

Distributed Operations for the Cassini/Huygens Mission

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ABSTRACT

The Cassini/Huygens mission to the Saturnian system is a complex mission spanning seven years of cruise and four years of “on orbit”. It is the last planned flagship solar system exploration mission, and is comprised of an orbiter, twelve science instruments and the Huygens probe. Cassini operations are conducted by the Cassini Mission and Science Operations Office at the Jet Propulsion Laboratory (JPL) in Pasadena, California. Huygens Probe operations are conducted at the European Space Operations Centre (ESOC) in Darmstadt, Germany.

The Cassini Project employs a concept known as “distributed operations” which allows independent instrument operations from diverse locations, providing full empowerment of all participants and maximization of limited resources. The benefits, challenges and risks of operations using a distributed system will be discussed.

Science investigators and probe operators participate in the full range of operations from their home institutions in a total of five states, three countries and six time zones. Each the Principal investigator (PI) is solely responsible for the design, construction, integration and flight operation of his or her own instrument, including mission planning, sequencing, instrument health and safety monitoring and science data acquisition, processing and analysis.

Uplink and downlink processes have been developed expressly to support the distributed nature of the project. As well, each PI has been supplied with a Science Operations and Planning Computer (SOPC) to form a direct link between the center of operations at JPL and the PI's own operational system. The SOPCs are designed to support each organization's communication needs, including command generation and submission, real-time monitoring, telemetry retrieval and voice communications. Teleconferencing capabilities are another part of the distributed system and additional agreements have been negotiated between the PIs and JPL to provide products and capabilities not available at the PI site.

Full empowerment and participation of the PIs reduces cost, allowing PIs to represent themselves and eliminating the intermediate layer of science personnel at JPL. Processes are streamlined. Duplication of science computing resources at JPL is eliminated and operational reliability is increased. Use of the SOPCs at the distributed operations sites also provides independence of computing resources so that limited operations can continue at one site even if one or all of the others are down.

The primary challenge of distributed operations for Cassini is the range of time zones between participants and the fact that prime shift at the European sites does not overlap with prime shift at JPL. Meetings, training and validation activities must be carefully managed to avoid over-burdening certain participants.

The primary risk of a distributed system is computer security. The goal of the distributed system is to provide access while protecting, both the SOPCs and the JPL operational system. Striking a balance between ease of use and prevention of security breaches is an ever-increasing challenge.

Distributed operations is a flexible scheme that allows for tailoring to individual needs and evolution of processes over time. It allows technological advances to be integrated as needed and is a scalable concept applicable to a wide range of mission profiles and budgetary constraints.