Final discussion

Michel Blanc
and the Horizon 2061 team

Contacts: michel.blanc@irap.omp.eu
Observatoire Midi-Pyrénés
September 13th, 2019

REPORT TO COSPAR

On the occasion of its

August 2020 General Assembly, Sydney, Australia

TENTATIVE OUTLINE

EACH CHAPTER TO BE A BOOK CHAPTER + A STAND-ALONE PEER-REVIEWED ARTICLE

Book edited by SOC committee + Pascal Willis, Editor-in-chief of Adv. Space Res.

CHAPTER 1: Summary - Horizon 2061 rationale, objectives and main results

CHAPTER 2: Key Science Questions

CHAPTER 3: Representative space missions

CHAPTER 4: Enabling technologies

CHAPTER 5: Supporting infrastructures

CHAPTER 6: Implementation opportunities and the role of cooperation between actors in the future of Planetary Exploration

REPORT TO EPSC-DPS
Geneva, Sept. 19th and 20th, 2019

PLANETARY EXPLORATION, HORIZON 2061 session MIT4

Friday, 20 September 2019 | Moon (Room 15)

Chairperson: Jeremie Lasue

An introduction to the Planetary Exploration, Horizon 2061 foresight exercise and to the preliminary conclusions of its synthesis workshop (Toulouse, Sept. 11-13, 2019)

Michel Blanc and the Scientific Organization Committee of H2061 Toulouse 2019

08:40–08:50 |

Report from Horizon 2061 Synthesis Workshop Pillar 1: From Science questions to representative space missions

Véronique Dehant, Steve Mackwell, and Michel Blanc

08:50–09:00 |

Report from Horizon 2061 Synthesis Workshop Pillar 2: From representative missions to technology requirements

Ralph McNutt, Pierre Bousquet, Anil Bhardvadj, **Manuel Grande**, Oleg Korablev, Franck Montmessin, Olivier Hainaut, and Michel Blanc

09:00–09:10 |

Report from Horizon 2061 Synthesis Workshop Pillar 3: Enabling technologies

Wing Ip, Advenit Makava, Patricia Beauchamp, Brook Lakew, Jean Broquet, Linli Guo, Jorge Alves, and **Michel Blanc**

09:10–09:20 |

Horizon 2061: Infrastructures, services & collaborative programs

Bernard Foing and the Horizon 2061 team contributors

On the Feasibility for Mining the Hydrogen Peroxide (H2O2) of Mars for Monopropellant Rocket Fuel

Francisco J Arias and Salvador De Las Heras

09:30–09:40 |

A New Mechanism to Make Mars Habitable

Edwin Kite, Ramses Ramirez, and Martin Turbet

09:40–10:00

Panel and discussion with the community

PLANETARY EXPLORATION, HORIZON 2061 session MIT4

Poster contributions (Thursday evening)

Attendance time: Thursday, 19 September 2019, 17:15–18:45 | Level 1

L1.33 |

EPSC-DPS2019-292

Surface Dating of Airless Bodies by Remote Sensing Luminescence

Rita Schulz

L1.34 |

EPSC-DPS2019-341

Solar and Hybrid Electric Propulsion Missions to the Outer Solar System

Edgar Bering, Matthew Giambusso, Alex Parker, Mark Carter, Jared Squire, and Franklin Chang Diaz

L1.35 |

EPSC-DPS2019-730

Smallsat Innovations for Planetary Science Missions

Rebecca Schindhelm, Karen McConnell, David Osterman, Shane Roark, Reuben Rohrschneider, Jeffrey Van Cleve, Michael Veto, and Jonathan Weinberg

L1.36 |

EPSC-DPS2019-2001

Report from Horizon 2061 Synthesis Workshop Session 3: foresight visions and programs from agencies and industry

Doris Daou, Francis Rocard, Kyeong Ja Kim, Hélène Boithias, Maria Antonietta Perino, and Michel Blanc

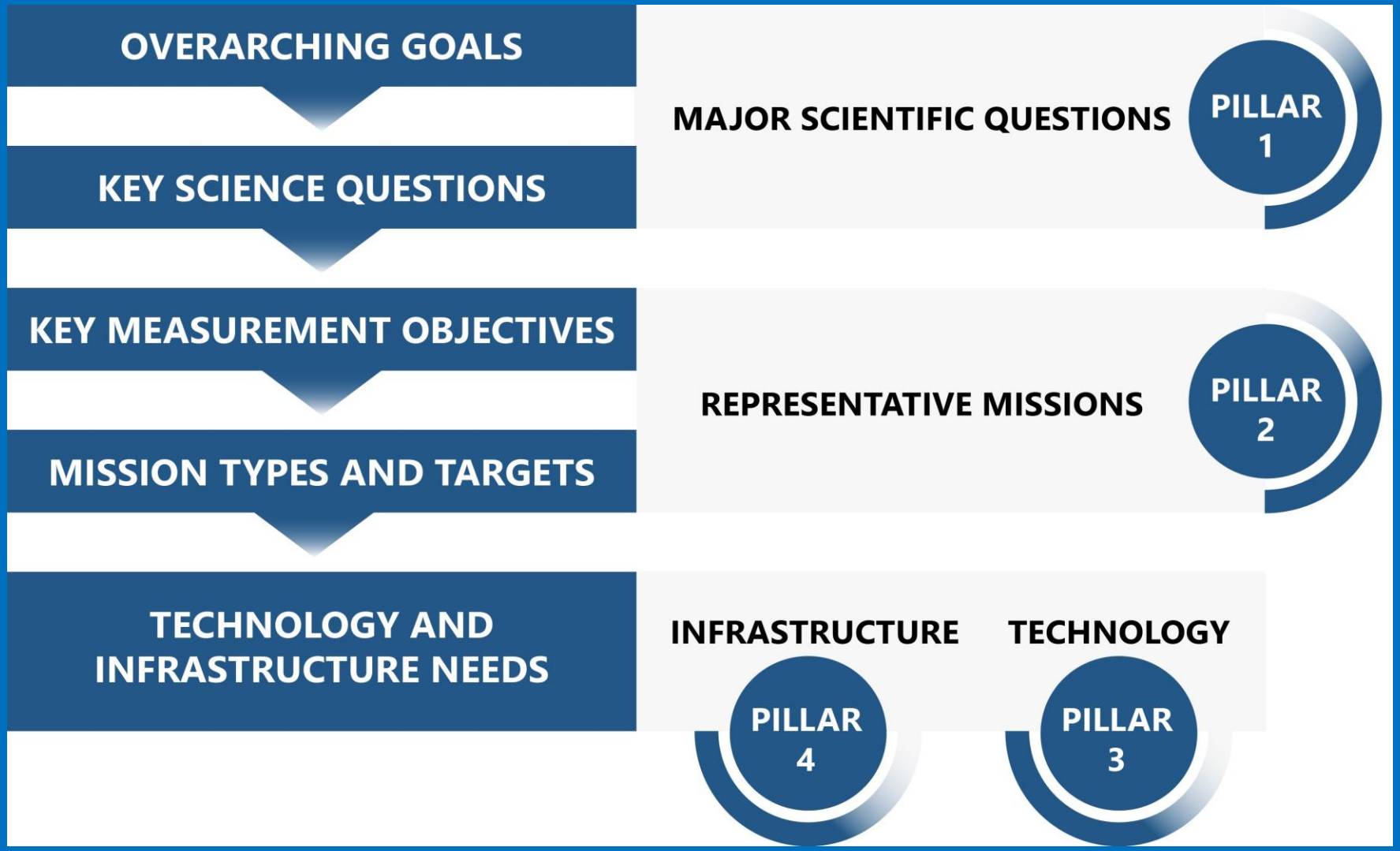
Special Horizon 2061 session
17th AOGS Annual Meeting 2020
South Korea

H2061 METHOD (1)

DESIGN AN

« INTEGRATED SPACE SCIENCE MISSION TO PLANETARY SYSTEMS »

BY BUILDING ITS TRACEABILITY MATRIX, WE WILL BUILD OUR « FOUR PILLARS »



METHOD (2)

Produce a 50-year foresight of

Planetary Systems Exploration (Solar System)

through a projection of its four « pillars »:

- **(1) major scientific questions**

Bern, Sept. 2016

(2) representative planetary missions

- **(3) enabling technologies**

Lausanne, April 2018

(4) supporting infrastructures

SYNTHESIS **Toulouse, June 5-7 2019**

Confront our long-term « science dreams » with a projection of our technical capacities

Pillar (1)

Major scientific questions

OVERARCHING SCIENCE GOAL

Study the formation and evolution processes leading to the growth of complexity, and ultimately to the possible emergence of life, through the diversity of planetary systems:

(1) the growth of molecular complexity, from the Interstellar medium (ISM) to planetary and moons environments;

(2) the growth of planetary environments complexity, and the conditions under which their evolutionary paths may lead them to become “habitable”.

Pillar (1)

Major scientific questions

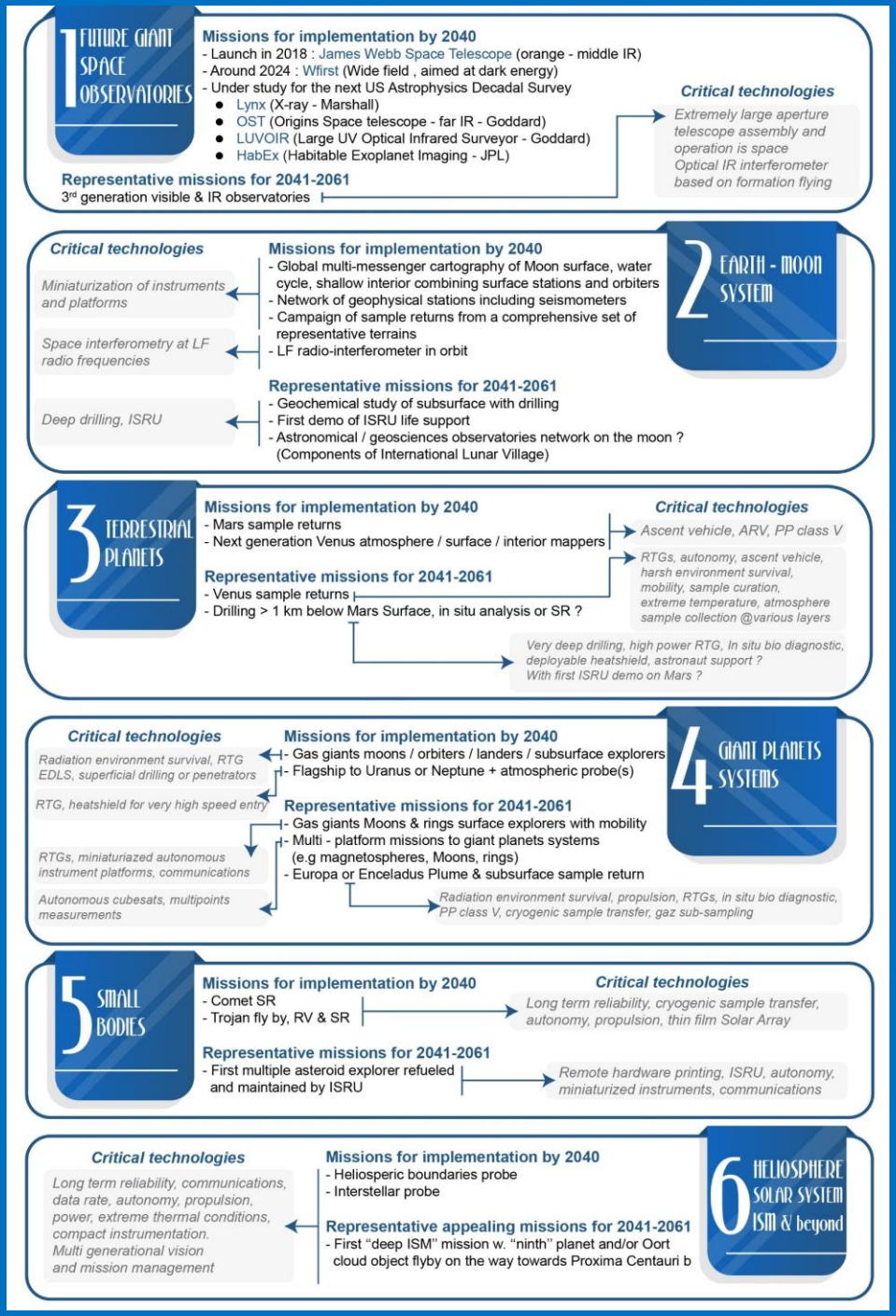
a. Origins of Planetary Systems
b. Formation and diversity of Planetary Systems architectures
c. Diversity of objects
d. Planetary Systems coupling mechanisms
e. Emergence of potential habitats
f. Detection of Life

FROM
KEY SCIENCE
QUESTIONS
TO
KEY MEASUREMENTS
AND TO
MISSION TYPES

Pillar (2)
Representative space missions
Tentative contents

1. Future Giant Space Observatories
2. The Earth-Moon System
3. Terrestrial planets
4. Giant planets and their systems
5. Small bodies
6. Heliosphere, Solar System, ISM and beyond

FROM
KEY MEASUREMENTS
AND
MISSION TYPES
TO
CRITICAL
TECHNOLOGIES



Pillar (3)
Enabling technologies
Tentative contents

1. Exploration platforms of the future
2. Platforms subsystems and enabling technologies
3. Reaching out to challenging destinations
4. New sensors and new sensor technologies for an expanding spectrum of science themes and disciplines
5. Meet the challenges of Sample Return
6. Disruptive technologies

Pillar (4)
Supporting infrastructures
6 main themes

1. Earth-Moon system gateways to the Solar System and beyond
2. Navigation and communication infrastructures
3. Solar System Space Weather
4. In-Situ Resources Utilisation facilities
5. Sample Return, Curation and Analysis facilities
6. Solar-System-Scale Observatories:
    1. Space-based global observartories
    2. Virtual Observatories

Additional contributions to the four pillars:
Visions from Agencies and industry

Session 3 - Foresight visions and programs from agencies and industry		
Chairpersons: K. J. Kim, Michel Blanc		
15’	JAXA’s planetary exploration plan for the next decades	N. Ozaki, Y. Toukaku
15’	Progress and Prospects of Unmanned Deep Space Exploration in China	LI Ming (CAST) Read by L. GUO
15’	KIGAM’s new direction for lunar science and exploration in conjunction with lunar and planetary ISRU	K.J. Kim
15’	**KEYNOTE TALK:** Eurospace recommendations for Human Presence & Exploration	Laura Gatti
15’	OHB Planetary Exploration Enabling Technologies Involvements	Marco Berg
15’	The view from TAS	Maria Antonietta Perino
20’	Round-table discussion – session 3	Moderator: Bernard Foing

Additional contributions to the four pillars: Students and early career professionals contributions

Session 6 – Students and early career professionals contributions			
Chairpersons: Gengxin XIE, David Mimoun			
15’	Towards an origami based compliant modular system for deep space exploration: the next generation of cubesat	S. Bonardi et al.	
15’	The Cathalus Mission Concept to Occator Crater at Ceres: Science, Operations and Systems Design	G. Acciarini et al.	
15’	The Calathus Mission Concept to Occator Crater at Ceres: Science, Operations and Systems Design	P. Panicucci et al.	
15’	CaLIBSow: Chemical Analysis with LIBS for Ocean Worlds. An instrument concept for Outer Solar System subsurface oceans	B. Chide	
15’	Assessing the Habitability of an Active Ocean World: the Etna Mission Concept to Enceladus' Tiger Stripes	P. Panicucci et al.	
15’	Remote Localisation and Characterisation of Venus' Seismic and Volcanic Events through a Network of Balloon-Based Instruments	L. Martire et al.	
15’	Lunar Outpost Sustaining Human Space Exploration by Utilizing In-Situ Resources with a Focus on Propellant Production	P. Guardabasso,.., D. Gaudin et al. (ISAE)	
15’	Sample Return Mission to Enceladus	Ignacio Albarran,.. E. Clavé et al.	
Session 7 – Implementation, international collaboration, workshop synthesis and reporting			
Chairpersons: Maria Teresa Capria, R. Mc Nutt			
20’	**Keynote talk:** The role of the Italian Space Agency in Solar System exploration and international collaboration	Eleonora Ammannito	
	Final round-table discussion	Moderators : M. T. Capria, R. Mc Nutt	