

Developing Space Mission Integrated Operations Scenarios

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Overview

An Integrated Operations Scenarios (IOS) product exhibits operations planned for a space mission. Operational scenarios are key to an operations concept, as they help to identify key issues and drivers on the operations system.

IOS cover operations for crew and system scenarios. Crew scenarios show how the crew interacts with the flight system and ground personnel. System scenarios show how systems of systems work together. Overall, the scenarios are a combination of the integration of human systems working together to complete the mission.

A flow diagram was developed to explain the interactions of the IOS product with mission concept and architecture functions, requirements development, technology development, overview timelines, resources needed, generic rules and constraints, command, control, communication, and training plan for crew and ground. This diagram has been very useful in communicating the needs for developing a Flight Plan for the upcoming Artemis missions.

Conceptual Framework/ Methodology

The International Space Station (ISS) developed IOS for each of their assembly flights, and they were very extensive. The Constellation Program also developed IOS, but as it is known it got cancelled. The Artemis Mission builds its IOS on previous programs experience, yet it does not represent an extensive product as the ones developed for ISS, and it is more frequently updated as new information from the different Artemis programs and providers is made available.

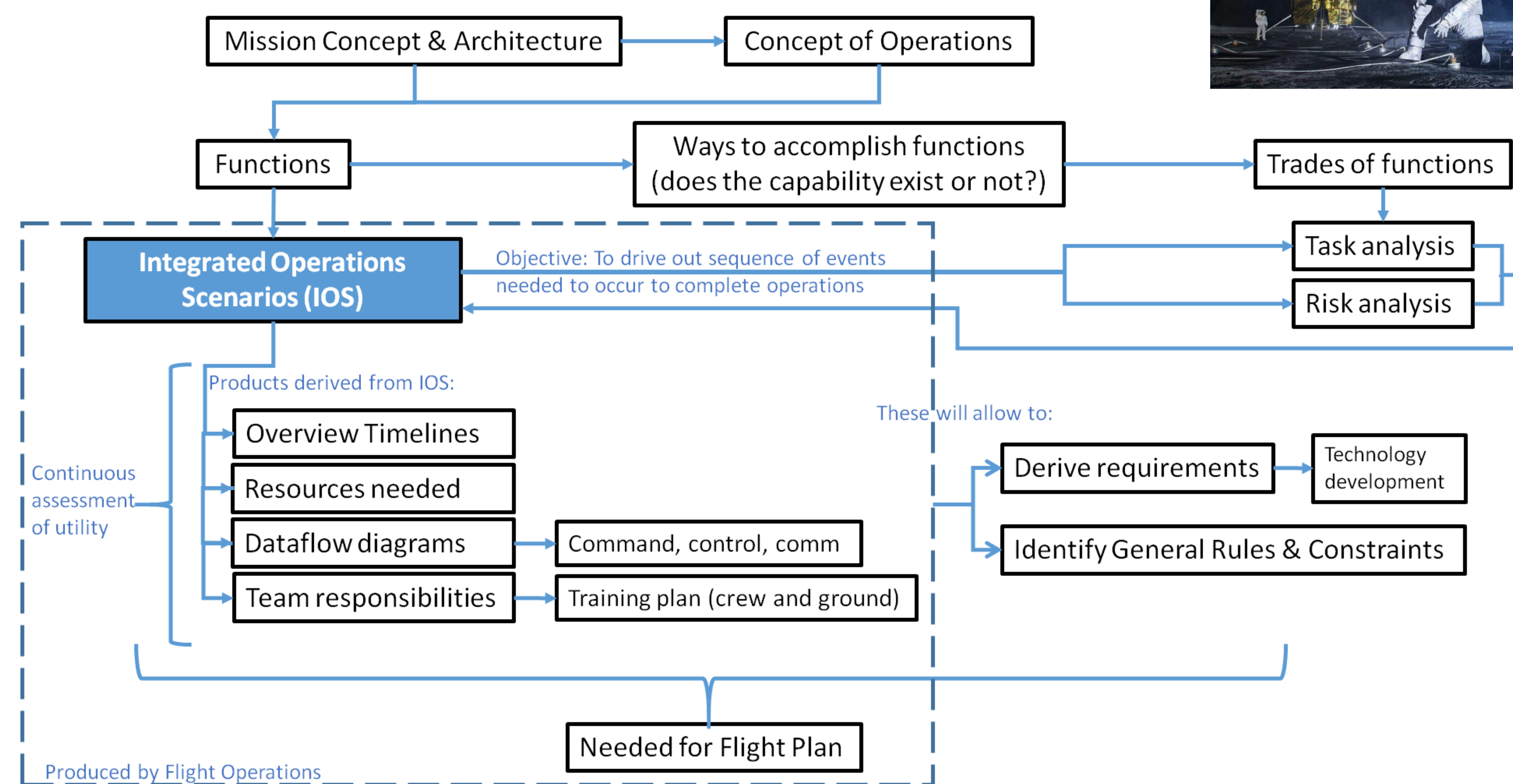
Its development and reviews include subject matter experts in the operations field. Further reviews of the initial product are being performed by experts of the different programs and organizations participating in the Artemis mission.

The Artemis IOS product contains: flight day, crew and system activities, description, rationale, assumptions, constraints, source and date of acquired information, owner, status and additional comments.

Acknowledgements

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IOS Flow Diagram



Impact

A first IOS product was developed for the Artemis sustainable mission, which is an Orion/Gateway/Human Landing System cross-program product covering nominal crew and mission control operations needed to accomplish mission objectives. It describes the sequence of tasks required to accomplish end to end functions from launch through transit, on-orbit operations, to safely return to Earth. IOS serve as reference for ongoing discussions during requirements development, task and risk analyses, concept of operations development, and as foundation to prepare a space mission flight plan.

Forward Work

Add to IOS Flow Diagram other products or activities developed by the Engineering, Safety & Mission Assurance, and Human Health & Performance Directorates that contribute to integrated operation scenarios. Some examples include human risk analysis, human in the loop developmental tests, human-hardware-software interactions, preliminary analyses/testing, and human rating certification processes.

References

- International Space Station & Shuttle Experience
- Larson, W., Pranke, L., Connolly, J., Giffen, R. (2014) "Human Spaceflight: Mission Analysis and Design," McGraw-Hill Companies, Inc.

