Manned Mission Space Exploration Utilizing a Flexible Universal Module. Peter. Humphries, Fred Barez, Aishwarya Gutti Shashidhar Gowda, and Thomas Brant. Affiliation (ASMS. Inc. P.O. Box 36231, San Jose, CA 95158. Email: contact@asms.space)

Introduction: The proposed Flexible Universal Module is in support of NASA's Deep Space Gateway Project. The Flexible Universal Module provides a possible Habitation or Manufacturing environment in support of Manned Mission for Space Exploration.

The ASMS Flexible Universal Module is in the form of a cylindrical vessel equipped to accommodate the members of a manned mission for thirty plus days within the module with the basic necessities while creating an environment for on-demand manufacturing of space structures and components to allow fabrication of parts in case of an emergency [1]. The Flexible Universal Module System consists of two modules where one unit is used as a dedicated habitation unit while the second could be used as the 'Space Fab Workshop.' The modules could be used as in logistics purposes [2].

The ASMS self-contained modular unit's designs, are of the size to fit in the cargo bay of X Type Space Vehicles utilizing available technologies. These modular units for space exploration applications will provide a safe environment against the harsh conditions of the outer space [3][4]. This Deep Space Gateway module, or modules could be tested on Earth in a remote location to demonstrate the upgradability and reconfigurability. Then tested on ISS, before going onto Deep Space Gateway.

Two such Universal Modules are connected through a docking mechanism to allow the crew to transfer between the two modules if needed. Parts could be manufactured using an advanced tracked robotic system and to move raw materials from storage bins to the fabrication stations equipped with various manufacturing processes. The CIM manufacturing operation option is monitored using, infrared, high definition cameras, and communication protocols to send command to various enabling manufacturing pieces of equipment not only from the second module, but also from Earth if needed [5]. The fabrication of large structures such as 'truss' members to be connected to create a platform for the logistics of loading and unloading of cargo as well as to allow the crew to have the opportunity to exit the modules to perform a EVA.

These ASMS Flexible Universal Modular Units are designed to provide a tracked robotic manufacturing facility to allow fabrication of various components using laser cutting and welding, wire feed laser 3D additive manufacturing, and robotic assembly of various components to form space structures for the purpose of repair of space vehicles. Multi-material additive manufacturing method using advanced imaging technology based on neutron radiography and tomography could provide extremely valuable components [6]. Investigations by various science community would enable them to do test materials, methods to fabricate components in development of space platforms and other structures.

The ASMS Flexible Universal Modules are designed to be upgradable-reconfigurable due to the, slidable platform with rollers such that various 'environments' could be set up for different operations and applications [7][8]. This would provide a major benefit for the science community as these modules could also be placed on Earth-Moon or other planets as a permanent 'habitation' or 'research lab' including a possible 'medical' facility in support of long duration space exploration missions [9]. Thus, it would meet NASA's requirement to leave something behind as resource for future space missions [10].

The ASMS Flexible Universal Modular Units can be configured for various applications including health care, manufacturing of exotic materials, engineered plants and other medical biological research in-situ, or on Earth prior to launch.

The expected impact of this will enable NASA's Deep Space Gateway platform the opportunity to have established not only a habitation environment, but also a manufacturing capability in support of exploration.

The specific benefit for NASA and its Deep Space Gateway Platform to establish itself as an enabling community in support of long duration crewed mission utilizing a flexible upgradable habitation environment as well as a demonstrated manufacturing capability needed for any long exploration mission. As well as an emergency backup if needed.

These modules would enable the private sector of the space community for commercial applications due to the flexibility and upgradability such as space hotels [11].

Expected Equipment, & Operational Requirements.

Estimated experiment properties	Description
Mass of hardware	16,000kg Module + 200kg manufacturing equipment + 500kg miscellaneous interior
Volume of hardware	4.6 m diameter x 7.6 m long for 126 cubic meters
Accommodation (e.g. internal/external)	Internal Habitation requirements and manufacturing hardware
Power required	10 Kw
Power required when no Astronaut in Habitation Module	4 Kw
Power required, for wire feed laser 3D printer	0.8kW- 2Kw
Data generated	Testing & evaluation of results 20GB approximately per day.
Pointing/viewing/line of sight needs	Hatch windows 120-degree angle view.
Birthing Docking Mechanism incorporating the Double Doors.	Upgradability and reconfigurability of slidable platform on rollers into habitation module.
Communications needed	SN, & Deep Space Communication Network
Duration of experiment	1st phase, 24 -36 months.
Crew tasks (if needed)	Controlling the manufacturing while in the Astronaut unit. Gathering CIM/CAD/CAE/CAM data from engineers on Earth.
Access and servicing by crew (if needed)	Utilizing a hybrid docking mechanism
Need for retrieval and return to Earth	30 Days plus, can stay in space for a longer period. Up to 1,100 days if required for Mars application.
Specific orbit needs (if any)	Currently studied for LEO. Could put in NRO, HALO.
Operations without crew (if any)	Yes, tracked robot-controlled manufacturing

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