Imagine a damaged spacecraft about to reenter Earth's atmosphere. You must quickly and precisely determine the spacecraft's expected trajectory and the point and time of impact, immediately sharing your findings with the Joint Functional Component Command (JFCC) for Space, Strategic Command, Pacific Command (PACOM), European Command (EUCOM), the White House, our allies, and the country where impact is expected. Using the Joint Space Operations Center (JSpOC) Mission System (JMS), you can.
THE CHALLENGE

It takes a great amount of work to create a cohesive operating picture of an event like an unplanned satellite reentry. For Joint Planning groups at JFCC Space, integrating data from a number of disparate sources during these high interest events is a time consuming but important task. During the uncontrolled reentry of the Phobos-Grunt spacecraft in 2011, it was crucial to calculate and communicate trajectory data as quickly as possible. Cutting, pasting, fat-fingering, and assembling something as seemingly simple as a PowerPoint slide of information could take up to an hour or more, not to mention the time it then takes to get it out to the distribution list. With JMS, the operating picture can be created and shared in near-realtime.

Sharing the JMS operational picture is a huge success across the globe. Both Col Jefferson (EUCOM) and Col Rebholtz (PACOM) have high praises for the ability to see our communities of practice.

Jason Baker
Member of JSpOC Capabilities Integration Office at USAF

WHY IT MATTERS

The Joint Space Operations Center needed a unified tool to bring integrated data from stove-piped systems, algorithms and tools for Space Situation Awareness, Command and Control. Many operations require referring to multiple data sources from disparate systems. Data must be transferred manually, introducing the opportunity for transcription errors. Calculations must be made using the data; results are moved to yet another system, again introducing the possibility of error. There was no system prior to the Joint Space Operations Center Mission System that covered all aspects of the mission. There were a handful of specialized tools and legacy systems operating beyond end-of-life, some created by specialty companies, some homegrown, some from prime contractors, and the Microsoft Office Suite.
THE SOLUTION

The Design Knowledge Company (TDKC) visited JSpOC to observe and interview operators. Interacting with Air Force Space Command and MITRE personnel gave insight into system requirements. We did technology evaluations to support a service-oriented architecture with an extensible plug-in framework. With the results of that work, and algorithms created by three other small businesses, we displayed the results of fusion algorithms in a laboratory environment at Schriever AFB. We expanded on that solution with work under an AFRL Center for Rapid Innovation task to create a prototype on the JSpOC floor. Operators interacted with the prototype while being observed by human factors engineers.

JMS represents “the keys to the kingdom.” Given where we were five years ago, that’s remarkable. I just didn’t think we’d figure out a way to get through. But we did. It’s awesome. It’s spectacular.

John Hyten
General at USAF

HOW IT WORKS

JMS uses a service-oriented architecture (SOA), meaning it can ingest data from an endless variety of disparate network-based information sources. The User-Defined Operational Picture (UDOP) is a SOA client based on the Eclipse open-source framework; all custom code is written in Java making it platform and operating system independent. It uses a core Agile Work Environment (AWE) set of functionality that includes collaboration support, interoperability with Microsoft Office products (you can create PowerPoint slides using the UDOP), role-based security and functionality, as well as the ability to customize the interface. Our approach emphasizes “Composability above the code base™; this is the capability of creating new information products without affecting the Information Assurance stance. The JMS UDOP runs on a standard desktop computer. It employs NASA WorldWind for 2D and 3D maps but has incorporated Google Earth and Satellite ToolKit. The development process integrates findings from preliminary and ongoing cognitive task analyses; human factors engineers are prominent on the design team. Builders, authoring tools, and automation scripts dramatically speed-up the development process.
IMPACT FOR THE FUTURE

An early test of the JMS capability was to create one slide using one of the specialized legacy tools and PowerPoint. Without the JMS, this task took an operator and a tool consultant 50 minutes to complete. A single operator with one hour of JMS training then accomplished the same task in 10 minutes. This reduction in the Observe-Orient-Decide-Act (OODA) loop time allows more focus on analysis and understanding of the situation.

JMS has been our largest continuing project. It is the origin of the core Agile Work Environment (AWE) that has since been ported to a wide variety of domains. The core AWE has been instrumental in winning a large amount of associated work.

The Agile Work Environment has been the core of the Integrated Operational Environment for JEFX 2011 and ACE 2011 and 2013. It is operational as JMS at Vandenberg AFB and as the Aircraft RAMP Visualization and Simulation System (ARViSS) supporting logistics at Warner-Robbins ALC. ARViSS is on the Air Force approved software list. These applications demonstrate the feasibility of using the AWE in multiple domains.

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MULTI-DOMAIN AGILE WORK ENVIRONMENT

JMS has a core of agile work environment functionality that has been adapted for use in multiple domains including air and cyber operations centers, air logistics, nuclear weapons, UAS mission support, civil engineering, as well as cross-domain applications. The approach supports rapid re-purposing of the core capability and has the potential for realizing enormous cost savings across situation awareness/command and control applications while dramatically improving interoperability.
GALLERY

A screenshot of data produced for a reentry event

Airman Ashley Taylor checks signals on a satellite receiver/transmitter at Hurlburt Field, FL

Atlas V launch from Vandenberg AFB, CA with WorldView-3 satellite
TDKC is a product design, development and integration business specializing in knowledge-based systems accepting input from a wide variety of heterogeneous data sources. Our core capability is the development of well-designed Agile Work Environments for situation awareness and command and control.

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