

is fully integrated, so that as it plays a vertical line scrolls across the OTAST, indicating the relevant actions and tasks. Similarly, dragging the vertical line along the task sequence moves the video clip to that point. Correcting the OTA data is easily done, by selecting a task or action, moving the video to that point, then clicking a button to correct the start or end time. Multiple video windows may be opened and run within the OTAST, for instance to see different instances of the same task being performed.

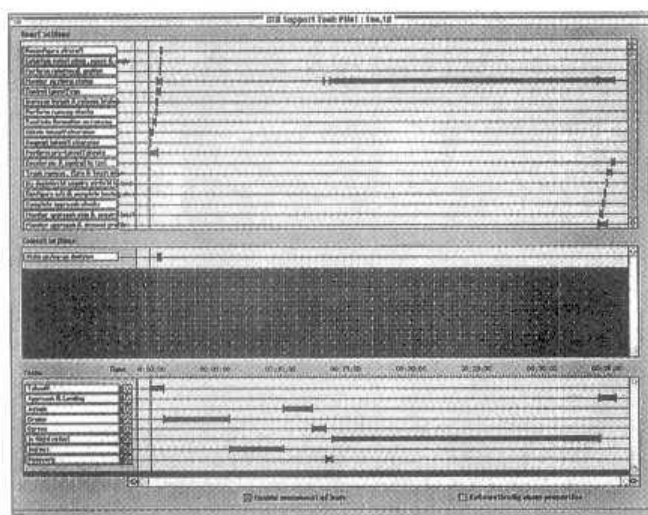


Figure 2 Operational Task Analysis Support Tool

Task "generification" (a way of deriving an average or generic version of the observed tasks) was then undertaken using the Task Generification Tool (TGT), which is embedded within the OTA Support Tool. When this is invoked an automated process examines all the instances of each task identified during the OTA, and determines how internally consistent the task is in terms of the actions it contains, their length, and the overall length of the task. The generic version of the task is then generated, along with the plus-one-standard-deviation version. Naturally, it is important that the user examines the generic version of a task and edits it as necessary, since like the "average" family of 2.4 children, it might not make sense in a single instance. (A concrete example occurs with ATC speech. In most cases, conversations occur on a turn-taking basis, and each observed instance of the task might reflect this. A generified version, however, might contain overlaps, that would when put through the workload calculation algorithm show unrealistic workload peaks).

Thus the OTAST and its embedded tools, the TST and TGT, allowed the creation of a baseline

definition of tasks and actions within the roles studied. PUMA also supports the creation of tasks from a conceptual level rather than simply from observation, and this is done using the Membership Editor, which allows the user to re-define the nature of the tasks to be performed in a top-down style. From the membership editor the user can call two further editors, which allow the operational concept to be explored from two different perspectives.

The Task-Action Ordering Editor (TAO Editor), called from the Membership Editor, allows the user to look at each task that has been defined, see the actions within it (both overt and covert), edit the durations and channel loadings of those actions, and calculate the workload for each of those tasks. Furthermore, the TAO Editor allows the user to see at a glance which role is connected with a task. A further feature of the TAO Editor is the ability to select all actions, and edit their durations and channel loadings. When the changes made using the TAO Editor are saved (to the Operational Concept file), they form the new global definitions of those variables.

The Event-Task Ordering Editor (ETO Editor), also called from the Membership Editor, allows the user to look at tasks from the perspective of events, i.e., the external triggers. It also allows the user to see which roles are associated with those tasks, and to calculate the resulting workload for that role. The start time of the events can be edited using the ETO editor. When the changes made using the ETO Editor are saved (to the Operational Concept file), they form the new global definitions of those variables.

Thus the new editors allowed a range of operational concepts to be defined very readily, and then examined from different perspectives, in terms of the workload involved in tasks, and the workload associated with individual roles. In addition, the use of a single master file that defines everything to do with the activities of the controllers (the Operational Concept file) made it easy to maintain configuration control of alternative operational concepts. The Membership Editor incorporates a built-in report generation facility, which was used to automatically create detailed reports of the operational concepts.

Having undertaken the activities outlined above, the next step was to develop the scenarios for which workload was to be calculated. The Scenario Builder/Editor (SBE) tool supports the process of creating an ATC scenario, which would typically involve defining a sector of particular dimensions, with reporting points, standard routes, and a number of aircraft of identified types with realistic flight