

# AVIATION WEEK

## & SPACE TECHNOLOGY

### Ops Adjustments

NASA looks to streamlined operations, new tools to tackle fixed costs in Constellation program

FRANK MORRING, JR./WASHINGTON

Engineers working on the first spacecraft in NASA's next generation of human spaceflight vehicles are just wrapping up their preliminary designs, but agency and industry planners already are considering how to operate them.

NASA's Constellation program wants to hold down life-cycle costs on its next-generation launchers, crew exploration vehicles and other advanced human spacecraft under development so it will have enough money to continue pushing human exploration out of low Earth orbit to the Moon and eventually to Mars.

While the biggest expense will continue to be the cost of producing the hardware, particularly given the small number of vehicles expected to be built, planners hope to make operations much leaner than they are today.

"The fundamental objectives are to operate fairly inexpensively, which frees up NASA money to go forward into the development of the follow-on vehicles like the lunar lander, like the Ares V lunar vehicle," says Bob Castle, director, operations integration, for the Constellation Program. "The objective is to be more operable and to cost less money, which generally means fewer people."

To get there, the agency and its industrial partners are drawing on lessons learned from the space shuttle and International Space Station programs. NASA already has told its workforce at Kennedy Space Center to expect the elimination of up to 6,400 jobs when the shuttle fleet retires in 2010. When the follow-on Ares I and Orion vehicles start flying, the agency

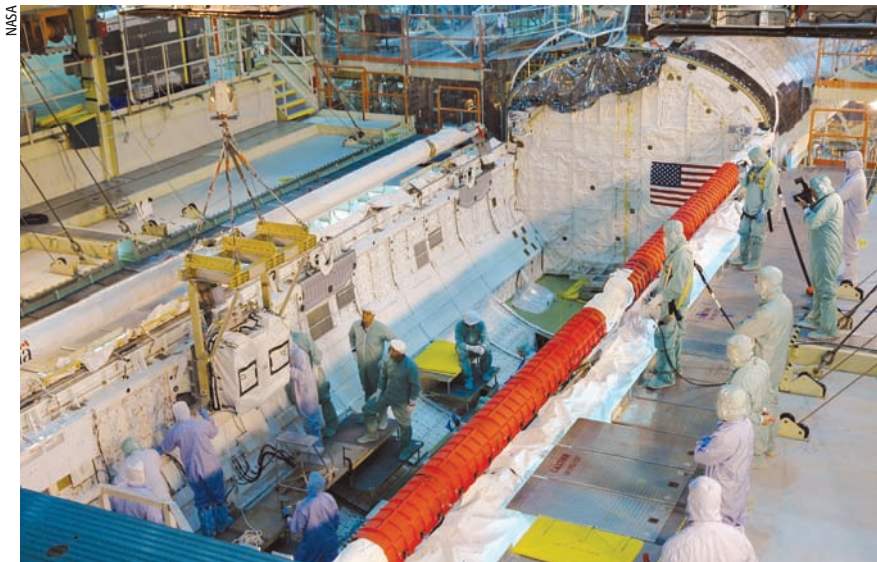
is planning a much smaller "standing army" to get them off the ground, to leave room for hiring workers for development of the follow-on vehicles like the Ares V and Altair lunar lander (*AW&ST* Apr. 7, p. 40).

Similarly, software experts at United Space Alliance (USA), NASA's spaceflight operations contractor, have developed a whole computerized toolkit—called "Questus"—to automate a lot of the ground-based mission control planning that goes into operating the ISS today. Software packages drawn from the ISS experience may one day help astronauts on the Moon make optimum use of their time, or quickly find a spare part that was stowed by an earlier crew, without having to radio back to Houston for expensive hands-on help.

"You're going to see some more streamlined things at Kennedy," says Castle, who is at Johnson Space Center. "You're going to see some more streamlined things, I think, in mission ops here. That's the fundamental thing, driving to streamline things, and to be willing to make some investments up front to make things run more efficiently."

At KSC, NASA and USA are adapting "paperless" tools that have guided shuttle ground ops for the next generation of launch vehicles, starting with the Ares I-X prototype flight test scheduled next year. By reducing or eliminating the time-consuming process of moving pieces of paper around, the evolving Collaborative Integrated Processing System (CIPS) is a big step toward the sort of efficiency Castle predicts.

The system is "wireless and widely distributed," says Larry Carr, deputy director for integrated systems at



NASA wants to cut the "standing army" needed to prepare the space shuttle for flight when it begins processing the follow-on Ares I and Orion vehicles.

KSC. In the shuttle processing facilities at KSC, technicians can tap directly into the system using wireless-tablet PCs to retrieve written and photo documentation of needed work and add more documentation to certify that it has been completed, and record how it was done.

Within the larger shuttle organization, documents are e-mailed around for approval, with the same advantage over snail-mail found elsewhere.

"This system allows us to track our progress to certificate of flight readiness," says Carole Scott, KSC deputy manager on the Ares I-X project. "By having this type of paperless system, you can tell where you are as far as tracking your progress in being ready to fly."

The system also allows quick incorporation of engineering changes during ground processing. In one example, a change order sent down while a set of solid-fuel shuttle boosters was being stacked was handled in about half an hour instead of the seven to 10 days required by the older paper-based system, she says.

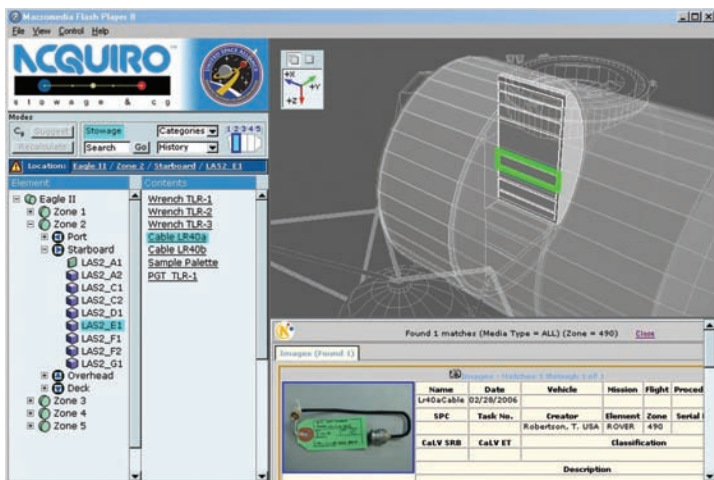
That sort of efficiency is the driver behind USA's Questus software, which the company bills as "the first-ever set of integrated applications and tools specifically created for space operations." The independent research and development (IRAD) package consists of six sets of software tools designed to address different aspects of human spaceflight operations in the next generation of spacecraft —mission management and planning; data retrieval; trajectory design; training and procedures; stowage, and lunar science (AW&ST Apr. 16, 2007, p. 22).

The mission management function—called "Temporis"—can already be used on the ISS to craft minute-by-minute individual timelines that guide

the activities of station crewmembers. It can automatically take into account factors as diverse as the Sun angle on the station solar arrays, the amount of sleep and exercise a crewmember has had, and the status of station systems needed for a given task. A lot of that work is still done by hand in the growing network of ground-based control centers dedicated to the ISS, and not always with the best results.

During the Expedition 16 station increment concluded on Apr. 19, Expedition Commander Peggy Whitson and her crew worked so efficiently that they frequently got ahead of their timelines, to the extent that planners on the ground began taking into account what they termed the "Peggy factor." The Temporis software would be able to handle that sort of variance without intervention from the ground, factoring in a crew's efficiency and letting them plan new activities if they are ahead of schedule or replan if they fall behind.

Once humans move beyond the station and return to the Moon, that sort of capability could be even more useful, allowing crews to adapt quickly to changing circumstances as they begin to explore the lunar surface, drawing on the extensive databases the USA tools could provide. A stowage-control system dubbed "Acquiro" would help them tackle the misplaced-item problem



**Acquiro, a software tool USA is developing for exploration, will help astronauts find spare parts stowed in lunar-surface habitats.**

that already plagues the space station, showing where articles are stowed and what they look like. The system also would recalculate the center of gravity for vehicles in space as new cargo arrives or is off-loaded.

Peter Kent, project manager for the "Attentus" element of the toolkit that allows crewmembers to retrieve engineering drawings and photo documentation of the systems they operate, says one goal across the Questus effort is to adopt industry data standards

to avoid the cost of customized software. At KSC, where the approach is used in the paperless shuttle systems, it is already saving NASA money even before the new vehicles start flying.

"That eliminated us having to go and recreate all of those complex data structures that we use," he says. "The life-cycle cost is the driver."

Although streamlined operations on the ground and in the way NASA manages humans in space can help hold down life-cycle costs for the entire exploration effort over the long haul, agency managers stress that the cost of hardware will remain a bigger factor overall.

"When you look at the really big macro picture, it's the cost of production that quite frankly drives things, more so than the number of people at Kennedy or here at Houston," Castle says. "It's how much does it cost to produce solid rocket motors and how much does it cost to produce upper stages. The things that you've got to keep doing to keep flying. It's pretty much that way if you look at the shuttle program today. You say you have cost of operations, well, what exactly do you mean? If you mean the cost of people at the Cape or the cost of people here at Mission Control, that's not anywhere near the major cost of the shuttle program. There are large costs other places."

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