Designing Facilities for Collaborative Operations

A methodology is emerging from efforts to design a mission operations facility.

A methodology for designing operational facilities for collaboration by multiple experts has begun to take shape as an outgrowth of a project to design such facilities for scientific operations of the planned 2003 Mars Exploration Rover (MER) mission. The methodology could also be applicable to the design of military “situation rooms” and other facilities for terrestrial missions.

It was recognized in this project that modern mission operations depend heavily upon the collaborative use of computers. It was further recognized that tests have shown that layout of a facility exerts a dramatic effect on the efficiency and endurance of the operations staff. The facility designs (example, see figure) and the methodology developed during the project reflect this recognition.

One element of the methodology is a metric, called effective capacity, that was created for use in evaluating proposed MER operational facilities and may also be useful for evaluating other collaboration spaces, including meeting rooms and military situation rooms. The effective capacity of a facili-
ty is defined as the number of people in the facility who can be meaningfully engaged in its operations. A person is considered to be meaningfully engaged if the person can (1) see, hear, and communicate with everyone else present; (2) see the material under discussion (typically data on a piece of paper, computer monitor, or projection screen); and (3) provide input to the product under development by the group. The effective capacity of a facility is less than the number of people that can physically fit in the facility. For example, a typical office that contains a desktop computer has an effective capacity of \(\approx 4\), while a small conference room that contains a projection screen has an effective capacity of around 10. Little or no benefit would be derived from allowing the number of persons in an operational facility to exceed its effective capacity: At best, the operations staff would be underutilized; at worst, operational performance would deteriorate.

Elements of this methodology were applied to the design of three operations facilities for a series of rover field tests. These tests were observed by human-factors researchers and their conclusions are being used to refine and extend the methodology to be used in the final design of the MER operations facility.

Further work is underway to evaluate the use of personal digital assistant (PDA) units as portable input interfaces and communication devices in future mission operations facilities. A PDA equipped for wireless communication and Ethernet, Bluetooth, or another networking technology would cost less than a complete computer system, and would enable a collaborator to communicate electronically with computers and with other collaborators while moving freely within the virtual environment created by a shared immersive graphical display.

This work was done by Jeffrey Norris, Mark Powell, Paul Backes, Robert Steinke, and Kam Tso of Caltech and Roxana Wales of Ames Research Center for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP [see page 1]. NPO-30457