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Commercial Sector Perspective

***On-Orbit Servicing (OOS) & Active Debris Removal (ADR):
Opportunities and Challenges for the Space Sector***
20 February 2013 - Singapore

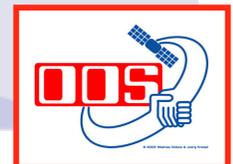
by

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“On-Orbit Servicing” (OOS)

- **OOS Is NOT an End Itself**
- **OOS ≠ Only One Solution**
- **Too Early to Judge**

Definitions, Nomenclature & Branding?

“Space-to-Space”

New Partnerships “S2S”

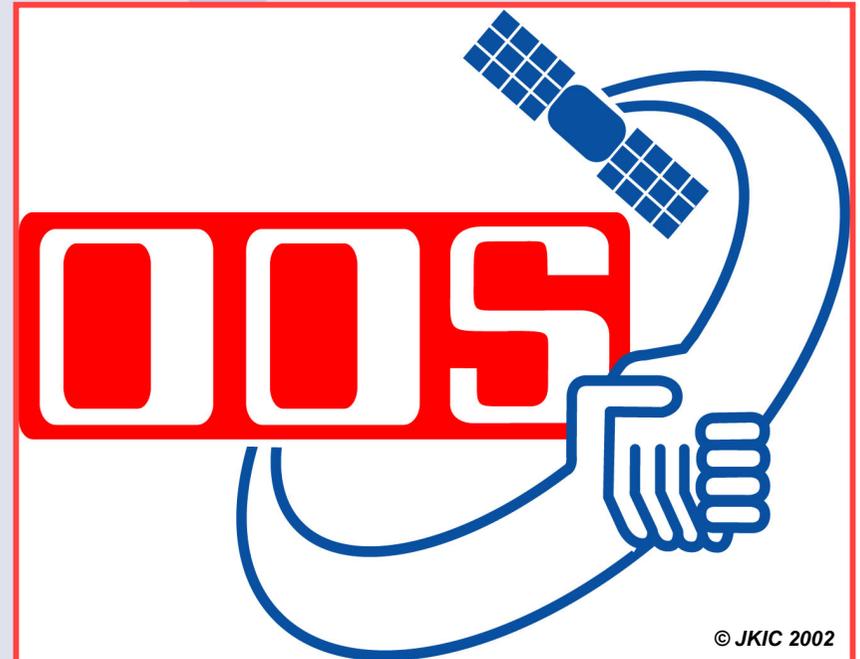
▪ What for?

- Fix Problems**
- Upgrade Systems**
- Increase Mission Flexibility**
- Enable for Entirely New Missions**

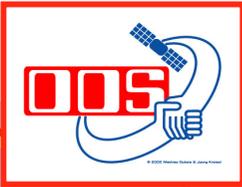
On-Orbit Assembly (OOA)

Active Debris Removal (ADR)

On-Orbit Manufacturing (OOM)



It's Not the “Space” Technology! – BUT Real World Drivers!



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The "OOS Eco-System"

Environment

- Political
- Legal
- Regulatory
- ...

In-Orbit Infrastructure

- A&R
- IP
- Wireless
- Nano
- ...

Business & Economics

- Value Proposition
- Business Model
- Partnerships
- Jurisdictions
- Risk Management
- Finance

Services, etc.

Mission Architecture & Logistics

- ASDR
- OOS
- OOA
- ...

G/S

A System & "Business Engineering" Challenge

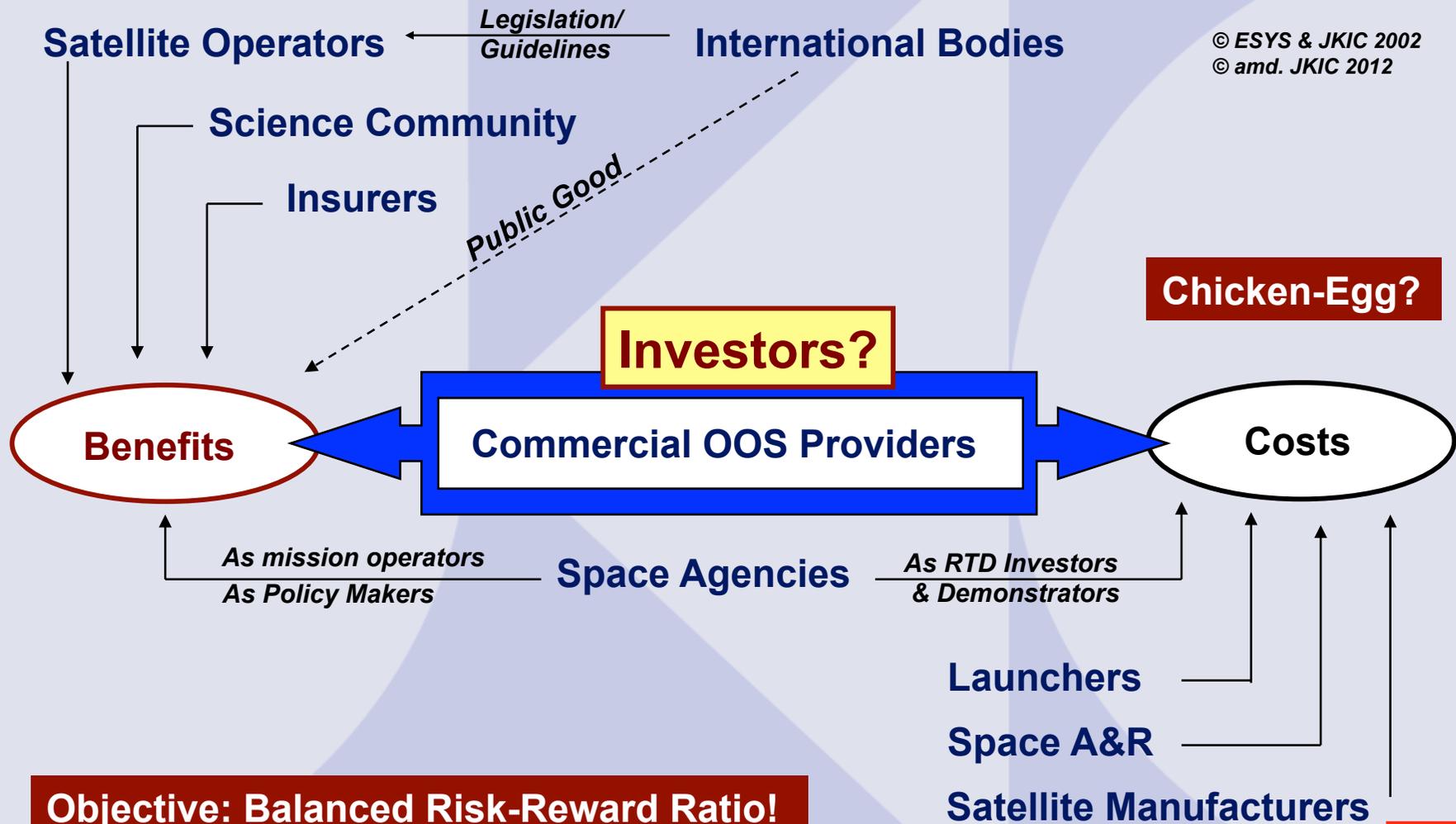


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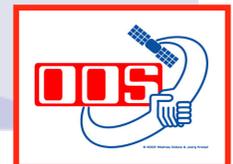
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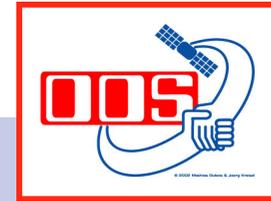
OOS Stakeholders



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OOS Stakeholder Benefits (Simplified)



**YES + NO
Camps!**

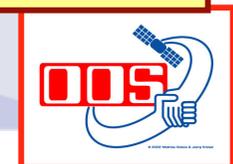
Commercial Satellite Operators	<ul style="list-style-type: none"> • Profit (Revenues!) – Seamlessness • Deferred CAPEX
Insurance Companies	<ul style="list-style-type: none"> • Risk Reduction • Premium Policy & Market
Satellite Manufacturers	<ul style="list-style-type: none"> • Design Feedback • Servicer Production/Economy of Scale • Co-Operative Satellite Design
Space Agencies	<ul style="list-style-type: none"> • Demonstration in Space • Space Infrastructure Development • Commercialization
Governments	<ul style="list-style-type: none"> • Knowledge Base • Budget Efficiency & Economic Growth
Science Community	<ul style="list-style-type: none"> • Safeguarding Projects
Launch Service Providers	<ul style="list-style-type: none"> • No. & Frequency of Launches
Space A&R Community	<ul style="list-style-type: none"> • Various
Intl. & Regulatory Bodies	<ul style="list-style-type: none"> • Debris, Orbital Clean-Up, Frequency
Suppliers	<ul style="list-style-type: none"> • Innovation & Standardization • Economy of Scale

Hard Factors

- Market
- Budget/Profit
- Cost-Benefit
- Structures
- Processes
- Technology
- Demonstration

Soft Factors

- Culture
- Mindset
- Psychology



Trust Building: "Realism vs. Dreams"



New Aircraft

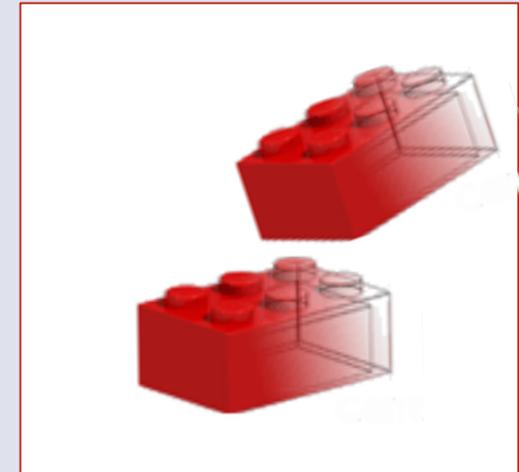


Mars Landing

Investors: "Often Just 2 Good 2B True!"

Thriving Questions

- **What Drives Industry the Most?**
 - OOS/ADR Service Providers & Suppliers
 - Customers
- **When Will Any OOS Happen for the 1st Time?**
- **What Do Governments Need to Do?**
- **Which Are Winning Business Models?**
- **What Will Have to Happen Next?**
- **Where Will We Stand**
 - In 5 Years from Now?
 - In 10 Years from Now?
 - By 2030 & Beyond?
- **What Would Be THE Horror Scenario?**



Industry in the Driving Seat?