ProRail
The paradox of explicit Systems Engineering behaviour in contracts
July-2009
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- ProRail Infraprojects
- Decomposition
- Transparency
- Responsibilities
- Standardisation

4 paradoxes on the interaction between Systems Engineering, Contract and Behaviour
ProRail Infraprojects

- > 600 projects in parallel
- 1 – 1.5 billion € building costs/year
- 600 FTE

Business lines:
- Civil engineering works
- Mega projects & new railways
- Major renewals/maintenance
- Logistics, safety & environment
- Railway Stations
Systems Engineering

- Started April 2007
- SE training programme: 150 participants
- 20 Pilot projects
- Transition phase started May 2009:
  - pilots, “oil splash approach”
  - roll-out, top-down approach
- Support team: 5 FTE, 13 members
- SE Community of Practice: 388 unique visitors
- Co-operation programme among principals and suppliers
Analysis & design

Stakeholders

Client Requirements Specification (CRS)

System Requirements Specification (SRS)

Analysis

Design

Contract Specification (VS)

Offer

apportionment
ProRail

Decomposition increases complexity

- Function Breakdown Structure
- Requirements Breakdown Structure
- System Breakdown Structure
- Work Breakdown Structure
- Contract Breakdown Structure
- Bill of Materials
- Tree-thinking is not a replacement for common sense
- Global System Design and Contracting Plan should be aligned from the beginning
- Sub system & Aspect system design should be combined and require intelligent clustering
- Multi-view design
### Tunnel Delft

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Risk area</th>
<th>Design</th>
<th>V&amp;V Realisation</th>
<th>Testing</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
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ProRail - ambitions in railinfra /
Transparency & responsibility

- SMART specifications
- Hidden specifications, mandatory documents
- Meta specifications, covering risks
- Unknown specifications
- Making compromises
- Implicit expectations

- They probably look for additional work
- They don’t have a clue about the operational concept
- The supplier is responsible for integration
- The principal is responsible for integration
- SH!@!@@#!, rolling stock specifications are not yet known
- We freeze the design anyhow. Interfaces are not our problem
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<table>
<thead>
<tr>
<th>‘Req</th>
<th>Risk</th>
<th>Cause</th>
<th>Consequence</th>
<th>Mitigation</th>
<th>Score</th>
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<tbody>
<tr>
<td>SYB5</td>
<td>Maximum speed restricted to 114 km/hr</td>
<td>Soil conditions are not stable at GD MV</td>
<td>Redesign or adapt timetable</td>
<td>Detailed geo-technical investigation and design review</td>
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</table>

**Expected value**

- **Values x 10^-8**
- **Values in Millions**

<table>
<thead>
<tr>
<th>5.0%</th>
<th>8.6</th>
<th>38.6</th>
<th>90.0%</th>
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<td>90.0%</td>
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</tbody>
</table>

- **Expected value**
  - (Sim # 1)
Standardisation

- Bottom-up component level
- Lack of architectural model
- Suppliers products don’t match the ‘model’
- Threat for creativity
- Product level: e.g. noise screens y/n?
- Maintenance urge/legacy