Paper ID: 72420
oral

29th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Constellations and Distributed Systems (7)

Author: Mr. Bruce Clarke
Space Generation Advisory Council (SGAC), United Kingdom

Mr. Lokdeep Kalaiselvam
Politecnico di Torino, India
Mr. Jorge Rubén Casir Ricaño
Bauman Moscow State Technical University, Russian Federation

A CONSTELLATION BASED APPROACH TO AN ORBITAL MANUFACTURING ECOSYSTEM

Abstract

The space environment offers unique possibilities for manufacturing. From manufacturing techniques that are only possible in microgravity to the innate cleanliness of a vacuum, a new area of the space industry is rapidly opening up. Two streams are evident within orbital manufacturing. Return missions provide services for manufacturing pure materials (e.g. creation of lightweight alloys for use in environmentally friendly airframes), while non-return missions use assembly techniques to combine components into complex assemblies (e.g. production of 3D printed composites for use in assembling orbital structures, or at a macro level, construction of structures such as the ISS). Initiatives such as NASA's OSAM-1 satellite show that these two mission profiles are not mutually exclusive and are critical for supporting future efforts for construction of large structures in orbit. As more actors become involved in on-orbit manufacturing the sector is becoming more complex, with areas beginning to interact in new and interesting ways. In short, a new orbital manufacturing ecosystem is developing.

This paper investigates how this new on-orbit manufacturing ecosystem might function. In addition to assessing the benefits of and markets for downstream products of a thriving on-orbit manufacturing ecosystem, this paper addresses areas that require technological advancement to unlock their full potential, and identifies where policy and regulation need to change in order to support growth. This paper proposes that an on-orbit manufacturing ecosystem also offers the potential to enhance space sustainability by reusing components and materials from decommissioned satellites, and discusses where orbital servicing technology could be repurposed to suit this aim.

It is evident that a complete manufacturing ecosystem presents significant logistical challenges from acquisition of raw material to deployment of the finished product. This paper proposes best practice approaches to on-orbit manufacture, and presents an analysis of advantages and limitations between difference on-orbit manufacturing paradigms. Finally, this paper outlines a satellite constellation based approach to orbital manufacturing, and highlights how distributing the tasks and manufacturing capabilities between multiple satellites within the constellation can provide support to all areas of an orbital manufacturing ecosystem.