Introducing Intuitive MBSE for the Ground Segment
Starting with the Euclid Mission

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Why?

- Complexity
- Flow of Information through mission phases
- Scattered Knowledge
- Domain-specific tools

- Paper Centric
What?

- Mange Complexity
- Collaborative
- Formal: engineering data with underlying data model and precise semantics
- Informal: model annotations, discussions

- Model Centric
• Change to BAU
• Risk: perceived as unnecessary risk
• “Big Bang” approach has failed in the past
• Formal Notations: SysML, BPMN, UPDM, etc
• Over-modelling Tendency
• Lack of guided methodology
• Must maintain formality and strong semantics
• Difficult: Extreme learning-curve
• Funding: New Tools, New Experts, ...
Solution?

- **Avoid Big Bang**
- Target low-hanging fruits
- **User-driven** development
- Pair modelling experts with end users
- Real use case: Euclid Mission
- Easy-to-use tool tailored to your needs
Our Tool: Paperless Ground Segment Engineering

- **ECSS standards**: systems, operations & software engineering, quality assurance

- **Configuration control**: support to multiple design baselines and review milestones

- **Document generation**: support transition phase, generated directly from the model

- **Integrated**: Interfaces with existing Software Development Environment tools
Data Model (under iteration)

Core Engineering Data Items:
- Components
- Requirements
- Interfaces
- Processes
- Tests
Intuitive graphical data exploration and editing
### Integrated Requirements Management, Import, Export

#### Details

<table>
<thead>
<tr>
<th>ID:</th>
<th>GS-01</th>
<th>Name:</th>
<th>MOC</th>
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#### Children, Requirements, Interfaces, Tests

<table>
<thead>
<tr>
<th>Name</th>
<th>Identifier</th>
<th>Text</th>
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<tbody>
<tr>
<td>MIRD-F-100</td>
<td>MIRD-F-100</td>
<td>The Euclid Mission Operation Centre (MOC) shall be responsible for mission opera... more</td>
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<tr>
<td>MIRD-F-110</td>
<td>MIRD-F-110</td>
<td>The NEW1 MOC shall perform the scheduling, monitoring and control of the spacecraft... more</td>
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<td>MIRD-F-120</td>
<td>MIRD-F-120</td>
<td>The MOC shall produce the data products for platform and instruments health check... more</td>
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<tr>
<td>MIRD-F-130</td>
<td>MIRD-F-130</td>
<td>MOC shall prepare and validate of the Flight Operations Plan and operations procedu... more</td>
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<tr>
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<td>MIRD-F-140</td>
<td>MOC shall prepare and validate the ground segment operations procedures necessary... more</td>
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<td>MIRD-F-150</td>
<td>MIRD-F-150</td>
<td>MOC shall perform the mission analysis, which output shall be reflected in the C... more</td>
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<tr>
<td>MIRD-F-160</td>
<td>MIRD-F-160</td>
<td>MOC shall be responsible for the definition of all the necessary interfaces to M... more</td>
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#### Description

Mission Operations Center
Configuration Management

- Git enables support for multiple baselines and dedicated branches
- Access to commit history and branch information
- Enables Concurrent Engineering (push/pull changes)
Workflow Processes

- Collaborative approval workflows: changes and milestone reviews, delegation, subscription, push notifications

- Changes to the model can be submitted and reviewed in dedicated Review Mode, prior to undergoing approval and merge to master branch
Collaboration

• Support for ad-hoc discussions, with tags linked to engineering data

• Discussions with types, including Problem Reports linked to JIRA

• Delegations, subscriptions, notifications support
Formal Validation

- Basic formal validation: Ecore meta-model
- Custom validation: user-defined OCL constraints
  -> Ensures rigour and consistency
  -> Answers questions
Document Generation

- Based on `.docx` templates, M2Doc
- Ensures consistent deliverables
- Templates and documents saved in the database
PLGSE: Next steps and future

- Add parametrics (QUDV) to front-end
- Validate: **shadow-engineering of Euclid Mission**
- More tools integration
- Reference libraries and architectures
- Expand existing tool interfaces
- Space segment inter-model mappings
- Executable models and links to analysis tools
- Integration with wider ESA/ESOC context:
  - Model-based X engineering?
    - Security, Reliability, Cost, Operations
Thank you for your attention!

Q&A and Discussion