Performance Based Logistics: Incentive Contracting in Service Parts Supply Chains

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Our Project: F-35 Joint Strike Fighter (JSF)
PBL Supply Chain – Military Aircraft

**Customer (DoD)**

- **Prime (Lockheed Martin)**
  - Supplier 1
    - Avionic system (power on time)
  - Supplier 2
    - Engine (engine cycles)
  - Supplier n
    - Landing gear (landing gear cycles)

**Supply Chain management**

- LRU (e.g. circuit board)
- Piece parts

**Output allocation**

- Pricing based on usages, costs and availability

**Aggregated lower level performance measure**
Extant knowledge

Repair and maintenance contract
Elements of Incentive Contracting

- Decentralized decision making:
  - Suppliers invest into spare parts inventories and cost reduction to maximize their profits.
  - The Prime cannot observe/direct suppliers’ actions.
  - The Prime wishes to induce desired actions from suppliers using contracts.

- Uncertain outcome with respect to both total cost and up-time performance:
  - Suppliers may act opportunistically and get away with little effort.

- Contracting parties are averse to risk.
Incentive Alignment Model

Sequence of Events

1. There is a performance requirement (system availability) imposed on the Prime (LM) by DoD.
2. Prime determines performance (subsystem availability) requirements for each supplier.
3. Prime offers contract terms to each subsystem supplier.
4. Suppliers optimize their supply chains by investing in cost improvement effort and resources to support subsystem availability so as to maximize profit under offered contract.
5. Performance is revealed, payments are made, profit/losses are realized.
Incentive Contracting in Defense Procurement: Fixed Price vs. Cost Plus vs. PBL contracts

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<tbody>
<tr>
<td>Maximum risk on suppliers.</td>
<td>Risk is shared.</td>
<td>Moderate risk on suppliers.</td>
</tr>
<tr>
<td>Greatest incentives to reduce costs.</td>
<td>Least incentives to reduce costs.</td>
<td>Moderate incentives to reduce costs.</td>
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Insight #1: The optimal contract with suppliers

- **Fixed Payment**: To allocate profits
- **Cost Sharing**: To share risks
- **PBL**: To ensure performance
Insight #2: Different contracts for different products

- Smaller cost reduction incentive to supplier
- Better cost reduction incentive to supplier
- Better performance incentives
- Prime’s share of costs
- Cost uncertainty
- Cost reduction important
- Risk sharing important
- Better performance incentive
- Cost uncertainty

- Performance incentive important
- Cost reduction important

- Risk sharing important
<table>
<thead>
<tr>
<th>Product deployment</th>
<th>Small performance incentive</th>
<th>Product maturity</th>
<th>Large performance incentive</th>
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<tbody>
<tr>
<td>Limited cost sharing (Fixed Price)</td>
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<tr>
<td>Extensive cost sharing (Cost Plus)</td>
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Estimation using data for a fleet of military aircraft (156 jets)

- Aggregated parts into systems, estimated risk aversion, failure rates, costs etc. for avionics, engine, landing gear, mechanical and weapons systems of an aircraft.
- Calculated contract terms

Customer (DoD)

Prime

Avionic system

Engine

Weapons

Mechanical

Landing gear

<table>
<thead>
<tr>
<th>System</th>
<th>Percentage</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Avionic</td>
<td>96.46%</td>
<td>$18.8M</td>
</tr>
<tr>
<td>Engine</td>
<td>99.96%</td>
<td>$0.25M</td>
</tr>
<tr>
<td>Weapons</td>
<td>98.80%</td>
<td>$6.13M</td>
</tr>
<tr>
<td>Mechanical</td>
<td>99.91%</td>
<td>$0.81M</td>
</tr>
<tr>
<td>Landing gear</td>
<td>99.88%</td>
<td>$0.50M</td>
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Summary

• Created a model that can be used to evaluate contractual terms under PBL agreements.
• The optimal contract for suppliers is a combination of Cost Plus, Fixed Price and PBL.
• Performance incentives are stronger when cost uncertainty is small (end of life), cost sharing is stronger when cost uncertainty is high (beginning of life).

• Some opportunities:
  • Empirical data to validate findings.
  • Combination of multi-indentured multi-echelon model with the incentive-alignment model to create decision-support tool.
  • Effort to increase product reliability (long-term decisions)?