



RAMA Rover visual on an alien landscape.

# In the Realm of the Unknown

LIQUIFER Systems Group, a multi-disciplinary design and development practice with offices in Mumbai and Vienna, develops RAMA <Rover for Advanced Mission Applications>; a mobile research laboratory to explore Moon and Mars.

*Text:* Ruturaj Parikh

*Images:* © LIQUIFER Systems Group / René Waclavicek.

We cannot underestimate our obsession with space exploration. Since Star Trek, 'The Final Frontier' has captured our collective imaginations the ultimate domain to be conquered, explored and understood. Space exploration is indeed a field that assimilates a diverse array of expertise in design and engineering. It deals with extremities and unknown variables constantly pushing limits of the possible and the comprehensible. Future

ventures in space will present us with an unprecedented opportunity to explore alien landscapes and geographies and will challenge our notions of life.

RAMA <Rover for Advanced mission Applications> is a mobile lab designed by LIQUIFER Systems Group as a self-sufficient pod that will

provide a habitable workspace for manned missions on Moon and Mars. This Rover, designed in the memory of the prolific writer Sir Arthur C. Clarke is seen as a habitat, a refuge, a laboratory and a controlled environment that will enable comfortable surface exploration on alien and at times hostile environments.

The Rover also accommodates essential scientific and operational requirements as it adapts to various mission objectives. Primarily built for Surface Architecture Study, the Rover is designed in variants that can inhabit two to four humans for a period of approximately 40 days

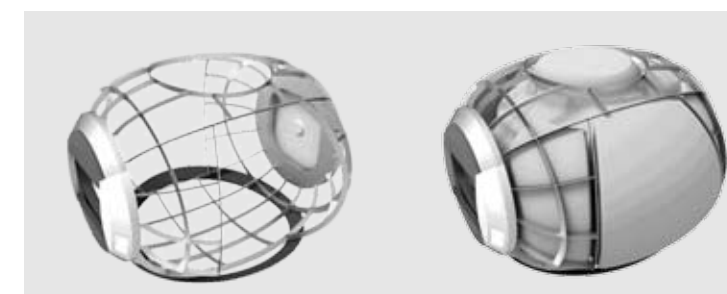
depending on the nature of mission. This pod uses liquid hydrogen or liquid oxygen fuel cell that allows the Rover to operate with or without sunlight. Standard equipments on board include a guidance system, a navigation system and an obstacle avoidance system. The Rover enables the astronaut to disembark and work on field in a space-suit while having a built-in remote manipulator – a mechanical arm to recover samples, deploy surface equipments and assist astronaut's field activities. This highly manoeuvrable vehicle can also collaborate with a surface station and thus replenish its resources periodically to sustain its crew and energy for longer or multiple missions.



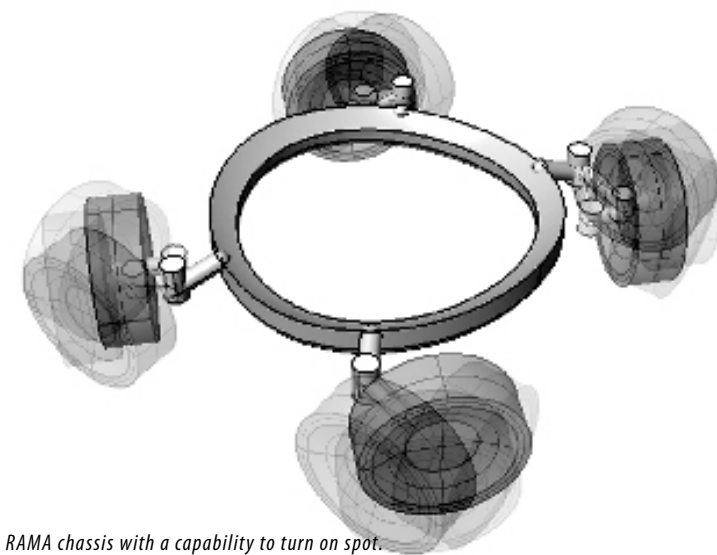
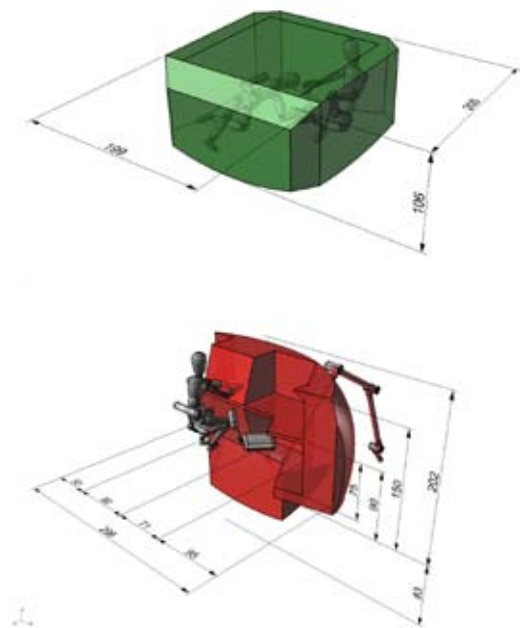
Spacesuit lock and hatch on the Rover.



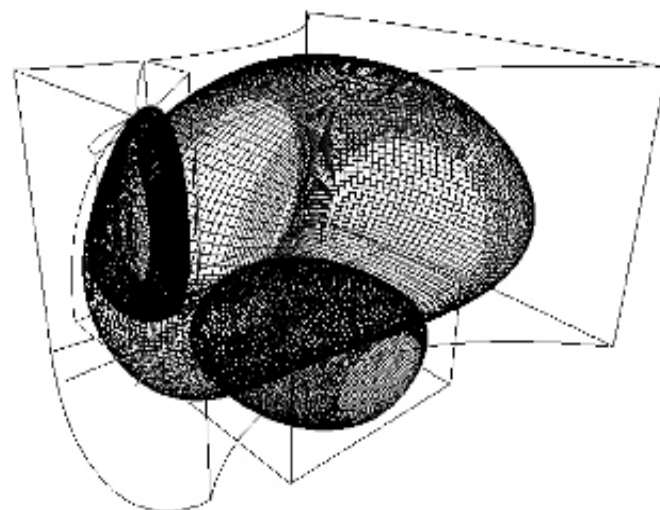
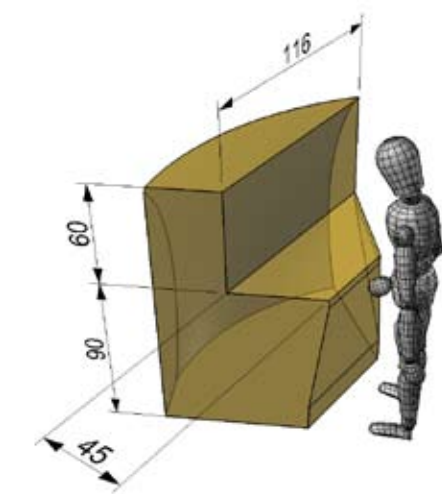
Robotic arm for equipment and assistance.



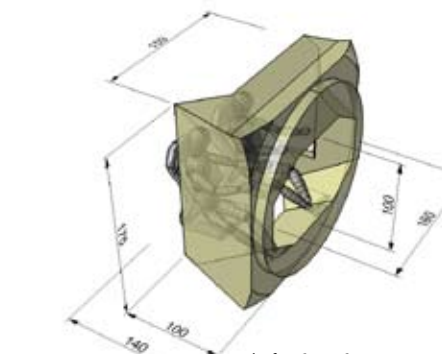
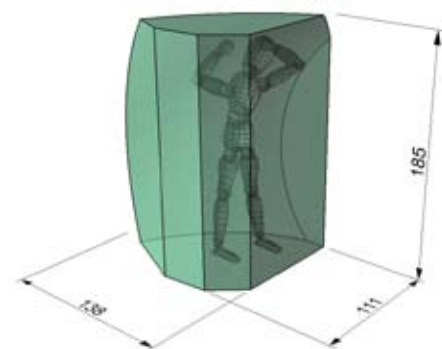
Structural frame and infill of the vehicle.



RAMA chassis with a capability to turn on spot.



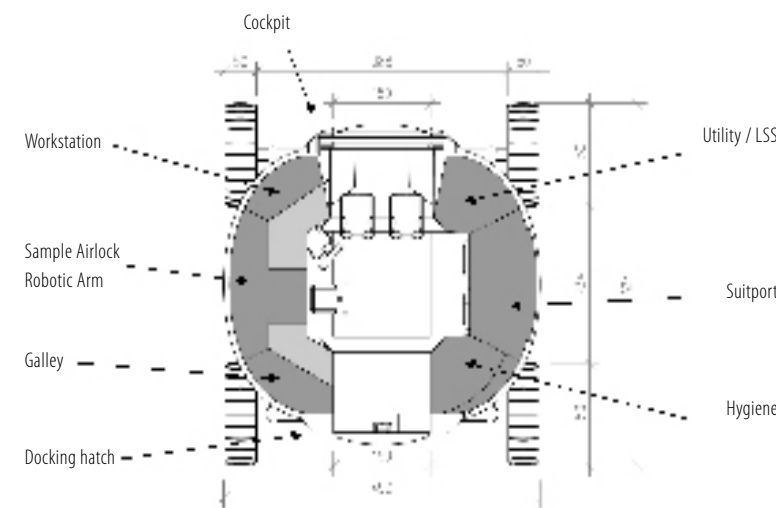
Study of interior space.



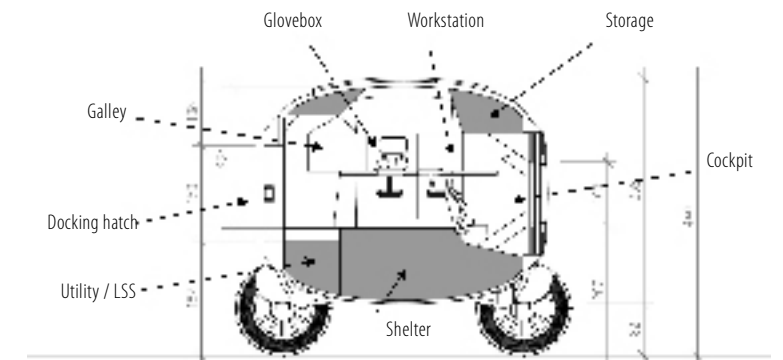
RAMA – space requirement ergonomic study for Crew Quarters, Laboratory, Gallery / Kitchen, Hygiene Facilities and Cockpit.

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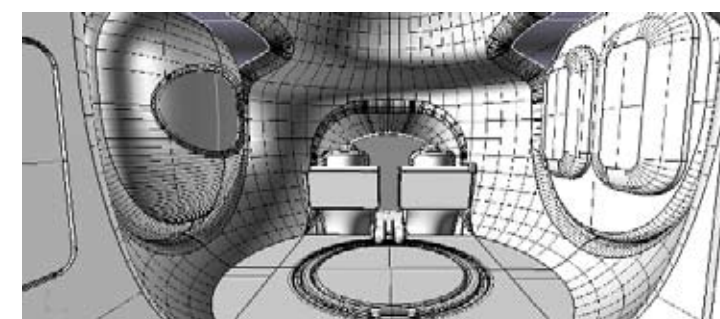
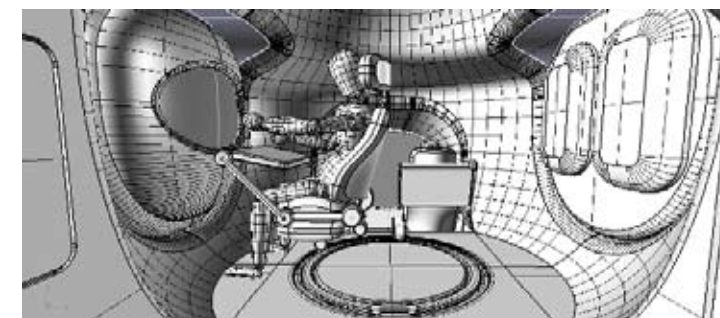
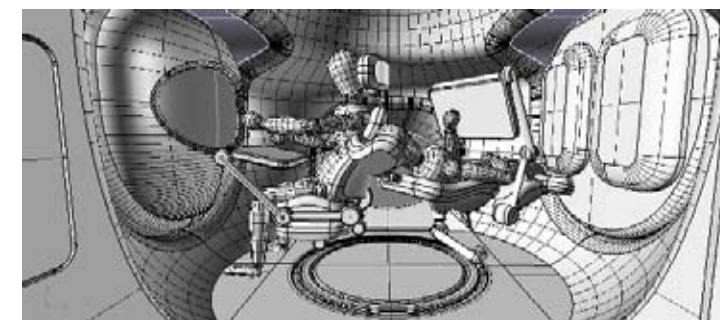
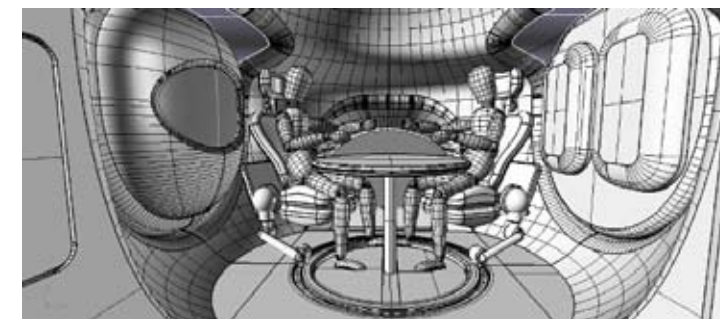
The brief by European Space Agency (ESA) was to develop space exploration architecture for planetary surfaces, transportation and in-space missions. LIQUIFER developed RAMA as a mobile research laboratory for the ‘surface’ segment taking into consideration the political and financial constraints in research and development of such technology. Issues like habitability, technical interfaces, safety, dust mitigation, contamination and radiation were considered and dealt with in the process of design after analysis. As RAMA is designed to operate independently as well as in collaboration with another rover or a base-station, the design integrates technology that enables such interaction. Issues of habitability and interface are thoroughly understood to control the “physical, social and psychological



PLAN WITH ELEMENTS



SECTION WITH ELEMENTS



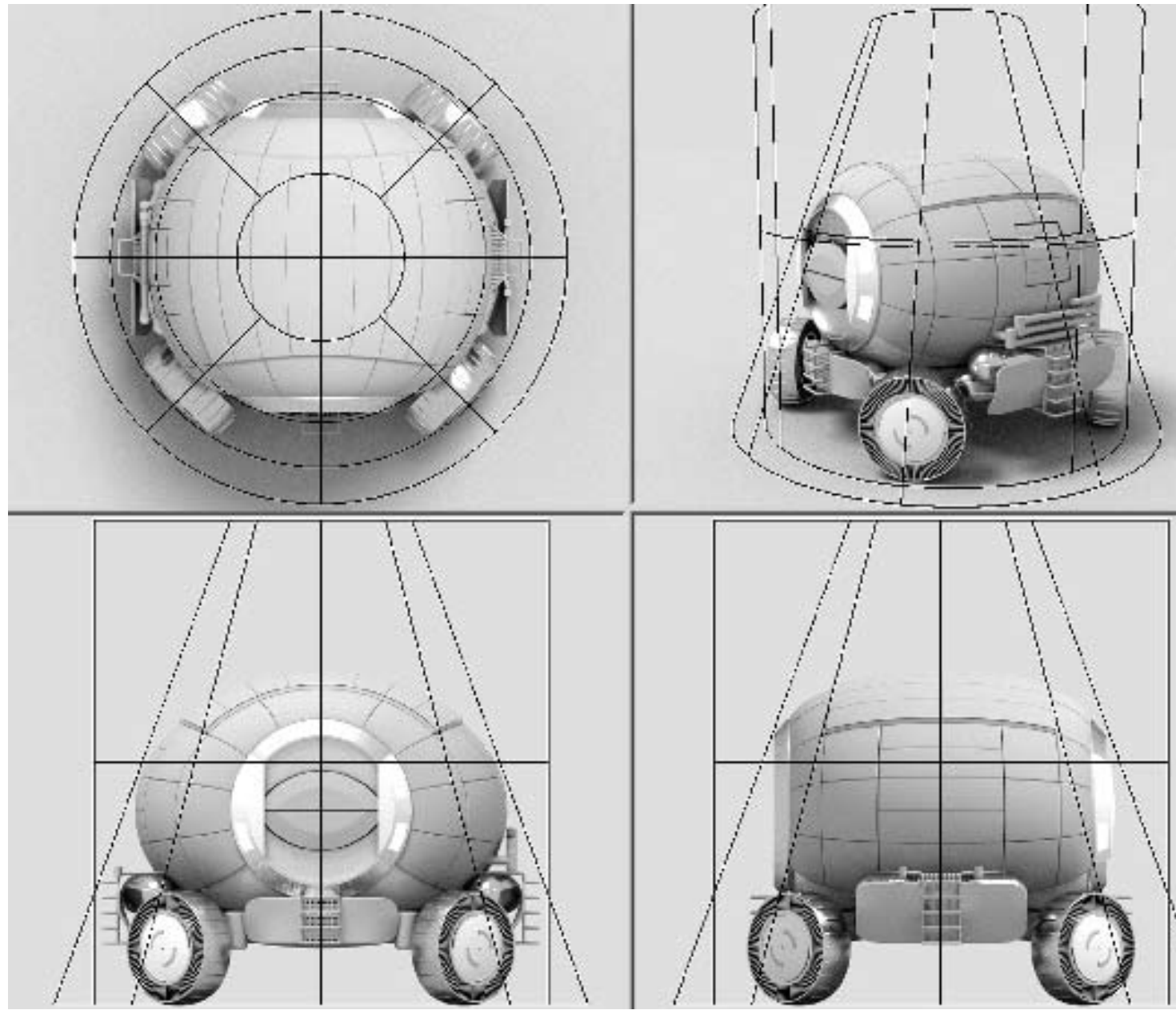
Multiple movement configurations of the seats in the capsule.

issues” within and around the capsule. The capsule and the work environment within is ergonomically articulated for maximum efficiency in work and in rest through studies in flexibility and adaptability. The environs within and immediately outside are controlled through user-controlled lighting design, provision of strategic windows, and placement and design of furniture. Design measures keep planetary dust and contaminating materials and radiation in control.

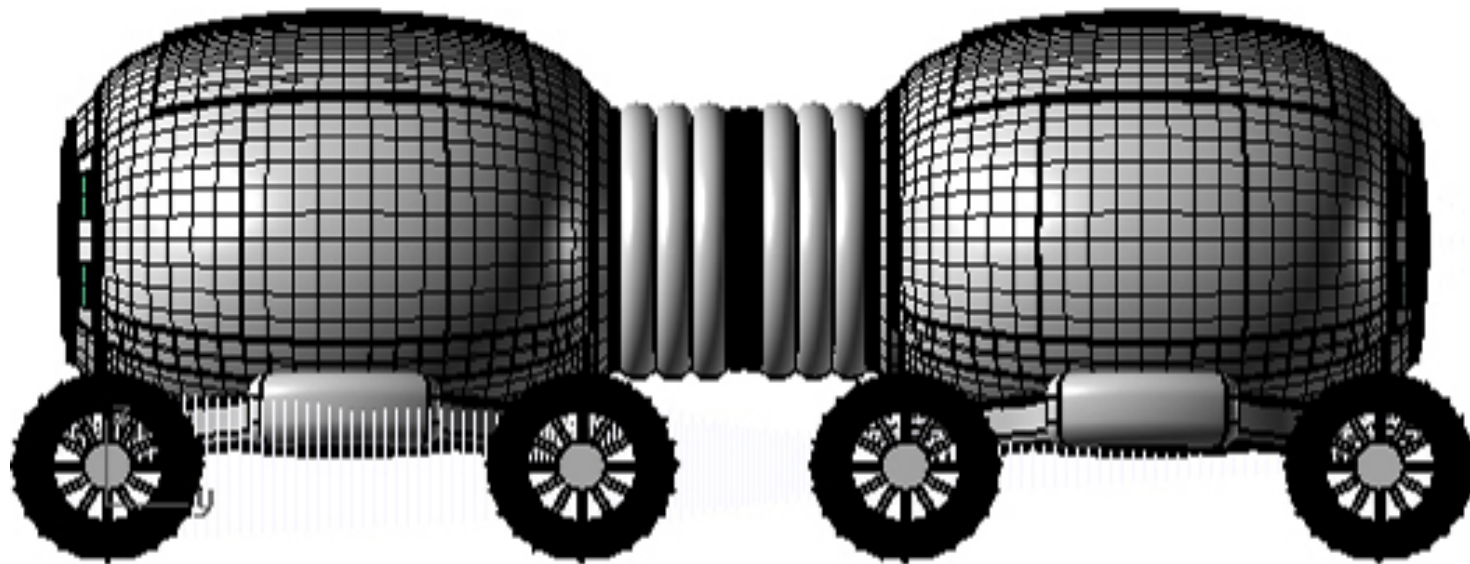
This pressurised Rover is designed to operate in environs of Moon and Mars thus having versions with minor design variations. Its ellipsoidal body changes dimensions to accommodate the crew of 2 to 4 persons with weight variation between 5500kg to 6000kg. The four wheels of the Rover are independently propelled with its suspension system set on a circular chassis. Though a wide array of technologies and engineering tools contribute to the overall composition of RAMA, design plays a key role in articulation, configuration and operation of the vehicle.

As we venture into extreme environments owing to our inherent need to push the limits, design becomes an essential to support human ambition. Architecture of habitation aids human inquisitiveness by giving solutions to the most complex situations. While once we thought that survival is the key to the unknown, logic and research drives us to create bubbles of familiarity and comfort in the most unfriendly terrains. Aggressive detailing ensures safety and a vivid imagination ensures compatibility in uncharted waters. Beyond reason and reasonability, our thirst to understand and explore the forbidden will ensure that we look towards design more often than ever before in time to come.

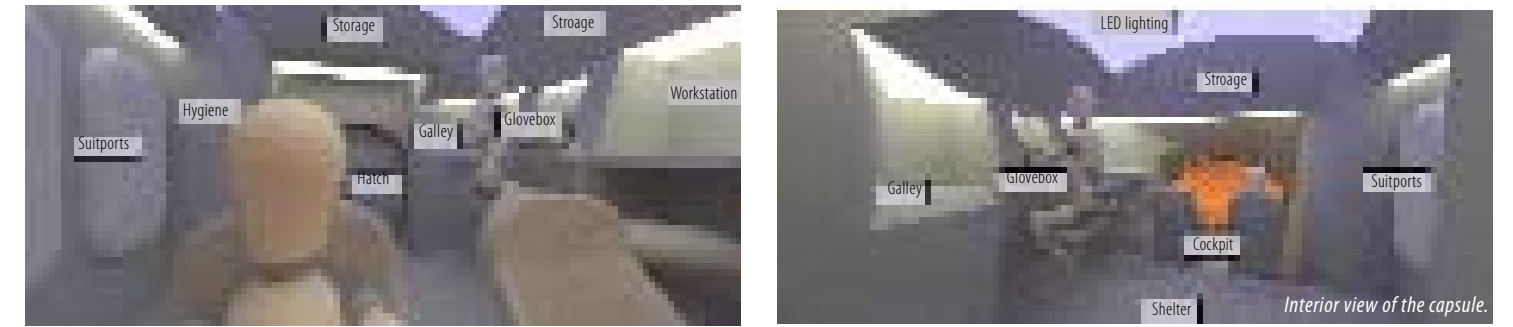
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Multipoint views of the Rover.



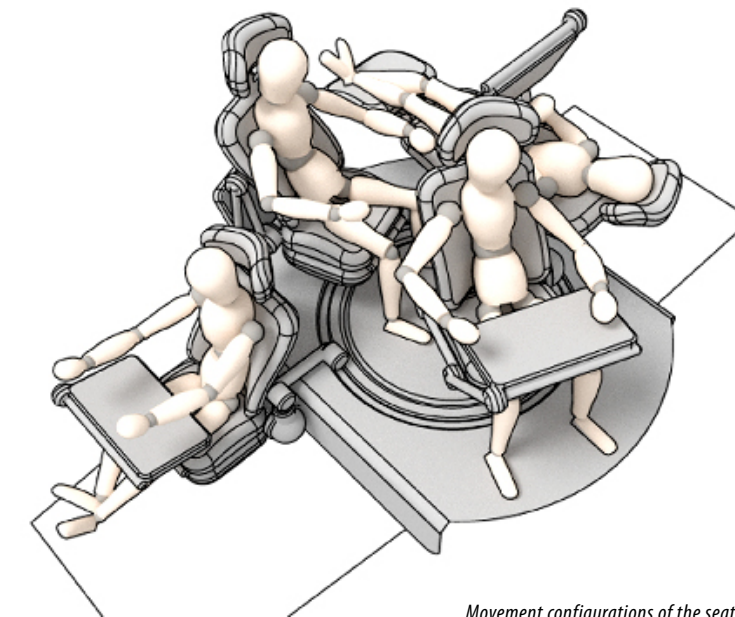
The Rover has a capacity to collaborate with other vehicles through the hatch.



Interior view of the capsule.



RAMA – Capable of operations on Moon and Mars.



Movement configurations of the seat.

**FACT FILE:**

Project	:	RAMA <Rover for Advanced mission Applications>
Company	:	LIQUIFER Systems Group (LSG)
Project Team	:	Barbara Imhof (Architect): Project Management, Concept Development, Detailed Design
Waltraut Hoheneder (Architect)	:	Contract Management, Concept Development, Detailed Design
Stephen Ransom (Engineer)	:	Systems Engineering, Concept Development, Detailed Design
Norbert Frischauf (Physicist)	:	Commercial Evaluation, Technology Roadmap, Radiation Research
Susmita Mohanty (Industrial Designer - Engineer)	:	Dust & Planetary Contamination Research
Sandra Haeuplik-Meusburger (Architect)	:	Habitability Research, Suitport Research
Kürsad Özdemir (Architect)	:	Operational Scenario Studies, Concept Development
René Wacławicek (Architect)	:	Detailed Design, 3D Modeling

The project was developed for the European Space Agency's Architecture Studies (European Exploration Strategy) under a contract to Thales Alenia Space.