

Resource Utilization Concepts for MoonMars



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In-Situ Resource Utilization (ISRU) Analysis

Introduction



What is “In-Situ Resource Utilization”?

What is unique, useful and/or needed from the Moon and Mars?

How do we approach the realization of In-Situ Resource Utilization?

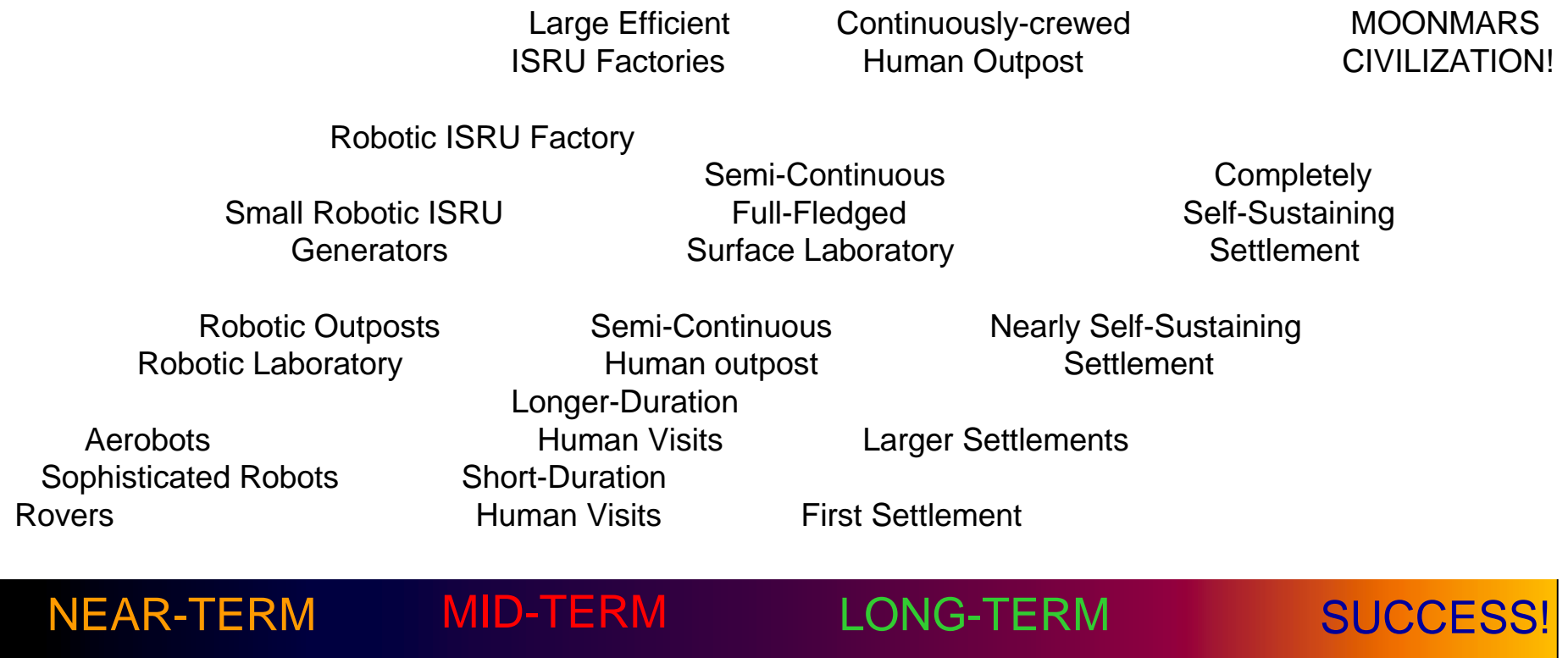
	MOON	←M/M→	MARS
NEAR	?	?	?
MID	?	?	?
LONG	?	?	?



General Stages of Development for MoonMars Exploration



Types of missions needed for In-Situ Resource Utilization

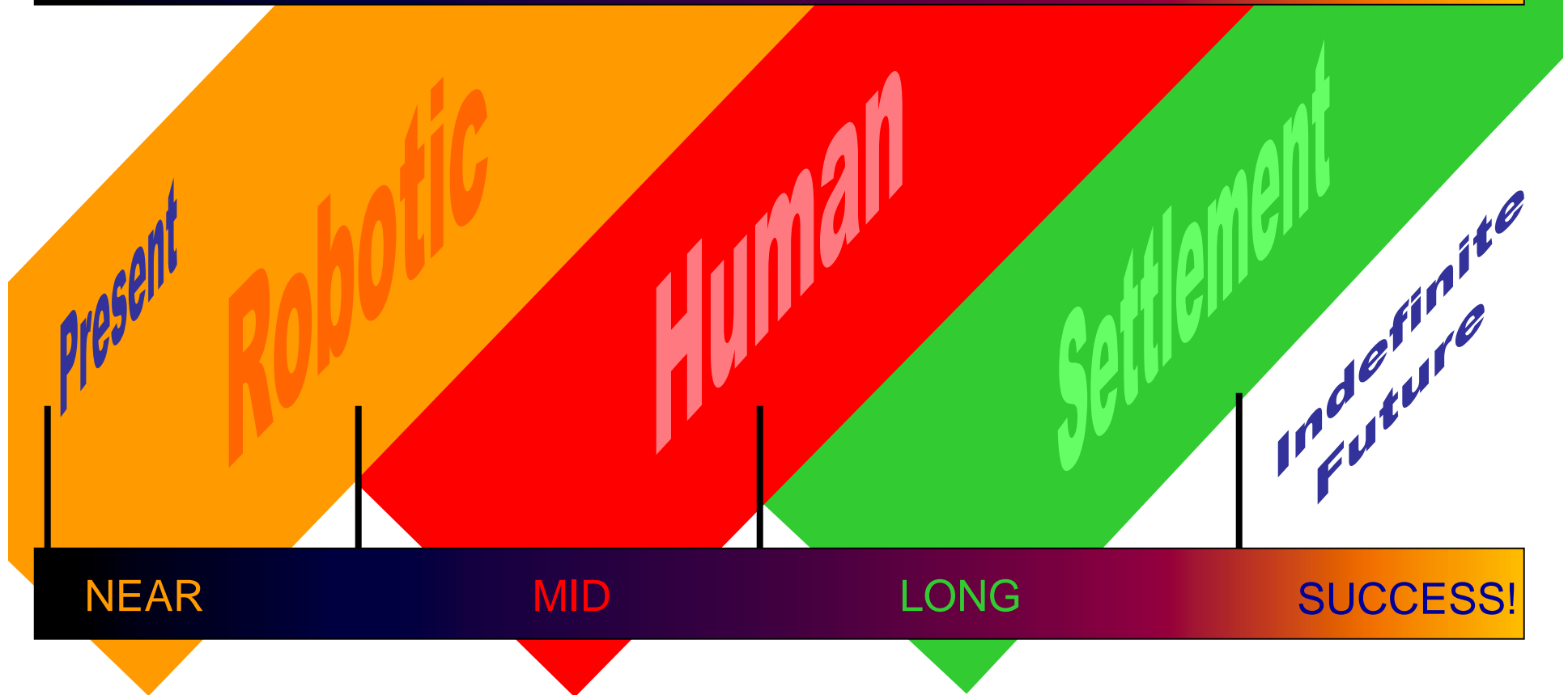




General Stages of Development for MoonMars Exploration



Generalized trend of development stages towards self-sustainability





In-Situ Resource Utilization (ISRU) Analysis

Stage 1 (Near Term): Robotic Outpost



Moon Resource Utilization

- Power Supply
 - Solar
 - Fuel Cell
- Lunar Volatile Technical Demonstration
- Confirmation of composition and structure of Lunar polar Hydrogen

Mars Resource Utilization

- Water extraction from soil and/or ice cap– reservoir.
- Production of Fuel from Martian atmosphere – reservoir.
- Power Supply
 - Solar power from orbit (beaming)
 - Fuel Cell
 - Hydrological Power

Commonality between Moon and Mars

- Significant knowledge gaps exist before utilization can commence, a major goal during this stage is to determine the resources available – Mars water and fuel production are much closer to being available.
- Use common technologies on Moon and Mars to cut down costs



In-Situ Resource Utilization (ISRU) Analysis

Stage 2 (Mid Term): Human Outpost



Moon Resource Utilization

- O₂ Regolith Extraction
- Greenhouse
- Information – human factors, technology needs
- Unique science possible

Mars Resource Utilization

- Phobos, Deimos – Determine composition, structure and use as a station.
- Greenhouse
- Information – human factors, technology needs
- Unique science possible

Commonality between Moon and Mars

- Combined architecture allows for NEO detection/orbital determination
- Fuel and Oxygen production established, used and proven in multiple environments establishing initial Moon/Mars ISRU.



In-Situ Resource Utilization (ISRU) Analysis

Stage 3 (Long Term): Human Settlement



Moon Resource Utilization

- Radio and Visual Astronomy
- Tourism and unique entertainment
- Low-g, Anhydrous Manufacturing
- Spaceport – Gate to the Solar System
- Closed loop systems
- Safe haven, secondary basket of mankind and culture
- Polar crater heating and vacuum seal
- Commercial Export to LEO

Mars Resource Utilization

- Safe haven, secondary basket of mankind and culture
- Closed loop systems
- Space-based Solar energy

Commonality between Moon and Mars

- Specific ISRU will develop with time, experience and vision



In-Situ Resource Utilization (ISRU) Analysis *Conclusions*



Commonalities

	MOONMARS
NEAR	Information Resources Demonstrate ISRU technology Begin to stockpile in-situ resources
MID	Utilize in-situ resources in human missions Information about space life Exploit environment for science
LONG	Begin exploitation for export commercial and entertainment Information about permanance in space



In-Situ Resource Utilization (ISRU) Analysis

Conclusions Continued



Key Differences

	MOON	MARS
NEAR	Needs more info	Better prepared
MID	Approach identical Technological details differ	
LONG	Export to Earth Entertainment	Permanent, independent habitat



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<http://moonmars.org>