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FROM CONCEPT TO FLIGHT:

Engineering Systems Software at JPL

Laura Mann, Software Engineer

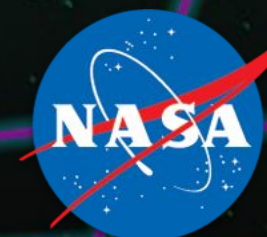
JPL

March 1st, 2018

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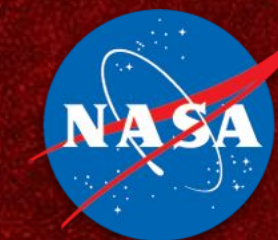
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FLIGHT PROJECTS



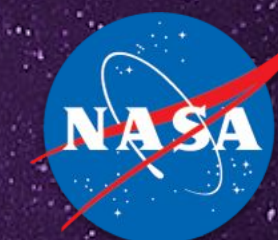
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PSYCHE

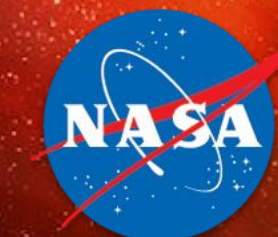
Planned Mission



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PHASES/LIFECYCLES

- Pre-Phase A: Concept Studies
- Phase A: Concept and technology Development
- Phase B: Preliminary Design and Technology Completion
- Phase C: Final Design and Fabrication
- Phase D: Assembly, Integration, Test and Launch
- Phase E: Operations and Sustainment
- Phase F: Close Out



DOMAINS/SUBSYSTEMS

A spacecraft has many subsystems, a general model including:

- Thermal
- Communication
- Mechanical
- Propulsion
- Command and Data handling
- Power
- Harness
- Integration and Test
- Payload
- Guidance, Navigation and control

In addition to the subsystems of a spacecraft, we must also design and implement:

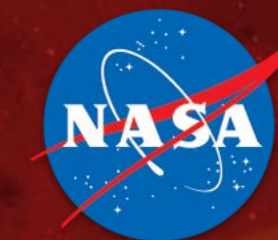
- Navigation
- S/C Planning and Sequencing
- Instrument Science Planning and Analysis
- Communications & Tracking
- Telemetry, Tracking and Command
- Ground Infrastructure



SYSTEMS ENGINEERING

What is a Systems Engineer?

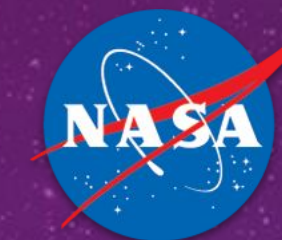
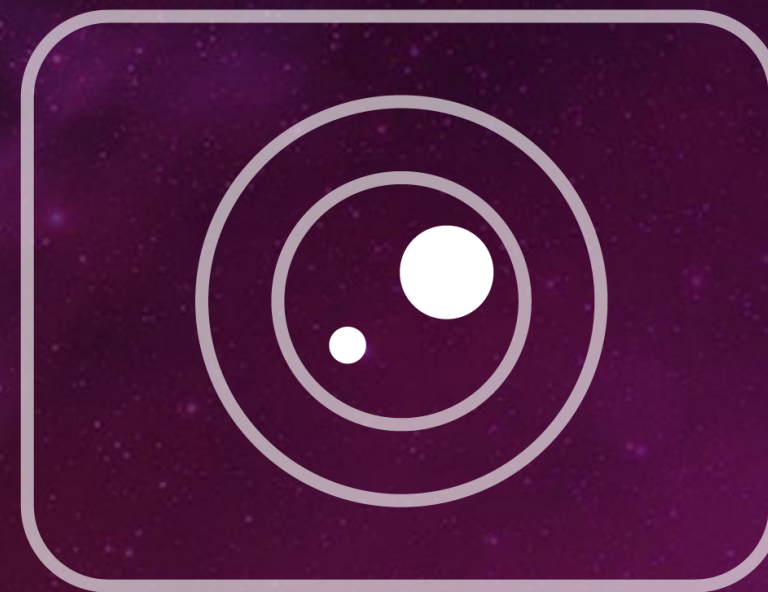
The sum of the parts is constructively greater than the whole



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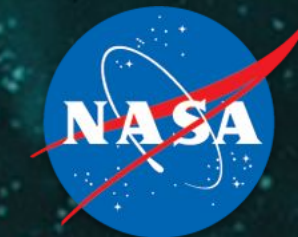
SYSTEMS ENGINEERING

Example #1: Field of View Example



SYSTEMS ENGINEERING

Example #2- Subsystems and Parts Visual



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SYSTEMS ENGINEERING

Example #3

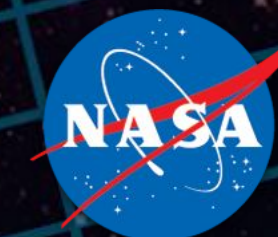


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SYSTEMS ENGINEERING

What System Engineers DO

- Develop the system specification
- Create requirements
- Verify and validate

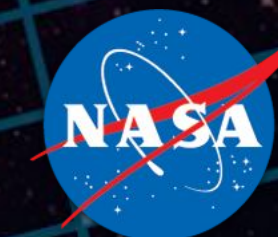


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SYSTEMS ENGINEERING

What System Engineers DO

- Use modeling languages and tools, requirements management tools and office productivity software



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OUR SOFTWARE

- Our responsibility is to provide the platform for engineering and development of the mission
- We provide tools (COTS) and custom development of software
- Enable users to write web applications against the data in the system model



MMS

Requirements

- Composite structure: class inheritance, property (read: variable) typing, separation of definition (read: instantiation or location in memory) and usage (read: pointer)
- Views: constructed from the model
- Key-value store for data, i.e. “documentation” => “Lorem ipsum.”
- Represent model as a graph
- Technical search



MMS

SERVICES LAYER

- CRUD
- Version Control Operations
- Search
- Query
- Analysis
- Notifications

DATABASE LAYER

ELASTICSEARCH

- Elasticsearch v5.6
- Types (multiple versions of metadata used a document store):
 - Elements
 - Artifacts
 - Commits

RDBMS

- Tables (current version of the graph)
 - Nodes
 - Edges
 - Artifacts
 - Commits



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RESULTS

- Substantial increase in performance
- A versioned facsimile of a graph
- Versioned data is inserted into elasticsearch
- Engineers are searching against the model



FUTURESCOPE

In Planning

- Graph database systems
- A distributive model
- Improving technical search
- Optimize versioned queries



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WHAT WE NEED

New Methodology

In systems engineering the data comes highly structured in a dense versioned graph. We need novel solutions in software architecture, storage and retrieval as the data becomes more complex and dense over time.



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IN CONCLUSION

New Methodology

Please visit: <http://www.openmbee.org/>

Links to our open source software (<https://github.com/Open-MBEE>)

Links to associated papers (<http://www.omgsysml.org>)

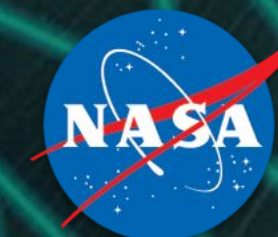
Links to our open source model the TMT

(<https://github.com/Open-MBEE/TMT-SysML-Model>)



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Thank You!



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