ASTEROID MINING

AstroForge, Karman+

1: Launch / Re-supply

Equipment launched from Earth. Raw materials & consumables from:

- 1) Earth
- 2) recycling
- 3) Moon
- 4) asteroids

SPACE RESOURCES TRANSPORTATION

Momentus, TransAstra, Orbit Fab, Lunasa, Impulse, Atomos, Astroscale, Coactum, ClearSpace, D-Orbit, Exotrail

SPACE DEBRIS RECYCLING

Redwire, CisLunar Industries, Orbit Recycling

RE-SUPPLY VECHICLES (2-WAY)

Dragon, Starship, Starliner, Dream Chaser, Sojuz, RFA

RE-SUPPLY VECHICLES (1-WAY)

Cygnus, Progress, HTV, Tianzhou

Path 1: Space Stations ISM Services

1) Launch orbital factory to the ISS or commercial station. As preparation or equipment together with supplies. 1a) Resupply raw materials & consumables (optional). 2) Use the automated space factory and help from (commercial) astronauts to manufacture the goods. 3) Use (the same) re-entry vehicles to return the products.

Path 2: Dedicated Free-Flyers

1) Launch (reusable) spacecraft (e.g. Cargo Dragon) raw materials, consumables and fully automated manufacturing apparatus included.

2) Use the free-flying spacecraft as factory in space. 3) Enter atmosphere and retrieve the (reusable) vehicle.

*The lists of example companies are not exhaustive

In-Space Manufacturing

2: On-Orbit Manufacturing

Using microgravity to make new products and materials, on or nearby multi-use or dedicated: 1) space stations (robotic or crewed) 2) free-flying spacecraft

SPACE STATIONS

ISS, Gateway, Tiangong

COMMERCIAL SPACE STATIONS /

Axiom, Nanoracks, Orbital Reef, Starlab, Gravitics, VAST

DEDICATED FREE-FLYERS

SpaceX, Space Tango, Space Forge, Varda, Space Rider, Sierra Space, The Exploration Company

V-TP-



MICROGRAVITY ACCESS SERVICES

Nanoracks, Ice Cubes, Bartolomeo, Space Tango, Yuri, Space Cargo

IN-SPACE MANUFACTURING

Redwire, FOMS, Flawless Photonics, Nanoracks, Apsidal, BioOrbit, Varda, LambdaVision, Maana Electric



IN-SPACE ASSEMBLY & CONSTRUCTION

Redwire, Arkisys, Above Space, Astroport, ThinkOrbital, Space Applications, Rovial, ICON, ArcSpace, Orbital Matter, GITAI



Spaceships

3: Use in Orbit / Re-Entry

1) Large-scale space structures, space solar power stations, space food etc will remain for use in space.

2) Re-entry capable vehicles to bring samples and products to Earth, which will likely be the largest market for many materials.



tode in Space

LARGE SPACE STRUCTURES

SPACE FOOD

Nanoracks, Starlab Oasis, Sierra Space, Interstellar Lab

RE-ENTRY SPACECRAFT & CAPSULES

Varda, Space Forge, In Orbit, Outpost, The Exploration Company, A-SpaX, ATMOS Space Cargo, ElevationSpace, Inversion

Space Station > Free-Flyer

- Recurring Dragon, Starliner, Starship etc flights.
- Extra 1-2 months is a small difference for near-future.
- Product quantinities likely small for the short term.
- Multi-use and more consumables due to resupply.
- More power, faster communications, mission control.
- Vehicle retrival (tracking, legal, transport) handled.
- Lower costs all around to help with ISM economics.

Free-Flyer > Space Station

- Reusable satellites or dedicated vehicles are flexible.
- Independence when aiming for vertical integration.
- Full use of payload capacity and 100% automation.

factoriesinspace.com Erik Kulu, 2024-04-01