



# The European Exploration Programme Aurora

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# Exploration Programme Strategy

- Recommended European approach:
  - Secure the best return on investment in the ISS Programme, as a test bed for future exploration, with a balanced and harmonised ISS utilisation and operations
  - Establish a meaningful and sufficiently autonomous role for Europe in the international Space Exploration agenda, with a robust approach with regard to changes of the international context
  - Maintain and enhance the European industrial, technological and scientific capabilities and experiences built-up during the ISS programme
  
- The overall strategy consists of:
  - continuation of the existing ISS Exploitation and ELIPS Programmes
  - implementation of ExoMars, the first exploration mission
  - preparation for future exploration missions, including to the Moon
  - preparation for a European participation in the joint development and operation of a reusable crew transportation system.

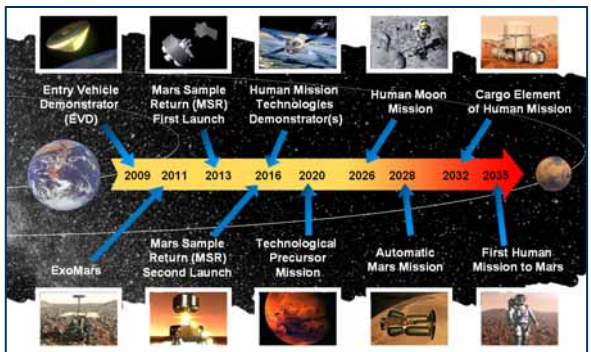




# AURORA ELEMENTS

## • 2001 - 2005: Aurora Preparatory Programme

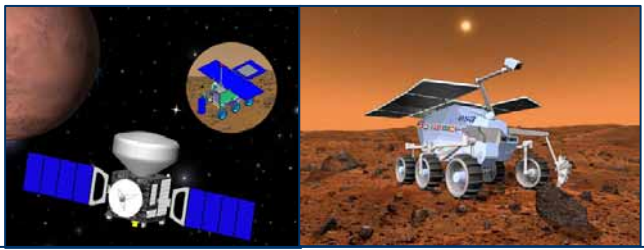
- Long term strategic planning and roadmapping → identification of key missions and capabilities to address European exploration objectives
- Systems study of exploration mission options
- Preliminary investigation of key exploration issues - human & robotic
- Focussed development of required technologies
- Maturation of near-term mission concepts



Initial Mission & Capability Roadmapping



Study and technology development for Mars Sample Return, Human Missions Aspects & Crew Transportation



ExoMars Mission Maturation and Development

Exploration Programme Proposal

ESA Ministerial Council 2005



EXPLORATION Capabilities



# EXOMARS

## Mission Objectives

### SCIENCE OBJECTIVES:

- Search for traces of past and present life on Mars
- Characterise the water/geochemical environment as a function of depth in the shallow subsurface
- Study the surface environment and identify hazards to future human missions
- Investigate the planet's deep interior to better understand Mars's evolution and habitability

### TECHNOLOGY OBJECTIVES:

- Develop and demonstrate European capability to land medium/large payloads on Mars
- Demonstrate high surface mobility and access to Martian subsurface
- Prepare technologies necessary for Mars Sample Return





# CORE PROGRAMME

## Outline

- Approved by Ministerial Council of 2005 – for the duration 2006 – 2009
- Aims to continue the European development and preparation for participation to exploration
- Structured around 4 main elements:
  1. Exploration Roadmaps, Scenarios & Architectures
  2. Mars Sample Return Preparation
  3. General Exploration Technology & Preparation for Lunar Exploration
  4. Awareness
- Next Ministerial Council of 2008 represents major milestone in progress of Core Programme. Main goals of Core Programme:
  - To establish set of exploration mission options for decision at next MC-2008
  - To develop technologies in support of mission options
  - To pursue coordinated development strategy towards longer term capabilities
  - To establish foundations of possible future programme elements





# European Strategic Cornerstones for Space Exploration

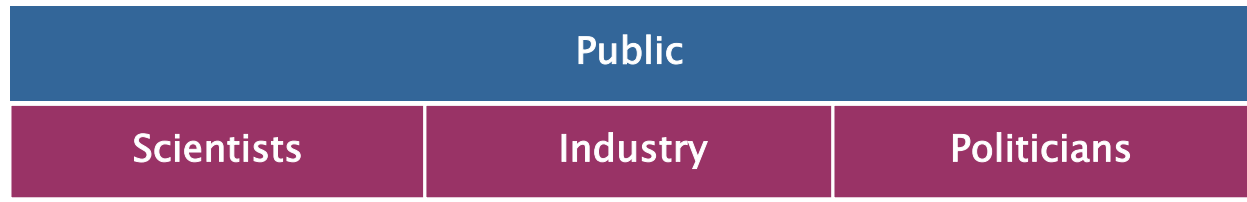


STRATEGIC CORNERSTONES	GOAL
EUROPEANS IN SPACE	Support the European project and implementation of European policies, secure Europe's position as a visible and strategic Partner within the international context
HABITABILITY AND LIFE BEYOND EARTH	Increase the knowledge of life, its environment and evolution
SUSTAINABLE HUMAN LIFE IN SPACE	Create innovation to support and improve human living conditions
SHARING THE SPACE ADVENTURES AND BENEFITS	Foster broad societal engagement through the creation of new perspectives for cultural, economic and educational development and the elaboration of an adequate framework which ensures global participation and wide sharing of benefits



# Strategy Development

## STAKEHOLDER CONSULTATIONS



*Interests, Objectives, Requirements, Priorities, Constraints*

## SCENARIO ANALYSIS



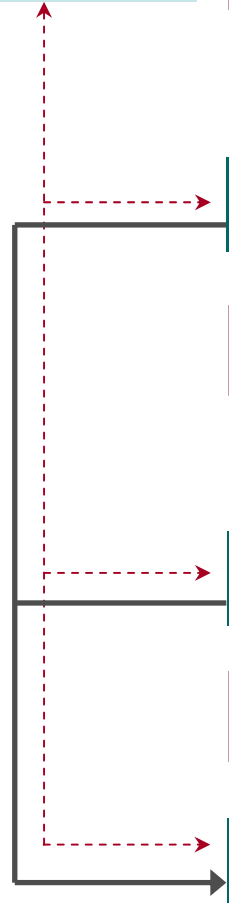
*High-level Requirements*

## ARCHITECTURE ANALYSIS



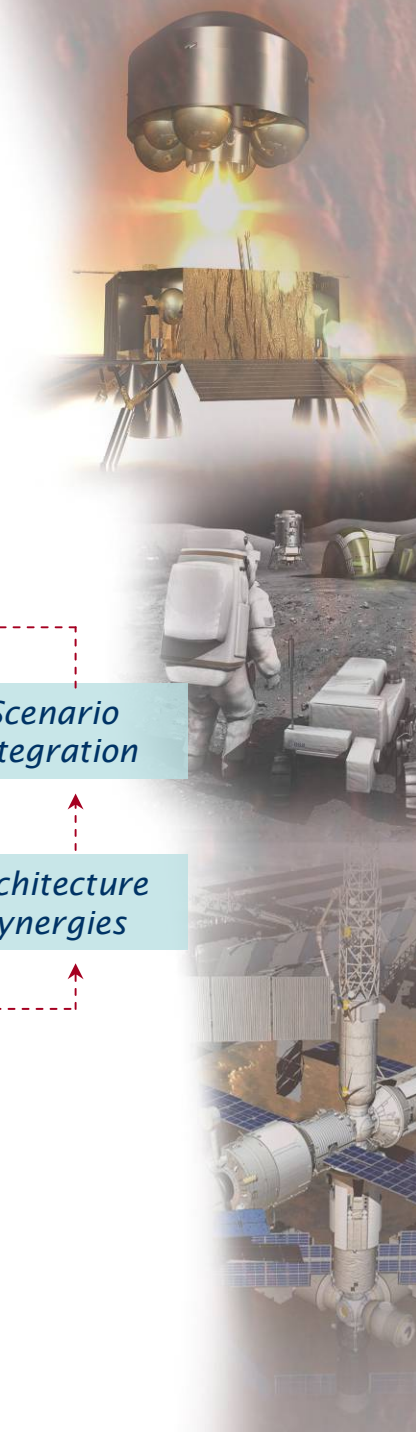
## MISSION AND CAPABILITY ANALYSIS

*International Plans and Capabilities*



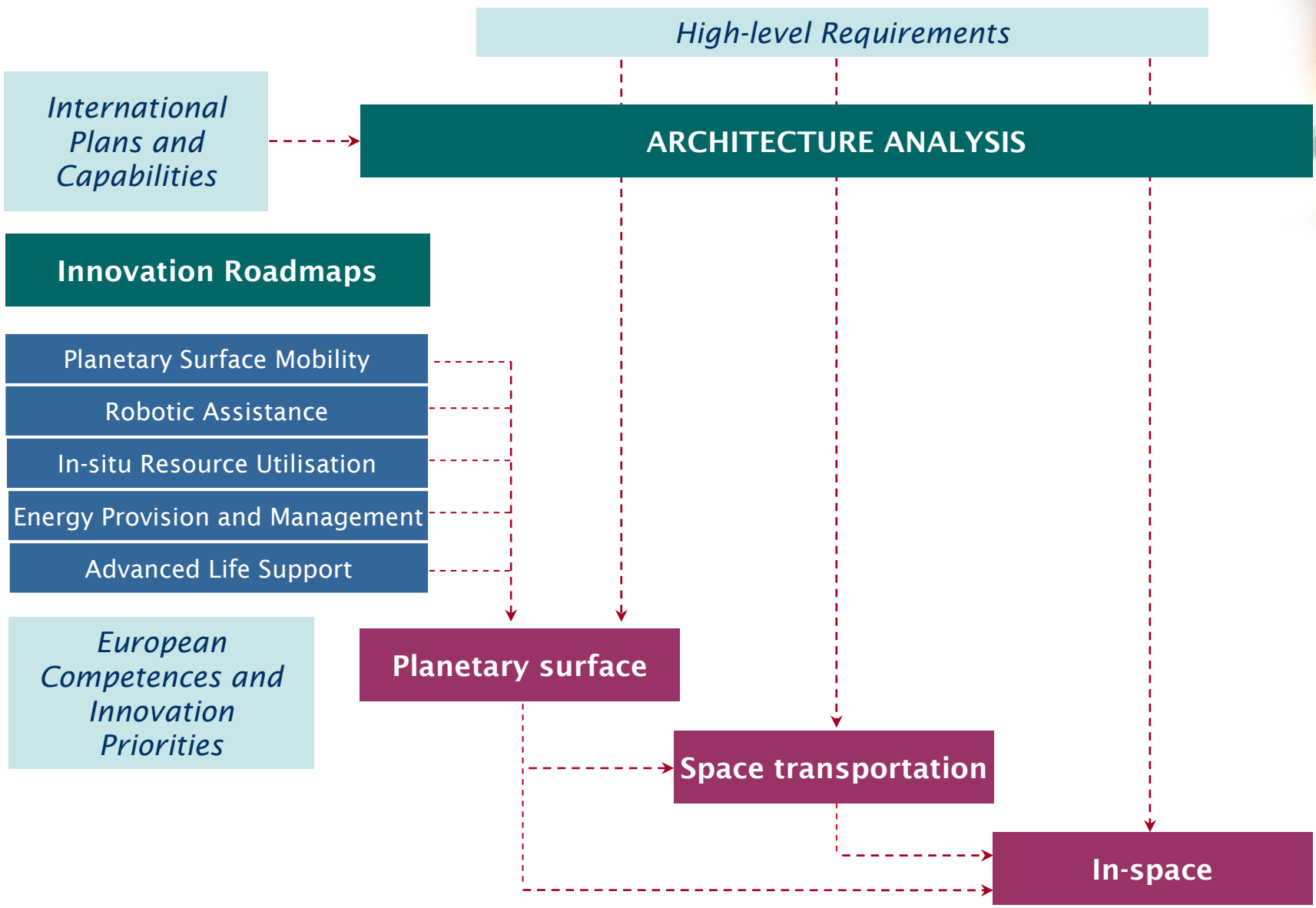
*Scenario Integration*

*Architecture Synergies*





# Architecture and Capability Analysis





# Mars Sample Return Preparation

Represents next major step in Mars exploration in terms of:

- achievement of long term science objectives, as identified by European, US and international science community
- development of key enabling capabilities for future exploration including advanced robotic and possible human missions

- Envisioned in ~2020 timeframe, and internationally recognised as an opportunity for cooperation
- Further European development for MSR structured around ongoing Phase A2 system study
- Refine MSR system architecture
- Address new & open issues
- Identify *PreCursor mission options*, for consideration in 2014/2015 timeframe, in preparation for Ministerial Council in 2008
- Guide ongoing & planned technology development work in key areas, e.g: soft-precision landing  
autonomous rendezvous

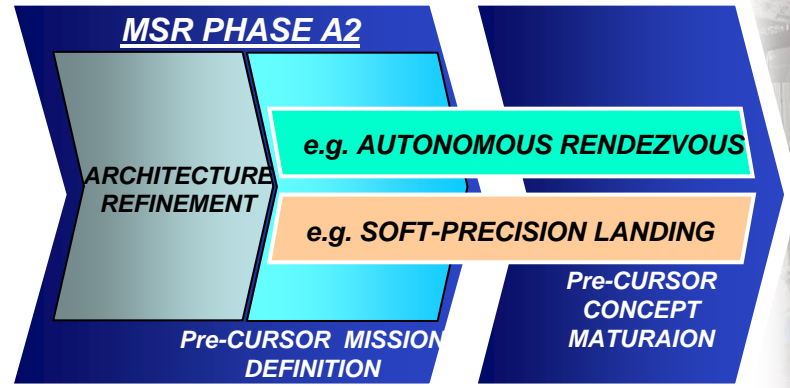


#1 MSR Orbiter with Earth Return Vehicle





#2 MSR Lander with Mars Ascent Vehicle





# General Exploration Technology & Preparation for Lunar Exploration

- Europe possesses strong heritage and experience in several technologies and capabilities specifically associated with human spaceflight;
- Renewed NASA-led initiative to return humans to Moon by 2020 prompts action to coordinate potential European participation
- Require general coordination to ensure Europe's resources are targeted wisely to ensure strong role in future robotic and human space exploration of Moon and Mars





# General Exploration Technology & Preparation for Lunar Exploration

- **Power**: Assessment of medium-long term power provision aspects in human exploration architectures, e.g: solar/fuel-cell/nuclear power systems
- **Robotic Assistance** : Investigation into use and applications of robotic assistance technologies in future human exploration scenarios, e.g: Eurobot
- **ISRU**: Systems assessment of In-Situ Resource Utilisation (ISRU) technologies, the necessary technology developments and the elaboration of future European strategy
- **Life Support**: Development & demonstration of systems for near term applications (e.g.ARES) Further development & maturation of medium term LSS systems, e.g: MELISSA
- **Habitation**: Continuation of preliminary development into inflatable habitation systems and technologies. Use of ISS for future exploration preparation, e.g. via use of MPLM. Refinement of system level understanding of habitation aspects, including requirements etc.

