Orion Program
Overview
HSF Knowledge Sharing Forum

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EXPLORATION MISSION 1 (EM-1) VEHICLE STACK

- Solid Rocket Booster
- Orion Stage Adapter
- Interim Cryogenic Propulsion Stage
- Orion Multi-Purpose Crew Vehicle
- Launch Vehicle Stage Adapter
- Core Stage and Vehicle Avionics
- RS-25 Main Engines
ORION MPCV SPACECRAFT OVERVIEW

Spacecraft Adapter
- Provide structural connection to the launch vehicle from ground operations through CM Separation
- Provide protection for SM components from atmospheric loads and heating during first stage flight

Service Module (SM)
- Provide support to the CM from launch through CM separation to missions with minimal impact to the CM

Crew Module (CM)
- Provide safe habitat from launch through landing and recovery
- Conduct reentry and landing as a stand alone module

Launch Abort System
- Provide protection for the CM from atmospheric loads and heating during first stage flight
- Safely jettison after successful pad operations and first stage flight
ORION IN-SPACE SYSTEM

CREW MODULE

CREW MODULE ADAPTOR

SERVICE MODULE

CREW AND SERVICE MODULE

ESA SERVICE MODULE

SPACECRAFT ADAPTOR

JETTISONED PANELS

SPACECRAFT ADAPTOR

NASA

esa

LOCKHEED MARTIN

AIRBUS

DEFENCE & SPACE
EXPLORATION MISSION PROGRESSION TO FIRST CREWED FLIGHT

- May 2010: PA-1
- Dec. 2014: EFT-1
- EM-1
- AA2
- EM-2
ORION PROGRAM: NASA CENTER ROLES

Marshall SFC
- Co-Lead Launch Abort System
- Support for Propulsion and ECLSS
- MPCV/SLS Integration
- MAF Interface

Ames RC
- TPS Advanced Development
- Support for Aero/Aero-thermal, Flight Software, and GN&C
- Mission Operations Tools, Training Applications, and Simulation Capabilities

White Sands TF
- Materials Testing

Glenn RC
- Lead European Service Module Integration
- Co-Lead Crew and Service Module and Spacecraft Adapter
- Lead Requirements and Interfaces Management
- Plum Brook Integrated Environment Testing

Johnson SC
- MPCV Program and Engineering
- Lead Crew and Service Module, Vehicle Integration, Avionics, Software, Flight Tests, GFE
- Mission Operations Systems
- Launch Entry and Abort Suit
- Crew Habitation and Life Support Systems

Kennedy SC
- Spacecraft Assembly, Integration and Production
- Ground Processing, Launch, Landing, and Recovery Planning and Operations
- Air Force Eastern Range

~3000 Orion Government + Industry Team Members in 45 States
ORION SERVICE MODULE TEAM

SM team spans two continents, 7 countries, 10 major defense contractors, and numerous parts suppliers and labor augmentation subcontractors.
## ORION PROGRAM DEVELOPMENT INTEGRATION MODELS

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<tr>
<th>Integration Element</th>
<th>Characteristics</th>
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<tbody>
<tr>
<td>Constellation Program – Orion Project</td>
<td>Increased “Level 2” systems engineering function with strong project participation</td>
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<tr>
<td>Exploration Systems Development – Orion Program</td>
<td>Cross-Program Integration Team w/ integrated task teams. Increased reliance on program self-integration</td>
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<tr>
<td>Prime Contractor (Exploration Flight Test 1)</td>
<td>High level of day-to-day integration and in-line NASA support. Procure flight test data – very limited set of Govt deliverables</td>
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<tr>
<td>Prime Contractor (Exploration Missions)</td>
<td>High level of day-to-day integration and in-line NASA support. Govt-led flight: DD250, CoFR, increased data deliverables</td>
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<tr>
<td>European Service Module</td>
<td>More limited day-to-day interaction. Higher reliance on integration through documentation</td>
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ORION INTEGRATION LESSONS LEARNED & COMMON THEMES

• Integration needs to occur at all levels throughout your organization

• Emphasize communication in all directions

• Multiple integration models can be applied successfully depending on your situation – demands a nimble, adaptable organization

• Don’t confuse oversight with integration – integration is most successful when participatory