

Worked Example Of The Use of PUMA in a Function Allocation Task

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INTRODUCTION

The PUMA method and toolset was used in an allocation of function study, involving the re-engineering of a major civil Air Traffic Control system. As is the case in advanced, process-control like systems, one of the major issues facing designers is the extent to which functions formerly undertaken by humans in the system may usefully be automated. In the case of ATC systems, safety remains the paramount consideration, but there is also a growing requirement to increase system throughput as the levels of civil air traffic continue to grow. For this reason, civil aviation authorities around the world are increasing their level of investment in ATC systems, and in many cases replacing obsolete systems with new technology. ATC remains however a human-centred control activity, a situation that is unlikely to change in the foreseeable future, and hence one of the major issues that faces designers is the extent to which system functions may usefully be delegated to computer control while still keeping the human firmly in the loop.

The study described below was undertaken in this context, and is an illustration of the use of the PUMA method and toolset for the purposes of task analysis and workload estimation, thus enabling decisions on functional allocation to be taken.

The PUMA Method

The basic PUMA method involves a number of stages:

- Establishing a base-line of controller activities by analysing (or drawing upon a pre-existing analysis of) ATC activities as they are currently performed;
- Breaking those activities down into those fundamental components which impose a predictable loading on the controller;
- Establishing what new circumstances or procedures are to be examined using the toolset, which might for instance involve introducing changes to the fine task

structure (typically associated with the use of new computerised support tools), and then setting that in the context of a scenario of aircraft movements within a sector;

- Calculating workload, using a technique based on Wickens' "multiple resource theory". This involves the concept of multiple channels within the user, upon which demands are made when tasks are undertaken, and which may conflict when complex tasks are carried out.

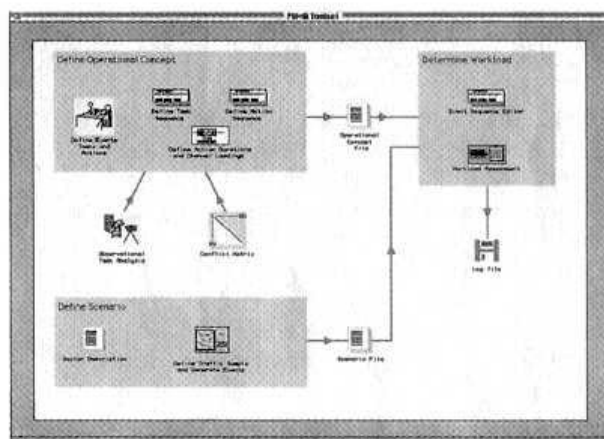


Figure 1 PUMA Top Level Diagram

The PUMA method is supported by the PUMA toolset, which has been built on top of the pre-existing NMSE (Network Modelling Support Environment) software, a LISP-based, object-oriented model-builder. The PUMA toolset consists of a family of independent tools with a common "look and feel", and the ability to exchange data between them readily. The philosophy has been followed that any data file is stored in a human-readable, English language ASCII form, and can be edited either within the tool that created it, or in text form within any standard word processor.

ANALYSIS

The starting point for the use of the PUMA method is a Definition of the Operational Concept, that is a