HUMAN-MACHINE INTERACTION IN SOLVING TASKS OF THE PLANNING DEPARTMENT

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ABSTRACT

The paper discusses issues of human-machine interaction in solving tasks of the planning department under severe resource restrictions using information technology.

There are shown negative factors influencing on specialists of planning department in solving their tasks under the circumstances. The specific features of designing the user interface in this subject area are noted. There are shown directions to increase the efficiency of reaction of the planning department's specialists to changing of current situation by visual and sound notification about various events. The approaches to develop user interface to generate conflict-free plan under severe resource restrictions are considered. The variants of informative presenting operational and statistical information to stakeholders are analyzed. These issues are discussed by the example of the planning department which solves the tasks of allocation of control facilities for spacecrafts.

INTRODUCTION

The allocation of various shared resources (resources of collective usage) is a very actual problem with a large number of different modifications [1-4]. The planning departments solving such task are used in many industry areas, such as the transportation industry, the rocket and space industry, the nuclear power industry, etc. As examples, planning departments of railway traffic, planning departments of road works, department of logistics transportation, traffic control departments, etc. [4-9].

In the modern world such departments often work under severe resource restrictions caused by not only scarcity of allocated resources, but also high requirements to the time of solving tasks of planning department. These requirements could be satisfied by using modern information technology. However, interaction of specialists with automated information system of planning department has sufficient influence on efficiency of solving its tasks even when there are a high degree of automation.

The main negative factors influencing on specialists of planning department in solving their tasks in the current conditions may include:

•a large amount of data to be processed, a significant number of factors to be analyzed;

•strict requirements to time of solving tasks under conditions when specialists should be resistance to stress;

•a necessity to continuous monitoring of the current situation for a prompt response to its changes.

The usage of successful approaches to human-machine interaction can significantly increase the efficiency of solving tasks of planning department. The issues of human-machine interaction in mentioned subject area are considered by the example of planning department solving tasks of allocation control facilities for spacecrafts.

THE INCREASING EFFICIENCY OF RESPONSE OF THE PLANNING DEPARTMENT'S SPECIALISTS ON CHANGING OF CURRENT SITUATION

One of the main factors, influencing on the efficiency of solving tasks of planning department, is a timeliness of specialists' response on changing of situation. This factor could be parried by prompt notification of specialists about changing of situation.

Such notification has a number of specificities. First of all, a group of persons for notification is not so big (from few to tens). All specialists work on their workplaces located on a quite small area (one or few rooms). All workplaces are equipped with computers. Each specialist has interest only in a specific list of events, i.e. data flows have address direction.

The receiving information into database can be considered as a completion of one technological operation and a beginning of another. For example, receiving additional request initializes a procedure of changing developed plan.

When receiving new information from subscribers, specialists of planning department are notified about this fact. Specialists are notified using both visual and sound messages. The notification may vary depending on the properties of the received information and of the current situation. It enables the specialist to promptly make a decision about urgency of processing received data even if he performs other tasks and do not work on the computer at that time. The specialist can interrupt the current task and switch to performing more priority one or begin processing the received information after the completion of the current task.

The visual component of notification is a popup window containing data about received information. An individual icon can be assigned to each type of event. Specialist can switch to processing of received data directly from message of visual notification. The sound notifications may vary depending on the properties of the received information. They may be repeated at specified intervals before receiving notification by specialist.

During the process of notification of specialists about changes of situation, all information are received into database, which is a central element of planning department's automated information system. The generalized diagram of propagation of messages about receiving new information is presented in fig.1 [10]. It was implemented by mechanism of advanced queues support in database management system Oracle - Oracle Advanced Queuing. The visual component of notifications (message) was implemented by Developer Express VCL (Visual Component Library).

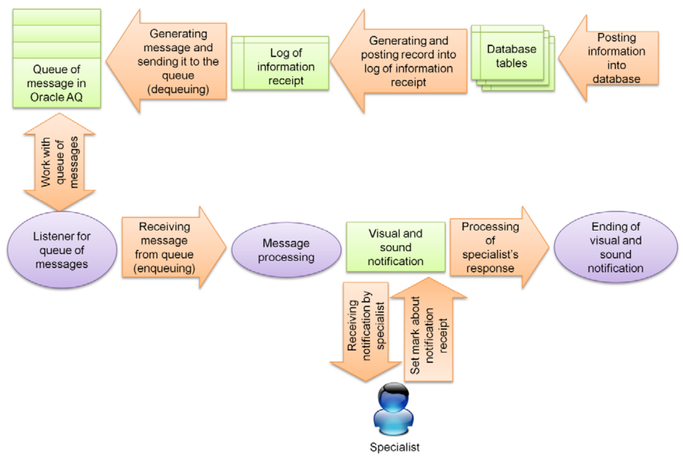

Figure 1. The propagation of messages about receiving new data

It should be noted that the usage of notification about changes of situation usually don't influence on the time of making a decision, but it enables to start making a decision earlier (see fig.2). This causes one of two consequences (or their combination): the decision making process is completed earlier or there are more time to make a decision. Thus, the notification about changes of situation not only can increase the efficiency of solving tasks of planning department by earlier start and, as a consequence, by the earlier end of the decision making process, but also can contribute to make a better decision due to the appearance of additional time for its production.

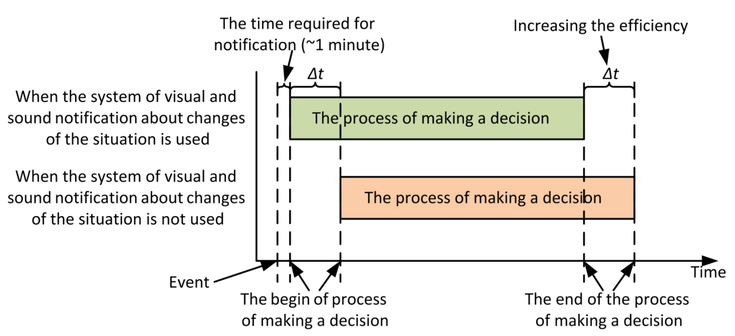

Figure 2. Schematic representation of the principle of increasing the efficiency of solving tasks of planning department by using the notification system about changes of situation

THE USER INTERFACE FOR DEVELOPING A CONFLICT-FREE PLAN UNDER STRICT RESOURCE RESTRICTIONS

As the number of consumers of shared resources under resource restrictions increases, the scarcity of shared resources also grows. This causes increasing of number of conflict situations (conflicts). The conflict is a contradiction between request on using shared resource and existing restrictions. It can be caused by the need to use the same resource for different consumers at the same time, the need to use the resource at the time of service operations, etc. The example of dependence of a quantity of conflicts from the number of consumers for the various number of planning objects is presented in fig.3.

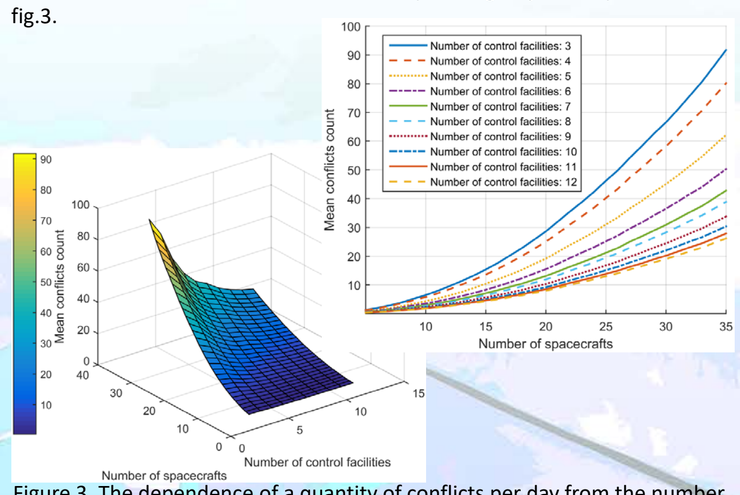

Figure 3. The dependence of a quantity of conflicts per day from the number of spacecrafts and the number of control facilities (calculated in 100 model experiments): a – 2D-plot, b – 3D-plot

Issues of human-machine interaction during solving task of developing conflict-free plan under strict resource restrictions have significant influence on the efficiency and the quality of solving this task. So, information capacity and ergonomic of user interface of software for developing plan are very important. The candidate plan can be viewed as in a tabular form as in a form of diagram for user convenience (e.g., fig.4). There was implemented a color indication of conflicts with possibility to view data about their reasons. So, the user can view requests that conflict with each other and data about state of the shared resources which cannot be used in accordance with requirements of the received requests.

Candidate solutions of conflicts can be developed using visualization of plan in the diagram containing available times of using each resource for each consumer. Such times can be considered as possible solutions of the conflicts. Also, user can view data about possible solutions of the conflicts. Such view of data representation is more intuitive and can make user's work easier.

When new requests on using resources are received, the indication about existing not-processed data is carried out by color highlighting of these data or showing total number of records to be processed.

It should be noted that specialists of planning department should prepare a large number of document in hard copy after developing or changing the plan. The batch printing of documents on the results of developing plan is provided to reduce time of this operation. The list of the documents to be printed is dynamically generated according to the content of the plan or its correction.

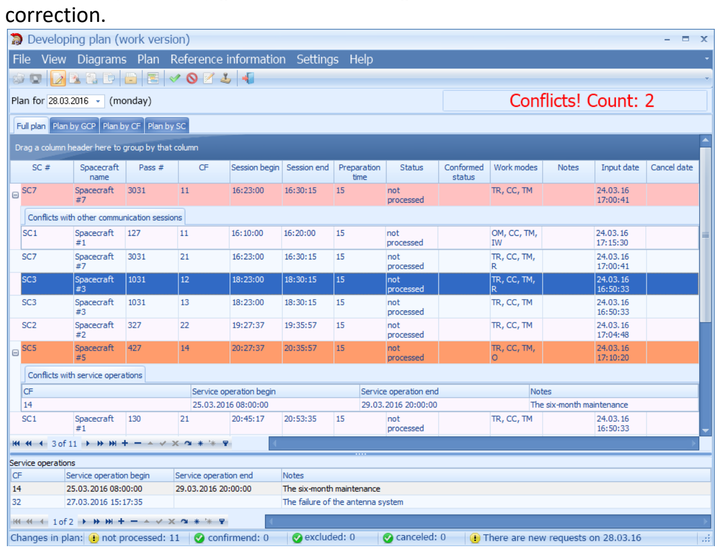

Figure 4. The main form of the program for developing conflict-free plan

THE VARIANTS OF INFORMATIVE REPRESENTATION OF OPERATIVE AND STATISTICAL DATA

Specialists of planning department need a compact and informative representation of data about current situation to perform prompt evaluation and analysis of it. It can be reached by presenting data in an interactive schematic form with possibility to drill down to the desired level (e.g., fig.5). In this example color indication of the status of shared resources (control facilities for spacecrafts) are carried out both in terms of serviceability and in terms of current use. There are the indication of status and existence of current communication sessions for consumers (spacecrafts) is implemented.

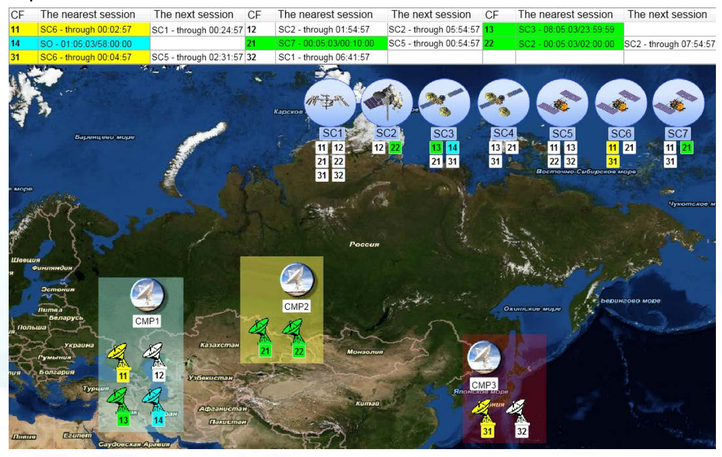

Figure 5. The operative presentation data about the current situation in the schematic form (CF – control facility, SC – spacecraft, CMP – control and measurement point)

The allocation of shared resources should take into account the results of analysis of their usage. Specialists of planning department need the various statistical data to perform such analysis. Statistical data manipulation can be done for various periods and various data slices (e.g., consumers, resources, etc.). The flexible generation of reports in accordance with current requirements of users should be provided. In addition, there should be an opportunity of calculating new statistical indicators based on the basic ones with applying to them predefined functions and groups.

CONCLUSION

Thus, there was performed the analysis of specific features of human-machine interaction in solving the tasks of planning department under strict resource restrictions using advanced information technology. The proposed approaches to developing user interface provide concentration attention of specialists of planning department on the most important data requiring priority processing. The system of visual and sound notification about important events was developed to increase efficiency of specialists' response on changes of the current situation. Specific features of user interface for developing conflict-free plan were noted. The variants of informative presentation of actual information about the current situation on the interactive scheme and flexible presentation of statistical data were proposed.

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