

October 1, 2004

2004 OOS Workshop

On Orbit Servicing from an Insurance Standpoint



Tokio Marine & Nichido Fire Insurance Co., Ltd.
Space Risks Division, Aerospace Department
Masahiro Koike

2

Areas of Analysis

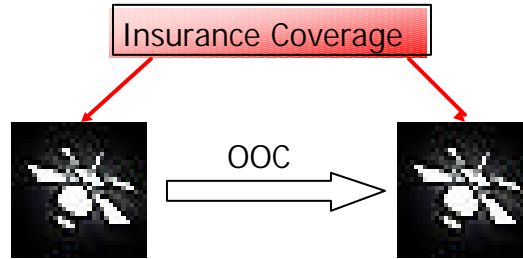


- On Orbit Construction / Maintenance / Rescue / Life
Extension ("OOC")

3 Insurance Industry's Potential Involvement



- Providing Insurance for Construction / Maintenance / Recovery / Life Extension (OOC) process

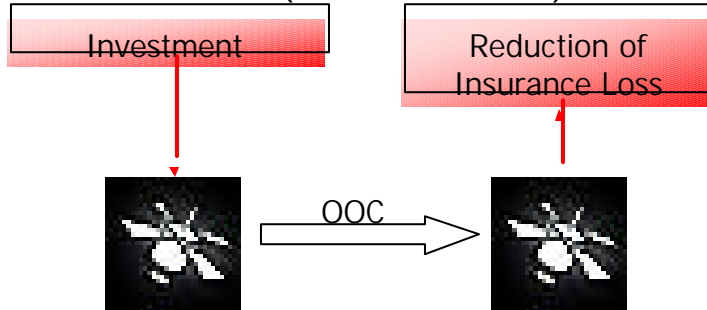


@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

4 Insurance Industry's Potential Involvement



- Investment in OOC (Individual Satellite)

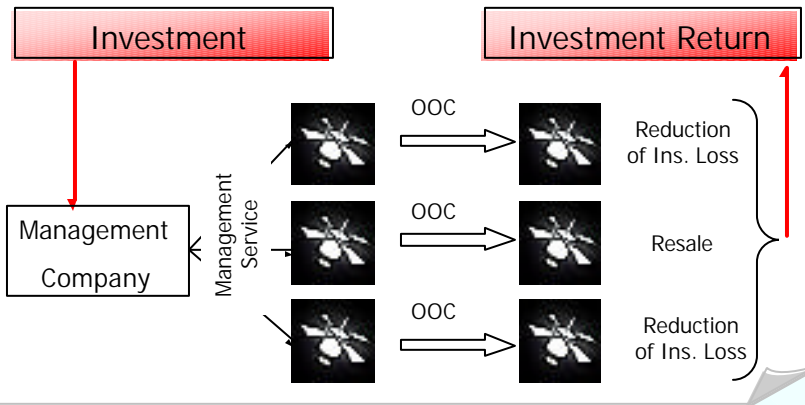


@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

5 Insurance Industry's Potential Involvement



- Investment in OOC (entire project)

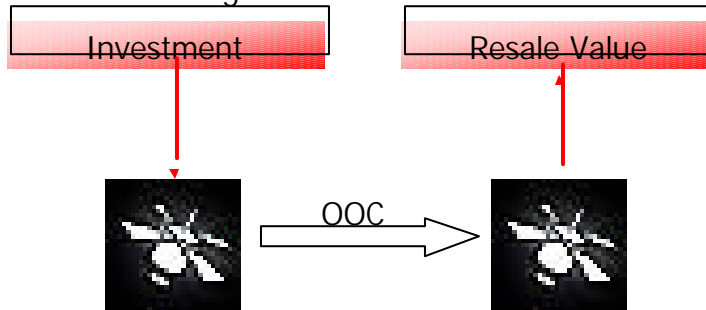


@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

6 Insurance Industry's Potential Involvement



- Resale of Subrogated Satellites



@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

7

Theoretical Evaluation - Insurance for Satellites not subject to OOC



- "Insured Value" x "Probability of damage to Satellite w/o Insurance Loss due to OOC" = a
- $a > 0$, therefore Insurance Industry will increase premium rates for Satellite Insurance (for satellites not subject to OOC)

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

8

Theoretical Evaluation - Insurance Coverage for OOC activities



- "Premium" - ("Insured Value" x "Probability of OOC Failure") = β
- If $\beta > 0$, Insurance Industry will accept
- (This applies to Insurance for Satellites performing OOC and Satellites subject to OOC.)

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

9

Theoretical Evaluation - Investment in OOC for individual satellite



- ("Reduced Insurance Loss" x "Probability of Satellite Enhancement") - "Cost of OOC" = ?
- **If ? > 0, Insurance Industry will invest**

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

10

Theoretical Evaluation - Investment in entire OOC project



- "Investment Return" (Reduction of Insurance Loss / Resale Value etc.) - "Investment Amount" = **d**
- **If d > 0, Insurance Industry will invest**

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

11

Theoretical Evaluation - Resale of Subrogated Satellites



- ("Resale Value" x "Probability of Satellite Enhancement") - "Cost of OOC etc." = e
- **If $e > 0$, Insurance Industry will invest**

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

12

Practical Points to Consider - Insurance for Satellites not subject to OOC



- How can "Probability of damage to Satellite not subject to OOC" be evaluated / calculated?
 - ? Satellites located afar from OOC operation will most likely not be charged any additional premium.
 - ? Satellites located close to OOC operations may suffer → Who will bear this increase?

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

13

Practical Points to Consider - Insurance Coverage for OOC activities (1)



- How can "Probability of OOC Failure" be evaluated / calculated?
 - ? Insurance Industry cannot accept unproven technology.
 - ? If calculation proves to be impossible / insufficient, Insurance Cover will not be provided.
 - ? Man Mission (Nov. 1984 : Rescue of Westar / Palapa by NASA (Astronauts Dale Gardner / Anna Fisher)) vs. Machine Mission
 - ? How many missions are necessary to attain "proven technology" status?

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

14

Practical Points to Consider - Insurance Coverage for OOC activities (2)



- How can "OOO success" be defined?
 - ? Definitions need to be predetermined (→ What if "fuel injection" is successful but satellite fails to function as planned?)
 - ? Damage to third party property is not within scope of current satellite insurance (→ No predetermined set of clauses to refer)

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

15

Practical Points to Consider - Insurance Coverage for OOC activities (3)



- Status quo of satellite insurance industry
 - ? Hard market (i.e. insurance is expensive)
 - ? Enough Demand to construct a balanced portfolio?

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

16

Practical Points to Consider - Investment in OOC for individual satellite



- How can "Probability of Satellite Enhancement" be evaluated / calculated?
- Potential conflict of interest between Insurance Industry / Satellite owners
 - ? If "Reduced Insurance Loss" (which will be refunded from Satellite owner to Insurance Industry) < Expected Profit from Satellite operation, what will happen?
- Cost comparison vs. backup satellite?
- Can Insurance Industry accommodate increase of maximum loss?

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

17

Practical Points to Consider - Investment in entire OOC project



- How can "Investment Return" be evaluated / calculated?
 - ? Is there enough demand to make this an attractive investment?
- What benefit will this bring in addition to "Investment Return" (e.g. Reduction of Insurance Loss)? (i.e. Any specific benefit to Insurance Industry?)

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

18

Practical Points to Consider - Resale of Subrogated Satellites



- How can "Probability of Satellite Enhancement" be evaluated / calculated?
- How can "enhancement" be proved to potential customers? (Will warranty be necessary?)
- Each satellite manufactured to meet owners / operators' specific needs ---- demand for repaired satellites?
- If demand (+), how can Insurance Industry access this?
- How large is the cost associated with resale activities?

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

19

Final Comments - Insurance Companies' Standpoint



- How can "risk" be evaluated / calculated?
 - ? Government involvement / funding necessary, at least in the infant stage (and perhaps for a longer period).
- How large is the demand for OOC?
- Any hidden lines of interest (e.g. advertisement / social responsibility)?

@October 1, 2004 / Copyright : Tokio Marine & Nichido Fire Insurance Co., Ltd.

THE END



*Tokio Marine & Nichido Fire Insurance Co., Ltd.
Space Risks Division, Aerospace Department*