EUROPEAN ORGANISATION FOR THE SAFETY OF AIR NAVIGATION

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Simulations Facilities for Air Traffic Control Training

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Abstract

This document proposes an analysis of the current practices in training simulations and a classification of the type of exercises and of the equipment. It compares Air Traffic Control (ATC) and flight simulators against questions on the opportunity to detail the requirements of the fidelity of simulators according to the training phase.

Keywords

Simulation (SIMUL)	Training Phases	Computer-based Training (CBT)
Training Design	Skill Acquisition (SA)	Training Centres
Simulator Requirements	Part-Task Practice (PTP)	Training Practices

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The use of simulation in the training process of Air Traffic Controllers (ATCOs) is today the main training/learning method and this will continue in the future.

So far the terminology used in describing the simulators, their parts and uses, has not been universally established or standardised. This causes considerable confusion among the groups of users and in the communication between users and the manufacturers. In order to remedy this situation the Task Force Technology-based Training Tools and Methods (TF-TTM) of the EATCHIP/EATMP[1] Human Resources Team (HRT) analysed the current and future training processes using simulators and simulation media. Based on the results of this survey it then defined training steps and uses.

In this analysis it has been found useful to compare the uses of Air Traffic Control (ATC) simulators and the related terminology with the already existing standards for flight simulators. Joint Aviation Authorities standards (JAA-1 and JAA-3) thus served as a benchmark for a similar system for ATC simulators. This comparison (see Chapter 4 of this report) ends with stating an objective for the improvement of training efficiency in the context of ATC.

After agreeing on a set of definitions about simulation processes and the simulator equipment the following five types of exercises were determined:

1. Skill Acquisition (SA).
2. Part-Task Practice (PTP).
3. Individual Simulation (IND SIMUL)
4. Team Simulation (TEAM SIMUL)
5. Group Simulation (GROUP SIMUL).

The following four types of equipment were also determined:

1. High-fidelity Simulator (HI FI SIM).
2. Simulator (SIM)
3. Part-Task Trainer (PTT).
4. Other Training Device (OTD).

Among the functionality and characteristics of simulators one characteristic has been particularly scrutinised: the fidelity to reality. The following four levels categorised from D to A have been established:

D. Real.
C. Very close to real.
B. Generic.
A. No importance.

[1] European Air Traffic Control Harmonisation and Implementation Programme / European Air Traffic Management Programme

After some considerations on cost the report ends with a conclusion on the improvement of training efficiency. Annexes, which consist of References, a Glossary of definitions, Abbreviations and Acronyms, and a list of the Contributors to this report, are provided at the end of this document.

Note: It is essential, in order to avoid any misunderstanding, to bear in mind that the meaning of the terms used in this document is as per the definitions provided in the Glossary and not the one that may be known or used by the reader in his/her professional environment.

1. INTRODUCTION

1.1 Background

Further to the recommendations made within the ECAC[2] Strategy for the nineties, the **Task Force Technology-based Training Tools and Methods (TF-TTM**) was created, under the auspices of the EATCHIP[3] Human Resources Team (HRT), by the Training Sub-Group at its seventh meeting (TSG7) on 2-3 June 1997 within the Human Resources Domain (HUM), to deal with a part of the subject of the Specialist Task covering the application of training methods and the provision of training tools (ST07.3000). The Task Force was only later, in 1998, established.

This is the second report produced by TF-TTM, the first one (EATCHIP, not published), dealing with some procedures for Computer-based Training (CBT) updating and with the provision of information on the Internet.

1.2 Terms of Reference of the Task Force

1.2.1 Objective

The objectives of the Task Force **Technology-based Training Tools and Methods (TF-TTM)** shall be to develop ideas, guidelines and tools for the efficient and harmonised creation of new generation teachware and define key functionalities of advanced training tools.

The Task Force shall acquire information from relevant industries and agencies and shall provide documents in order to ensure, in the future, that users develop training ideas which are realistic and that providers will be enabled to construct equipment that is needed.

The Task Force shall ensure that it takes full cognisance of the impact of technology in the Human Factors context. The importance of behavioural aspects shall be taken into account in the development of any tools and methodologies. Regular coordination shall take place with the task forces on Job Description, Selection, Licensing and Common Core Content (CCC).

1.2.2 Authority

The Task Force Technology-based Training Tools and Methods (TF-TTM) is created under the auspices of EATCHIP (now EATMP) and shall report to the Training Sub-Group (TSG) of the EATCHIP\EATMP Human Resources Team (HRT).

[2] The European Civil Aviation Conference
[3] The 'European Air Traffic Control Harmonisation and Integration Programme', now the 'European Air Traffic Management Programme (EATMP)'

1.2.3 Tasks

The Task Force Technology-based Training Tools and Methods (TF-TTM) shall, as its first priority:

a) Define mechanisms for the maintenance and updating of current CBT guidelines, and specify and define the next generation of CBT templates;

b) Develop guidelines for the establishment of a system for the provision of information on the Internet about existing Air Traffic Management (ATM) teachware;

c) Identify and describe technology-based teaching support tools and methods.

Subsequently it shall:

d) Identify new, and for ATM training usable, technology-based training tools and methods and suggest development of projects of common interest with special regards to human aspects developments;

e) Identify and describe teaching support tools and methods desirable on new generation simulators;

f) Develop guidelines for third generation simulator training philosophies and methods, which take into account output from (e) above.

1.2.4 Milestones

The Task Force Technology-based Training Tools and Methods (TF-TTM) shall meet the following three milestones:

Provision of draft deliverables about updating procedures for CBT new templates and methods of distribution	June 1998
Provision of draft deliverables on simulation and its tools	March 1999
Provision of draft deliverables on training methods and tools	December 1999

1.3 Scope of the Document

This document is an intermediate report. It will be consolidated and integrated into a future deliverable entitled ‘Specification of Training Methods and Tools’ (EATMP, expected year of publication: 2001).

1.4 Characterisation of the Approach

The approach is a human-centred approach. The Task Force always focused on the optimisation of the learning process: this explains why our classification is mainly based on the training progression rather than on the physical characteristics of the equipment. Human factors are, as required by TSG, given priority on the hardware.

The approach is also based on the very valuable experience of ATC training centres in Europe today. These explain why Chapters 6 to 9 on current practices have been included in this report and the reason of our concern in a definition of functions to be performed and the benchmarking with other fields of activities.

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2. CLASSIFICATION OF ATC TRAINING SIMULATORS

2.1 Introduction

It is easy and frequent in everyday language to mix the simulator and the simulations which are played on them, to mix exercises and their support. In addition to this source of confusion the terms used in both domains are so widely accepted that we end by calling very different things at very different levels of cost and of sophistication with the same name.

In this paragraph we have based our work on the already approved document 'Specifications of Training Tools and Methods Air Traffic Control – Volume 1: Guidelines on Tools and Methodology for the Development and the Provision of ATC Training (with Examples on ATCO Basic Training Phase)' (EATCHIP, 1999a) to create a rationale in order to clarify all this terminology.

2.2 Simulations and Simulators

2.2.1 Definitions

The process is to consider a model of communication where the learner, either **individually** or **in group** receives information through a **media** at a **rate** according to a **method**. The combination of these elements defines the training event. In this report the method is always simulation.

2.2.1.1 Media

Media is the physical means by which an instructor or a training designer communicates a message. One media can use several supports (for instance, a Multimedia Computer (MMC) could use a diskette or CD-ROM). In this document we are going to define the media related to simulation but shall not attempt to make an exhaustive list of the many types of support and educational materials.

For our concern we need to define the following five media:

1. *Real Equipment*

Either used in operational conditions (On-the-Job Training [OJT]) or in non-operational conditions (shadowing or demonstration).

2. HI FI SIM: *High-fidelity Simulator*

A full size replica of Controller Work Positions (CWPs) including all equipment and computer programmes necessary to represent full tasks of the sector or the tower and their environment. In the case of aerodrome it includes an out-of-the-tower view.

3. SIM: *Simulator*

A device which represents the student a representation of the important features of the real situation and reproduces operational conditions which enable him/her to practise real-time tasks directly.

4. PTT: *Part-Task Trainer*

A training machine which allows the student to practise some operational functions independently from other functions which are not represented there, although they are necessarily associated to the first ones in the operational task.

5. OTD: *Other Training Device*

A training machine that allows to present the student with some operational functions on a non-realistic reproduction of the operational devices. It includes a generic MMC. An MMC or workstation (networked or stand-alone) is dedicated to one student or to a small cell. The hardware is off-the-shelf and has not been deeply modified for specific ATC purposes.

2.2.1.2 Rate of Learning

We might use any of the three rates of learning although most of our exercises will be in real time.

1. SELF: *Self-paced Learning*

A learning/teaching system whereby the learner is able to control the pace at which he/she works.

2. RSTD: *Time-restricted learning*

A learning/teaching system whereby the course developer or the instructor controls the pace at which the learner has to work.

3. REAL: *Real Time*

A learning/teaching system whereby the pace at which the learner has to work is the same than in real operation.

2.2.1.3 Method

The only method to be used is simulation but, due to the importance of simulation and its extensive use, we have defined several **types of simulation** and differentiated between pre-simulation and simulation exercises, and we have added the notion of guided simulation.

Note: Further refinements might be necessary and they require to go to the level of training events. At this report level the introduction of simulation type allows to access to the appropriate level of accuracy.

1. SIMUL: *Simulation*

Provision of knowledge, skills and attitudes by means of a representation of air traffic responding to any student action as real air traffic. Simulation always includes briefing, tutoring and debriefing.

2. GSIMUL: *Guided Simulation*

There is extensive interaction between the student and the computer in the form of questions, feedback, comments, instructions and assessment. This guidance assumes the existence of a theoretical model against which the student can be compared.

2.2.2 Types of Simulations

- ***Individual Simulation (IND SIMUL)***

  Real-time full-task simulation involving a single student.

- ***Team Simulation (TEAM SIMUL)***

  Real-time full-task simulation involving an individualised cell made of several students. A team consists of two or more students who are required to work together on related or interacting tasks.

- ***Group Simulation (GROUP SIMUL)***

  Real-time full-task simulation involving several individual or team simulations simultaneously.

2.2.3 Types of Pre-simulations

- ***Skill Acquisition (SA)***

  It allows self-pace, restricted or real-time practice of a part of the skills necessary for the operational task in a possibly non-realistic environment (e.g. 2-D aerodrome).

- ***Part-Task Practice (PTP)***

  It allows to practise, in restricted or in real time, a part of the skills which are necessary for the operational task in a realistic environment (PTT or SIM).

- ***Guided Skill Acquisition (GSA)***

  SA with interactive assessment, comments and guidance.

- ***Guided Part-Task Practice (GPTP)***

  PTP with questions, feedback, comments, indications and assessment.

2.2.4 Training Events Supplementary to Simulation

A training event is a set of actions (instructional events) identified in the training program and the student timetable as the smaller unit. The training event has a name but is more accurately described by the association of a method, media, learning rate and mode of delivery. However, we have stopped our terminology at the type of simulation because the combination becomes too numerous. There are also supplementary training events that have to be performed along with the simulation.

- **Brief*: Briefing***

  With regard to training a briefing is an introduction for a training event during which interruption of the student's activity is not normally anticipated (e.g. OJT and simulation). Briefing and debriefing are always included as an integral part of the training technique and considered as supplementary training events.

- **Debrief*: Debriefing***

  With regard to training a debriefing is a review and discussion on the outcome of a training event based on a formative assessment of that event. Briefing and debriefing are always included as an integral part of the training technique and considered as supplementary training events.

- ***Tutoring***

  The act of giving additional knowledge and guidance to an individual or small group of trainees in an off-the-job, informal training situation. Tutoring is considered as a supplementary training event and may be automated in the case of guided simulation.

2.2.5 Best Use

The following is a rough idea on which media best suits each type of simulation. This notion will be further detailed according to the phase of training and the nature of the control (centre or aerodrome).

Training institutes will optimise their practices by offering the adapted equipment to the required practice.

The Task Force strongly believes that practice and theory have to be mixed right from the beginning of the training.

> A training process where first a Skill Acquisition (SA) is proposed, followed by some Part-Task Practice (PTP) and then by simulations. Allows to optimise the efficiency of the training.
>
> The increase of the requirement of training resources is managed so that the additional resources are only provided when needed; SA is done on a generic device, the task is practised on a Part-Task Trainer (PTT) while integration of the tasks, strategy and judgement are performed in front of a realistic simulation.

These principles might be amended to adapt to local specificity (such as a momentary over capacity of simulator positions and a lack of PTT positions that lead to practise part task on a simulator).

	Other Training Device (OTD)	**Part-Task Trainer (PTT)**	**Simulator (SIM)**	**High-fidelity Simulator (HI FI SIM)**
Skill Acquisition (SA)	Best use ✦ ✦ ✦	Not necessary	Not necessary	Not necessary
Part-Task Practice (PTP)	Not sufficient	Best use ✦ ✦ ✦	Best use ✦ ✦ ✦	Not necessary
Individual Simulation (IND SIMUL)	Not sufficient	Not sufficient	Best use ✦ ✦ ✦	Best use ✦ ✦ ✦
Team Simulation (TEAM SIMUL)	Not sufficient	Not sufficient	Best use ✦ ✦ ✦	Best use ✦ ✦ ✦
Group Simulation (GROUP SIMUL)	Not sufficient	Not sufficient	Best use ✦ ✦ ✦	Best use ✦ ✦ ✦
Guided Simulation (GSIMUL)	Not existing	Not existing	Not existing	Not existing

2.3 Fidelity of Simulators

The Task Force tried to detail the notion of 'fidelity'. Fidelity is the degree to which simulation matches the real system and the environment in terms of physical characteristics, functional characteristics (stimulus and response options) and conceptual fidelity (realism of the thought processes stimulated in the student).

The final aim was to be able to define a 'global' category of fidelity for equipment. However, it was felt necessary to first define which features the simulators replicated. During this process it was not obvious that the best way to conceive the equipment was to determine an homogeneous level of fidelity. For example, at some training stage it might be required to display a high level of fidelity to the real aircraft performances while requirement on the fidelity to the display of data is not so high.

This is why we developed the fidelity tables.

2.3.1 Fidelity Tables

There are two types of tables. One is related to simulators including an out-of-the-tower view (aerodrome simulators); the other does not require such a view (centre simulators*).*

These tables list the categories of constituents of a simulator from a controller's point of view.

The simulator is considered to be made of the four following categories of constituents:

- **Equipment**,
- **Environment**,
- **Human Resources**,
- **Air Traffic Model**.

The constituents are further divided if necessary and their list might be increased due to the occurrence of new operational components or to the specificity of the activity to simulate.

For each of the constituents three requirements are considered:

- **Reality,**
- **Presentation,**
- **Performance**.

The Reality means that a piece of the operational equipment is used in the simulator: the two other columns are then not relevant.

The Presentation broadly means that the simulated world looks like the real one.

The Performance means that it acts and reacts like the real one.

The table answers the following questions:

- To perform a certain type of simulation which degree of fidelity is required for equipment, for environment and for human actors in terms of presentation or performance?
- Which part needs to be a real one?
- How accurate should the model be?

The tables are also used to describe an existing simulator.

The tables only specify the level of fidelity, and so do not include considerations on the tutoring, the guidance or the creation of exercises which are essential functions but not part of the fidelity.

2.3.2 General View

This view summarises the items developed in Chapter 2.3.1 concerning the fidelity tables.

Code of Table	Centre or Aerodrome	Type of Simulation	**Real**	**Presentation**	**Functionality or Behaviour**
		Training phases	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Equipment	Information Displays				
	Air/Ground Communication				
	Human-Machine Interaction				
	CWP (Console)				
	Ground/Ground Communication				
Environment					
Air Traffic Model					
Human Resources					

Meaning of the four levels:

Level D: Real.
Level C: Very close to real, respect the specifications of the operational item or activity.
Level B: Generic.
Level A: No importance.

For Human Resources the four levels need to be defined differently:

Level D: Qualified ATC Instructor/Professional Pilot or Blip Driver.
Level C: Any person who follows a script.
Level B: No human/system simulated.
Level A: None.

Every item is likely to be further extended according to the local specificities. Generic expanded tables are after the example of one fidelity table. They are to be used as a 'legend' when making use of one of the tables.

2.3.3 Training Phases in ATC Training

The following definitions are in line with the proposals of the EATMP Licensing Group and the Common Core Content Task Force (TF-CCC) as drafted in March 1999:

- **Institutional Training**

  Training provided in an establishment designed or designated specifically for training, and staffed for that purpose. It comprises basic training and rating training:

  ⇨ **Basic Training**

  Training designed to impart fundamental knowledge and skills, to enable student ATCOs to progress to specialised ATC training.

  ⇨ **Rating Training**

  Specialised ATC training to provide knowledge and skills related to a job category and appropriate to the discipline to be pursued in the ATS environment. (Pending definitions: types of rating training.)

- **Operational Training**

  Training given in the operational work situation and following institutional training. It comprises transition training, pre-OJT and OJT:

  ⇨ **Transition Training**

  Phase following rating training during which site-specific theoretical knowledge and understanding will be transferred to the trainee using a variety of methods and during which skills will be developed through the use of site-specific simulations.

  ⇨ **Pre-OJT**

  Phase of locally based training during which extensive use of simulation using site-specific facilities will enhance the development of previously acquired routines and abilities to an exceptionally high level of achievement.

  ⇨ **OJT**

  'Live training' where previously acquired skills and routines are further developed and consolidated under the supervision of a qualified coach in a live traffic situation.

2.3.4 Codes of Fidelity Tables

Our purpose is to determine which level of fidelity is required to perform an exercise defined by two parameters: a type of simulation and a phase of the training. These define 35 types of exercises that we coded according to the following table:

	Institutional Training (Centre)	**Institutional Training (Aerodrome)**	**Pre-OJT (Centre)**	**Pre-OJT (Aerodrome)**	**Continuation Training (emergency, new procedure, refresher, TRM)**
Skill Acquisition (SA)	IC1	IT1	OC1	OT1	E1
Part-Task Practice (PTP)	IC2	IT2	OC2	OT2	E2
Individual Simulation (IND SIMUL)	IC3	IT3	OC3	OT3	E3
Team Simulation (TEAM SIMUL)	IC4	IT4	OC4	OT4	E4
Group Simulation (GROUP SIMUL)	IC5	IT5	OC5	OT5	E5

2.3.5 Requirements According to the Type of Exercise

Using the preceding definitions we are now able to state the requirements on the simulator for each type of exercise.

As this report is an intermediate report TF-TTM decided to give one example of such requirements on IC5 (decoded: Institutional Centre Group Simulation). The Training Sub-Group (TSG) asked the task to be pursued for the other types of exercises (e.g. the operational and conversion training). This work will then lead us to a maximum of 35 tables from which we can try to ‘reverse’ to the attribution of a global level of fidelity.

The following fidelity table illustrates the example IC5: Institutional Centre Group Simulation.

IC5: Institutional Centre Group Simulation

IC5	Centre	Group Simulation	Real	Presentation	Functionality or Behaviour
		Rating Training	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Equipment	Information Displays	Traffic display		B	B
		Flight data display (electronic and or strip)		B	B
		Additional info (met, frequencies, runways in use, etc.)		C	C
		Assistant tools (conflict detection, arrival manager or sequencing program, etc.)		B	B
	Air/Ground Communication	R/T		C	B
		Datalink		B	B
	Ground/Ground Communication	Telephone		C	B
		Datalink		B	B
	Human-Machine Interaction	Input devices: mouse, push button, keyboard, trackball, etc.		B	B
	CWP (Console)			C	C

Level D: Real.

Level C: Very close to real, respect the specifications of the operational item or activity.

Level B: Generic.

Level A: No importance.

IC5: Institutional Centre Group Simulation (continued)

IC5	Centre	Group Simulation	Real	Presentation	Functionality or Behaviour
		Rating Training	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Environment		1) General ambience of simulator room 2) Relative position of CWP 3) Relative positions of actors		B	N/A
Air Traffic Model		Aircraft movements		B	B
		Sector geography		B	B
		Aircraft equipment (datalink, 4D, etc.)		B	B
		Sample of traffic		B	B
Level D: Real. Level C: Very close to real, respect the specifications of the operational item or activity. Level B: Generic. Level A: No importance.					

IC5	Centre	Individual Simulation	Real	Presentation	Functionality or Behaviour
		Rating Training	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Human Resources		Team mate		D	D
		Adjacent controllers		C	C
		Pilots		B	B
For Human Resources the four levels need to be defined differently: Level D: Qualified ATC Instructor/Professional Pilot or Blip Driver. Level C: Any person who follows a script. Level B: No human/system simulated. Level A: None.					

2.3.6 Presentation of the Table: CENTRE

The following table sums up the meaning of levels A, B, C or D for each of the items of the centre simulator.

Code of Table	Centre or Aerodrome	Type of Simulation	**Real**	**Presentation**	**Functionality or Behaviour**
		Training phases	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Equipment	Information Displays	Traffic display	Use of a 2kx2k or of an OTS 23 inches	Look of traffic symbols	Modification of traffic symbols upon user action
		Flight data display (electronic and/or strip)		Look of info	User actions: search, sort, etc.
		Additional info (met, frequencies, runways in use)	Real system or table on a PC screen	Look of info	User actions: search, sort, etc.
		Assistant tools (conflict detection, arrival manager or sequencing program, etc.)	Real system or table on a PC screen	Look on display	Accuracy of indications, reaction to user queries
	Air/Ground Communication	R/T	Use of pro-intercom	Headset, pedal, frequency selection device	Frequency changes ,on and off, talk and listen, sound
		Datalink	Real system or table on a PC screen	Look of info	Reaction on controller input, display of pilot or system inputs
Level D: Real. Level C: Very close to real, respect the specifications of the operational item or activity. Level B: Generic. Level A: No importance.					

Presentation of the Table: CENTRE (continued)

Code of Table	Centre or Aerodrome	Type of Simulation	**Real**	**Presentation**	**Functionality or Behaviour**
		Training phases	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Equipment	Ground/ Ground Com.	Telephone	Head set dialling device	On and off, sounds, signals, dialling principles	On and off, sounds, signals, dialling principles
		Datalink	Real system or table on a PC screen	Look of info	Reaction on controller input, display of other team members
	Human-Machine Interaction	Input devices: mouse, push button, keyboard, trackball, etc.		Look of dialog means and devices	Use of the devices by the controller
	CWP (Console)		Real console or kitchen furniture	Look of the console, relative position of the CWP components	Performance of miscellaneous items such as light
Environment		1) General ambience of simulator room 2) Relative position of CWP 3) Relative positions of actors	Part of OPS room or full replica or desktop simulator	Noise, etc. Physical organisation	N/A
Level D: Real. Level C: Very close to real, respect the specifications of the operational item or activity. Level B: Generic. Level A: No importance.					

Presentation of the Table: CENTRE (continued)

Code of Table	Centre or Aerodrome	Type of Simulation	**Real**	**Presentation**	**Functionality or Behaviour**
		Training phases	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Air Traffic Model		Aircraft moves	Real only when linked to Flight Simulator Training (JOINT)	*Appearance of moves (turns, image updating rate)*	Accuracy of performances
		Sector geography	Real or generic	Layout of the sector	Activation of zones, constraints, SID, STAR, LOA
		Aircraft equipment (datalink, 4D, etc.)	Real only when linked to Flight Simulator Training (JOINT)	Discrimination of the types of a/c on controller tools	Content of air system input
		Sample of traffic	Real only when extracted as a block from real traffic	Airlines, call signs, types of aircraft	Traffic load, nature and number of conflict, timing
Level D: Real. Level C: Very close to real, respect the specifications of the operational item or activity. Level B: Generic. Level A: No importance.					

Presentation of the Table: CENTRE (continued)

Code of Table	Centre or Aerodrome	Type of Simulation	**Real**	**Presentation**	**Functionality or Behaviour**
		Training phases	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Human Resources		Team mate		Sound like	Production of part of the team work
		Adjacent controllers		Sound like	Content of coordination, realistic negotiation, corresponding inputs
		Pilots	Real only when pilots are involved in Fight Simulator Training (JOINT)	Sound like, human voice or synthetic voice	Content of voice com., content of datalink pilot input

For Human Resources the four levels need to be defined differently:

Level D: Qualified ATC Instructor/Professional Pilot or Blip Driver.

Level C: Any person who follows a script.

Level B: No human/system simulated.

Level A: None.

2.3.7 Presentation of the Table: AERODROME

Code of Table	Centre or Aerodrome	Type of Simulation	**Real**	**Presentation**	**Functionality or Behaviour**
		Training phases	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Equipment	Information Displays	Traffic display	N/A	Look of: • airfield, • aircraft, • vehicles, • vision (day, night, rain, fog), • lighting.	Lighting
		Flight data display (electronic and or strip)		Look of info	User actions: search, sort, etc.
		Additional info (met, frequencies, runways in use, etc.)	Real system or table on a PC screen	Look of info	User actions: search, sort, etc.
		Assistant tools (conflict detection, arrival manager or sequencing program, etc.)	Real system or table on a PC screen	Look on display	Accuracy of indications, reaction to user queries
	Air/Ground Communication	R/T	Use of pro intercom	Headset, pedal, frequency selection device	Frequency changes, on and off, talk and listen, sound
		Datalink	Real system or table on a PC screen	Look of info	Reaction on controller input, display of pilot or system inputs
Level D: Real. Level C: Very close to real, respect the specifications of the operational item or activity. Level B: Generic. Level A: No importance.					

Presentation of the Table: AERODROME (continued)

Code of Table	Centre or Aerodrome	Type of Simulation	**Real**	**Presentation**	**Functionality or Behaviour**
		Training phases	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Equipment	Ground/Ground Communication	Telephone	Headset, dialling device	On and off, sounds, signals, dialling principles	On and off, sounds, signals, dialling principles
		Datalink	Real system or table on a PC screen	Look of info	Reaction on controller input, display of other team members
	Human-Machine Interaction	Input devices: mouse, push button, keyboard, trackball, etc.		Look of dialog means and devices	Use of the devices by the controller
	CWP (Console)		Real console or kitchen furniture	Look of the console, relative position of the CWP components	Performance of miscellaneous items such as light

Level D: Real.

Level C: Very close to real, respect the specifications of the operational item or activity.

Level B: Generic.

Level A: No importance.

Presentation of the Table: AERODROME (continued)

Code of Table	Centre or Aerodrome	Type of Simulation	**Real**	**Presentation**	**Functionality or Behaviour**
		Training phases	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
Environment		1) Full replica (360) or partial replica with real CWP or desktop screen 2) Relative positions of actors	N/A	Noise, etc Physical organisation	N/A
Air Traffic Model		Aircraft moves	Real only when linked to Flight Simulator Training (JOINT)	*Appearance of moves* *(turns, image updating rate, aliasing)*	Accuracy of performances, accuracy of positions (taxiing, parking, etc.)
		Airfield	Real or generic	Layout of the sector	Activation of zones, constraints, SID, STAR, LOA
		Aircraft equipment (datalink, 4D, etc.)	Real only when linked to Flight Simulator Training (JOINT)	Discrimination of the types of a/c on controller tools	Content of air system input

Level D: Real.

Level C: Very close to real, respect the specifications of the operational item or activity.

Level B: Generic.

Level A: No importance.

Presentation of the Table: AERODROME (continued)

Code of Table	Centre or Aerodrome	Type of Simulation	**Real**	**Presentation**	**Functionality or Behaviour**
		Training phases	**D: Yes Blank: No**	**C, B or A**	**C, B or A**
		Sample of traffic	Real only when extracted as a block from real traffic	Airlines, call signs, types of aircraft	Traffic load, nature and number of conflict, timing
Vehicles		Vehicles moves	N/A	*Appearance of moves* *(turns image updating rate, aliasing)*	Accuracy of performances, accuracy of positions
Human Resources		Team mate		Sound like	Production of part of the team work
		Adjacent controllers		Sound like	Content of coordination, realistic negotiation, corresponding inputs
		Pilots	Real only when pilots are involved in Flight Simulator Training (JOINT)	Sound like, human voice or synthetic voice	Content of voice communication, content of datalink pilot input

For Human Resources the four levels need to be defined differently:

Level D: Qualified ATC Instructor/Professional Pilot or Blip Driver.

Level C: Any person who follows a script.

Level B: No human/system simulated.

Level A: None.

3. COST OF SIMULATORS

3.1 Aerodrome Simulators

This paper considers only three dimensional (3-D) aerodrome simulators with wall screens representations.

Market evolutions on hardware make cost estimation very difficult. In this paper we will try to give estimated costs based on today state-of-the art in the domain, and particularly show how choice of lots can have a heavy influence on prices, operational costs and maintenance costs.

3.1.1 Today Costs Consideration

3.1.1.1 Allotment of costs

We define three equipment lots:

- simulator (software and hardware),
- image generator (up to nine channels),
- infrastructure (room, furniture, consoles and communication system).

We should add more lots corresponding to services:

- maintenance costs,
- environment data and mobile objects creation (new airport),
- exercises conception and maintenance,
- number of pseudo pilots used in the configurations.

3.1.1.2 Estimate of Costs

Today prices for existing configurations may vary from MEURO 1 to 4.5, without any estimation for maintenance and operational costs. The three lots (simulator, image generator and infrastructure) roughly contribute equally to the initial purchase cost. This should not hide the fact that the additional services might generate a great part of the additional cost.

3.1.2 Main Factors Influencing Costs

3.1.2.1 Image Generator

In the past years this very important part of 3-D aerodrome simulators required very costly hardware. PC-based image generators now provide lower cost aerodrome and mobile objects representations with a high level of realism. The buyer will have to choose between a very high quality and an acceptable quality of images, depending on their required training needs.

Estimated costs for PC-based image generators should be more or less one third of today prices for station-based image generators.

3.1.2.2 Number of Channels (0 to 360°)

Minimum representation to provide 3-D aerodrome simulation is 180°, the physiological characteristics of the human eye. That means three channels/ three projection systems (projectors, mirrors, wall screens).

Added cost from 180° to 360° is not simply twice the initial price. For questions of room size, projection distance, it induces eight to nine channels representation and projection system.

Price for a 360° representation will be more or less three times higher than for 180° representation. This has also an influence on maintenance costs, especially for projection systems. Setting up nine projectors is more complex and time-consuming.

For this part the choice will be between 180° (with possible 360° visualisation by switching different 180° views) or more, up to 360° permanent representation, with very high cost for visualisation. It is again a pedagogical cost-effective equipment choice.

3.1.2.3 Infrastructure

Prices for simulation room, furniture, consoles, communication system and peripheral equipment (radar display, touch input devices, lighting, weather and flow control data, etc.) will easily vary from one to five, or even more.

Again, real pedagogical needs should be expressed by people who are directly in charge of training. Choice will have to be made between a full replica of control tower equipment and a realistic simulator with generic pieces of equipment which is efficient enough for the required training.

The number of control (student) positions is also important. How many are necessary to provide efficient *Ab Initio* continuous training? Do training aims require to reproduce all the positions of a big size airport simultaneously?

This choice will determine prices for equipment but also for pseudo pilots and instructors according to the necessary number. It will also influence the complexity of exercises (preparation and documentation).

3.1.2.4 Simulation Functions

In this domain too much difference between acceptable realism for training and full replica of an airport with all features and hundreds of different mobile objects (sometimes including airport workers and birds ...) will strongly increase software development costs and time.

More complexity in software produces operational problems (bugs) in the first months, inducing delays to run exercises - to produce efficient training. This cost is difficult to evaluate. However, it does exist.

3.1.2.5 Pseudo pilots Interfaces and Real-time Functions

Design of pseudo pilot interfaces and complexity of real-time pilot functions have a major influence on operational costs because of the number of piloting operators required for each control position. This number can vary from one to four and significantly increase the operational costs when professional operators are used.

3.1.2.6 Environment Data and Mobile Objects Creation (New Airport) / Exercises Creation

The creation of new simulated airports includes layout, specific air and ground procedures, mobile objects (aircraft and vehicles), software development for airport devices (lighting, radar display, etc.) and the creation of exercises on the new airport.

Manufacturers can provide new airports on client specifications but prices and delays should be discussed when buying the simulator, in order to avoid too high prices when new environment is needed for training.

We can expect that the PC-based image generator will very soon allow users to create and modify the environment and mobile objects themselves. This possibility will contribute to reducing costs and will enable the use of several airports on the same simulator.

Another aspect of operational costs is the creation and maintenance of simulation exercises. These should be handled by the instructors in charge of the preparation of training programs - it is most of the time possible on existing equipment.

3.1.2.7 Operational Staff

Instructors and pseudo pilots are necessary to run a simulator.

The choice of hardware and software also influences the job description of specialists/technicians in charge of the maintenance tasks. These tasks are necessarily as follows:

- setting up of projectors,
- maintenance,
- problem identification,
- dealing with manufacturers (even in the case of maintenance contracts for computers).

3.1.2.8 Maintenance Costs

Costs for yearly maintenance on hardware or software represent 10% of the total costs, which is a very high percentage. PC-based solutions should significantly reduce the operational costs.

3.1.2.9 Number of Students

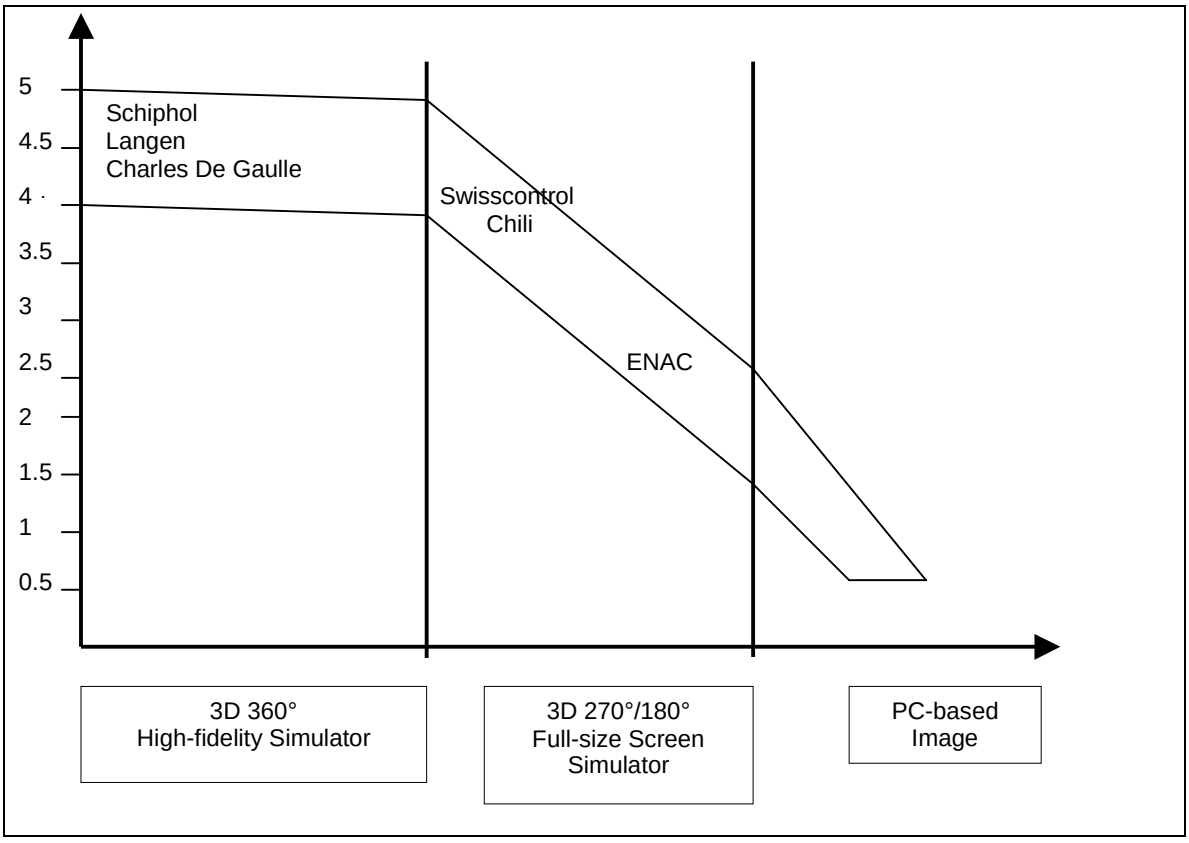
The number of students trained yearly will also have a great impact on the choice of the simulators. A full 360° simulator will induce limitations to the number of student ATCOs who can be trained. Group simulation is difficult to prepare, run and evaluate.

The training managers will have to choose, according to the number of students they have and their budget, between several low cost simulators for actual use and one full replica high-fidelity simulator for demonstration purposes.

3.1.3 Estimate of Costs

Today we can estimate that prices between a PC-based 180° aerodrome simulator and a 360° high-fidelity aerodrome simulator may vary from MEURO 0.5 to 5. Between these minimum and maximum everyone can find their appropriate combination.

To this basic maintenance cost (up to 10% yearly), operational costs (pseudo pilots, instructors and maintenance staff) and costs for a simulation room with basic fittings have to be added to obtain real costs.



3.2 Radar Simulator

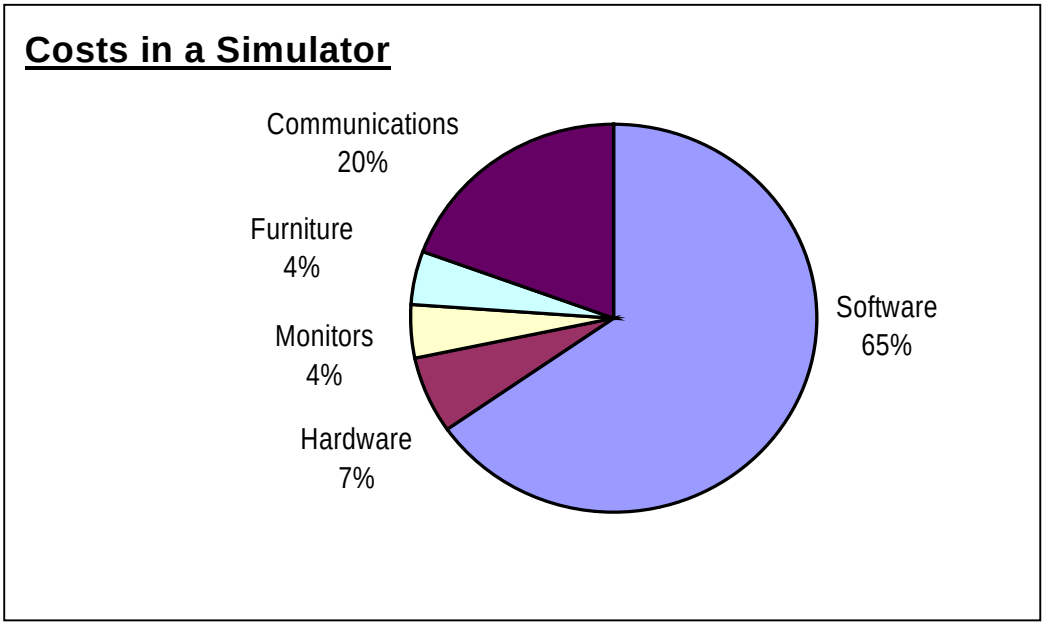
The following costs shown are an example of the 'raw material costs' for a simulator.

3.2.1 Simulator

Networked or stand-alone system one pilot to one controller, 50cm monitors (1,280 x 1,024) for controllers and pilots, ATC style furniture for controllers, off-the-shelf desks for pilots, basic communications system:

Costs	KEURO
Software	30
Hardware	3
Monitors	2
Furniture	2
Communications	9
TOTAL	46

A total of KEURO 46 per trainee position.



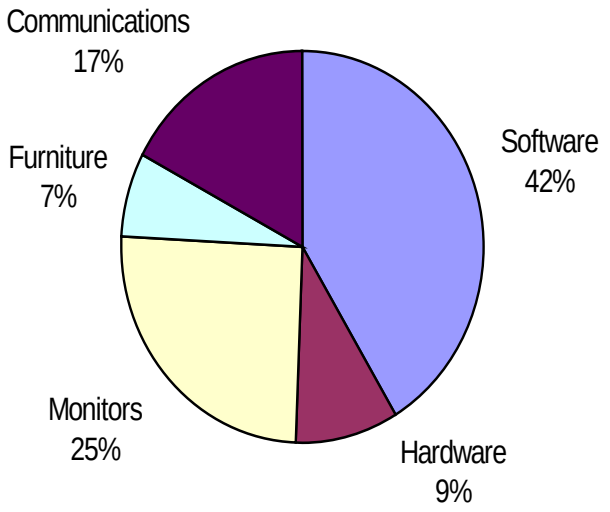
3.2.2 High-fidelity Simulator

Networked system with two pilots to one controller, SONY 2K×2K monitor for controller, 50cm monitor (1,280×1,024) for pilots, close replication of operational furniture for controller, purpose made furniture for pilots, fully configurable communications replicating operational equipment.

Costs	KEURO
Software	54
Hardware	12
Monitors	33
Furniture	9
Communications	23
TOTAL	131

A total of KEURO 131 per trainee position.

Costs in a High-fidelity Simulator



3.3 Total Project Costs

The following factors could affect the cost of a typical commercial project:

- any project-specific development/customisation;
- project labour (project management, Quality Assurance (QA), installation, testing, training, documentation, etc.);
- overhead recovery (changes on materials and labour);
- freight and insurance;
- accommodation and travel expenses;
- warranty;
- spares;
- financial charges;
- risk cover;
- profit.

The magnitude of the above costs will depend on:

- the nature of the project;
- the required levels of support, testing, warranty;
- the number of training seats being delivered;
- the overheads and fee policy of the supplier;
- how the overheads are recovered against labour and materials;
- the location of the delivery;
- the perceived risks (exchange rate risks, insurance, performance bonds/penalties, the customers payment record);
- the cashflow / payment schedule.

When all of these factors are considered the rough result is that the 'raw' figures can increase by 100% to 200% to reflect typical commercial prices.

As a result a typical range of prices is as follows:

	Lower End (KEURO)	**Upper End (KEURO)**
SIM	90	135
HI FI SIM	240	360

4. COMPARISON TO FLIGHT SIMULATORS

4.1 Flight Simulators (Joint Aviation Authorities Standards)

4.1.1 Introduction

As a benchmark we have analysed the use of simulation and simulators in pilot training. We had the opportunity to visit flight simulators and be presented with the reference documents, the Joint Aviation Authorities (JAA) standards.

The JAA standards JAR-STD 1A and JAR-STD 3A apply to those persons, organisations or enterprises seeking **qualification** of Flight and Navigation Procedure Trainer (FNPT) and of flight simulators and flight training devices.

4.1.2 Terminology

JAA states that, due to the technical complexity of flight simulator, it is essential that standard terminology be used throughout.

In particular, the terminology used includes the following concepts:

- **Flight Simulator Qualification (Simulator Qualification)**

  ICAO and JAR ‘qualify’ simulators:

  Qualification is the level of technical ability of a simulator as defined in the compliance document.

  Neither ICAO nor JAR ‘certify’ simulators. Certification is defined in international standards as a procedure by which a third party gives written assurance that a product, process or service conforms to specified requirements.

- **Qualification Test Guide (QTG)**

  A document designed to demonstrate that the performance and handling qualities of a simulator agree within prescribed limits with those of the aeroplane and that all applicable regulatory requirements have been met. (The QTG includes both the aeroplane and simulator data issued to support the validation).

  Note: This QTG is proposed by the operator to the authority. When approved it becomes a master QTG, which is the basis for the simulator qualification and subsequent recurrent simulator evaluations.

- **Simulator Approval**

  The extent to which a simulator of a specified qualification level may be used by persons, organisations or enterprises as approved by the authority. It takes account of aeroplane to simulator differences and the operating and training ability of the organisation.

4.1.3 Types and Levels

In fact, JAR differentiates between:

- flight simulator,
- flight training device (including FNPT),
- synthetic training device.

JAR defines four levels for flight simulator (A, B, C, D) and two types for FNPT. Flight training devices are defined as devices other than a simulator for which training and checking credit may be granted.

4.1.4 Principles

The operation must apply for qualification to the appropriate authority. A qualification letter is issued following satisfactory completion of an evaluation by the authority. The qualification is valid for a limited period of time. Validity is extended after revaluation.

- **Rules Governing the Operator**

  The operator must demonstrate his/her ability to maintain the performance, functions and other characteristics of the qualification type or level: maintain a quality control system, update the system according to the aeroplane modifications or to progress in simulation techniques, ensure safe and reliable operation in a suitable environment.

- **Requirements**

  The documents list the seven areas where the device must be assessed. They differentiate the validation tests and the functions and subjective tests. Both tests are specified in detail in the JAR documents which include, for instance, typical subjective test profile.

4.1.5 Conclusion

These standards are based on:

- a set of **detailed** approved documents,
- an agreed classification of the devices,
- a **defined authority** for qualification.

They apply:

- to an airborne equipment which is **certified**,
- on training procedures which are **approved**,
- for the benefit of personnel who are **licensed**.

4.2 Comparison

In our conclusions we have detailed a series of factors relevant to the flight simulators.

It is very hazardous to think that they will apply to ATC simulators equally.

4.2.1 Air Traffic Control Equipment

Air Traffic Control (ATC) equipment, in particular CWP, is not currently certified. It is also more specific to each control centre, even if harmonisation is progressing. Therefore, it is very difficult to find a benchmark with which to compare the simulator.

4.2.2 Licensing

This task is currently in progress within the Licensing Task Force (LTF). There are two points linked to licensing:

- **Instructor Rating**

  It would be necessary to specify in a separate document which management and staffing are required to provide an approved training (similar to Para. 10 to 19 of the Appendix 1 to JAR-FCL 1.055 'Flying Training Organisations for Pilots Licences and Ratings'). One could imagine that this is for instance a 'simulator instructor rating (or endorsement)' giving the privilege to train a student or a trainee in simulation.

  In fact, at the time of writing LTF is considering this question.

- **Full Range of Training Phases**

  When the complete range of licences, ratings and endorsements will be available, it will be possible to complete this range by all the training phases and to link the types of training equipment and practices to these different phases.

4.2.3 Authority and Standards

The acceptance and the application of JARs in general and of JARs to training devices in particular are a remarkable achievement of a lengthy process. It was said that the creation of the standards took about fifteen years.

4.3 Benefits of a Qualification Process

Setting up a process for qualification of ATC training devices will require a lot of time, efforts and resources.

What are the potential benefits of this process in the context of ATM?

4.3.1 Increase of the Efficiency of Training

A definition of efficiency in training:

- **Provisional Definition**

  An increase in the efficiency of training could be defined by an increase of the average exit level of the students associated with a reduction of either student training time or training cost (human cost + investment + operation of the equipment).

- **Student Flow Consideration**

  In fact, the efforts done to improve the training efficiency might be jeopardised by a bottleneck during the training process. The methods to sort out the occurrence of bottlenecks during the institutional phases are more or less known (Investment in the capacity and outside contracts). The solutions are much more difficult to implement during the operational phase. In the Guidelines 'Air Traffic Controller Training at Operational Units' (EATCHIP, 1999b) it is stressed how critical this phase is, and more especially the OJT phase. Several measures to improve the transition and pre-OJT periods are recommended, in order to 'achieve the maximum possible reduction of training under live conditions'. Since the publication of these guidelines several factors have contributed to increase their relevance (increase of traffic, flow management measures).

- **Operating Cost and Safety Consideration**

  All training phases are safety related but OJT phase is safety critical because the team trainee-OJT Instructor (OJTI) is controlling real traffic. It is not easy to isolate the factors causing incidents but it is accepted that the presence of a trainee on the position might be one contributing factor to incidents.

  In the same way it might be assumed that the service provided to airlines might be less satisfactory in this situation.

  On the Air Traffic Services (ATS) provider point of view it is also to be noted that this is a two-person team where only one person is needed.

  So the OJT phase is far to be 'free' in terms of cost and safety.

  Consequently, the achievement of a reduction of the OJT phase would be beneficial for safety and cost.

4.3.2 Objective for an Increase Training Efficiency in Air Traffic Management

The considerations on the cost, safety and on the student flow lead us to propose the following definition:

‘An increase of training efficiency in ATM is mainly to be searched in an increase of the level at minimum cost at the end of the pre-OJT phase and a reduction of the OJT phase. It is to be noted that the current minimum experiences of ICAO annex one (one month or 90 hours for aerodrome and three months or 180 hours for approach, approach radar, area or area radar control rating) could be fixed as objectives.’

The increase of the level at the end of the pre-OJT phase is performed in such a way that the total training time is reduced.

4.3.3 Contribution of Training Devices Qualification to the Increase of Efficiency in Training

A qualification of the training devices will contribute:

- to optimise the equipment used in each phase,
- to increase the level at the end of the pre-OJT phase,
- to make this increase measurable and credible.

4.3.4 Improvement of the Specifications of Simulators

The reference to the qualification documents (such as the requirements, the technical requirements, the qualification programme, the validation tests, and the tables of functions and subjective tests) will shorten and standardise the specifications of new simulators, simplify the dialog with manufacturers and contribute to clarify the simulator market.

5. CONCLUSION

According to its Terms of Reference (TOR) the Task Force Technology-based Training Tools and Methods (TF-TTM) was required to identify and describe teaching support tools and methods desirable on new generation simulators. In order to achieve this it was necessary for TF-TTM to consider current tools and methods.

Accordingly the Task Force examined various manufacturers' projects and was introduced to the most advanced training practices of a number of European institutions.

Based on the experience of its members the Task Force produced a classification of simulators and simulations in order to provide a useful tool for optimisation of training.

It was also necessary to broaden our view of simulation and to inquire about qualification process and to provide elements of information, but it is beyond the TOR of TF-TTM to pronounce itself on the necessity of qualification procedures.

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6. DIAGRAMS OF CURRENT PRACTICES

6.1 Introduction

The analysis of the current practices is necessary to clarify the concepts of type of simulation and of type of equipment. The discussion about the implementation varying according to the countries enables us to extract the latest trends both in the development and the use of simulation. It also allows us to structure the requirements and to define the future needs.

The Task Force gathered data in two steps: first, internally (each expert bringing data from his/her own institute), then externally. The principle was to provide the definitions made by the Task Force and ask the data provider to answer according to his/her own feeling (He/she determines what is the type of simulator in use and what is the type of simulation performed).

The information is not exhaustive. It includes data about thirteen locations and is centred on institutional training.

The numbers have to be interpreted with care: the following three concepts should be differentiated:

- **Capacity of simulators.** The number of physical positions available to students for practice of control (exclusively) on given equipment.

  For instance, let us call a simulator SIM1 and suppose that it is composed of one single unit. This unit includes one planning controller position and one executive controller position. The capacity of SIM1 is two.

- **Current practices (capacity for different types of exercises).** Takes into account the different practices on equipment. Also allows us to differentiate the number of students who can be trained according to the different types of exercises. Gives us an idea on the frequency of use of the different types of exercises.

  For instance, let us suppose that SIM1 is used for two types of exercises: PTP and TEAM SIM. The equipment offers two seats for PTP and two seats for TEAM SIM. The capacity for practices is four (2x2).

- **Number of student hours.** Measures the real output of equipment as a product of the number of students by the number of hours, and can be detailed by type of exercise; this is not addressed in this document.

The general table summarises who operates which type of exercise on which media. Then, series of tables present the capacity for practices of simulation in each of the place in a more detailed manner. Two diagrams summarise the relative capacity of the different types of simulators and the distribution of the types of exercises.

6.2 General Table

	Other Training Device	Part-Task Trainer	Simulator	High-fidelity Simulator
Skill Acquisition	Denmark EUROCONTROL Germany Italy The Netherlands	EUROCONTROL France Italy Spain	Denmark Ireland	France
Guided Skill Acquisition	Spain	Germany	Ireland	
Part-Task Practice		Germany United Kingdom Belgium	France Ireland Czech Republic	
Guided Part-Task Practice		Germany		
Individual Simulation		Germany	EUROCONTROL France Germany United Kingdom Ireland Denmark Czech Republic	France Italy United Kingdom
Team Simulation			Belgium Czech Republic EUROCONTROL Spain Ireland Italy United Kingdom	Italy Spain The Netherlands
Group Simulation			EUROCONTROL Spain Ireland Czech Republic Belgium	France Germany Italy Spain United Kingdom
Guided Simulation				
Note: CBT	*EUROCONTROL* *France* *Germany* *Spain* *United Kingdom*			

6.3 Belgium – BELGOCONTROL - Brussels

BELGOCONTROL	**Other Training Device**	**Part-Task Trainer**	**Simulator**	**High-fidelity Simulator**
Skill Acquisition				
Guided Skill Acquisition				
Part-Task Practice		PC System: 4 Position: 4 Stud./Pos.: 1 Pil./Pos.: 1 Stud./Ins.: 1		
Guided Part-Task practice				
Individual Simulation				
Team Simulation			First: 6 Position: 3 Stud/Pos.: 2 Pil/Pos.: 2 Stud./Ins.: 2	
Group Simulation			First : 6 Position: 3 Stud./Pos.: 2 Pil/Pos.: 2 Stud./Ins.: 2	
Guided Simulation				
Note: CBT				

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.4 Czech Republic - Air Navigation Services – Praha

ANS of Czech Republic	Other Training Device	Part-Task Trainer	Simulator	High-fidelity Simulator
Skill Acquisition				
Guided Skill Acquisition			Cass.: 8 Position : 8 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	
Part-Task Practice				
Guided Part-Task Practice			Cass.: 8 Position : 8 Stud./Pos.: 1 Pil./Pos.: 3 Stud./Ins.: 1	
Individual Simulation			Cass.: 8 Position : 4 Stud/Pos.: 2 Pil./Pos.: 3 Stud./Ins.: 2	
Team Simulation			Cass.: 8 Position: 4 Stud./Pos.: 2 Pil./Pos.: 3 Stud./Ins.: 2	
Group Simulation				
Guided Simulation				
Note: CBT				

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.5 Denmark – CAA Academy - Copenhagen

CAA Academy	**Other Training Device**	**Part-Task Trainer**	**Simulator**	**High-fidelity Simulator**
Skill Acquisition	CBT Room: 28 Position: 28 Stud./pos.: 1 Pilots/pos.: 0 Stud./Ins.: 14		RADSIM: 16 Position: 16 Stud./pos.: 1 Pilots/pos.: 2 Stud. /Ins.: 2	
Guided Skill Acquisition				
Part-Task Practice				
Guided Part-Task Practice				
Individual Simulation			RADSIM: 16 Position: 16 Stud./pos.: 1 Pilots/pos.: 2 Stud./Ins.: 2	
Team Simulation				
Group Simulation				
Guided Simulation				
Note: CBT				

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.6 EUROCONTROL Institute of Air Navigation Services (Luxembourg)

EUROCONTROL IANS	**Other Training Device**	**Part-Task Trainer**	**Simulator**	**High-fidelity Simulator**
Skill Acquisition	CBT room: 20 Position: 20 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 12	First Twr 2d: 2 Position: 2 Stud./Pos.: 1 Pil./Pos.: 1 Stud./Ins.: 1		
Guided Skill Acquisition				
Part-Task Practice				
Guided Part-Task Practice				
Individual Simulation			First: 6 Position: 6 Stud./Pos.: 1 Pil./Pos.: 1 Stud./Ins.: 1	
Team Simulation			First: 6 Position: 3 Stud./Pos.: 2 Pil./Pos.: 1 Stud./Ins.: 1	
Group Simulation			First: 6 Position: 6 Stud./Pos.: 1 Pil./Pos.: 1 Stud./Ins.: 1	
Guided Simulation				
Note: CBT	*CBT room: 20* *Position: 20* *Stud./Pos.: 1* *Pil./Pos.: 0* *Stud./Ins.: 12*			

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.7 France - Ecole Nationale de l'Aviation Civile - Toulouse

ENAC	Other Training Device	Part-Task Trainer	Simulator	High-fidelity Simulator
Skill Acquisition				Aer./Sim.: 8 Position: 4 Stud./Pos.: 2 Pil./Pos.: 1 Stud./Ins.: 2
Guided Skill Acquisition		PTT: 16 Position: 16 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 8		
Part-Task Practice			Scanor: 16 Position: 8 Stud./Pos.: 2 Pil./Pos.: 1 Stud./Ins.: 2 Scanrad: 16 Position: 8 Stud./Pos.: 2 Pil./Pos.: 1 Stud./Ins.: 2	
Guided Part-Task Practice				
Individual Simulation			Scanor: 8 Position: 8 Stud./Pos.: 1 Pil./Pos.: 1 Stud./Ins.: 2	Aersim: 8 Position: 4 Stud./Pos.: 2 Pil./Pos.: 1 Stu./Ins.: 2 Electra: 32 Position: 16 Stud./Pos.: 2 Pil./Pos.: 1 Stud../Ins.: 2
Team Simulation				
Group Simulation				Electra: 32 Position: 16 Stud./Pos.: 2 Pil./Pos.: 3 Stud../Ins.: 2
Guided Simulation				
Note: CBT	*CBT Room: 32* *Position: 32* *Stud./Pos.: 1* *Pil./Pos.: 0* *Stud./Ins.: 32*			

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.8 Germany – Deutsche Flugsicherungsakademie - Langen

DFS	Other Training Device	Part-Task Trainer	Simulator	High-fidelity Simulator
Skill Acquisition	CBT room: 16 Position: 16 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 16			
Guided Skill Acquisition		Basim: 16 Position: 16 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 1		
Part-Task Practice		Basim: 16 Position: 16 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 1		
Guided Part-Task Practice		Basim: 16 Position: 16 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 1		
Individual Simulation		Basim: 16 Position: 16 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 1	Basim: 16 Position: 16 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 1	
Team Simulation				
Group Simulation				Asim: 64 Position: 32 Stud./Pos.: 2 Pil./Pos.: 4 Stud./Ins.: 2 Tosim: 9 Position: 3 Stud../Pos.: 3 Pil./Pos.: 4 Stud./Ins.: 3
Guided Simulation				
Note: CBT	*Groups of 32,* *0 instructor,* *0 pilot*			

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.9 Ireland – Irish Aviation Authority Training - Shannon

IAA	Other Training Device	Part-Task Trainer	Simulator	High-fidelity Simulator
Skill Acquisition			First: 12 Position: 12 Stud./Pos.: 1 Pil./Pos.: 1 Stud../Ins.: 1 SIMTAC: 3 Position: 3 Stud./Pos.: 1 Pil./Pos.: 1 Stud../Ins.: 1	
Guided Skill Acquisition			First: 12 Position: 12 Stud./Pos.: 1 Pil./Pos.: 1 Stud../Ins.: 1 SIMTAC: 3 Position: 3 Stud./Pos.: 1 Pil./Pos.: 1 Stud./Ins.: 1	
Part-Task Practice			First: 12 Position: 12 Stud./Pos.: 1 Pil./Pos.: 1 Stud../Ins.: 1 SIMTAC: 3 Position: 3 Stud./Pos.: 1 Pil./Pos.: 1 Stud../Ins.: 1	
Guided Part-Task Practice				
Individual Simulation			First: 12 Position: 12 Stud./Pos.: 1 Pil./Pos.: 1 Stud../Ins.: 1 SIMTAC: 3 Position: 3 Stud./Pos.: 1 Pil./Pos.: 1 Stud./Ins.: 1	

Ireland – Irish Aviation Authority Training - Shannon (continued)

IAA	Other Training Device	Part-Task Trainer	Simulator	High-fidelity Simulator
Team Simulation			First: 24 Position: 12 Stud./Pos. 2 Pil./Pos.: 2 Stud./Ins.: 2 SIMTAC: 6 Position: 3 Stud./Pos.: 2 Pil./Pos.: 1 Stud./Ins.: 1	
Group Simulation			First: 12 Position: 6 Stud./Pos.: 2 Pil./Pos.: 1 Stud./Ins.: 1 SIMTAC: 6 Position: 3 Stud./Pos.: 2 Pil./Pos.: 1 Stud../Ins.: 1	
Guided Simulation				
Note: CBT				

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.10 Italy - Ente Nazionale di Assistenza al Volo - Roma

ENAV	**Other Training Device**	**Part-Task Trainer**	**Simulator**	**High-fidelity Simulator**
Skill Acquisition	CBT room St:ud.: 10 Position: 10 Stud./pos.: 1 Pilots: 0 Stud./Ins.: 10	PcTwr pre-trainer Stud.: 10 Position: 10 Stud./pos.: 1 Pilots: 0 Stud./Ins.: 0		
Guided Skill Acquisition				
Part-Task Practice		Pc Twr Trainer Stud.: 10 Position: 10 Stud./pos.: 1 Pilots: 1 Stud./Ins.: 1		
Guided Part-Task Practice				
Individual Simulation				Alenia-Atres Stud.: 4 Position: 4 Stud./pos.: 1 Pilots: 1 Stud./Ins.: 1
Team Simulation			Twr 2d visual Stud.: 8 Position: 4 Stud./pos : 2 Pilots : 2 Stud./Ins.: 2 Sim App Stud.: 8 Position: 4 Stud./pos.: 2 Pilots: 2 Stud./Ins.: 2	Alenia-Atres Stud.: 8 Position: 4 Stud./pos.: 2 Pilots: 1 Stud./Ins.: 2
Group Simulation				Alenia-Atres Stud. : 8 Position: 4 Stud./pos.: 2 Pilots : 1 Stud./Ins.: 2
Guided Simulation				
Note: CBT				

First line: Name of simulator
Second line: Number of students simultaneously trained
Third line: Number of positions
Fourth line: Students per position
Fifth line: Pseudo pilots per sector/position
Sixth line: Students per instructor

6.11 The Netherlands– Luchtverkeersleiding Nederland - Schiphol

LVLN	Other Training Device	Part-Task Trainer	Simulator	High-fidelity Simulator
Skill Acquisition	PC-CBT: 16 Position: 16 Stud./Pos.: 1 Pil./Pos.: 0 Stud../Ins.: 16			
Guided Skill Acquisition				
Part-Task Practice				
Guided Part-Task Practice				
Individual Simulation				
Team Simulation				AAA Sim: 4 Position: 2 Stud./Pos.: 4 Pil./Pos.: 6 Stud../Ins.: 4 TWR Sim: 4 Position: 2 Stud./Pos.: 4 Pil./Pos.: 6 Stud./Ins.: 4
Group Simulation				
Guided Simulation				
Note: CBT				

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.12 Spain - CEANA/SENASA - Madrid

SENASA	**Other Training Device**	**Part-Task Trainer**	**Simulator**	**High-fidelity Simulator**
Skill Acquisition		Aer.: 6 Position: 2 Stud./Pos.: 3 Pil./Pos.: 3 Stud./Ins.: 3 Radar: 6 Position: 2 Stud./Pos.: 3 Pil./Pos.: 3 Stud./Ins.: 3		
Guided Skill Acquisition	CBT room: 12 Aer.: 12 Position: 1 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 6			
Part-Task Practice				
Guided Part-Task Practice				
Individual Simulation				
Team Simulation				Indra Satca2: 6 Position: 3 Stud./Pos.: 2 Pil./Pos.: 3 Stud./Ins.: 6
Group Simulation			Twr. sim.: 2 Position: 1 Stud./Pos.: 2 Pil./Pos.: 6 Stud/Ins.: 1	Indra Satca2: 6 Position: 3 Stud./Pos.: 2 Pil./Pos.: 3 Stud./Ins.: 2
Guided Simulation				
Note: CBT	*CBT room: 12* *Position: 12* *Stud./Pos.: 1* *Pil./Pos.: 0* *Stud./Ins.: 12*			

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.13 Sweden – Swedish Air Traffic Services Academy - Malmö

SATSA	**Other Training Device**	**Part-Task Trainer**	**Simulator**	**High-fidelity Simulator**
Skill Acquisition	CBT room: 15 Position: 15 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 15	Twr.: 1-4 Position: 1 (4) Stud./Pos.: 1 (4) Pil./Pos.: 3 (12) Stud./Ins.: 1 (4)	Pro T: 6 Position: 1 (6) Stud./Pos.: 1 (6) Pil./Pos.: 1 (6) Stud./Ins.: 1 (6)	
Guided Skill Acquisition				
Part-Task Practice				
Guided Part-Task Practice				
Individual Simulation			BaRT/BERT Position: 23 Stud./Pos.: 1 Pil./Pos.: 1-2 Stud./Ins.: 1	SMART Position: 14 Stud./Pos.: 1 Pil./Pos.: 1-2 Stud./Ins.: 1
Team Simulation		Twr. sim.: 1-4 Position: 2 Stud./Pos.: 1 Pil./Pos.: 3 Stud./Ins.: 1	BERT.: 1-2 Position: 16 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	SMART Position: 14 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1
Group Simulation			BERT.: 1-2 Position: 16 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	SMART Position: 8 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1
Guided Simulation				
Note: CBT	*CBT room: 15* *Position: 14* *Stud./Pos.: 1* *Pil./Pos.: 16* *Stud./Ins.: 12*	*CBT room: 15* *Twr room: 4* *ProT room: 6* *Bart: 7 Rad/14Pil* *Bert2: 8rad/16pil* *Smart: 28works*		

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.14 Switzerland – Swisscontrol Zürich/Geneva

Swisscontrol	**Other Training Device**	**Part-Task Trainer**	**Simulator**	**High-fidelity Simulator**
Skill Acquisition	CBT room: 12 Position: 12 Stud./Pos.: 1 Pil./Pos.: 0 Stud./Ins.: 12			
Guided Skill Acquisition		BASIM: 6 Position: 6 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	BASIM: 6 Position: 6 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	
Part-Task Practice		BASIM: 6 Position: 6 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	BASIM: 6 Position: 6 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	
Guided Part-Task Practice		BASIM: 6 Position: 6 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	BASIM: 6 Position: 6 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	
Individual Simulation		BASIM: 6 Position: 6 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	BASIM: 6 Position: 6 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1	INTRAS ZH: 12 Position: 6 Stud./Pos.: 2 Pil./Pos.: 2.5 Stu./Ins.: 2 INTRAS GE 8 Position: 4 Stud./Pos.: 2 Pil./Pos.: 2.5 Stu./Ins.: 2 TOSIM ZH: 3 Position: 1 Stud./Pos.: 3 Pil./Pos.: 4 Stu./Ins.: 3

Switzerland – Swisscontrol Zürich/Geneva (continued)

Swisscontrol	**Other Training Device**	**Part-Task Trainer**	**Simulator**	**High-fidelity Simulator**
Team Simulation		BASIM: 12 Position: 12 Stud./Pos.: 2 Pil./Pos.: 2 Stud./Ins.: 2	BASIM: 12 Position: 12 Stud./Pos.: 2 Pil./Pos.: 2 Stud./Ins.: 2	INTRAS ZH: 12 Position: 12 Stud./Pos.: 1 Pil./Pos.: 1.25 Stu./Ins.: 2 INTRAS GE 8 Position: 8 Stud./Pos.: 1 Pil./Pos.: 1.25 Stud./Ins.: 2 TOSIM ZH: 3 Position: 3 Stud./Pos.: 1 Pil./Pos.: 1.33 Stud./Ins.: 3
Group Simulation				INTRAS ZH: 12 Position: 12 Stud./Pos.: 1 Pil./Pos.: 1.25 Stud./Ins.: 2 INTRAS GE 8 Position: 8 Stud./Pos.: 1 Pil./Pos.: 1.25 Stud./Ins.: 2
Guided Simulation				
Note: CBT				

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per instructor

6.15 United Kingdom - CAA College of ATC - Bournemouth

CATC	Other Training Device	Part-Task Trainer	Simulator	High-fidelity Simulator
Skill Acquisition				
Guided Skill Acquisition				
Part-Task Practice		SIMTAC: 16 Position: 16 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1		
Guided Part-Task Practice				
Individual Simulation			SIMTAC: 16 Position: 16 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1 Skywatch: 9 Position: 9 Stud./Pos.: 1 Pil./Pos.: 3 Stud./Ins.: 1	First: 20 Position: 20 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1
Team Simulation			Skywatch: 6 Position: 3 Stud./Pos.: 2 Pil./Pos.: 3 Stud./Ins.: 1	
Group Simulation				First: 20 Position: 20 Stud./Pos.: 1 Pil./Pos.: 2 Stud./Ins.: 1
Guided Simulation				
Note: CBT	*CBT room: 6* *Position: 6* *Stud./Pos.: 1* *Pil./Pos.: 0* *Stud./Ins.: 6*			

First line: Name of simulator and number of students simultaneously trained
Second line: Number of positions
Third line: Students per position
Fourth line: Pseudo pilots per position
Fifth line: Students per Instructor

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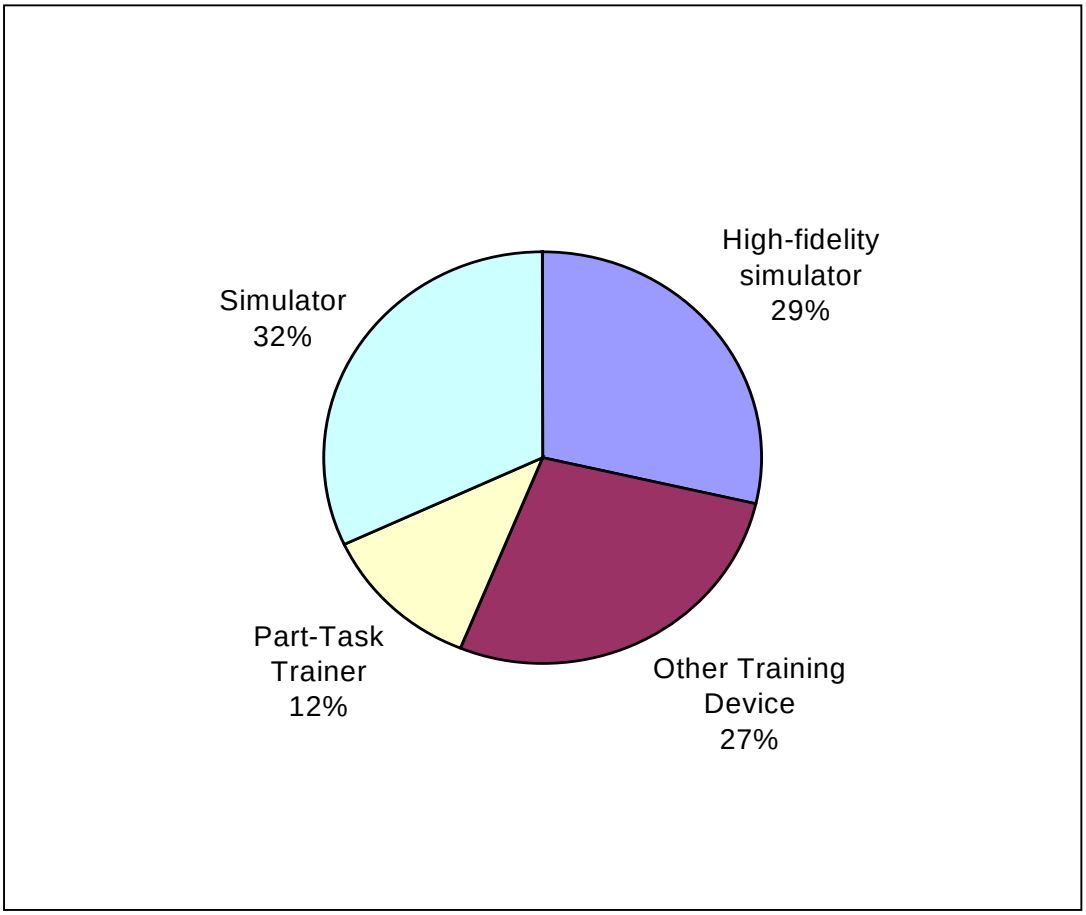
7. CAPACITY OF DIFFERENT MEDIA



This diagram represents the physical relative capacity of the different media in use at thirteen European locations.

The capacity is, in terms of seats, offered to the student and does not take the real practice into account (for instance, some Other Training Device (OTD) are counted here when they are used only for skill acquisition, despite the fact that they are mainly used for CBT lessons on subject other than ATC operation).

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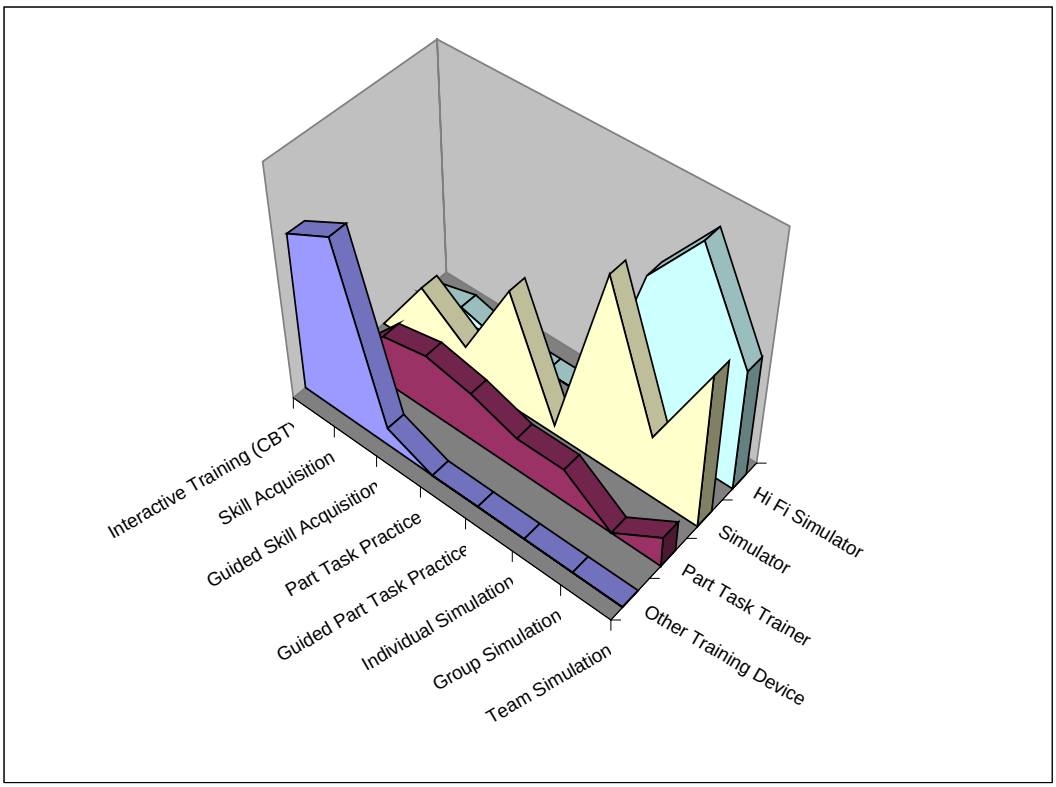
8. CURRENT PRACTICES



This diagram represents the distribution of the types of exercises in the same thirteen locations but not their quantitative weight in number of student hours.

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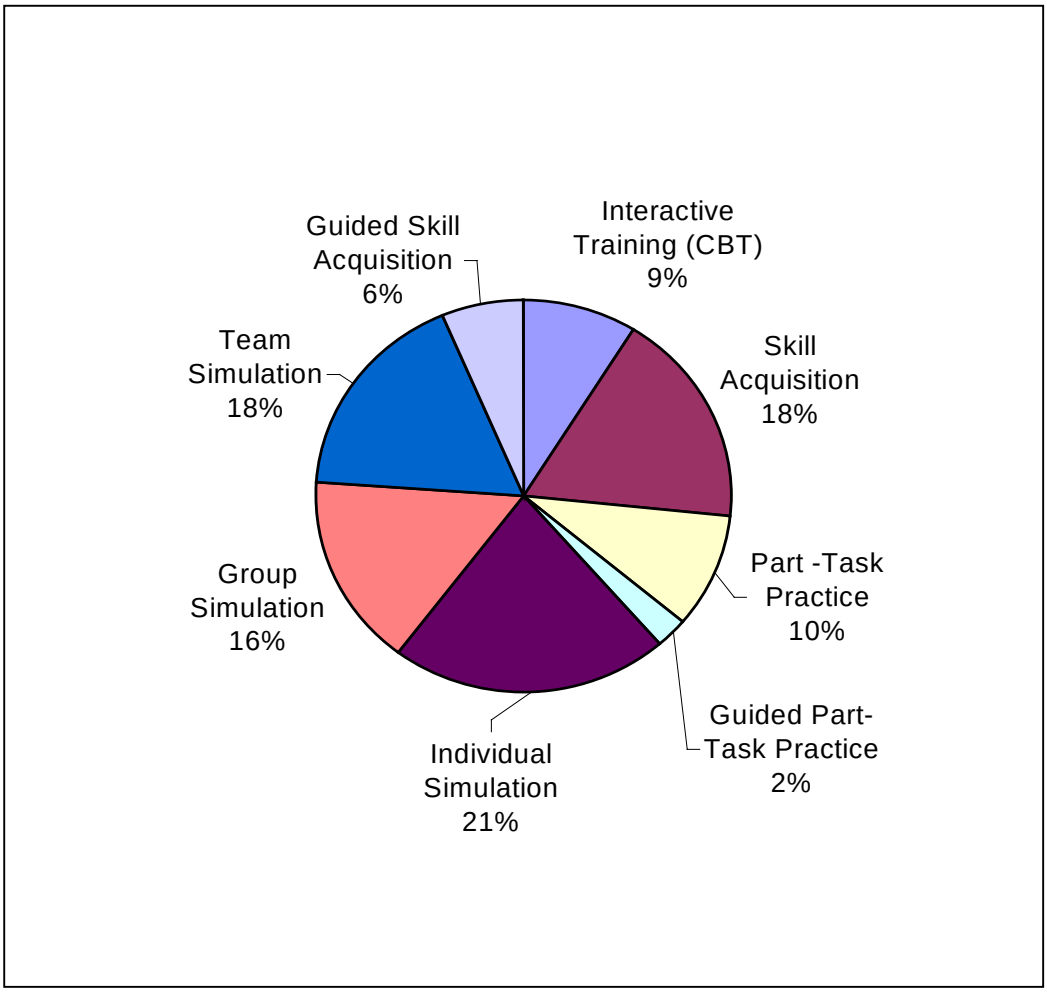
9. USE OF DIFFERENT TYPES OF EXERCISES



This diagram represents the purposes for which the various media are used at the thirteen European locations.

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GLOSSARY

For the purposes of this document the following definitions shall apply:

Term	Abbreviation or Acronym	Definition
Ability		Capacity or power to do something (either mental or physical).
Basic Training		A training designed to impart fundamental knowledge and skills to enable student ATCOs to progress to specialised ATC training.
Briefing	Brief	With regard to training a briefing is an introduction to a training event, during which interruption of the student's activity is not normally anticipated (e.g. OJT and simulation).
Case Study	Cases	A technique in which a real or fictional situation or series of events is presented to trainees for their analysis and consideration of possible solutions or problems identified. Their findings in a real situation can be compared with what actually occurred.
Computer-based Classroom Presentation		Use of a computer by an instructor to provide audiovisual aids in the classroom. There is no direct interaction between the student and the computer.
Computer-based Training	CBT	Provision of knowledge and skills by means of a computer with numerous interactions, student response analysis and free individual rhythm of learning (self-paced manner). This encompasses interactive guided learning and interactive exploration.
Continuation Training		Provision of training related to a job category in order to increase knowledge and skills and/or to prepare for new technologies.
Conversion Training		Provision of knowledge and skills appropriate to change in jobs category, environment and systems.

Term	Abbreviation or Acronym	Definition
Courseware		The instructional package of educational material comprising software (particularly teachware), documentation and other media resources.
Debriefing	Debrief	A review and discussion on the outcome of a training event based on a formative assessment of that event. Briefing and debriefing are always included as an integral part of the training technique.
Demonstration	Demo	A teaching method. The instructor, by doing, shows the student what to do and how to do it and with his/her associated explanations indicates why, when and where it is done.
Distance Learning		Any form of learning in which the teacher and student are not together in the same place.
Fidelity (of Simulation)		The degree to which simulation matches the real system and the environment in terms of physical characteristics, functional characteristics (stimulus and response options) and conceptual fidelity (realism of the thought processes stimulated in the student).
Formative Assessment		A verbal or written factual assessment given for personal development purposes which should have an important and lasting influence on individual abilities or attitudes. Should be applied to the attention or use of one person in particularly.
Guided Part-Task Practice	GPTT	A PTP with questions, feedback, comments, indications and assessment.
Guided Simulation	GSIMUL	There is extensive interaction between the student and the computer in the form of questions, feedback, comments, instructions and assessment. This guidance assumes the existence of a theoretical model against which the student can be compared.
Guided Skill Acquisition	GSA	Skill acquisition with interactive assessment, comments and guidance.

Term	Abbreviation or Acronym	Definition
Group Training		Either the provision of stimuli or the analysis and the processing of the feedback cannot be made separately for each student.
Group Simulation	GROUP SIMUL	A real-time simulation involving several individual or team simulations simultaneously.
Hands On		A supervised practice on real equipment which is not in operation.
High-fidelity simulator	HI FI SIM	A full size replica of CWPs including all equipment and computer programmes necessary to represent full tasks of the sector or of the tower and their environment. A spare operational position used as simulator is a good example of HI FI SIM. In the case of aerodrome it includes an out-of-the-tower view.
Individual Simulation	IND SIMUL	A real-time full-task simulation involving one single student.
Individualised Training		The provision of possibly different stimuli to each student, the separated analysis of their response and the provision of consequent new stimuli independent of the answers of other students.
Institutional Training		A training provided in an establishment which is designed or designated specifically for training and staffed for that purpose. It might comprise basic and rating training.
Interactive Exploration		The student is allowed to follow his/her own path through the training material. There is extensive interaction between the student and the computer in the form of questions, feedback and participation.
Interactive Guided Learning		The student has to follow a predetermined path through the training material. There is extensive interaction between the student and the computer in the form of questions, feedback and participation.
Interactive Training	Interactive	The provision of knowledge and skills by means of a computer with numerous interactions, student response analysis and allowing, when appropriate, free

Term	Abbreviation or Acronym	Definition
		individual rhythm of learning (self-paced manner).
Lecture	Lect	A straight talk or exposition, possibly using visual or other aids, with no group contribution other than questions, usually asked after the conclusion of the lecture.
Lesson	Lesson	A training method using a number of instructional techniques designed to ensure the participation of the students in reaching the specified behavioural objectives. The instructor is able to ascertain whether material is being assimilated.
Media		Physical means by which an instructional message is communicated.
Mode of Delivery		The way used to deliver a training (group or individualised, material or instructor dependent).
Model		The description of a real or hypothetical situation, usually formal and simplified, which is used to develop understanding.
Multimedia		The integrated use of various communications media in the construction of a learning programme, in such a way that each part of the information being taught is carried by the most appropriate medium.
Multimedia Computer	MMC	A (networked or stand-alone) multimedia computer or workstation dedicated to one student or to a small cell. The hardware is off-the-shelf and has not been deeply modified for specific ATC purposes.
Objective		A clear and unambiguous statement of what a student is expected to be able to do with the minimum level of acceptable performance (quality, quantity and time allowed for completion) and conditions under which the performance is to be carried out.
On-the-Job Training	OJT	‘Live training within which previously acquired skills and routines are further developed and consolidated over the supervision of a qualified coach in a live

Term	Abbreviation or Acronym	Definition
		traffic situation.
Other Training Device	OTD	A training machine which presents the student with some operational functions on a non-realistic reproduction of the operational devices. It includes generic MMC.
Part-Task Practice	PTP	A method to practise, in restricted or in real time, part of the skills which are necessary for the operational task in a realistic environment (PTT or simulator).
Part-Task Trainer	PTT	A training machine for the student to practise some operational functions independently of other functions which are not represented there, although they are necessarily associated to the first ones in the operational task.
Pre - On-the-Job Training	Pre-OJT	A phase of locally based training during which extensive use of simulation using site-specific facilities will enhance the development of previously acquired routines and abilities to an exceptionally high level of achievement.
Rating Training		Specialised ATC training to provide knowledge and skills related to a job category and appropriate to the discipline to be pursued in the ATS environment.
Real Time	Real	A learning/teaching system whereby the pace at which the learner has to work is the same than in real operation.
Refresher Training		The process of further training in work currently performed in order to improve job performance. Also further training given in skills previously acquired but in which the individual may not currently be up to standard.
Role Plays	Role	Students act out a working model of some real-world human situation in interacting group. They are provided with background data and roles to play together with constraints which may change as simulation proceeds.

Term	Abbreviation or Acronym	Definition
Self-paced Learning	Self	A learning/teaching system whereby the learner is able to control his/her work pace.
Simulation	SIMUL	The provision of knowledge, skills and attitudes by means of a representation of air traffic responding to any student action as real air traffic. It always includes briefing, tutoring and debriefing.
Simulator	SIM	A device that presents the student with a representation of the important features of the real situation and reproduces the operational conditions under which the student can practise real-time tasks directly.
Skill Acquisition	SA	A method for self-pace, restricted or real-time practice of a part of the skills necessary for the operational task in a possibly non-realistic environment (e.g. 2-D aerodrome).
Supervised Practices	Sup Pract	Manipulations of equipment or job aid where the instructor provides the necessary feedback.
Syllabus		A listing of the subjects, topics, elements and items showing the training necessary to fill the training gap and achieve the course aim. Indicates time to be devoted to each part but usually neither methods nor order.
Systems Approach to Training	SAT	In applying SAT, training development is undertaken on a planned basis in a logical series of steps (training objectives, plans, formulation, validation and evaluation) which constitute a cycle.
Teachware		Software which is specifically used to provide CBT to a student (it is derived from teaching and software).
Team Simulation	TEAM SIMUL	A real-time full-task simulation involving an individualised cell made of several students. A team consists of two or more students who are required to work together on related or interacting tasks.

Term	Abbreviation or Acronym	Definition
Text	Txt	The provision of written documents including paper handouts, posters, training manuals, etc.
Time Restricted Learning	RSTD	A learning/teaching system whereby the course developer or the instructor controls the pace at which the learner has to work.
Topic		A theme that presents a unity and corresponds to one main training objective.
Training Event		A set of actions (instructional events) identified in the training plan (and later in the training program and in the student timetable) as the elementary unit.
Transition Phase		The phase that follows the basic training during which site-specific theoretical knowledge and understanding will be transferred to the trainee, using a variety of method, and during which skills will be developed through the use of site-specific simulations.
Transition Simulation		Operational traffics samples, situations and problems presented to the trainee in a gradual, analytical, time-controlled and piecemeal manner, in order to prepare him/her to upgrade to pre-OJT simulation.
Tutoring	Tutoring	The act of giving additional knowledge and guidance to an individual or a small group of trainees in an off- the-job and informal training situation.
Validated Training Material		Takes the form of a well-documented and repeatable package which has been tested and has shown to be effective.

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ABBREVIATIONS AND ACRONYMS

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

2-D	Two dimensional
3-D	Three dimensional
a/c	aircraft
ATC	Air Traffic Control
ATCO	Air Traffic Controller / Air Traffic Control Officer (US/UK)
ATM	Air Traffic Management
ATS	Air Traffic Services
Brief	Briefing
CBT	Computer-Based Training
CCC	Common Core Content
CD-ROM	Compact Disc - Read Only Memory
com.	communication
CWP	Controller Work Position
Debrief	Debriefing
DED5	Human Resources Bureau *(EUROCONTROL, EATCHIP; now DIS/HUM or HUM Unit)*
Demo	Demonstration
DIS	Director(ate) Infrastructure, ATC Systems & Support *(EUROCONTROL, EATMP)*
DIS/HUM	ATM Human Resources Unit *(EUROCONTROL, EATMP; also known as the HUM Unit; formerly DED5)*
EATCHIP	European Air Traffic Control Harmonisation and Integration Programme *(now EATMP)*
EATMP	European Air Traffic Management Programme *(formerly EATCHIP)*

ECAC	European Civil Aviation Conference
EEC	EUROCONTROL Experimental Centre *(France)*
ET	Executive Task *(EATCHIP, also used during the transition period between EATCHIP and EATMP)*
EUROCONTROL	European Organisation for the Safety of Air Navigation
EWP	EATCHIP/EATMP Work Programme
FNPT	Flight and Navigation Procedure Trainer
GPTP	Guided Part-Task Practice
GROUP SIMUL	Group Simulation
GSA	Guided Skill Acquisition
GSIMUL	Guided Simulation
HI FI SIM	High-Fidelity Simulator
HRS	Human Resources Programme *(EATMP, HUM)*
HRT	Human Resources Team *(EACHIP/EATMP)*
HUM Unit	ATM Human Resources Unit (EUROCONTROL, EATMP; also known as DIS/HUM; formerly DED5)
HUM	Human Resources (Domain)
IANS	EUROCONTROL Institute of Air Navigation Services *(Luxembourg)*
ICAO	International Civil Aviation Organization
IND SIMUL	Individual Simulation
Interactive	Interactive Training
JAA	Joint Aviation Authorities
JAR	Joint Aviation Requirements
LECT	Lecture
LESSON	Lesson
LOA	Letter Of Agreement
LTF	Licensing Task Force

MET	Meteorology
MMC	MultiMedia Computer
N/A	Not Applicable
OJT	On-The-Job-Training
OJTI	On-The-Job Training Instructor
OTD	Other Training Device
PC	Personal Computer
Pre-OJT	Pre - On-the-Job Training
PTP	Part-Task Practice
PTT	Part-Task Trainer
QA	Quality Assurance
QTG	Qualification Test Guide
R/T	Radio Telecommunication
REAL	Real Time
ROLE	Role Play
RSTD	Time Restricted learning
SA	Skill Acquisition
SAT	Systems Approach to Training
SDE	Senior Director, Principal EATMP Directorate *(EUROCONTROL, formerly SDOE)*
SDOE	Senior Director(ate) Operations and EATCHIP *(EUROCONTROL, now SDE)*
SELF	Self-paced learning
SID	Standard Instrument Departure
SIM	Simulator
SIMUL	Simulation
ST	Specialist Task *(EATCHIP, also used during transition period between from EATCHIP to EATMP)*

STAR	Standard Arrival
Sup Pract	Supervised Practices
TDH Unit	Training Development and Harmonisation Unit *(EUROCONTROL, IANS)*
TEAM SIMUL	Team Simulation
TF-CCC	Task Force Common Core Content
TF-TTM	Task Force Technology-Based Training Tools and Methods
TRM	Team Resource Management
TSG	Training Sub-Group
TXT	Text

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