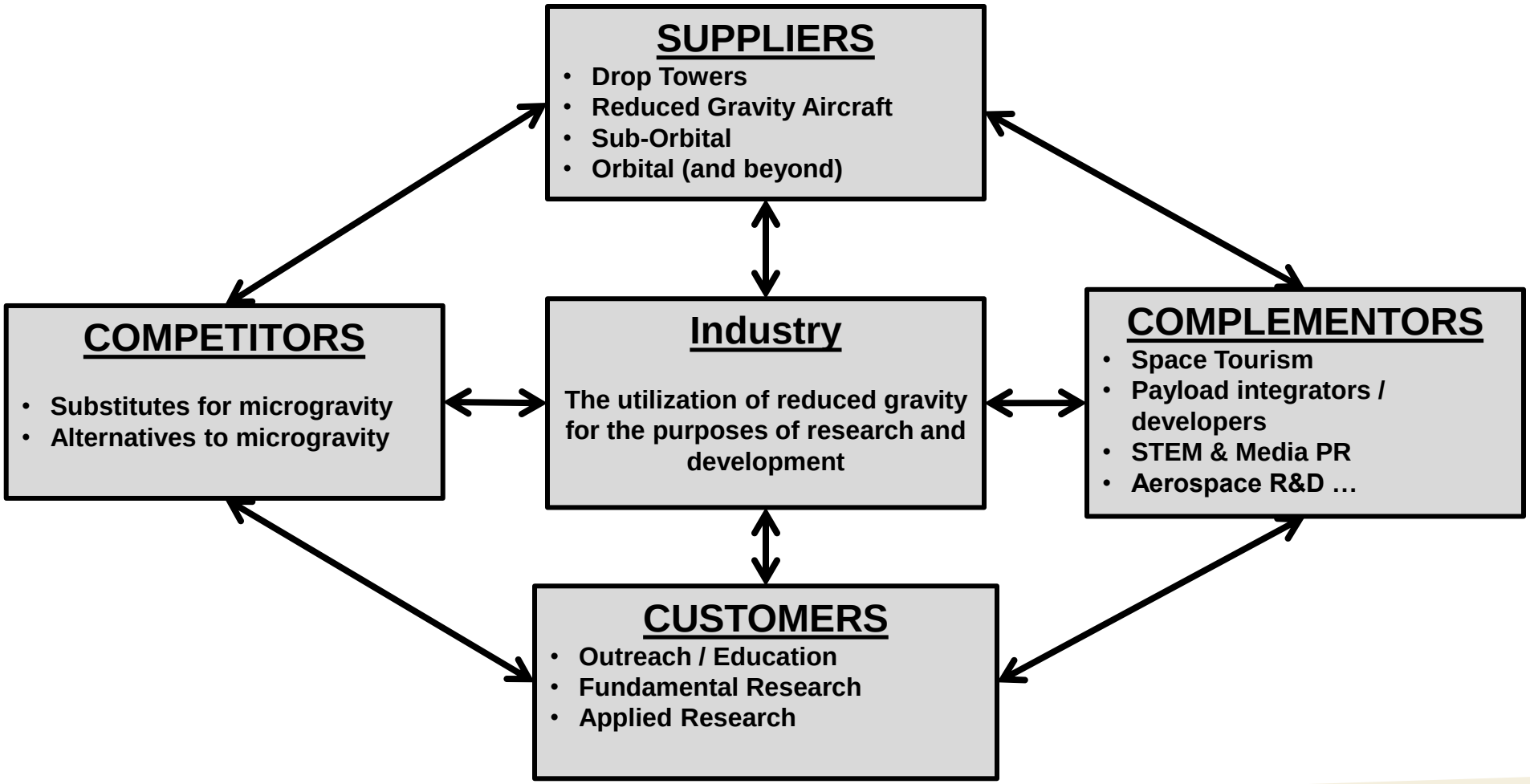
ESIL-04
Out-brief

Objectives

- Review industry status and trends
- Apply the PARTS market model to the microgravity utilization market
- Identify potential growth strategies

Value Net


SUPPLIERS
• Drop Towers
• Reduced Gravity Aircraft
• Sub-Orbital
• Orbital (and beyond)
COMPETITORS
• Substitutes for microgravity
• Alternatives to microgravity
Industry
The utilization of reduced gravity for the purposes of research and development
COMPLEMENTORS
• Space Tourism
• Payload integrators / developers
• STEM & Media PR
• Aerospace R&D …
CUSTOMERS
• Outreach / Education
• Fundamental Research
• Applied Research

Statement of industry

- Reduced gravity utilization for the purposes of research and development
  - Spaceflight tourism is complementary to this field
  - Other benefits of specific providers compliment this industry acknowledged

Suppliers

- Drop towers
  - NASA/Other governmental agencies and universities
- Reduced gravity aircraft
- Sub-orbital flights
  - Sounding Rockets
  - Reusable Launch Vehicles
    - Crewed/uncrewed
  - High Altitude Balloons
- Orbital (To LEO and beyond)
  - Greater than or equal to energy (relative to earth) for LEO
  - Escape/interplanetary/planetary(Lunar/Martian)

Competitors

- Replacement/substitute for reduced gravity
  - Diamagnetic levitation
  - Neutral buoyancy
  - Computer simulations
  - Bioreactors, etc.
  - Bed rest
- Doing something else to achieve the same ends (in research)
  - For example: genome research

Complementors

- Space participation/tourism
- Scientific Technologies
  - Bio reactors
  - Centrifuges
- Other uses for the environment of space
  - High altitude / vacuum / Etc.
- Payload developers/integrators/go-betweens
- Media PR / STEM education
- Aerospace Industry R&D

Customers

- Outreach
  - Education
- Fundamental Research
  - Testing hypothesis
- Applied Research
  - Tech development
  - Product development
  - Simulation validation

Government

- Cross cutting through the entire value net
  - Supplier of several platforms
  - Funding competing technologies
  - Customer of science and tech demos
  - Complements industry with funding and receives value from economic growth, international prestige
- Major financial contributor to the sector
- Regulatory “Rule” making body
  - NASA, FAA and equivalent entities

Added Value

- New Tech / Risk Reduction
  - Increase / Accelerating TRL
- New Products
  - Protein Crystal Development (i.e., drugs)
- New Processes
  - Manufacturing / Material Studies, (i.e., 3D printing)
- Capability to discover new phenomena
  - Bacterial virulence / multiphase fluid flow / non-convection env.
- Investigate known phenomena in a novel environment
  - Bacterial resistance to antibiotics, gene expression
- Tool for Industrial Innovation
  - Economic Growth

Rules

- Government
  - FAA / International (as it relates to the vehicle)
  - IP regulation and export controls
- Supplier
  - Payload users guide (restrictions / requirements / capabilities)
  - Safety and payload assurance (payload / people / vehicle)
  - Protection of sensitive technologies
- Customer
  - Accountability, quality of product, service and credibility of supplier
- Legalities (Law, Contracting, Insurance)

Perceptions

- Unreliable schedule and performance claims
- Usefulness of microgravity is not well understood
  - Gravity is a constant that cannot be changed
  - Space industry terminology does not translate to other industries:
    - *"Sub-orbital", "Parabolic Flight",* "*Microgravity*", and acronyms
  - Microgravity means: "*going to space*"
  - Space is hard & complex, (rocket science mentality)
- High risk (safety, schedule and cost)
  - One opportunity to fly

Tactics

- Do outreach as an industry, instead of as individual sectors
  - Leverage existing capabilities to promote emerging ones (i.e., test with parabolic flight prior to ISS campaign)
- Cooperate to perform fundamental research to enable future reduced gravity focal directions
- Develop payload technologies to enable basic reduced gravity research
  - Standardization, modularization (i.e., cubesat format, plug-and-play)
- Improve transparency
  - Schedule, complexity of hardware and cost
- Have competition at each level (with multiple providers)

Scope

- Reduced gravity utilization for the purposes of research and development
  - Government
  - Academia
  - Industry