



International Partnerships and Interface Standards for Exploration

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- Human and robotic lunar exploration will be an international endeavor
- NASA is actively engaged bilaterally and multilaterally with space agencies
 - Exploring areas of common interest, common objectives
 - Interest is high and growing
- Enabling a sustained and robust program of exploration
 - Strengthen existing partnerships, build new partnerships
 - Interoperability, standards
- Space Enterprise Council work was excellent and has guided NASA in developing the framework for multilateral dialog on standards
 - Focus on commercial standards that have long term applicability
 - Enabling Commercial Off The Shelf (COTS) type solutions
 - Identifying the best US and international standards that could be applied to lunar interfaces
 - Prioritizing work

International Space Exploration Coordination Group (ISECG)



- ISECG
 - 13 of 14 GES signatories participate
 - Voluntary, Non-binding, open, inclusive
 - Next Meeting, March 10-12, Yokohama
- Facilitates Communication
 - Objectives, Interests, Plans
 - Enables parties with common interests to work together
- Most Active Working Groups:
 - INTERSECT
 - Interface Standards Working Group (ISWG)/International Architectures Working Group (IAWG)
 - Multilateral Lunar Architecture Workshops



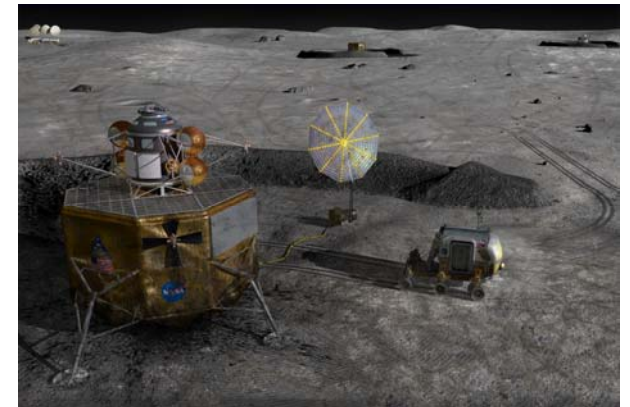
International Architectures Working Group



- Objective: Involve interested international agencies in a discussion of lunar surface system exploration scenarios and architectures in order to facilitate identification of interfaces benefiting from standardization and possible contributions to multilateral exploration activity
- NASA leadership, conducted openly and transparently
- Three workshops conducted: Bremen (Sept 2008), Cocoa Beach (Oct 2008), Houston (Feb 2009)
- Discussion topics to date:
 - Common human mission objectives and resultant exploration scenarios
 - Polar outpost buildup, sortie and extended stay sortie to anywhere on the moon
 - Importance of robustness in critical functions such as crew transportation and logistics
 - Initial look at interfaces that could benefit from standardization
 - Communication, Docking Systems underway
- Additional Workshops to perform multilateral lunar architecture study
 - Concludes in mid-2010 to inform NASA Lunar Surface System decisions (LSCR) and decision points for other participating agencies

- Multiple Scenarios
 - 7 day sortie
 - Extended stay sorties
 - Polar outpost
- Multiple Function/Element Teams
 - Human Transportation
 - Habitation
 - EVA
 - Mobility
 - Cargo Transportation
 - Logistics
 - Crew Rescue
 - ISRU
 - Servicing
 - Science
 - Power
 - Comm

Mid-2010
*Global Point of Departure
Lunar Exploration
Architecture*



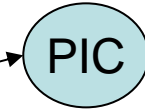
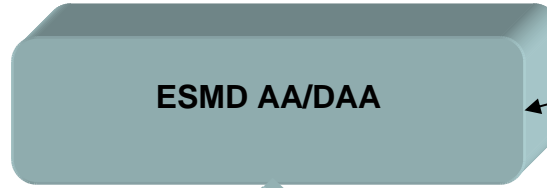


Building Partnerships for Exploration

ESMD Partnership Authority

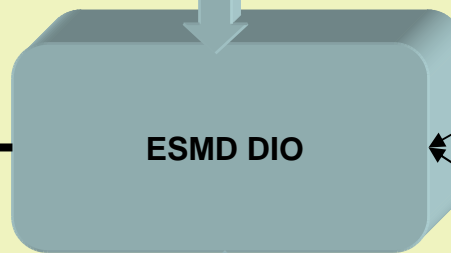
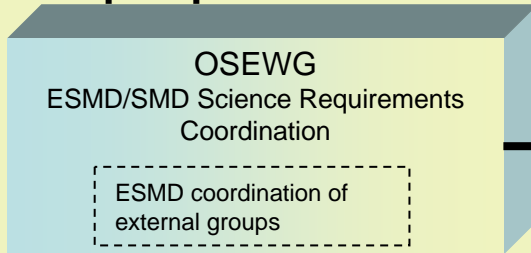


Sets Goals/Priorities
Decision Making Authority



Cross Mission Directorate
Coordination

Leads Partnership Implementation Activities

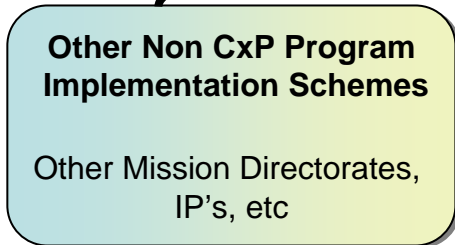


Partnership Strategy Review and Coordination
(Including OER)

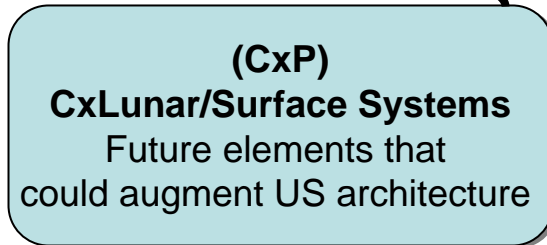


Coordinates Commercial Partnership Review

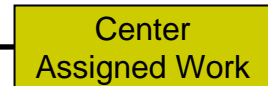
Technical Support



Other Mission Directorates,
IP's, etc



Future elements that
could augment US architecture



Center
Assigned Work

DIO – Directorate Integration Office, ISECG – International Space Exploration Coordinating Group, IP – International Partners, OER – Office of External Relations, OSEWG – Outpost Science Exploration Working Group, PIC – Partnership Integration Committee

Lunar Architecture Team Science Capability Focus Element Work Flow



181 Objectives
from Global
Strategy Team



ALL Science
Objectives
(45 internal +
external)



Each Objective Deconstructed
to Define Needed Capabilities
and Mapped to Architecture



PRIORITIES from
Tempe Workshop



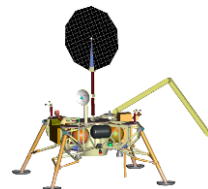
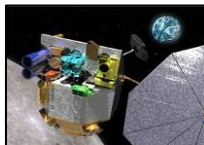
Top Objectives



Grouped into key
reference payloads



Mapped to
Architecture
options



Space Enterprise Council – International Standards



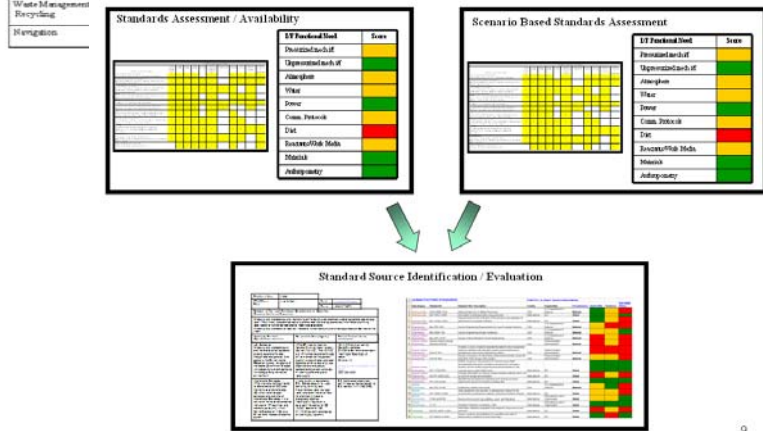
Lunar Surface Elements versus Interface Functional Needs Matrix

Interface Functional Needs	Lunar Surface Element											
	Surface Suit	Living Habitat	Work Habitat	Health Habitat	Power Systems	Surface Transport	Comm & Net	Logistics Supply	ISRU Production	Emergency Egress	Surface Coasts	Scientific Equip.
Pressurized Mechanical Interface	X	X	X	X		X		X	X	X	X	X
Unpressurized Mechanical Interface	X	X	X	X	X	X	X	X	X	X	X	X
Atmosphere/Environmental	X	X	X	X		X	X	X		X	X	X
Water	X	X	X	X		X	X	X		X	X	X
Power	X	X	X	X	X	X	X	X	X	X	X	X
Communicational protocol	X	X	X	X		X	X	X		X	X	X
Diet	X	X	X	X		X	X	X		X	X	X

Examples of Standards Sources

Functional Area for Standards	U.S. Standards	International Standards
Power		Enmax; International Space Station Program
Water	EPA, NDWAC	International Standards Organization (ISO)
Human Factors	Dept. of Defense (DOD), FAA	ISO, International Labour Organization (ILO)
Unpressurized Mechanical Interfaces	AIAA	ISO

Lunar Architecture Standards Process and Products



Standards Source Evaluation Database / Human Factors Example

1	HUMAN FACTORS STANDARDS			STWG POC: Dr. Adam F. Howell (acknowledgement)					
2	Subcategory	Standard ID	Standard Title / Description	Country	Organization	Personnel	Applicability	Timeliness	Spaceflight History
3	Anthropometry	DDO-WG01-7426	Anthropometry of U.S. Military Personnel	USA	U.S. Department of Defense		National		
4	Anthropometry	ISO 12501-2005	Anthropometry of anthropometric measurements	International	ISO		Global		
5	Anthropometry	ISO 15536-3-2007	Requirements for the verification of the functions and validation of dimensions of computer monitors	International	ISO		Global		
6	Human Factors	ML-STD-1801	Human Engineering Requirements for User/Computer Interface	USA	U.S. Department of Defense		National		
7	Human Factors	ML-HQ00-759	Human Engineering Design Guidelines	USA	U.S. Department of Defense		National		
8	Human Factors	ML-STD-1472P	Design Criteria Standard: Human Engineering	USA	U.S. Department of Defense		National		
9	Human Factors	Human Factors Design Standard (HFDS)		USA	Federal Aviation Administration		National		
10	Human Factors	FAA-HF-302	Provides a source of data to evaluate the extent to which equipment having an interface with operators meets human performance requirements and human engineering criteria	USA	Federal Aviation Administration		National		
11	Human Factors	FAA-HF-304	Results of analyses of critical tasks performed to provide a basis for evaluation of the design of the system	USA	Federal Aviation Administration		National		
12	Human Factors	ISO 17399-2003	Defines all generic requirements for manned space flight vehicles/habitat structures and flight crew/bearing or simulation facilities and the related equipment that directly interfaces with manned space system flight crew	International	ISO		Global		
13	Human Factors	ISO 18992-2002	Provides information on human-centred usability methods which can be used for design and evaluation	International	ISO		Global		
14	Human Factors	ISO 14819-2003	Specifies the procedure for preparing and carrying out space experiments and processing the resulting data	International	ISO		Global		
15	Human	ML-STD-1474D	Establishes military access limits	USA	U.S. Department of Defense		National		
16	Human	ISO 14595-3-2006	Users guidelines and specifies a standardized method for the assessment, using human subjects, of thermal comfort in vehicles	International	ISO		Global		
17	Human	C148 and R156	Working Environment (air pollution, noise and vibration)	International	International Labour Organization		Global		
18	Human	C 118	Radiation Protection Convention, 1980	International	International Labour Organization		Global		
19	Physiology	ISO/TS 16976-1-2007	Information related to respiratory and metabolic responses to rest and work	International	ISO		Global		
20	Physiology	ISO 80000-14-2008	Names, symbols, and definitions for quantities and units of biometrics related to human physiology	International	ISO		Global		

SEC work informed NASA on process, priorities, and availability of global standards.

ISECG Interface Standardization Principles



- Interface standards will benefit both human and robotic exploration programs
 - add robustness to an architecture
 - open new opportunities for collaboration
 - maximize efficient use of resources across the global community
- Opportunities for standardization/commonality will be guided by multilateral architecture work maturation
- Criteria should be applied to guide initiation of work on interface standardization/commonality
 - Opens new opportunities for collaboration
 - Maximizes efficient use of resources across the global community
 - Affordability
 - Opens a new area for a partners economic expansion
 - Number of partners involved
 - Number of times an interface is used across the architecture
 - A sole resource provider that each element will “see”
 - International standard exists and is applicable
 - Timeliness and level of complexity
- IAWG will identify interfaces that can benefit from standardization and recommend them to the ISECG
 - Including priorities, timeframes, necessary participants
- The ISECG will ensure that an appropriate organization is identified to define the specifics of the interface



ISECG Standardization Activities In-Work



- Communication
 - ISECG pursuing interaction with Interagency Operations Advisory Group (IOAG)
 - Includes necessary interfaces to CCSDS for standardization of data and information transfer
- Docking/Berthing Standardization for Operability
 - Discussions underway with NASA, Russia, JAXA, ESA, CSA
 - Soft Capture, Hard Docking, System implications
- ISECG intent is to let exploration architectures dictate future interfaces benefiting from standardization/commonality

Partnerships make dreams a reality



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