions given.

Please note that there is an important logic behind the REST sequence, building consecutively the situational awareness for

1. environment framework
2. environment of operations
3. operations.

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<sup>8</sup> {SAA}

## After a Hand-over

- The handing-over controller should remain available for a few minutes following the handover, particularly in dynamic traffic situations, to provide clarifications/assistance regarding any points which may subsequently arise;
- Other controllers on the sector should only impart additional information after a hand-over is complete.

### 2.1.2.6.2 Eurocontrol Study<sup>9</sup>

After a study, the information received from 9 ANSPs and from an individual ATCO that is consolidated below, complements that which can be read under the previous point. It is evident from the responses that a variety of means are used to assist controllers with the handover of operational working positions. The principal findings are:

- Most ANSPs have some form of checklist to assist in the handover/takeover process; the content is roughly the same but there are differences between checklists used in ACCs, APP and TWR.
- Popular mnemonics for checklists include: REST, WEST, PRAWNS. Examples are provided below.
- At ACCs, checklists tend to be based on a ‘corporate level’ format/content and are often mandated for use whilst in the aerodrome environment the design (format/content) and to a certain extent the use of checklists, is left to the discretion of local management.
- Checklists need to be short, easy to use and relevant. If they are too long and contain too much (irrelevant) detail, controllers are dissuaded from using them.
- Checklists are, not exhaustive, it is the responsibility of both parties to ensure that all relevant aspects have been covered although in general it is accepted that overall responsibility for the successful completion of the handover/takeover sequence lies with the handing over controller.

## General Themes

Other themes, common to the handover/takeover procedure of all ANSPs, irrespective of the working environment, include:

### **Before Handover:**

- The importance of pre-briefing, i.e. before the start of the operational shift/watch<sup>10</sup>
- A handover produces workload of its own. The role of the Supervisor is important in particular regarding the current and expected traffic situation and possible sector splits. Careful consideration should be given regarding the timing of the handover and if it seems likely that it will be necessary to split a sector within 10 minutes then the split should occur before the handover.
- Simultaneous double handovers of Executive/Radar and Planner/Coordinator controllers on the same sector/working position should be avoided where possible.

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<sup>9</sup> {SAS}

<sup>10</sup> More information can be found in  
{SKB}

**During Handover:**

- Avoid distracting controllers involved in a handover. E.g. OJT briefings should be held away from the handover in progress and Coordinator/Planner inputs should be saved until after the handover whenever possible.
- Follow the operational handover checklist (e.g. REST, WEST, PRAWNS).
- The outgoing controller must ensure that all relevant information has been passed on. The oncoming controller must assimilate, and where necessary clarify, all information relevant to a safe handover and should accept responsibility only after he/she is completely satisfied that he/she has a total awareness of the situation.

**Post-Handover:**

- Some ANSPs also insist on an ATCO overlap period whereby the handing over controller is required to remain at the control position for a specified period until it is clear the taking over controller has full command of the situation.
- Until the handover is complete, other controllers on the sector should not give additional information unless operationally necessary.

As part of a wider initiative to improve ATCO visual scanning processes, one ANSP unit has provided the following general handover guidance to its operational controllers:

**Controller 5 Point Handover Check:**

1. Are you fully rested/mentally ready to take the handover?
2. Approach the handover with the correct mental attitude...concentrate!
3. Take a while to watch what is happening before starting handover, particularly where traffic situation is complex.
4. Do not attempt to take over when a critical task needs completing (e.g. traffic on short final with one on runway still not cleared for take-off).
5. Off-going controller monitor situation after handover for a short while to ensure the on-coming controller has assimilated all the essential information.

Finally, several ANSPs also stated that it was important that controllers do not shortcut the existing good practice during low vigilance periods.

**Handover Checklists - ACCs**

The two most common checklists used by ANSPs in ACC are: WEST and REST.

**Note:** The elements cited in the third column of the tables below are illustrative only and are non-exhaustive.

- WEST

<b>W</b>	Weather	Turbulence, winds, CBs, icing, pressure
<b>E</b>	Equipment	Radio, radar, telephone, spt information, navaids
<b>S</b>	Situation	Sector configuration, individual agreements, military areas, holding, special flights, CFMU/flow regulations etc.
<b>T</b>	Traffic	Traffic on frequency, pending traffic and future tasks, potential traffic conflicts and planned solutions



- REST 1

<b>R</b>	Runway in use	Runway in use, weather
<b>E</b>	Equipment	Radio, radar, telephone, spt information, navaids
<b>S</b>	Situation	sector configuration, individual agreements, military areas, holding, special flights, CFMU/flow regulations etc.
<b>T</b>	Traffic	Traffic on frequency, other important traffic and future tasks

- REST 2

<b>R</b>	Restrictions	Flow, TSAs, Danger, Prohibited and other special airspace
<b>E</b>	Equipment	Radio, radar, telephone, spt information, navaids, maintenance
<b>S</b>	Situation	weather, staffing. configurations, strips, holding
<b>T</b>	Traffic	Traffic on frequency, pending traffic, military, VIP, unusual aerial activity, non-compliance with ATM reg (RVSM, RNAV, 8.33 , ACAS etc.), VFR flights, clearances

### **Terminal (Approach and Tower) Checklists**

A mnemonic used in the TMA/Approach environment is PRAWNS.

<b>P</b>	Pressure	High, low, MSL
<b>R</b>	Roles	Own and adjacent sector
<b>A</b>	Airports	Runway(s) in use
<b>W</b>	Weather	Visibility, avoidance, winds
<b>N</b>	Non-Standard/Priority Info	Nav aids, danger areas, EATs, holdings, non-standard frequencies
<b>S</b>	Strips to display	

Another checklist uses the mnemonic SUSIS

<b>S</b>	Sector	Runway configuration, runway change, spacing, restrictions, overflights, direct routings, actual conflicts and planned solutions
<b>U</b>	Unusual	RSV, Parachute activity, Military, Y/Z flights, VFR, priority flights etc.
<b>S</b>	Situation	Equipment status: unserviceabilities, maintenance; navaids
<b>I</b>	Information	Weather, pilot reports, miscellaneous
<b>S</b>	Split	Transfer of control, frequencies, diversions etc.

Another ANSP provides a common handover crib sheet which details the runway in use at the unit, the runway in use at a close adjacent unit, the minimum stack level for aircraft transferred from the TMA sector and several other specific items. The sheet also includes a section for free text messages relating to non-standard items:

- QFU Runway XX (Own unit)
- Runway designator, eg. 14/32
- QFU Runway YY (adjacent unit)
- Unserviceabilities & Other Information
- STD Lanes
- Safeguards
- Para dropping
- LVPs

Another unit from the same ANSP has developed an “**Attention Directed Handover System**” where the handover procedure is guided by physically numbering the salient points of the handover information and directing the attention of the on-coming ATCO to each item in turn:

### **Visual Control Room (Tower)**

1. Information board
2. ILS status
3. Weather
4. Nav aids- status and serviceability
5. Airfield ground lighting panel status
6. Traffic situation

### **Approach**

- 1) Information board
- 2) Weather
- 3) ILS status
- 4) Nav aids- status and serviceability
- 5) Traffic situation

The “Attention Directed Handover System” is deliberately different between Tower and Approach:

1. Firstly, the position of the information in each of the two positions is in different places, therefore to encourage expediency in the handover it is more suitable that the various parts of the handover are addressed in a different order.
2. Secondly, the different order promotes awareness in the controller that the handover is taking place in a different operational environment which has proved valuable when dual-valid controllers are moving between operational positions without breaks.
3. One of the advantages of this system is that as the off-going ATCO is briefing the on-coming ATCO their attention is physically directed to each part of the process and it is therefore methodical and structured.

The goal of shift handover is the accurate, reliable communication of task-relevant information across shift changes, thereby ensuring continuity of safe and effective working. The handover process has been proved to be error provocative and a contributing factor in some incidents/accidents. In order to ensure system resilience during the handover, effective communication and coordination strategies are needed.



## Section 3 Conclusions and Recommendations

### 3.1 Conclusions

#### 3.1.1 General

As a general conclusion, it appears that there is a lack of standard. The actual situation allows too much freedom and so the users are drifting away from any standard. The opposite situation with a strong standard with very restricted freedom can lead to loss of flexibility.

The recommended situation is a well-defined and known standard with some freedom and known limits, which will lead to more normal distribution of the user population around the established standard.

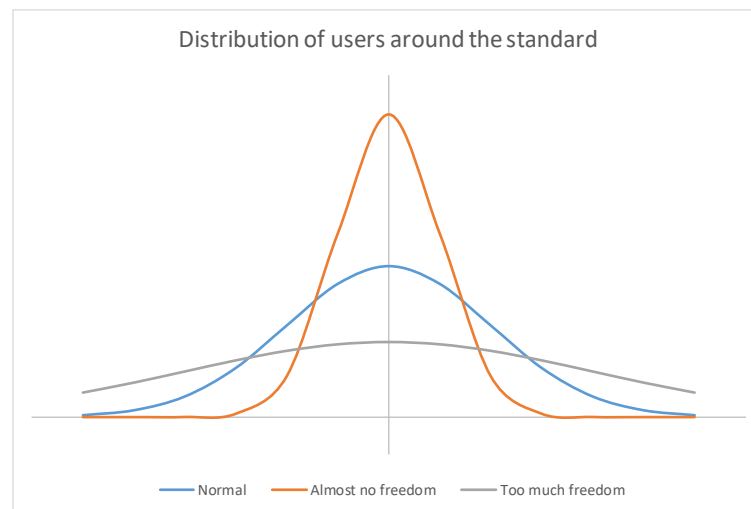


Figure 4: Distribution of users around the standard

It was observed that the knowledge of the processes, procedures and systems are most of the time in the hand of only a very limited number of experts.

The departure of one of those experts would mean a big loss of knowledge and could have a big impact on the ANSP activities.

The following drawings represent the observed situation and the recommended one.

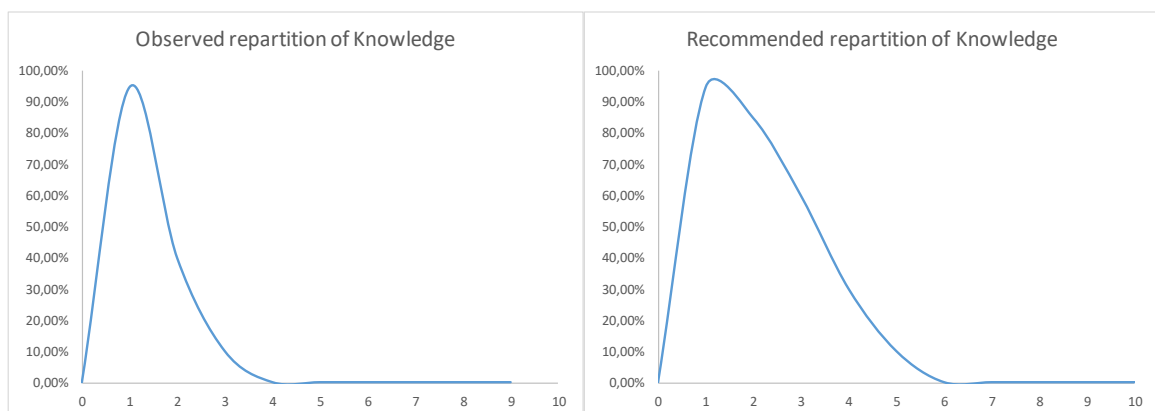


Figure 5: Observed and recommended repartition of Knowledge

### 3.1.2 Handover/Takeover

In theory 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 to provide additional information or support, and only leaves when he/she is certain that the incoming controller has the traffic situation under control and receives a formal confirmation of that from him/her. 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) and to play an active role in the taking of "responsibility" for a sector.

Currently within some ATC units, there is no formally implemented HOTO process and discrepancies exist between the Ops Manuals' principles and the day-to-day application or implementation. The HOTO training is mainly performed during the OJT with some reminders during refresher courses.

The observations allow to notice the:

- insufficient information exchanged between controllers during a position swap
- lack of a sufficient overlap time between 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
- handover is a social event, a moment when ATCOs exchange greetings and may be an opportunity to chat, so disturbing the formal transfer of traffic information
- simultaneous change of ATCOs, which even if declared to be avoided are performed on a daily basis with a potential loss of situational awareness
- lack of pre-briefing of the ATCOs
- lack of common team briefing and organization at the start of the shift

### 3.1.3 Personal Settings

The observations and questionnaires point out differences between the TWRs and the CANAC2 Opsroom. As already mentioned, the majority of TWRs use a common standard setting of the HMI. In the CANAC2 Opsroom, much more customisations are performed. This study did not succeed in defining the exact source of the 'big' difference in the use of settings and habits between the units.

According to the information received and the available documentation, the implementation of Personal Settings to the extent it is currently being requested is not possible in some ATM systems. The current customisation of settings is based on LFUNC and Roles and allows only three sets of settings for these. The implementation of Personal settings would require an update and a new development of the system. It should also be noticed that there is a request of the ATCO community that the log-in to access their personal setting should remain anonymous as they seem to fear a "Big Brother is watching you!". This request could have potential important impact on the workload for the DSS and be the source of some additional constraints or errors.

The Study proves that most ANSPs do not have personal setting functionalities, and those having personal settings do not have major problems as long as there is a strict evolutionary safety framework and a valuable monitoring of the use made of the customisable functions by the ATCOs. It was also proven that the ATCOs use more or less the same settings when put in

the same conditions (role, sector, configuration, workload, etc.) and that most, if not all, of the individual settings can generally be summarized in a dozen main standard settings.

The observations and questionnaires seem to prove that the modifications to or the verifications of the Eurocat-E HMI settings concentrate on only a few main items (i.e.: label field, active maps, colour, range, brightness and filter), but also that there is a lack of knowledge on the existence and the content of already predefined default settings.

Several interviews and meetings reveal that the request for personal settings is also triggered by the fact that some ATCOs complain not to understand or being confused by the settings of their colleagues, so it appears that allowing even more freedom could worsen the problem. However, the ATCOs should have the possibility to modify some parameters of the system according to their needs and the situation. This should be based on a common strong standard setting and remain within a strictly defined and controlled safety framework.

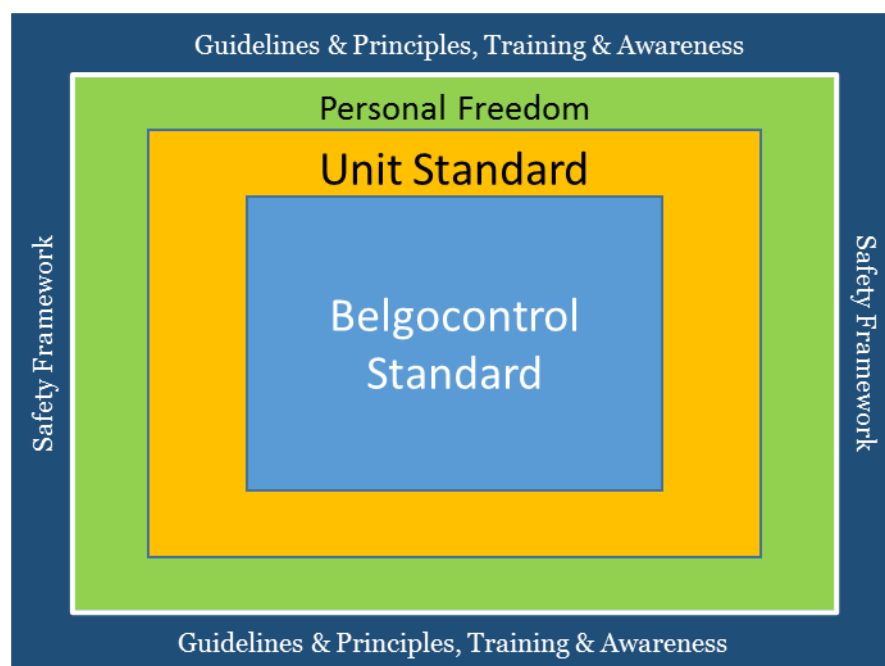


Figure 6: Settings Standard, Personal and Framework

If the implementation of personal settings might have an impact on the working conditions and productivity of the ATCOs, the choice to implement or not personal settings depends more on a strategic decision. Nevertheless, it should trigger a thorough safety assessment in order to define both the common standard to be used as well as the safety framework.

## 3.2 Other ANSP's Summary & Conclusions

All ANSPs are convinced that:

1. to reduce the HOTO workload, it is a good practice to be present some 5-10 minutes before takeover and watch and listen to the traffic – this may reduce the number of items that are needed (by handover ATCO) to transfer to takeover ATCO
2. it is also good practice for handover ATCO to stay some 5-10 minutes at the position (after handover/takeover process is completed) and watch and listen to the traffic and ATCO in order to be sure that all information has been transferred to takeover ATCO.
3. Special attention needs to be paid, when there is a trainee on the position under OJTI

Some ANSPs admit that some ATCOs are not willing to spend a few minutes before takeover and a few minutes after handover, because they say that such process will reduce their breaks (especially during low workload handover/takeover with small numbers of items that need to be communicated between leaving and incoming ATCOs).

The use of Checklists or HOTO tools available at the WP are implemented or developed in most ANSPs. The Briefing process depends on the unit practices, and is seldom monitored as the ATCOs are considered as professionals who should never assume their duty without a proper briefing. Nevertheless, most ANSPs performing surveys on this subject notice some gaps in the Briefings and HOTO issues for which new solutions should be found.

Most ANSPs do not have personal settings possibilities in their ATM system. They have standard default settings from which ATCOs can modify certain parameters but which have to be restored to the default ones before the HOTO unless agreed to by the incoming ATCO.

The ANSP having personal settings for their ATCOs have tailor-made ATM systems for which the involvement of ATCOs in the development project was part of the success. Nevertheless, even if the customisation is possible, ATCOs are never allowed to modify mandatory settings and safety-related tools (e.g.: maps, STCA, MTCD...). The settings remain under strict control all the time and the ATCOs can only change some parameters within a strict safety framework which evolves with time and experience.

It should also be noted that even in the ANSP where personal settings exist, it is proven that most of the ATCOs<sup>11</sup> use the same settings when put in the same conditions (role, sector configuration, workload, etc...) and that most, if not all, of the individual settings can generally be summarized in a dozen main standard settings. With experience and involvement of ATCOs in the development of the systems, a trend towards standardization through common use of the tools is appearing.

The ATM systems and environments that are the most successful and appreciated are those for which the involvement of ATCOs has been and still is encouraged in all domains and projects regarding their working environment.

From a technical point of view, all ATM systems having personal settings, store those settings in the CWP and not in a central server to allow quick and efficient access to the data in the critical period of a handover.

The ANSPs also use the log-in of the ATCO to record the working periods, sectors and roles of the ATCOs in the scope of the license validation justification.

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<sup>11</sup> Some exception, outsider always exist.

## Section 4 Observations on used CWP

During the observations, it was observed that the change/rotation of ATCOs at the CWP during the HOTO could take different form depending on the unit, the sector, the period of the day, etc...

### 4.1 Rotation with 2 ATCOs (standard)

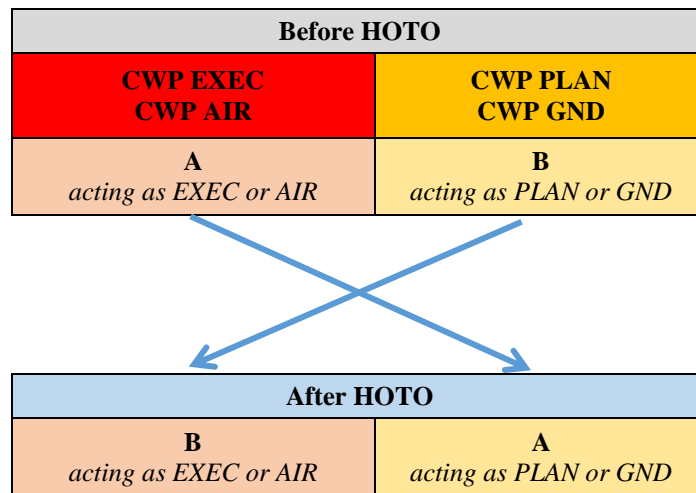


Table 1: Rotation with 2 ATCOs (standard)

#### Advantages:

- The role of the CWP with specific settings remains the same.
- Telephone lines and frequencies remain on same CWP.
- Since the physical change of positions is done, the HOTO is better achieved, because the physical swap helps the mind-set of having a new role.

#### Disadvantages:

- ATCOs working with different settings need to adapt their personal settings.
- Requires a simultaneous swap of physical positions.

**Current use:** Tower units / APP when 2 people are working, because the different CWP have different additional tools and requirements, also done where EXEC is radar position and PLAN is “strip” position.

## 4.2 Rotation with 2 ATCOs (non-standard)

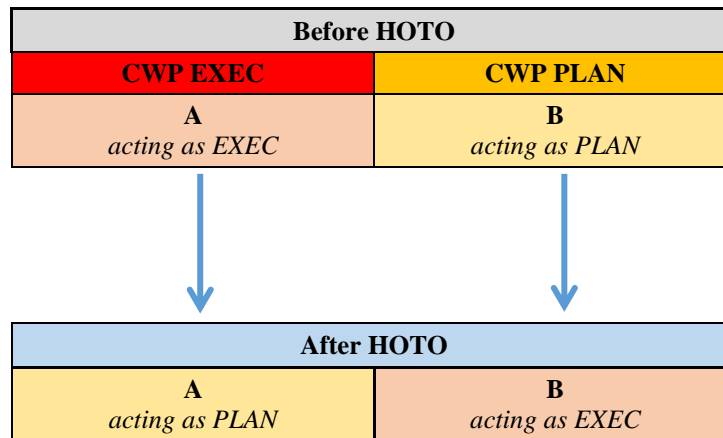


Table 2: Rotation with 2 ATCOs (non-standard)

### Advantages:

- ATCOs working with different settings don't need to adapt their personal settings.
- Doesn't require a simultaneous swap of physical positions.

### Disadvantages:

- The roles of the CWPs with specific settings are not always correctly configured.
- Telephone lines need to be forwarded with the risk that CWP Exec can't be reached if he works on CWP Plan position.
- Frequencies need to be switched with risk of missing transmissions.
- The ATCO needs to re-design his CWP for this new role (ex. Need for coordination fields on EXEC position, possible higher filter range for PLAN compared to EXEC, change of label fields, use of 2<sup>nd</sup> radar view ...)
- Complaints from coordination partners on receiving calls from PLAN but expecting EXEC "priority" coordination. Also confusion on how to reach EXEC or PLAN if needed.
- Since there is no physical change of positions, the HOTO could be reduced to the minimum or be inexistent, and the mind-set of having a new role may take more time.

**Current use:** ACC in case of a system change because ATCOs need to be familiar with new system and e.g. strip-less environment. With the swapping of positions' roles, ATCOs could remain at their CWP and didn't need to adapt their CWP each time to their personal preferences.

### 4.3 Rotation with 3 ATCOs (NEW to “HOT to COLD”)

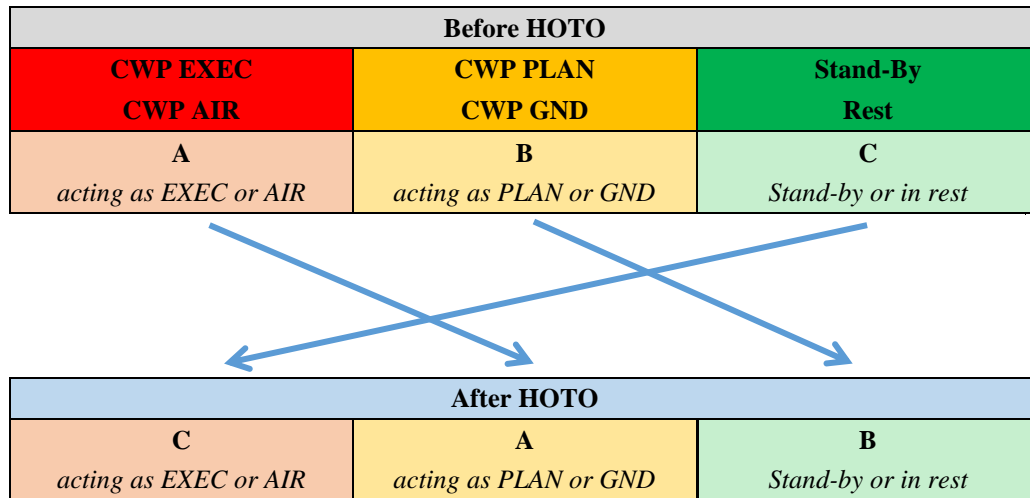


Table 3: Rotation with 3 ATCOs - "HOT to COLD"

#### Advantages:

- The role of the CWP with specific settings remains the same.
- Telephone lines and frequencies remain on the same CWP.
- Since the physical change of positions is done, the HOTO is better achieved, because the physical swap helps the mind-set of having a new role.
- ATCO who has been working in “hot” seat remains at the sector in case situational awareness of “new” ATCO is not fully complete.
- Full HOTO is needed between “hot” and “new” ATCO but in case of no full situational awareness or additional needs the previous “hot” ATCO is still at the sector. Smaller HOTO on coordination issues is usually needed between “hot” and “cold” ATCO

#### Disadvantages:

- ATCOs working with different settings need to adapt each time their personal settings.
- During heavy traffic period ATCO who had the “hot” seat needs to remain at sector before going on break.

## 4.4 Rotation with 3 ATCOs (NEW to “COLD to HOT”)

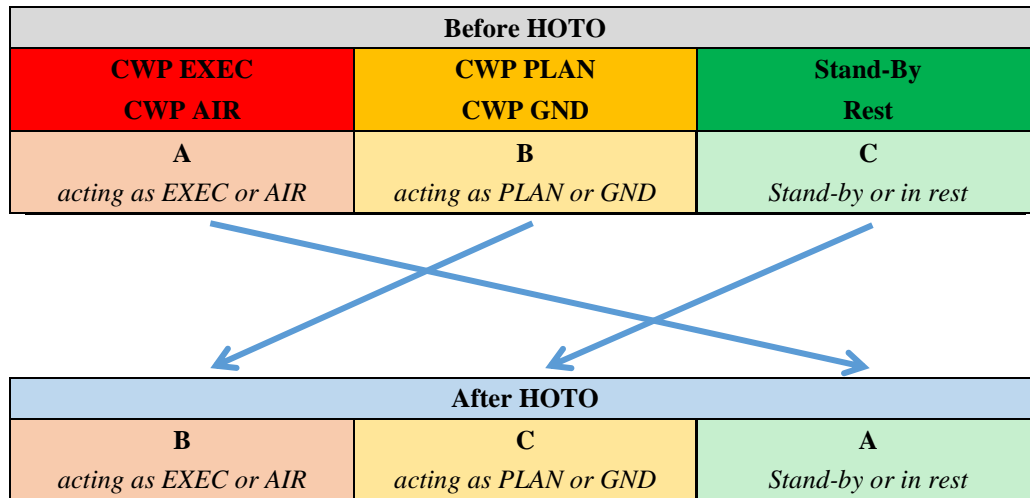


Table 4: Rotation with 3 ATCOs - "COLD to HOT"

### Advantages:

- The role of the CWP with specific settings remains the same.
- Telephone lines and frequencies remain on the same CWP.
- Since the physical change of positions is done, the HOTO is better achieved, because the physical swap helps the mind-set of having a new role.
- In heavy traffic situations controller who was working in “hot” seat can go on break.

### Disadvantages:

- ATCOs working with different settings need to adapt each time their personal settings.
- Higher risk of not giving full HOTO from “cold” to “hot” position, since the “hot” ATCO assumes “cold” ATCO has sufficient situational awareness.
- Higher risk that current traffic situation is not fully understood by ATCO changing from “cold” to “hot” position since he was giving full HOTO to “new” ATCO.



## 4.5 Rotation with 3 ATCOs (Swap of position)

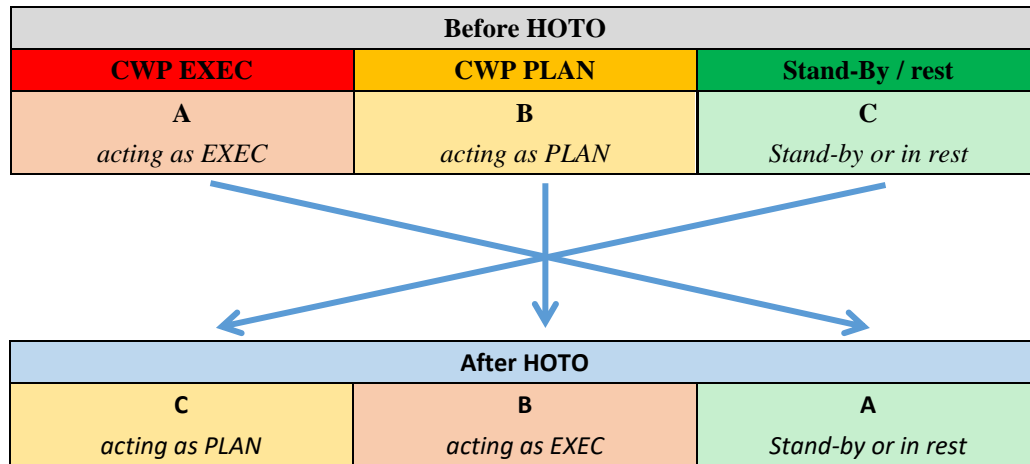


Table 5: Rotation with 3 ATCOs - Position Swap

### Advantages:

- ATCOs working with different settings don't need to adapt their personal settings.
- Doesn't require a simultaneous swap of physical positions.
- In heavy traffic situations controller who was working in "hot" seat can go on break.

### Disadvantages:

- The roles of the CWPs with specific settings are not always correctly configured.
- Telephone lines need to be forwarded with the risk that CWP Exec can't be reached if he works on CWP Plan position.
- Frequencies need to be switched with risk of missing transmissions.
- The ATCO needs to re-design his CWP for this new role (ex. Need for coordination fields on EXEC position, possible higher filter range for PLAN compared to EXEC, change of label fields, use of 2<sup>nd</sup> radar view ...)
- Complaints from coordination partners on receiving calls from PLAN but expecting EXEC "priority" coordination. Also confusion on how to reach EXEC or PLAN if needed.
- Higher risk of not giving full HOTO from "cold" to "hot" position, since the "hot" ATCO assumes "cold" ATCO has sufficient situational awareness. (ref. loss of separation para EBZW)
- Higher risk that coordination issues are not given to "new" ATCO because he receives HOTO from "hot" ATCO who was EXEC.
- Since there is no physical change of positions, the mind-set of having a new role may take more time.

## 4.6 Rotation with 4 ATCOs (NEW team)

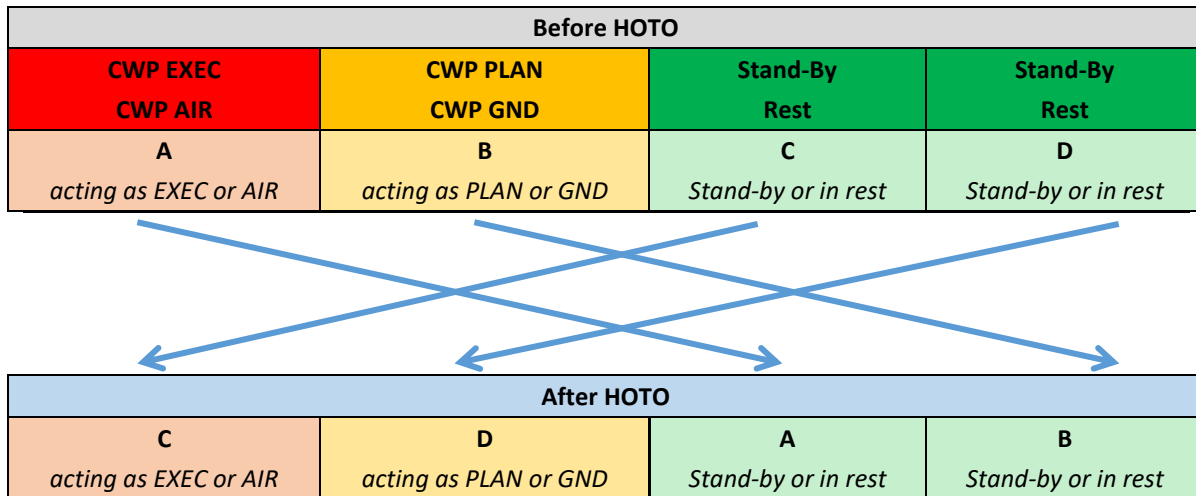


Table 6: Rotation with 4 ATCOs - Change of Team

### Advantages:

- The roles of the CWPs with specific settings remain the same.
- Telephone lines and frequencies remain on same CWP.
- Since both ATCOs have to give a HOTO to 1 “new” ATCO, the HOTO is usually better given / really needed.

### Disadvantages:

- ATCOs working with different settings need to adapt their personal settings.
- Requires a simultaneous HOTO of both positions.
- Simultaneous HOTO of both positions has to be avoided as much as possible<sup>12</sup>. Both new ATCOs can have no full situational awareness, and, after a short while, preceding ATCOs are no longer available on position.

<sup>12</sup> The ACC Ops Manual states: “Simultaneous take-over of all the sector positions (e.g. both Executive and Planner Controllers) should be avoided.

## 4.7 Rotation with 4 ATCOs (NEW team with position swap)

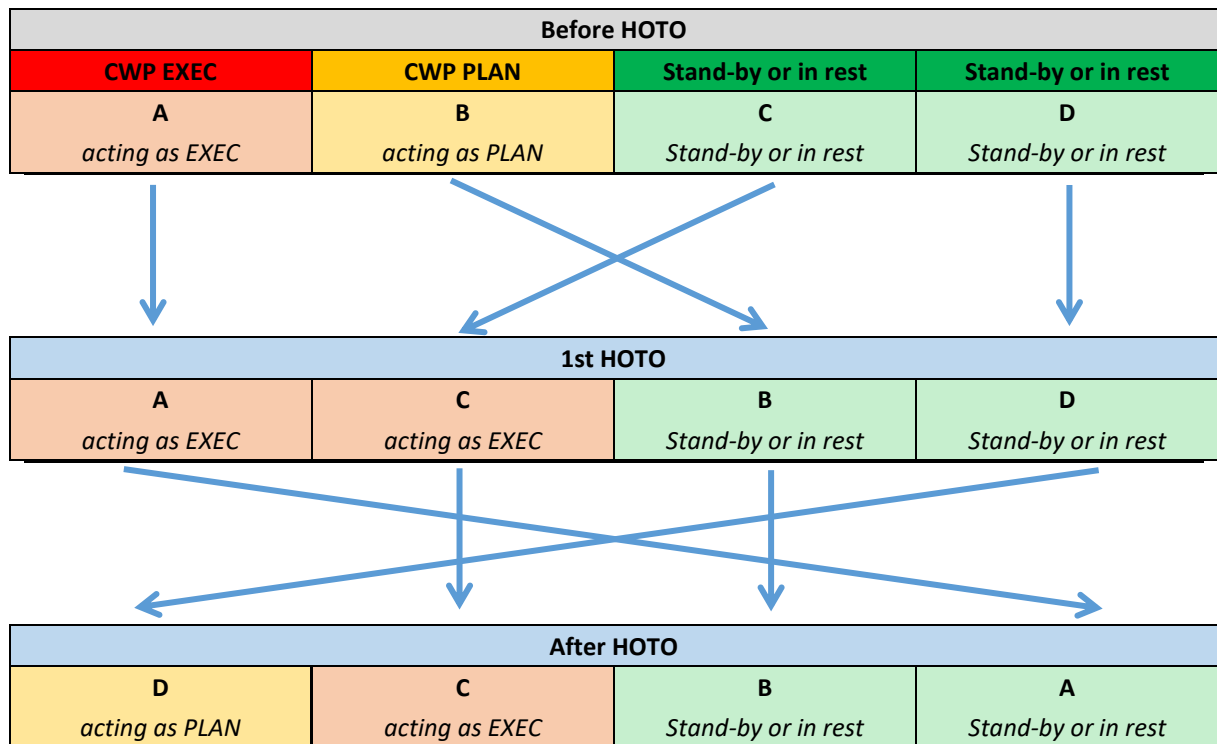


Table 7: Rotation with 4 ATCOs - Change of Team with swap of position

### Advantages:

- “new” ATCO can prepare his personal settings before starting as EXEC

### Disadvantages:

- ATCOs working with different settings need to adapt their personal settings.
- Requires a simultaneous HOTO of both positions.
- First “new” ATCO receives HOTO from PLAN, then second HOTO from EXEC when frequency is swapped.
- High risk of not giving full HOTO on coordination issues since old PLAN gives HOTO to new EXEC, but new PLAN receives HOTO from old EXEC
- The roles of the CWPs with specific settings are not always correctly configured.
- Telephone lines need to be forwarded with the risk that EXEC can’t be reached if he works on CWP PLAN position.
- Frequencies need to be switched with risk of missing transmissions.
- Both ATCOs need to re-design their CWP for their new role (ex. Need for coordination fields on EXEC position, possible higher filter range for PLAN compared to EXEC, change of label fields, use of 2<sup>nd</sup> radar view ...)
- Complaints from coordination partners on receiving calls from PLAN but expecting EXEC “priority” coordination. Also confusion on how to reach EXEC or PLAN if needed.
- High risk that new team has insufficient traffic situation awareness due to simultaneous HOTO on top of switching positions. (ref. occurrence with TCAS Resolution)

## 4.8 Conclusion

If during HOTO we want to assure that both ATCOs have the same information and the full picture, the HOTO should be done on the same CWP.

When the HOTO is done with switch of position, the outgoing ATCO must make sure that all necessary information is displayed on the takeover position after the HOTO (relevant maps, essential information, highlights, etc...)

## Appendix A Communication Theory & Implications for Effective Shift Handover Communication<sup>13</sup>

<b>Aids to effective communication</b>	<b>Implications for effective shift handover communication</b>
The intended communication must first be encoded and physically transmitted in the form of a signal, which may be written, spoken or gestured. The introduction of redundancy to a communication reduces the risk of erroneous transmission. Redundancy refers to repetition of a message by more than one communication channel, i.e. written, verbal or non-verbal.	Information should be repeated via more than one medium, e.g. verbal and one other method (for example: written, diagrammatic etc..)
Availability of feedback increases accuracy of communication	Two-way communication with feedback is essential at shift handover
Effective communication can be aided by qualitative aspects of speech, such as assessments of comprehension, confidence, competence gained via pace, phrasing, hesitancy and fluency.	Verbal face-to-face communication at handover is desirable
Accurate alignment of present and future perceived system states (mental models) with actual system states, depends on successful communication. Successful communication is facilitated by a shared mental model.	Miscommunications and misunderstanding are most likely to occur when mental models held by incoming and outgoing personnel differ widely. This can occur during deviations from normal working, plant maintenance, following a lengthy absence and between experienced and inexperienced staff. In order to achieve shared mental models, handovers can be expected to take longer at such times.
Written communication is facilitated by design of documents which consider the information needs of the user, support the communication task and demand inclusion of relevant categories/types of information	Operator supports (logs, computer displays) based on specification of the information needs of personnel at shift handover are likely to facilitate accurate communication.
<b>Barriers to effective communication</b>	<b>Implications for effective shift handover communication</b>
The intended message may be buried in irrelevant, unwanted information or “noise”, which requires time and effort to extract and interpret	Key information needs to be specified and presented, and irrelevant information excluded.

<sup>13</sup> Ronny Lardner, June 1996, “Effective Shift Handover – A literature Review”, prepared for the Health and Safety Executive Offshore Safety Division, The Keil Center, <http://www.hse.gov.uk/research/otopdf/1996/oto96003.pdf>

<b>Aids to effective communication</b>	<b>Implications for effective shift handover communication</b>
Natural language is inherently ambiguous	Effort needs to be expended to reduce ambiguity by <ul style="list-style-type: none"> <li>1) carefully specifying the information to be communicated</li> <li>2) facilitating two-way communication which permits clarification of ambiguity (which process are you referring to?)</li> </ul>
Transmission of information is limited by the capacity of the communication channel	Eliminate unnecessary information
Misunderstandings are an inevitable feature of human communication and effort needs to be expended to identify, minimise and repair misunderstandings	Communication needs to be two-way, with both participants taking responsibility for achieving accurate communication.
People and organisations frequently refer to communication as unproblematic, implying successful communication is easy and requires little effort. Over-confidence and complacency are common	Effort needs to be expended by organisations to address complacency by <ul style="list-style-type: none"> <li>a) emphasising the potential for miscommunication and its possible consequences</li> <li>b) setting standards for effective communication</li> <li>c) developing the communication skills of organisational members</li> </ul>