AN ANALYSIS OF THE TASK LIST IMPACT UPON RAMS WORKLOAD CALCULATIONS

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Summary

The overall aim of this undergraduate thesis is to analyze the impact of the task list, task duration times and actors who are responsible for task resolution on the calculation of workload in the Reorganized ATC Mathematical Model Simulator (RAMS).

During preparation for running a Fast Time Simulation (FTS) using RAMS one of the problems was task list definition. The task list in FTS using RAMS was designed in accordance with the opinions of controllers and expert teams, but there is no explanation of the task descriptions, task duration (weighting) and reasons for the weightings. Air Traffic Control (ATC) tasks from the currently used task list vary in importance, frequency and duration within and between different CEATS and no-CEATS sectors, due to the different route network, sector shape, ATC tools, traffic density and controller training in those sectors. The task list currently used in FTS3 produced a discrepancy between FTS and RTS workload results. Hence it was necessary to develop a new task list that includes a revised set of tasks performed by the CEATS controllers. ATC controllers who were trained for work in the Central European Air Traffic Services (CEATS) environment, including their experience in Real Time Simulation (RTS) played a very important role in providing the data necessary for this thesis. Their opinions about tasks in the CEATS environment, duration of task and some descriptive workload parameters such as importance and frequency of task execution were taken into consideration to define a new data base for workload calculation in RAMS. Based on the defined problem, the research process was conducted using several questionnaires and an interview with controllers prepared for work in CEATS experiments, in order to collect the necessary information and to ensure the design of a unified task list, which is applicable in all CEATS sectors. This task list and data collected during the research process were used as a basis for setting various scenarios in FTS using RAMS.

The results obtained using a different task list show the significant influence of task list and/or task duration on RAMS workload calculation. Therefore, to obtain more realistic workload results with RAMS, the design of an appropriate task list is a very important step in the preparation of input data for FTS.

In addition, one part of this thesis aims to examine possible differences in controller assessments of task duration times and actors who are responsible for task resolution, depending on where they work (National ACC or CEATS environment). The survey results show that the controllers' assessments of these values vary considerably and depend significantly on the National ACC from which they come.

Recommendation of standard task list for CEATS sectors for further FTS is made according to results of research process conducted in CEATS and non-CEATS environment.

Structure of paper:

The presentation of this paper in regard to survey and results obtained is done through following parts:

Central European Air Traffic Services-CEATS

Explanation of the CEATS Programme and its supported units (CEATS Strategic Planning and Development Unit or CSPDU, CEATS Upper Area Centre or CUAC, CEATS Training Centre or CTC) particularly CEATS Research Development and Simulation Centre (CRDS) will be presented in this part. CRDS located in Budapest provides Real Time Simulations (RTS) and Fast Time Simulations (FTS) for the CEATS States and other bodies, ensures the training of controllers and control teams and the verification of their ability. [3]

These simulations had different objectives: to determine capacity figures for CEATS sectorisation, to evaluate sector groups and CUAC interface with subjacent and adjacent airspace and to investigate the change in collective and individual working activity including impact on coordination, communication and controller workload. Estimation and evaluation of controller workload is an important goal in this research, but workload results produced by RTS and FTS are obtained under different conditions.

Basic features of Real Time and Fast Time Simulations

Real Time Simulation (**RTS**) always involves the participation of human operators who bring a lot of knowledge and abilities to the system where they work, concerning flexibility, adaptability and motivation. During their work, their workload is affected by many factors from the controller environment. ATC participants in RTS are controllers and pseudo pilots who are situated in two separate control rooms. The simulated air traffic sample is presented to controllers at both control positions (Planning and Executive controller). The pseudo pilots operate the aircraft involved in the scenarios, in accordance with controller instructions, using changes in heading, altitude and speed in order to achieve a more realistic traffic control environment. The running air traffic sample produces the events that generate the tasks which should be performed by controllers participating in the simulation. During Real Time Simulation, controllers estimate workload by ISA method. They have to decide every two minutes pressing one of the buttons in accordance with workload at that moment. Their workload can be expressed as Very Low, Low, Fair, High or Very High. [2]

Fast Time Simulation (**FTS**) generally includes the repetitive exercise of different scenarios and provides databases needed for operations research. This type of simulation is done without human observers or controllers and can be called a computer simulation. Controller behavior and decision making are defined by the rule base of the FTS tool.

The features of some simulations (FTS3 and SSRTS3) conducted in CRDS take a significant place here. The results produced using of various scenarios in simulations will be compared to existing workload results obtained in FTS3, as well as with results obtained in SSRTS3.

Objectives

The Task list currently used in FTS3 produced disagreement between FTS and RTS results. Therefore, the development of a new database including a revised set of controller tasks was suggested as a good approach in order to minimize the discrepancy between FTS and RTS workload results. It has already been mentioned that the new task list will be defined based on the subjective opinions of controllers participating in the Real Time Simulation, performed at CRDS.

The **Objectives** of this research were:

- Data collection - Several questionnaires and an interview with controllers trained for work in CEATS simulations were used to create a more realistic task list that included the minimum and maximum task duration times, task distribution between controllers, the importance of the tasks and frequency of task execution.

- Setting different scenarios for running simulations in RAMS in order to analyze the impact of the task list on controller workload calculations in RAMS.

- Examination of possible differences in controller opinions about task duration times and the actors responsible for task resolution between National ACC and CRDS, using a questionnaire.

Data Collection and Survey Results

This part describes the research process for gathering data which were used to design a new task list, define the task duration times and estimate the importance and frequency of task execution. Data collection was conducted during the testing week and preparation week for Multi Sector Planner (MSP) which is called Prototyping Real Time Simulation 2 (PRTS2). The survey was organized using several questionnaires and an interview, and it produced all the necessary data for designing a new task list. Interview was performed in order to complete the questionnaire results and collect information about the factors affecting controller workload.

The controllers who participated in this research were from Czech Republic, Slovak Republic, Italy, Hungary, Austria, Slovenia and Croatia. A total of 10 controllers and 1 RTS expert were involved in this research.

The survey consisted of:

Start Questionnaire (during the testing week, in September 2003)

Progress Questionnaire (during the testing week, in September 2003)

Final Questionnaire + Interview (during the PRTS2 Simulation week, between October 06th and 10th 2003)

Start Questionnaire

The questionnaire was offered to CEATS controllers who were asked for their opinion about the tasks that are usually performed in CEATS simulations and to divide those tasks into the five groups existing in RAMS: Flight Data Management, Co-ordination, Conflict Search, Routine R/T and Radar Tasks. In addition, the controllers had to estimate the average time needed for task performance, the actors involved in resolving the task, the approximate time necessary for thought process and the aircraft affected by the task.

The approximate time necessary for thought processes concerns the time needed to make a decision before starting task execution.

Aircraft affected by the task concerns the following situations: climbing, descending or cruising aircraft.

In the form described above the questionnaire produced difficulties for controllers when deciding about the grouping of tasks, as well as gathering of other data. The controllers did not describe the name of the task in the same way, which produced around 160 different answers, most of which, in essence, had the same meaning. Therefore, it was necessary to aggregate the tasks, which resulted to list of 29 tasks.

Other information obtained in the first questionnaire was not used for further analysis, but it was very useful for designing the first new task list including a total of 29 tasks.

Progress Questionnaire

The survey using the Progress Questionnaire was conducted several days after the first survey, and included the same controllers. The aim was very similar to the first time, but in this case the defined task list was presented to controllers based on the results obtained in the Start Questionnaire. The task list included 29 tasks. They decided for each task on the list whether the task was performed by the planning or by executive controller and estimated the task duration time for each actor (PC and EC). In the second part of the questionnaire they had to decide which five tasks were the most important for them and which five tasks were the least important.

The data collected showed very different opinions concerning the importance of the tasks and in some cases completely opposite opinions, i.e. the most important task for one controller was the least important task for another controller. Particularly, the tasks from group "monitoring tasks" and "transmit tasks" were given greatly different estimates of importance. For example, almost 50% of controllers believe that those tasks are very important and the other 50% think that they are unimportant.

It was decided that the questionnaire should be written in a different way in order to collect reliable information about the importance and the frequency of each task and to define the task duration times.

The Progress Questionnaires collected data about the tasks performed by controllers in CEATS Simulation and provided new ideas for designing the Final Questionnaire. [1]

Final Questionnaire

The **Final Questionnaire** was designed in order to collect data concerning the time necessary for task performance, the actors who resolved those tasks and some factors affecting controller workload. The questionnaire consists of three parts:

- The first part was prepared to gather information about the minimum and maximum task duration times and the actors who perform the task. The minimum and the maximum time duration were estimated in seconds and the actors were chosen marking one of the numbers 1, 2 or 3.
  - 1 for planning controller (PC)
  - 2 for executive controller (EC)
  - 3 for both controllers (PC/EC)
- The second part was prepared in order to estimate the importance of the task. It was based on the assumption that it includes the situation where controllers have a very busy sector and high workload and where every single task should be undertaken. In that case they were asked to define their priority (what would they do first?)

The priority in this questionnaire is used to define the importance of the task. The different

[1] The list of 31 tasks was presented to controllers in Final Questionnaire. The designing of the task list was done using the 29 tasks collected by questionnaire and by two added tasks from the task list in FTS3.

numbers from 1 to 5 were assigned to each task based on the subjective opinion of the controllers.

v 1 - very small importance

v 2 - small importance

v 3 - medium importance

v 4 - high importance

v 5 - very high importance

♦ The third part of the questionnaire was prepared in order to estimate task frequency, considering peak hour period. The frequency is used in this questionnaire to define how often controllers perform the task.

The different numbers from 1 to 5 were assigned to each task based on the subjective opinion of the controllers.

v 1 - very small frequency

v 2 - small frequency

v 3 - medium frequency

v 4 - high frequency

v 5 - very high frequency

The **Interview with CEATS controllers** was done in order to complete the questionnaire results and collect data about factors affecting controller workload.

Interview was conducted during the PRTS2 Simulation week, after the Final Questionnaire with the same controllers who participated in the questionnaire survey. Since the controllers did not estimate average duration in the Final Questionnaire, it was decided that the interview should be realized in order to collect that data.

Calculation of average value of task duration time as a mean between minimum and maximum average values was not acceptable as realistic, because in real ACC environment there are situations when average task duration time is close to minimum and sometimes is close to maximum.

During the interview controllers were asked to estimate the average duration of each task based on their experience. It should be mentioned that each controller had the opportunity to check his answers to the Final Questionnaire and to examine his decision. They also gave subjective opinions about the factors which they considered to have a major impact on their workload.

The thesis also contains statistical analysis of data collected in the Final Questionnaire and Interview. Final results of this analysis will be presented in this paper including:

v Average minimum and maximum values of task duration times

v Average values for importance of each task.

v Average values for frequency of task execution.

v Task distribution between controllers (actors performing the tasks).

v Factors affecting controller workload

The average values for importance of each task and frequency of task execution were used to sort the tasks from the most important to the least important and from the most frequent to the least frequent task.

RAMS Workload Calculation

The RAMS simulator is an Air Traffic Control (ATC) event generator that reports its discreet events or triggers, thereby enabling the modeler to program a unique set of activities, including user defined sets of ATC tasks and ATC participants. All ATC tasks are grouped in five main categories: Flight Data Management, Co-ordination, Conflict search, Routine R/T Communications and Radar tasks. [4]

Predefined triggers activate ATC tasks (one task or set of tasks). The trigger is the event (sector entry, sector exit, conflict found, new flight level reached…) that calls for the recording of a specific ATC task. The tasks are assigned to defined actors, i.e. planning and/or executive controller. Each task has an associated time offset defined in seconds which presents the time of activated trigger. Positive, negative or zero values can be defined as a time offset depending on specified trigger. For example trigger "ATC Sector Pierce" has a time offset (-60s) and trigger" ATC Sector Exit" has a time offset (10s).

The workload model provides the possibility to assign a task weight (i.e. duration in seconds) to an unlimited number of ATC tasks. In certain situations a task can include more than one control position and different task duration times (weight) can be allocated to each position. In addition, a different task duration times can be allocated to the same task performed in different sectors.

The Re-organized ATC Mathematical Simulator (RAMS) calculates the workload on each position (PC and EC) which is expressed as time in seconds

and calculated as a sum of time duration of each task triggered during simulation and also the percentage loading on each position over certain peak periods (generally one and three hours).

Controller percentage loading can be:

The peak 1-hour percentage loading represents total time spent by a working position on the tasks recorded by the RAMS model during the busiest 60-minute period for that position and is expressed as a percentage of the 60 minutes. This loading is used in order to assess possible workload problems on individual working positions and to compare the results of the different organizations.

The average 3-hour percentage loading represents the total time spent by a working position on the tasks recorded by the RAMS model during the busiest 3-hour period and are expressed as a percentage of the time. Average percentage loading is used in order to assess the balance of workload between working positions and to compare the results of the different organizations. [1]

The following criteria are used in the interpretation of these loading:

v Severe 1-hour loading in excess of **70%** (capacity is exceeded)

v Heavy 1-hour loading in excess of **55%** (sector is overloaded)

v Severe 3-hour loading in excess of **50%** (capacity is exceeded)

v Heavy 3-hour loading in excess of **40%** (sector is overloaded)

Comparison of Workload Results

This part will present inputs or data for setting scenarios in RAMS. In particular, scenario 1 and scenario 2 will be explained including comparison of obtained workload results after simulation 1 and simulation 2 with existing workload results in FTS3. A very important part concerns comparison of workload results between planning and executive controller during each simulation. The thesis also concerns comparison of workload results with results in SSRTS3, but just short overview of these results will be explained during the presentation.

Some features of FTS3 present a base for the other simulations. These features include:

v Traffic sample taken from 28 June 2002 increased to Initial Level by 32% for CEATS area

v Route network ARNV4bis

v Sectorisation was based on FTS2 results- 31 sectors

Running RAMS with scenario 1

Simulation 1 was done by scenario 1 that uses the task list from FTS3 for CEATS sectors (**15 tasks**). A new average task duration time estimated by interview was aligned to each task and actors were determined by questionnaire survey.

The workload results produced by scenario 1 in one peak hour period concerning all simulated sectors were compared with existing workload results in FTS3 for both control positions (planning and executive controller). This presentation concerns differences in workload results in few sectors that are showed in figures:

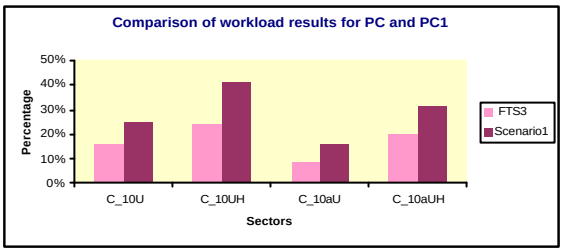

Figure 1. Sectors C_10U, C_10UH, C_10aU and C_10aUH (PC1 & FTS3)

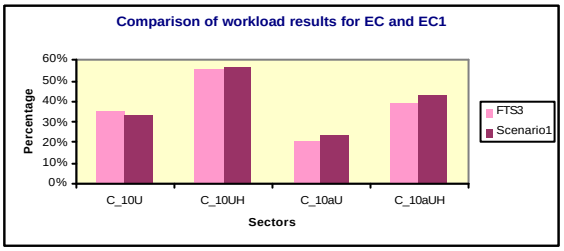

Figure 2. Sectors C_10U, C_UH, C_10aU and C_10aUH (EC1& FTS3)

After comparison of the workload results produced in simulation 1 and in FTS3, the following conclusions have been reached:

1. There is an increase of workload for PC1 after simulation 1, compared to workload results in FTS3.

2. Sector C-15UH exhibited workload results for the planning controller of 32.39% after simulation 1 and the workload of the same controller in FTS3 was 36.78%. Only in this case was the workload for the PC[2] in FTS3 higher (4.39%) than workload after simulation 1.

3. The workload results for the EC[3] were higher in FTS3 than after simulation 1 in six sectors.

4. Workload results for executive controller were very similar in certain sectors, comparing FTS3 and simulation 1. The differences were less than 1%.

5. Comparing relative differences between PC and PC1[4], it can be concluded that PC1 had approximately 70% higher workload than PC in most sectors. In case of EC and EC1[5], it can be concluded that EC1 has similar workload to EC.

Running RAMS with scenario 2

Simulation 2 is done by scenario 2 that includes a new task list for CEATS sectors (**31 tasks**) defined by the Final Questionnaire as well as a new task distribution. The new task duration time (estimated average time) was defined by interview and aligned to each task.

The workload results produced by scenario 2 in one peak hour period concerning all simulated sectors were compared with existing workload results in FTS3 for both control positions (planning and executive controller). Differences in workload results are presented in following figures concerning some sectors:

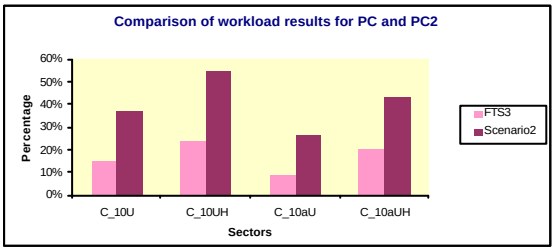

Figure 3. Sectors C_10U, C_10UH, C_10aU and C_10aUH (PC2 & FTS3)

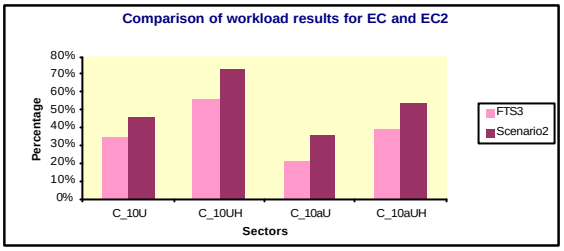

Figure 4. Sectors C_10U, C_10UH, C_10aU and C_10aUH (EC2&FTS3)

After comparing workload results produced by simulation 2 with workload results in FTS3 the following conclusions can be made:

1. There is an increase of workload for both controllers in each sector after simulation 2.

2. Increase of workload is higher for PC2[6] than for EC2[7] (for PC2 ~ 130% and for EC2 ~ 50%)

Sector overview after FTS3, Simulation 1 and Simulation 2

Concerning all simulated sectors (31 sectors), percentage values of number of sectors with acceptable workload (< 55%; blue paint), heavy workload (between 55% and 70%; red paint) and severe workload (> 70%; yellow paint) for both controllers are presented in following figures.

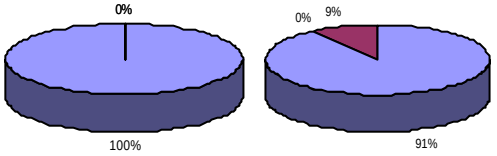

Figure 5. Sector overview after FTS3 (PC and EC)

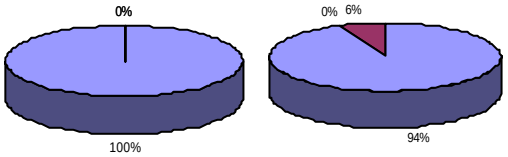

Figure 6. Sector overview after Simulation 1 (PC1 and EC1)

[2] "Planning Controller in FTS3"
[3] "Executive Controller in FTS3"
[4] "Planning Controller in simulation 1"
[5] "Executive Controller in simulation 1"

[6] "Planning Controller in simulation 2"
[7] "Executive Controller in simulation 2"

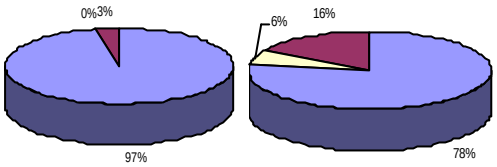

Figure 7. Sector overview after Simulation 2 (PC2 and EC2)

From the Figure 5, it can be concluded that there is no overloaded sector in FTS3 concerning PC (presented by blue paint in the figure) and there is 9% (3 sectors) overloaded sectors in case of EC.

From Figure 6, it can be seen that there is no overloaded sector in simulation 1 concerning PC1, but 2 sectors or 6% are overloaded in case of EC1. Workload in one sector is also very close to reaching capacity level defined at 70%.

Figure 7 shows that 97% of sectors have an acceptable level of workload and 3% of sectors are overloaded concerning PC2. In five sectors (16%) workload results for EC2 were between 55 % and 70%. These sectors were overloaded after simulation 2. Capacity level, defined by 70%, was reached in two sectors (6%) and presented by yellow paint in the figure. There is a group of sectors with workload results between 50% and 55%. These sectors can be called critical sectors, since, small changes in the task list or increasing of duration of task performance in further simulations can provoke overloading of these sectors. The same changes in some sectors can provoke reaching of capacity level in further simulations.

Comparison of obtained workload results with results in SSRTS3

Short comparison of workload results obtained after each simulation with existing workload results recorded during SSRTS3 will be explained.

Estimation of controller workload in SSRTS3 is defined by ISA method, i.e. controllers have to press one of the buttons on their control desk corresponding to appropriate level of workload defined in five rates as Very Low, Low, Fair, High or Very High. Controller workload in FTS is defined as a percentage value. In order to compare workload results between these two types of simulations the rates from 1 to 5 must be expressed as percentages. The estimation of percentage values of workload, which are aligned to ISA rates, was made based on the subjective opinion of the author of this paper.

Sensitivity Analysis

This part describes the influence of change of task duration times on controller workload. Selection of the tasks that were included in this analysis was based on specific factors: high range between average minimum and maximum task duration times, task importance and task frequency.

The tasks that were taken into consideration were those with a high range between average minimum and maximum duration such as: “Screen Set Up”, “Conflict resolution”, “Surveillance of A/C in sector” and “Monitoring of all A/C influenced by an A/C climbing or descending”. The ranges for these tasks are:

1. Screen set up-19.64 seconds

2. Conflict resolution-18.73 seconds

3. Surveillance of A/C in sector-16.36 seconds

4. Monitoring of all A/C influenced by an A/C climbing or descending-18.46 seconds

The task “Screen set up” was eliminated, because controllers usually performed that task only once during their working hours. The task “Monitoring of all A/C influenced by an A/C climbing or descending” was eliminated because the same task can be grouped together with task” Surveillance of A/C in sector”, based on controller opinions.

The frequency of task execution was checked after running simulation 2, because the same task list is used in simulation 3 (sensitivity analysis). Frequency was checked in each sector in one Peak Hour Period. Very frequent tasks were:” Conflict resolution”, “Surveillance of A/C in sector”, “Updating label data”, “Level change coordination” and “Identification of A/C”.

The tasks “Updating Label Data”, “Level change coordination” and “Identification of A/C” were eliminated because their range between the minimum and maximum task duration times was small, around 5 seconds.

The importance of tasks was also considered when deciding which tasks should be included in the Sensitivity Analysis. Average values for importance of two tasks were **4.73** (Surveillance) and **4.91** (Conflict Resolution). After all this analysis it was decided that

1. “Surveillance of A/C in sector”

2. "Conflict resolution", should be included in the sensitivity analysis.

Running RAMS with scenario 3

The sensitivity analysis (simulation 3) was performed using RAMS with scenario 3. The task duration times in this scenario are the same for all tasks as in scenario 2, except for two selected tasks. These two tasks were included in scenario 3 with their maximum task duration times.

Workload results produced after simulation 3 were compared with workload results in simulation 2. This presentation concerns certain sectors.

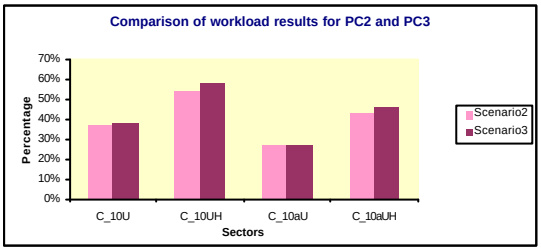

Figure 8. Sectors C_10U, C_10UH, C_10aU and C_10aUH (PC2&PC3)

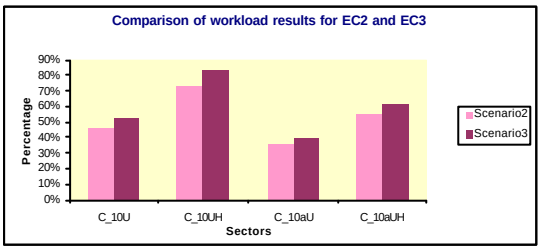

Figure 9. Sectors C_10U, C_10UH, C_10aU and C_10aUH (EC2&EC3)

According to the results obtained, it is clear that every change, which increases the task duration times of certain tasks, provokes higher workload in sectors.

After comparing the workload results obtained by simulation 2 and simulation 3, the following conclusions can be made:

1. If the maximum task duration times of the tasks "Surveillance A/C in sector "and "Conflict resolution" are used workload results after simulation 3 are higher than in simulation 2.

2. There is an increase of workload in each sector for both controllers (PC3 and EC3)

3. Increase of workload is higher for the executive controller than for the planning controller.

4. PC3 has approximately 5% higher workload than PC2 and EC3, approximately 9% higher workload than EC2, concerning relative difference in workload between these controllers.

Sector overview after simulation 3

Concerning all simulated sectors (31 sectors), the percentage values of number of sectors with acceptable, heavy and severe workload for PC3 and EC3 are presented in following figure.

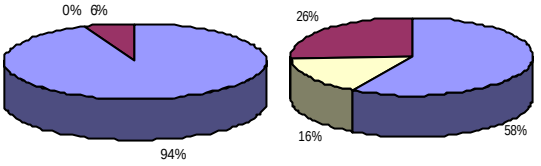

Figure 10. Sector overview after simulation 3 (PC3 and EC3)

From Figure 10 it can be seen that 94% of all sectors had acceptable workload (< 55%) and 6% of all sectors were overloaded (>55%) in case of PC3.

The figure also shows that 58% of all sectors had an acceptable level of workload (< 55%), concerning EC3. The rest of the sectors were overloaded (> 55%) and some of them had reached capacity level (>70%).

Survey Results: National ACC versus CRDS

During the research process and after conversation with the controllers from different countries who participated in CEATS simulations, it was obvious that controllers did not have the same opinions about minimum and maximum task duration time, actors who perform the tasks and the importance and frequency of task execution. According to that conclusion it was decided that the same survey, using the Final Questionnaire should be made in National ACCs, since controllers work in different environments, use different systems, they have different levels of training and work skills and they are faced with different traffic conditions and different sectorisations.

This part of the paper will present some differences between the survey results from controllers in National ACCs (ACC Bratislava, Budapest and Vienna) and controllers in CEATS simulations (CRDS environment). The average task

duration times and task distribution between controllers were main aim of this survey.

Some conclusions were made:

1. Average task duration times are very similar in ACC Bratislava, Budapest and CRDS. The controllers' answers in ACC Vienna were very different compared to controller answers in ACC Bratislava, Budapest and CRDS. The duration of tasks was estimated as much longer than in other ACC-s and also controller answers were very different.

2. There is a group of tasks which has the same Task distribution between controllers in each ACC and CRDS (13 tasks)

3. The tasks "Usage R&B[8]" and "Usage MTCD[9]" are performed in National ACC very rarely and the task duration times for the group of "Monitoring" tasks were not estimated by most of the controllers.

Conclusions

Based on comparison of workload results obtained by these simulations, the following conclusions are made:

1. Workload calculation in RAMS is significantly affected by changes in numbers of tasks, task duration and task distribution between controllers (PC, EC or PC/EC). The influence of different task lists upon workload calculation in RAMS can be seen after the analysis of workload results after each simulation. Therefore, designing a task list, estimating the duration of tasks (weightings) and task assignment to controllers should be undertaken with great care.

2. After comparison of workload results between simulations performed in this study with obtained workload results in SSRTS3 there is a higher agreement between workload in FTS and RTS.

3. It clearly proved very difficult for controllers to estimate the duration of monitoring tasks which can be grouped together as a subgroup of "Surveillance" tasks. The task "Passing time revision" was estimated as the least important task and least frequent task performed by controllers in CEATS simulation. Most of them do not perform this task. Recommendation is that this task should be eliminated from the standard task list for CEATS. In accordance with the above conclusions for the following simulations is a recommended standard task list for use in CEATS sectors that consists of 24 tasks.

5. Comparison of the survey results obtained from controllers in National ACCs (Bratislava, Budapest and Vienna) and controller answers in CRDS Budapest shows that different traffic sample, sector shapes, controller level of training and traffic procedures have a significant influence on task duration times and task distribution between controllers. This conclusion is very important and indicates that education programs for CEATS controllers, concerning their level of skills and work experiences should be developed with great care, affording all controllers the same training conditions.

Recommendations

In order to better align FTS and RTS results concerning workload calculation some recommendations are given for further research:

1. Observing controllers during performance of tasks in an RTS environment and measuring the duration of tasks which they performed at both control positions (PC and EC)

2. Conducting a similar survey by questionnaire but with participation of more controllers.

3. Defining other approaches for transformation of workload values obtained in RTS into percentage values that will ensure comparison of FTS and RTS workload results in a reliable way.

References

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Biography

My name is Mara Cujic and I was born on August 27 in Zemun, Serbia and Montenegro. I finished Primary School in Golubinci, in 1992 and High School in Stara Pazova, in 1996.

I attended Faculty of Transport and Traffic Engineering, University of Belgrade and graduated in 2004 from Department of Air Traffic, Division of Airports and Air Traffic Safety.

I completed training period at Eurocontrol from 01.09.2003 until 31.12.2003. The training period was spent at the CEATS Research Development and Simulation Centre in Budapest, Hungary and the title of my work which also was the subject of my undergraduate thesis is "An Analysis of the Task List impact upon RAMS Workload Calculations".

Footnote 1
Footnote 2