EUROCONTROL

EXPERIMENTAL CENTRE

FACILITY SPECIFICATION
S 20 DED4 RVSM DFS Route Study

The 4th Continental RVSM Simulation
PART 2 - ANALYSIS

Draft
23/04/97

Prepared By : R. Deransy

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

ATC   Air Traffic Control
EATCHIP European Air Traffic Control Harmonisation and Implementation Program
EEC   EUROCONTROL Experimental Centre
CHI   Computer Human Interface
CWP   Controller Working Position
DSR   Display System Replacement
HCI   Human Computer Interaction
ISA   Instantaneous Self Assesment
MBB   Messerschmitt, Bölkow und Blohm
ORA   Operational Research and Analysis
PUMA   Performance and Usability Modelling technique for ATM
RTO   Real Time Operations
SIM5+   The current Brétigny simulator
STC   Simulation Technical Co-ordinator

1. SIMULATION ANALYSIS

(1)   This chapter specifies the different kinds of analysis that shall be available within the simulation environment in support of the **DED4 RVSM DFS Route Study** (S20) for the two phases of the simulation : Preparation and Post-Simulation analysis.

(2)   This evaluation will be measured in terms of Separation losses, Number of aircraft on frequency, Workload, System Performance and System Usability.

(3)   The objectives of the simulation are defined in Part I of the Facility Specification.

Page 1-5

1.1 PRE-SIMULATION ANALYSIS

(1)   The preparation and analysis conducted prior to the simulation is capable of giving the following elements :

- **Measured Hour**

The busiest periods of time for a given interval in terms of the number of aircraft passing through the simulated airspace.

- **Analysis of sector occupancy**

The number of aircraft in the sector,
The number of aircraft entering / leaving,
The number of aircraft present at the beginning and at the end of the measured hour,
The aircraft distribution from one sector to the adjacents,
The time spent within a sector,
The number of cruising aircraft at each flight level,
The number of aircraft requesting a given flight level.

- **Analysis of traffic at a specific point**

The number of departures and arrivals at an airport,
The number of aircraft overflying specified beacons or occupying specified route segments.

- **Analysis of separation losses**

The separation losses which are predicted to occur based on the aircraft flight plans and flight characteristics.

- **Analysis of performances**

The fuel consumption for the traffic if the information is available at this date.

- **Maps**

Maps of traffic flow and maps of predicted conflict positions are available.

1.2 OBSERVATION and DEBRIEFING

(1)   It will be possible to replay all or part of the exercises in the debriefing room where a UNIX station will be provided for the ART tool (Analysis and Redisplay Tools). In particular, this tool can be used to show the location and severity of any loss of separation for discussion with the controllers. The conflict can be replayed for analysis.

(2)   We will use Video-camera to record controller interaction with the system and to discuss with the controllers after the end of the exercises. This Video-Camera is part of the **PUMA** method (Performance and Usability Modelling technique for ATM) which help us in evaluating the controller workload by observing individual action.

1.3 POST-SIMULATION ANALYSIS

(1)   The analysis conducted after the simulation is capable of giving the following elements:

- **Analysis of sector occupancy**

  The number of aircraft on sector frequency,
  The number of aircraft entering / leaving,
  The number of aircraft present at the beginning and at the end of the measured hour,
  The aircraft distribution from one sector to it's adjacents,

  The time spent within a sector,
  The time spent in climb / in descent / in cruise within a sector,
  The distance within a sector,
  The distance in climb / in descent / in cruise within a sector,

  The number of cruising aircraft at each flight level,
  The number of aircraft requesting a given flight level.
  The number of flight levels (plus list) by aircraft :
      Did the aircraft reach its RFL ? If yes, After how many level changes ?

  The time and distance of aircraft from the sector boundaries at sector transfer,

- **Analysis of traffic at specific point**

  The number of departures and arrivals at airports,
  The time aircraft spent in holding stacks,
  The number of aircraft overflying specified beacons or occupying specified route segments.

- **Analysis of Separation losses**

  The separation losses which occured.
  The number of STCA,
  The correlation between STCA and separation losses,

- **Analysis of performances**

The fuel consumption for the traffic.

- **Maps**

Maps of traffic flow and maps of conflict positions are available.

- **Telecom**

Telephone communications
    For each type of telephone communication (Direct access, Intercom, Conference, ...) by sector we have :
- The total time spent speaking with another sector,
- The total time spent waiting for response / taken to give a response,
- The number of telephone calls sent / received.

Radio communications
    For each sector we have :
- The number of R/T calls sent / received,
- The total time spent on the frequency (sent / received) expressed as a percentage of the measured period,
- The maximum percentage of frequency occupation during a period of 6'.

- **Subjective analysis**

ISA (Instantaneous Self Assessment)

The ISA technique allows the participant to assess his/her workload during the course of a simulation exercise. The participant is provided with a warning (flashing red light) every two minutes. The warning will continue for 30 seconds during which time the participant makes an assessment of his/her workload by pushing the appropriate button to the input choice. The selection provided consist of :

ISA DEFINITION	
Rating	**Self Assessment of Workload**
Very High	The participant is behind the work, has no spare capacity and is shedding tasks
High	The participant has very little spare capacity and non-essential tasks are delayed. Perhaps one or two acft would push him into overload.
Fair	The participant has enough work to do. All tasks are under control and done in time. Tasks are interesting, challenging but not overloading. Time appears to pass quickly.
Low	The participant have more time than necessary to do his job. Time appears to pass slowly.
Very Low	The participant has a little to do and have a great deal of spare capacity. Time appears to pass very slowly.

The percentage of usage of the different ISA buttons gives a good idea of the workload for each controller. From experience, a percentage of 40% usage of button 4 and 5 implies a situation where the sector is overloaded.

- **Other analyses**

MBB

The MBB gives an objective evaluation of the workload of a sector. The MBB is calculated every two minutes to be compared with the ISA value. The formula is :

MBB= Tot $\quad$ +0.2*Mil + 0.24*Evol + 0.26*FIR+0.30*TMA + 0.38*RV
$\quad\quad\quad\quad$ +1.4*Nconf + 0.6*Nhold

where :
$\quad\quad$ Tot $\quad$ = Nb. of acft entering the sector
$\quad\quad$ Mil $\quad$ = Nb. of military acft entering the sector
$\quad\quad$ Evol $\quad$ = Nb. of acft changing flight-level
$\quad\quad$ FIR $\quad$ = Nb. of acft transitting between FIR and UIR
$\quad\quad$ TMA $\quad$ = Nb. acft transferring from or to the APPROACH
$\quad\quad$ RV $\quad$ = Nb. Radar vectoring orders give by the controller
$\quad\quad$ Nconf = Nb. of inputs to resolve conflicts made by the controller
$\quad\quad$ Nhold = Nb. of acft in placed in holding pattern

Pilot orders analysis

Percentage of order usage. Any kind of aggregation can be made. The possible aggregation should be defined as soon as possible.

Index synthesis

For each controller working position, a comparison between ISA, number of aircraft within the sector, the MBB index, the percentage of frequency loading, the number of conflicts (By type).

1.4 QUESTIONNAIRES

A set of questionnaires shall be prepared by the EEC and the Client prior to the Simulation. These will be used to obtain the controllers' opinions on the different scenarios.

(1)   **Pre-Simulation Questionnaire** : Questions relating to current working environment to try and identify problems areas and expectation for the future.Asks about expectations from the simulation.

(2)   **Post-Exercise Questionnaires** : Questions relating to the workload, system performance, traffic realism. Also asks about some specific problems related with the simulated airspace and ATC procedures used. (Quick 2 pages questionnaire).

(3)   **Questionnaires to compare Organisations** : Designed to compare the two the two FLOS (Single and Double Alternate) on a Uni/Bi-directional route structure.Trys to highlight the controllers preferences and the problems encountered.

(4)   **Post-Simulation Questionnaire** : To be presented to all controllers at the end of their participation in the simulation. Questions designed to assess their impression of the simulation, whether it was successful, what could be done better, what was done well ...