On-Orbit Servicing and Space Insurance

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AXA XL Space Team Principles

Six underwriters, three offices, one team

- We embrace risk
- We pay claims expeditiously
- We innovate to adapt to the changing space market
- We share ideas with industry to foster growth, safety, and mission success
## Space Insurance Coverages

### By mission phase

<table>
<thead>
<tr>
<th>Phase →</th>
<th>Pre-Launch</th>
<th>Launch and In-Orbit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Integration &amp; Test</td>
<td>Launch Vehicle Flight</td>
</tr>
<tr>
<td></td>
<td>Transit to Launch Site</td>
<td>Initial Operations</td>
</tr>
<tr>
<td></td>
<td>Launch Site Processing</td>
<td>In-Orbit Operations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Re-Entry</td>
</tr>
</tbody>
</table>

### Insured ↓

<table>
<thead>
<tr>
<th>Satellite Owner / Operator</th>
<th>Satellite Manufacturer</th>
<th>Launch Services Provider</th>
<th>Satellite User</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contingent Business Interruption</td>
<td>Marine Cargo (Transit &amp; Pre-Ignition)</td>
<td>Marine Cargo (Transit &amp; Pre-Ignition)</td>
<td>Contingent Business Interruption</td>
</tr>
<tr>
<td>In-Orbit</td>
<td>In-Orbit</td>
<td>Launch Liability</td>
<td>In-Orbit</td>
</tr>
<tr>
<td>Re-entry / Recovery</td>
<td>In-Orbit Liability</td>
<td>Re-Entry Liability</td>
<td></td>
</tr>
</tbody>
</table>

### Other Coverages:
- Political risk (e.g., export license rescission), credit risk (e.g., insolvency), contingent risk (e.g., launch delay), human spaceflight (e.g., A&H), ...

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**AXA XL Seamless Coverage**
What Is Space Insurance?

➔ Space insurance...
  ➔ ...includes virtually all technical risk from launch onwards
  ➔ ...covers all risks, with few exclusions
  ➔ ...is the third largest program cost
  ➔ ...represents 0.02% of global insurance premiums

➔ Challenges
  ➔ Actuarial: small population = large variance, low frequency + high severity = volatility, large range of values
  ➔ Market: short tail, high cash flow, uncorrelated risks, low cost of entry, overcapacity / soft insurance market
### Incumbent Space → Entrepreneurial Space

A reality check

<table>
<thead>
<tr>
<th>Issue</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>New technologies and applications</td>
<td>Complexity and diversity of risks</td>
</tr>
<tr>
<td>New launch vehicles</td>
<td>Higher failure rates</td>
</tr>
<tr>
<td>Smaller satellites</td>
<td>Less redundancy and testing</td>
</tr>
<tr>
<td>Large constellations</td>
<td>Generic anomalies</td>
</tr>
<tr>
<td>Legal, regulatory, geopolitical</td>
<td>Market and investor uncertainty</td>
</tr>
<tr>
<td>Supply chain stress</td>
<td>Program delays</td>
</tr>
<tr>
<td>Massive magnitude of investment</td>
<td>Long timelines</td>
</tr>
</tbody>
</table>
### On-Orbit Servicing Following Anomalies

GEO satellites launched since 2000 - average opportunities per year

<table>
<thead>
<tr>
<th>Type of Servicing</th>
<th>Launch Anomaly</th>
<th>Satellite Anomaly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-Orbit / De-Orbit</td>
<td>0.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Life Extension</td>
<td>--</td>
<td>2.7</td>
</tr>
<tr>
<td>Inspection / Repair</td>
<td>--</td>
<td>3.3</td>
</tr>
</tbody>
</table>
On-Orbit Servicing
Insurance considerations

Servicer satellite

Third party satellites

Client satellite

Insurance coverages:
- Physical damage
- Mission success
- Business interruption
- Third party liability
- ...etc.
Legal and Regulatory Landscape

Who’s doing what?

30+ organizations developing efforts on responsible space activity

- International: CCSDS, ECSS, IADC, IISL, ISO, IUAI, UNOOSA / COPUOS, WEF...
- Space Agencies: CNES, DLR, ESA, JAXA, NASA, UKSA...
- Co-operation, competition, conflict resolution...

Best practices

- Anomaly response: reporting, attribution, RCCA data sharing / clearinghouse...
- Conops: deorbit / reorbit plan (contingency and EoL), interference, RPO...
- On-orbit servicing: assembly, inspection, refueling, reorbit / deorbit, repair...
- SSA and STM services: AGI / ComSPOC, ExoAnalytics, LeoLabs, SDA...
- Technologies: beacons, “bottle law”, fiducials, grapple fixtures, OBDII / USB, retroreflectors, RFID tags...

Regulatory authority vs. burden

- Regulation vs. standards vs. best practices

Incentives for responsible behavior

- Insurance discounts? Expedited licensing? Who’s responsible to monitor?
Summary

- Space insurance is an enabler of innovation and investment.
- Competitive, volatile space industry and insurance market demand diligence.
- New applications and technologies – and emerging risks and hazards – stress the space industry.
- Let’s learn, educate, and collaborate to address the complex and dynamic space industry.