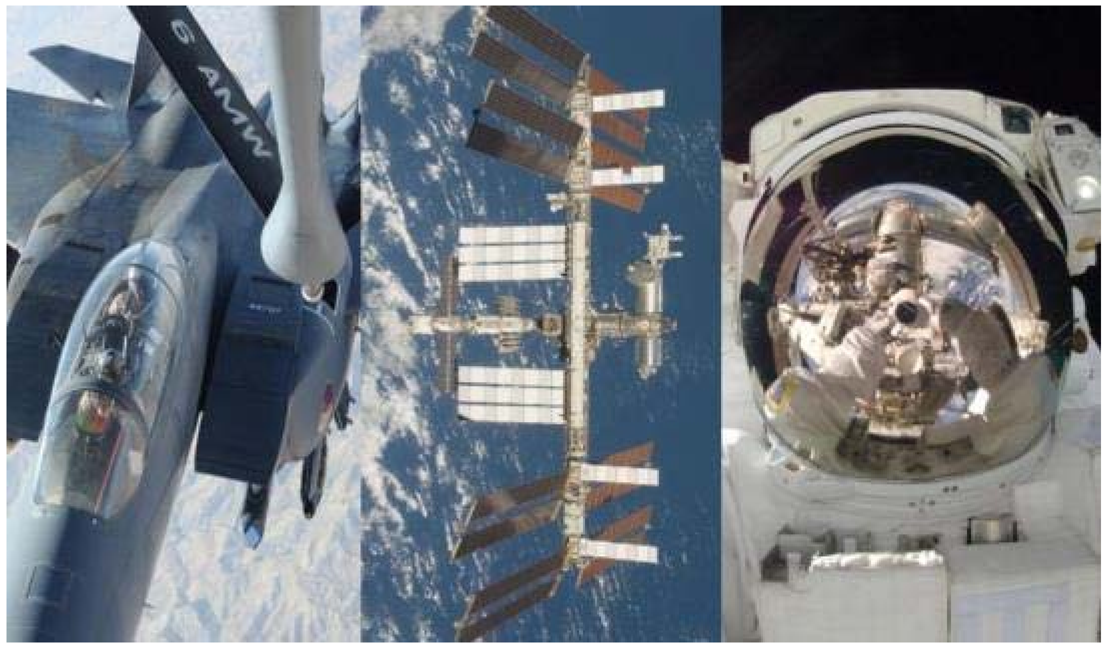
ZIN Technologies

Enabling ISS Commercial Utilization



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What impedes ISS/LEO commercial utilization?

- From the vantage point of an potential user seeking to utilize the unique environment of LEO but with no experience or NASA contacts
  - Good information exists but not complete and difficult to put into an operational or technical context (confusing)
    - Facilities, Capabilities, Concept of Operational Research and Investigations, Costs, Schedule
    - Wide spread lack of gravity dependent knowledge of industrial processes and material development
  - Difficult to understand what organization or entity is Point of Entry
  - Not widely known that ISS is designated as a U.S. National Laboratory
  - Not widely known that CASIS is entity that manages the ISS National Laboratory Assets
  - ISS National Laboratory is not managed quite like other national laboratory assets with "Institutionalized" support or detailed facility capability knowledge offered

Toward a Commercial Process

to utilize the unique properties of space

ZIN TECHNOLOGIES

ZIN has designed, fabricated and operated over **200 man-rated space flight payloads with thousands of hours of space flight operations** logged on the shuttle, MIR, and ISS (inclusive of both NASA and CASIS commercial payloads).

A potential space customer finds many barriers today

- Lack of technical information tailored to my needs
- No clear information on costs and schedule
- Difficulties in understanding available facilities and options
- Hard to find, conflicting information on requirements for publicity, publication of results, background or generated intellectual property, international crew involvement, and many other questions

What other government user facilities make easy to find

- Step by step user guide
- Searchable details on previous public research
- Descriptions of detailed available capabilities tailored to user
- Directory of integration partners that can be searched, sorted, and compared
- User discussion forums
- Sample agreement language

ZIN has developed and operated 75% of all physical science research since 2001. Between ISS increment 30 and 37 the ZIN payloads have accounted for the development and operations of 80% of all physical science research on ISS and customer for ISS Glovebox, ExPRESS, Maintenance Work Area, Fluids Integrated Rack, Combustion Integrated Rack and ExPRESS Logistics Carrier.

How are other unique National Laboratory Assets operated?

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Cooperative Steward-Partnership Model (partners are within participating and collaborative research groups represented by Gov., Academia and Industry) – Stewards of various facilities – DOE, NSF, NIST etc.

- Synchrotron Radiation Facilities, Strategic Neutron Source, High Magnetic Field Facilities (DOE, DOC, NSF) – various facilities*
- National Transportation Research Center (DOE,DOT)
- Bioproducts, Sciences, and Engineering Laboratory (BSEL) at the Pacific Northwest National Laboratory (DOE)
- Applied Process Engineering Laboratory (APEL) at the Pacific Northwest National Laboratory(DOE)

Need to develop ISS/LEO user community – current community contracted a few years ago and current community represented by mix of NASA exploration technology road map investigators and fundamental investigators

- How to expand use current user base outside of NASA?
    - Need to seed/invest in Defense-Industrial community
    - Engage other user/partner research working groups within Defense-Industrial community
    - Develop/expand evidence base specific to markets (biotech, life science, remote sensing/imaging, materials..)

* - Stanford National Accelerator Laboratory (SLAC) at Stanford University, Advanced Photon Source (APS) at the Argonne National Laboratory – partial list

Examples of Current User Community - GRC

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Experiment Name	Applications	Industry
Capillary Flow Experiment	Efficient liquid management in spacecraft; passive phase separation	Computers, bio-tech, spaceflight
Cool Flames Investigation	HCCI engines, combustion engine efficiency	Engine manufacturers
Investigating the Structure of Paramagnetic Aggregates from Colloidal Emulsions	Enable smart fluids technologies	Construction, robotics devices, bio-medical, automotive
Constrained Vapor Bubble	Wickless heat pipe design; advanced heat transfer technology	Computers, electronics, spacecraft
Burning And Suppression of Solids	Spacecraft fire safety	Space vehicles
Flame Extinguishment Experiments	Increased understanding of combustion in engines	Engine manufacturers
Advanced Colloids Experiment and Binary Colloidal Alloy Tests	Consumer product improvement for multi-billion dollar industry	Consumer products (soap, cosmetics, foods), bio-medical
Coarsening of Solid-Liquid Mixtures	Algorithms for metallic alloy design	Metallic alloys manufacturing
IntraVenous fluid GENeration for exploration	Convert potable water to sterile IV fluids using portable self-contained system	Bio-medical
Glenn exercise harness	Enables and improves on-orbit exercise capabilities	Exercise industry
Space Communications and Navigation Testbed	Advances communications technologies	Communications
Materials International Space Station Experiment	Improves surface treatments for space components	Spacecraft

How to increase collaboration (interagency, Academic and industry users)?

- User Academic, Interagency and industry working groups need to be established
- Interagency dialogue – Steward (NASA) Partners – NASA, DOE, DOD, Industry working groups
- Potential Users exist in other programs that could benefit from experimental work in LEO – currently no connection or mention possible use of ISS National Laboratory Assets
  - A2P Program evaluating micro-assembly technologies bridging "assembly gap" between atomic placement and traditional manuf. (DARPA)
  - Refinement of Rare Earth Minerals - develop new rare-earth substitutes for critical industrial uses (e.g., phosphors, permanent magnets, lasers, advanced batteries) (DOE – Critical Materials Inst.)

Toward a Commercial Process - Partnership

minimize barriers to efficient use of ISS

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Historical ISS Utilization
"space experiment"

Driven by science requirements
- NASA Peer Reviewed Science
- Science objectives are negotiated to benefit many potential interests

Driven by risk aversion and rigid ISS process
- Multiple requirements documents and review templates for all payload types
- > 6 year timeline – rigid verification
- < 80% COTS – custom hardware
- Multiple verification and safety product submissions

Driven by Operational constraints
- Crew time, training, downlink, up mass , down mass and NASA defined priorities.

Driven by mostly academic user participation
- Low TRL towards a future demonstration

Commercial Utilization
"product or process development/ improvement"

Driven by Return on Investment
- Value creation – Intellectual property
- COTS - Commercial Product/Process Improvements

Driven by Efficiency
- Fast track integration; Common interface usage; Simplified operations planning; One stop integrated transport/operations certification
- < 1 year timeline – with more frequent cycles
- > 80% COTS, using common hardware/interfaces
- Often re-purposes existing support hardware to reduce cost and schedule

Driven by Access
- Launch, operations, timely return
- < 1 year timeline
- Collaboration, use of upgraded capabilities , effective process, automation, automated operations

Driven by Market Success
- Successful outcomes provide evidence to gain other customers