

ORBITAL DEMONSTRATION OF INDUSTRY FOR IN-ORBIT SERVICE AND MANUFACTURING

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ABSTRACT

During our SPINternship, we developed a plan to facilitate manufacturing in orbit for UK companies including: a business strategy, concept design and technical requirements. A LEO station will be established providing the necessary electrical and computing power for In-Orbit Manufacturing with standardised docking points so further modules can be added.

BENEFITS OF MANUFACTURING IN SPACE

- Microgravity
- Vacuum
- Temperature gradient
- In-Situ Resource Utilisation
- Economic Motivator to accelerate space exploration
- Lower dependence on launch constraints
- Assembly and construction of unprecedented spaced structures
- Debris removal - using space sustainably

POSSIBLE PARTNERSHIPS

- UKSA
- ESA
- Innovate UK
- D-Orbit
- LMO
- Astroscale
- Orbex
- MTC
- Know.Space
- HVMC
- AIG Insurance
- Alden Legal
- Momentus
- Space Forge

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WHAT IS IOSM?

There are multiple aspects to In-Orbit Service and Manufacturing (IOSM). Manufacturing can be undertaken for Earth applications for products such as fibre optics, ceramic turbines, pharmaceuticals and metallic alloys or space - antennas and semiconductor materials for solar panels. All benefit from being manufactured in the space environment.

In-Orbit servicing is, as the name suggests, also a part of IOSM. This can include the servicing of existing satellites to extend their lifetime, using methods like refuelling or recharging. Debris removal is also a key element of in-Orbit servicing.

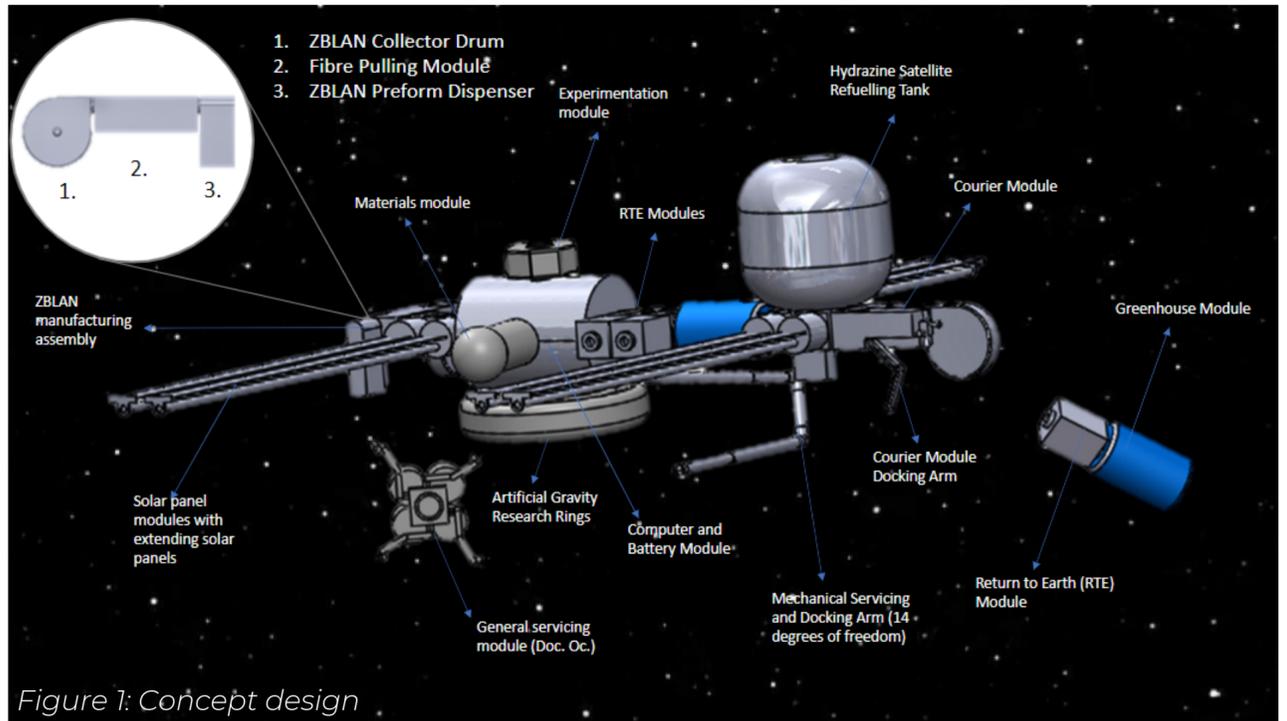


Figure 1: Concept design

WHAT IS THE PROBLEM?

The UK Platform for Growth Report concluded that IOSM is a potentially massive emerging market. The report predicted in-orbit manufacturing alone to be worth £70 m - £1.43 bn p.a. by 2028. Currently, in-orbit servicing and manufacturing are activities undertaken by a very small number of companies, mainly residing in the US. These companies are funded and supported by NASA and are given an extremely limited place on the ISS to carry out their manufacturing. Therefore, companies that lack funding or space industry experience are unable to manufacture in orbit, and the UK are severely lagging behind.

OUR PLAN

Our plan - to establish an autonomous, modular, self-servicing station in Low Earth orbit that will have the capability to safely manufacture products to either use in space or return back to Earth. The first module launched, the solar panel power module, will have its' support 3D

printed in orbit with the panels rolled-up, during launch, into a scroll to minimise space. This launch will be followed by the ZBLAN fibre optic manufacturing module. Each stage will act as a proof of concept to assess the feasibility of further modules, that will be eventually added. By making the station autonomous size is reduced and any risk of human error, during the manufacturing process, is eliminated, as well as mitigating danger to human life. The modular design of the station has several advantages. Firstly, the size of the station will not be limited by launch capabilities as small modules will be launched and then assembled in orbit. Secondly, if a part of the station is damaged or no longer necessary it can be replaced or removed without having to decommission the entire station. Finally, if a new station capability is desired a module can be designed and retrofitted. In addition, by making the station self-servicing it will not be dependent on other external factors. Operating procedures have also been outlined, in our full report, for manufacturing, return to earth, re-supply, servicing, refuelling, docking and debris avoidance.

This plan proposes to create a programme that will enable UK individuals and businesses, with ideas relating to IOSM, to develop, launch and test their concepts. This programme will function similarly to Catapult's Access to Space programme, where a slot on the station will be advertised.

WHAT WILL THIS ACHIEVE?

- Boost the UK economy
- Help the UK claim a bigger stake in the global space economy ensuring we don't get left behind
- Make space more accesible to companies from a variety of sectors

TIMELINE

