What's the Difference Between Digital Engineering and Product Lifecycle Management (PLM)?

STEVEN H. DAM, PH.D., ESEP

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SPEC INNOVATIONS

Agenda

- What is PLM?
- What is Digital Engineering?
- How are they different?

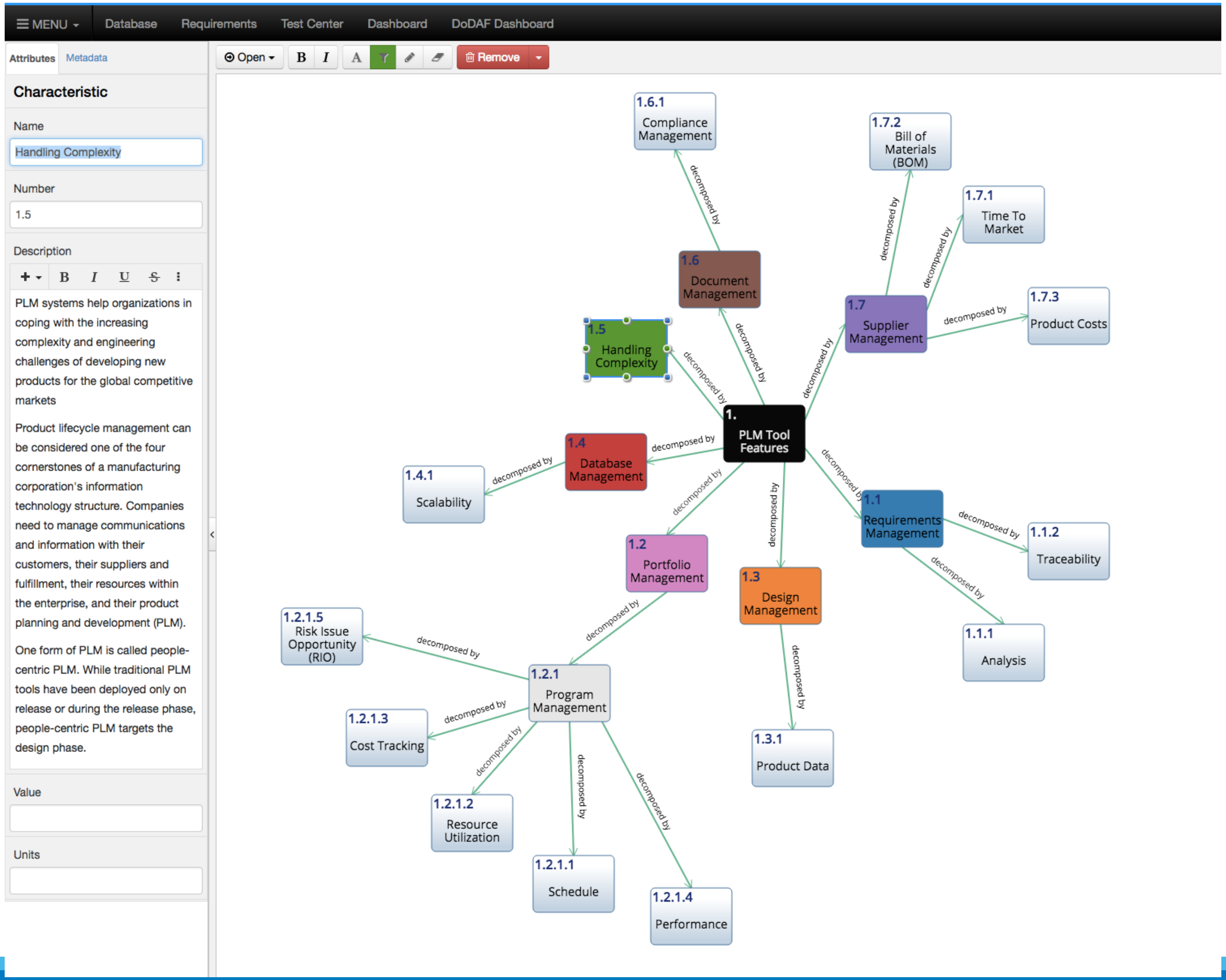
What Is Product Lifecycle Management (PLM)?

Defining PLM

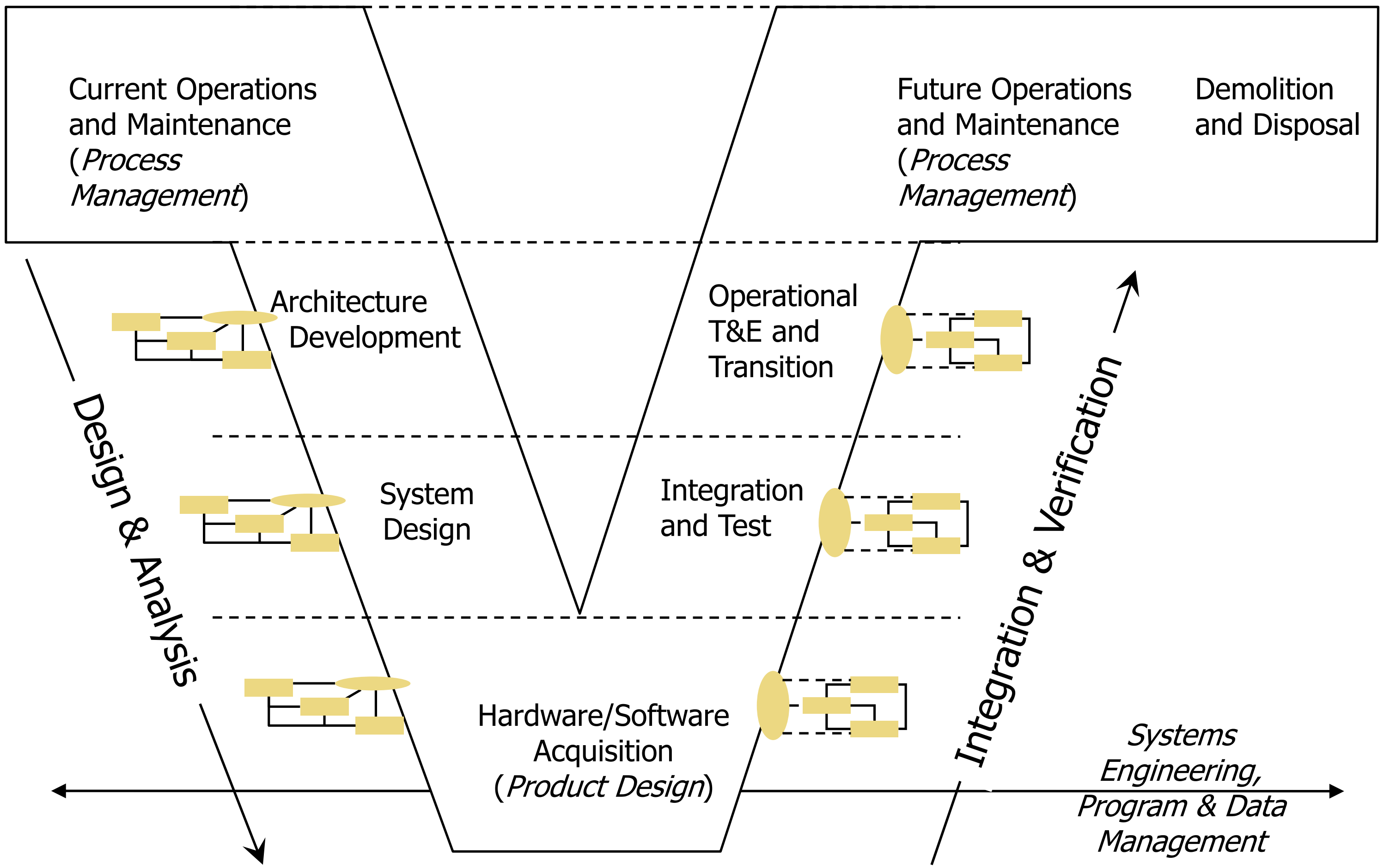
- PLM combines five distinct disciplines
  - Systems Engineering
  - Program Management (which includes Portfolio Management)
  - Product Design
  - Process Management for Manufacturing
  - Product Data Management
- Many practices focus on one or two of these disciplines in depth, but to be successful we know that all five areas (and more) are needed to manage products through the entire lifecycle

PLM Disciplines In-Depth

- Further analysis shows that the five primary PLM disciplines have a number of sub-disciplines and products
- A complete PLM capability needs all these features
- It must produce the deliverables in all these areas
- To better understand these requirements, we need to understand the lifecycle processes better

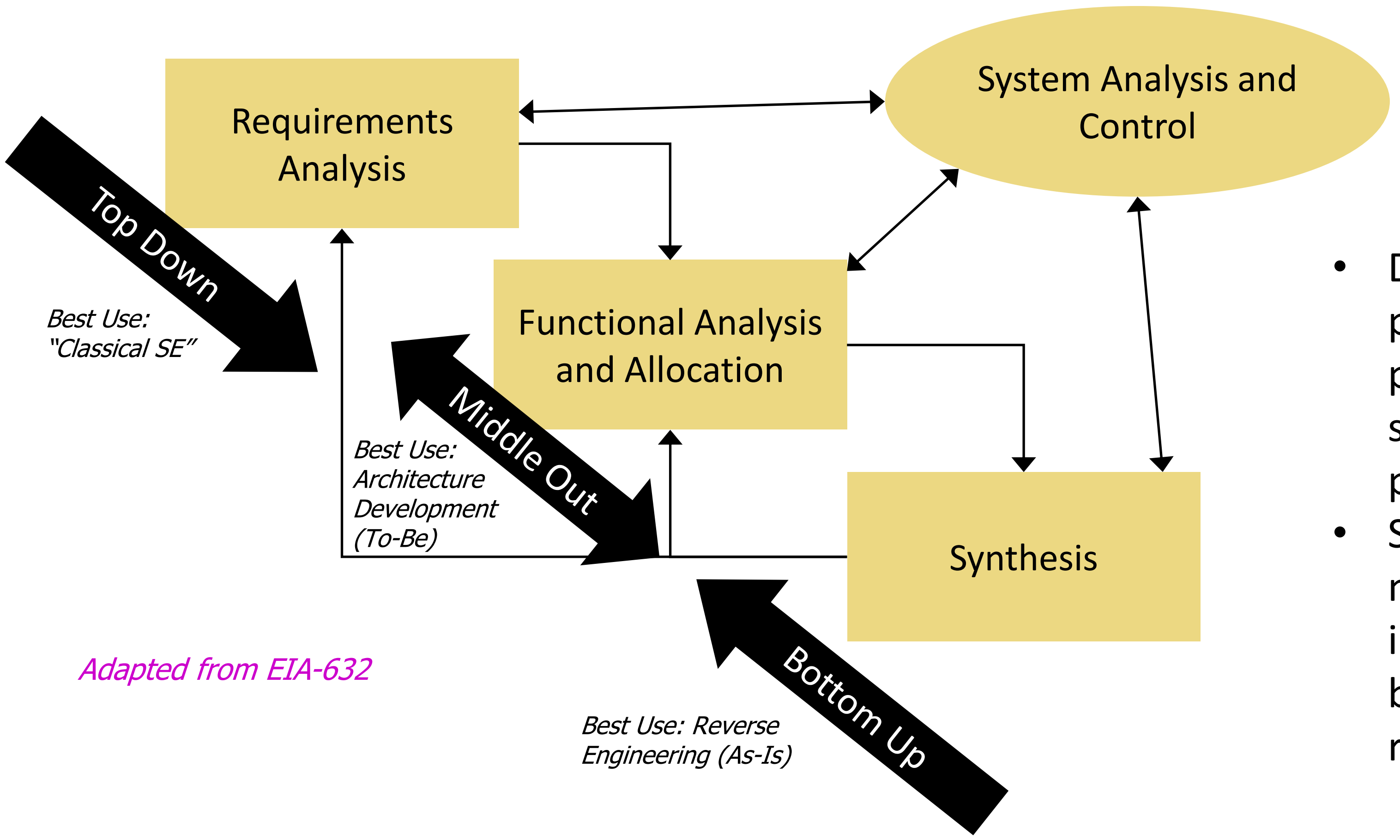


The Product Lifecycle



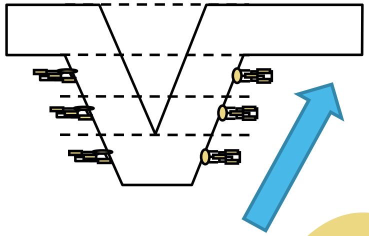
- Many ways to visualize the lifecycle, but they all have essentially the same phases and steps
- We need to capture information in each phase and step to provide understanding and documentation for the design and development of any product
- SE and PM cut across the entire lifecycle

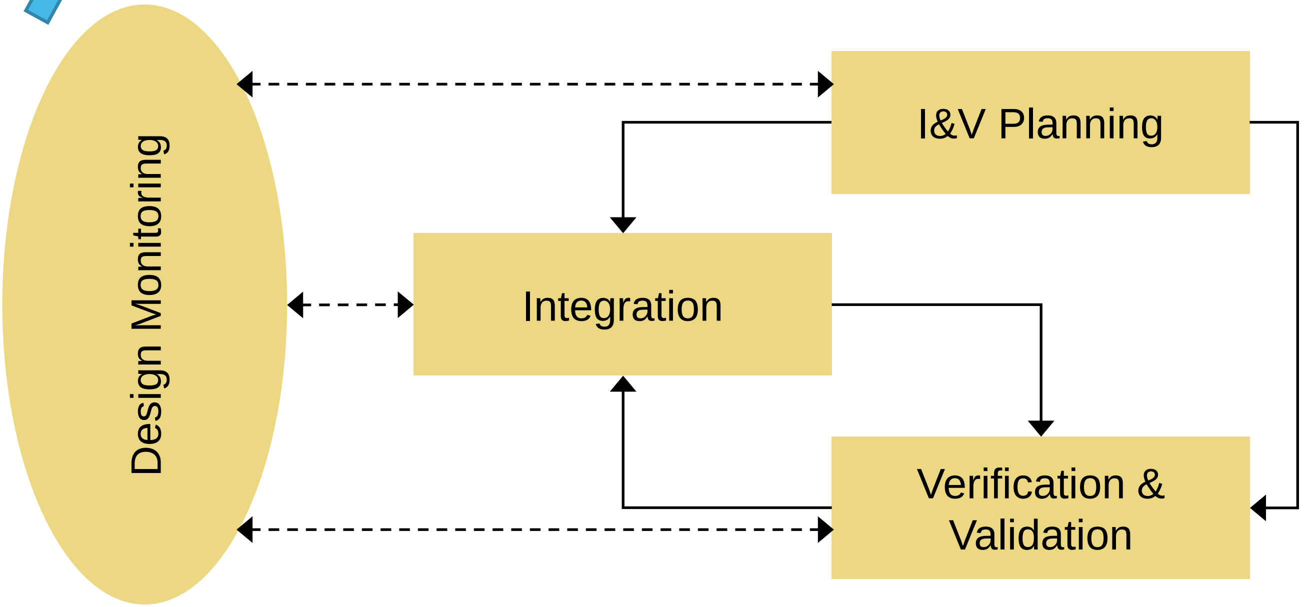
Processes During Design Phase



- Design and Analysis processes consist primarily of classic systems engineering and program management
- Specifications, bills of materials, and other information needed to buy or build products result

Coming Up the Vee





- Once components are procured, the integration and verification processes ensure that requirements were met
- Customer satisfaction and transition to operation is a key part of these steps

What is Digital Engineering?

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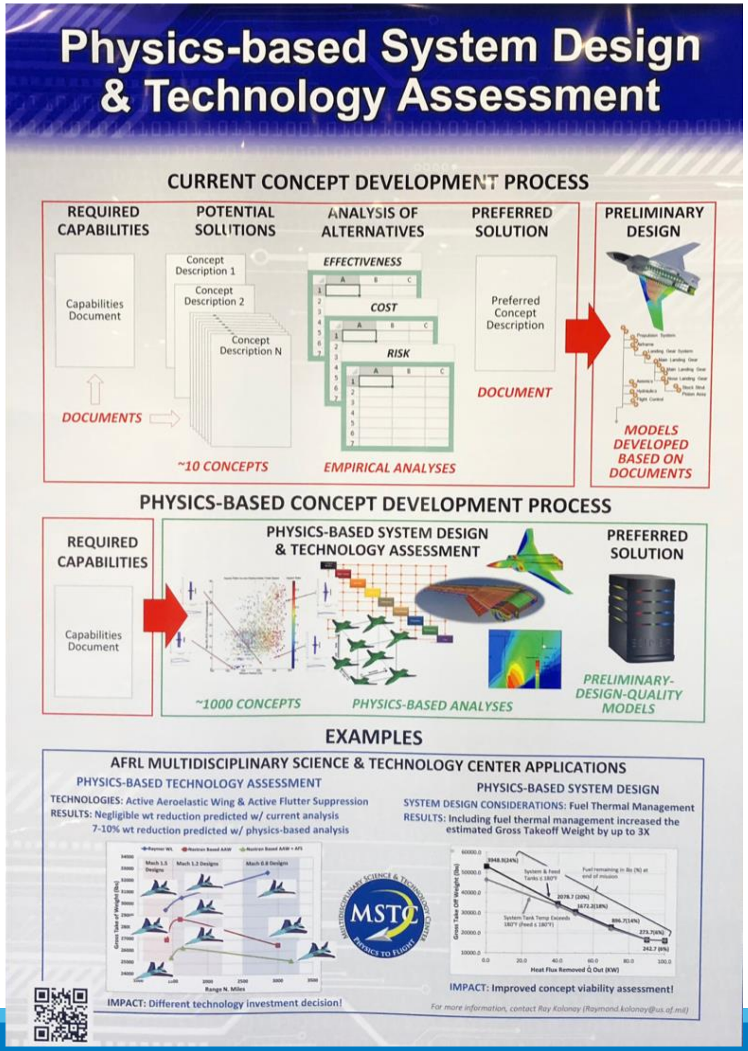
Digital Engineering Definition

- "Digital engineering (DE) (closely related to model-based engineering or model-based systems engineering) is an initiative championed by ODASD(SE). DE is intended to help streamline the way the DoD designs warfighting systems, conducts design trade-off analyses, and collects, retains, and shares data via models (which take the form of data, process, and/or algorithm), with increased use of interoperable engineering tools and virtual environments in the design process."
  From www.acq.osd.mil retrieved 11/17/2017
- But what does this mean in practical terms?

Implementing Digital Engineering

- Digital Engineering has been around for a long time. A quick search revealed an IEEE paper published in 1969 using this term
- The main idea being pursued by DoD is to integrate a set of tools to create an end-to-end digital model, ultimately putting the information into a “database” to create a “Digital Twin” – a “single source of truth”
- The emphasis has been on “physics-based” models
- But have we not been applying physics-based models early in the lifecycle whenever possible already?
- So what’s the real problem?



Lack of Tool Interoperability

- The main problem that many have identified is the lack of tools being able to interoperate with each other
- This problem has been particularly difficult for systems engineering tools
  - Requirements tools don’t talk to the modeling tools, which don’t talk to the simulation tools, etc.
- For years organizations such INCOSE and NDIA have been trying to overcome this problem
- The fundamental problem is really a lack of a common ontology and set of rules for the visualization of information
- The problem only gets worse when we try to integrate with high fidelity, physics-based modeling and simulation tools, such as CFD

How Are They Different?

How do they compare?

- PLM
  - Systems Engineering
  - Program Management
  - Product Design (CAD)
  - Process Management for Manufacturing (CAM)
  - Product Data Management

- Digital Engineering
  - Systems Engineering
  - Program Management
  - Product Design (CAD)
    - CFD
    - Electrical Engineering tools
    - Etc.
  - Process Management for Manufacturing
  - Product Data Management
  - Test and Evaluation Support
  - Operations and Maintenance Support

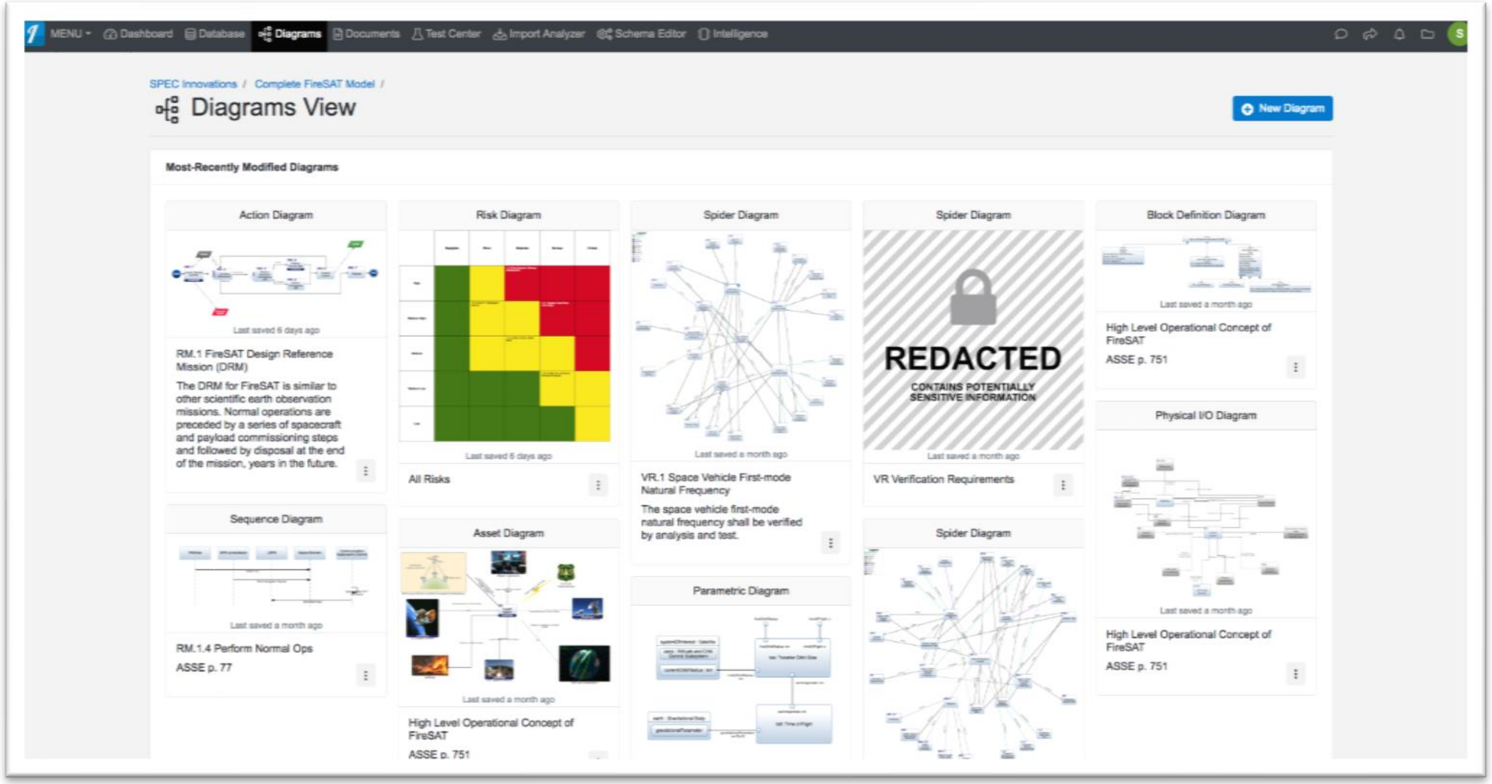
So PLM provides a very good starting point for Digital Engineering

How Do We Get to DE from PLM?

- Various tools provide varying capabilities that can be used for Digital Engineering
  - Some have integrated CAD tools, some don't
  - Some do a better job on systems engineering than the others
  - Some are easy to extend (via schema/APIs), others not
- A key feature needed for complete DE is built-in simulation capabilities
  - Simulators enable process modeling and verification
  - Simulators can be linked to each other or at least use results from higher fidelity, physics-based simulators
- So what other features do we need?

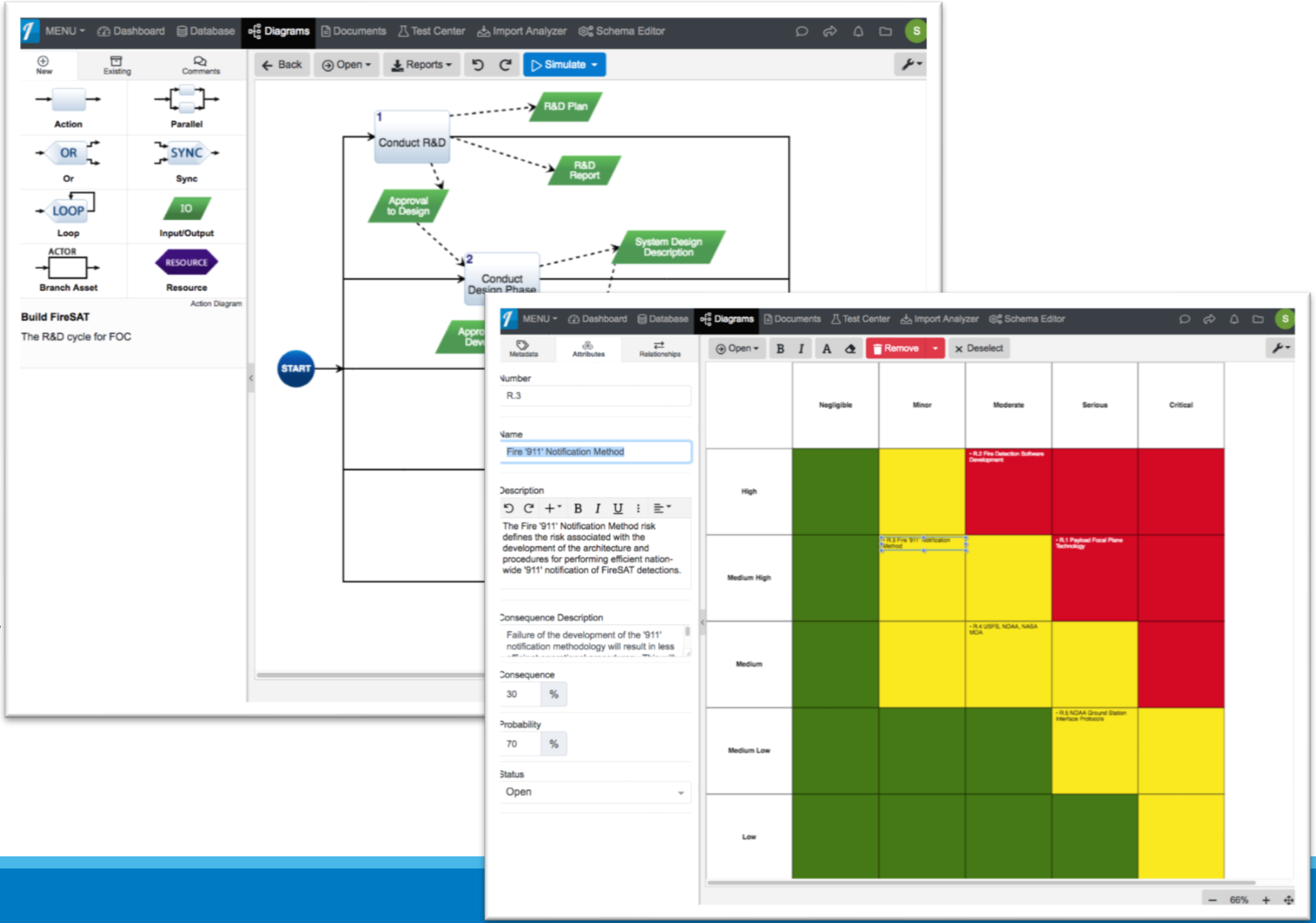
Do a Better Job of Systems Engineering

- Use a complete systems engineering environment
  - Requirements View
  - Functional and Physical Diagrams
  - Discrete Event and Monte Carlo simulators
  - Test Center



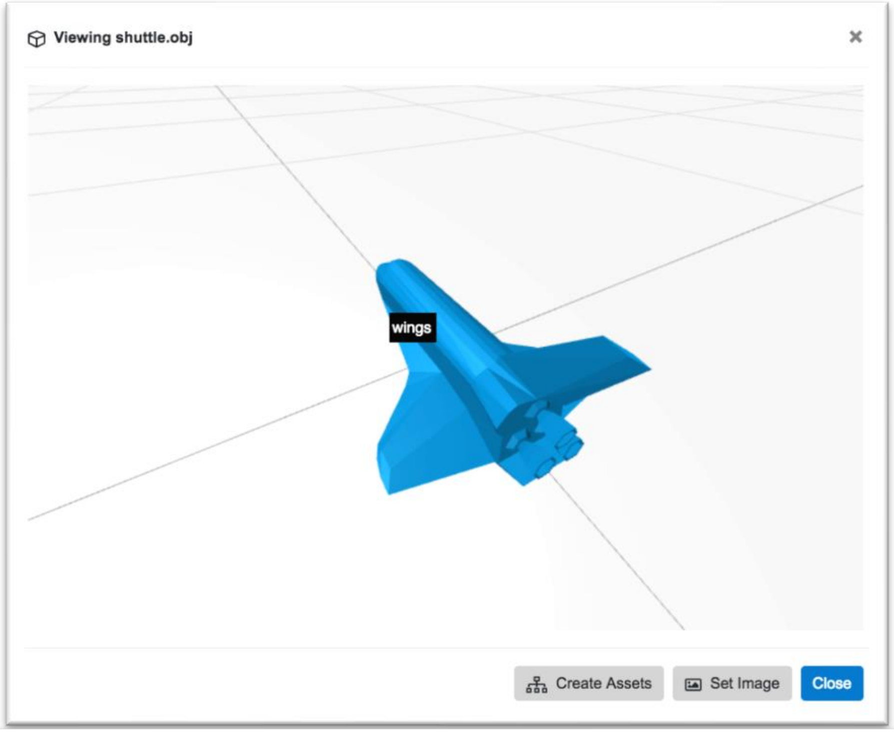
Capture and Relate Program Management Information

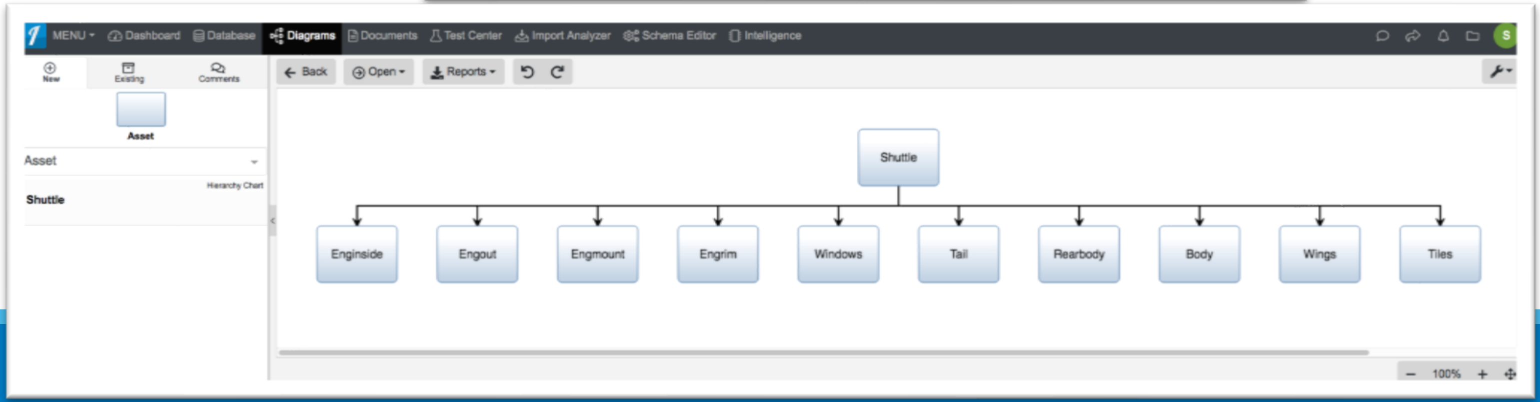
- Model management processes
- Create work breakdown structures
- Capture decisions
- Identify and manage risks
- Gantt Chart and cost
- MS Project interoperability



Capture Product Design Information

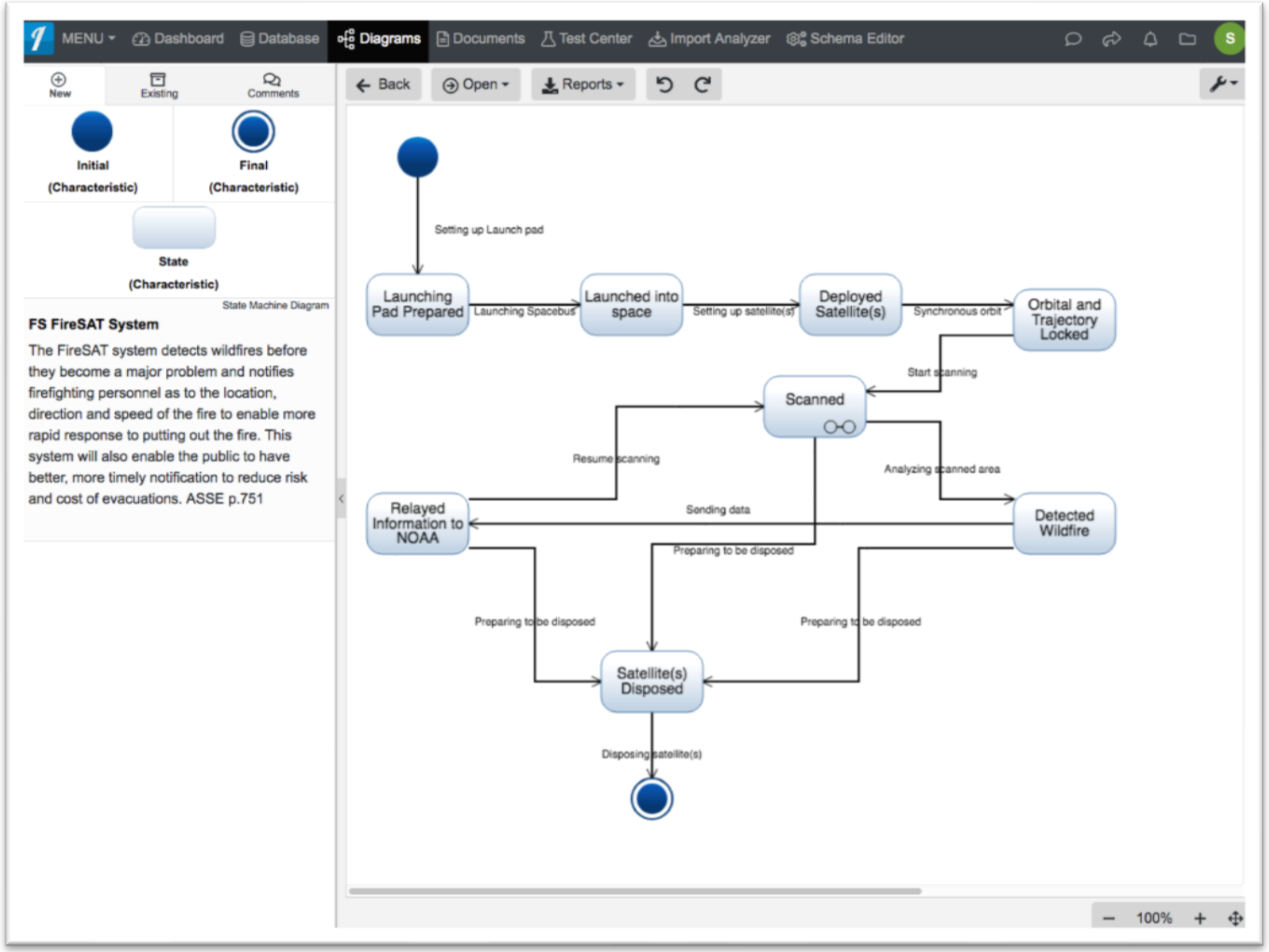
- Capture and visualize CAD files
- Decompose into database objects
- Capture artifacts from other, more detailed analyses
- Develop design specifications from models, automatically
- Develop test plans and capture test results





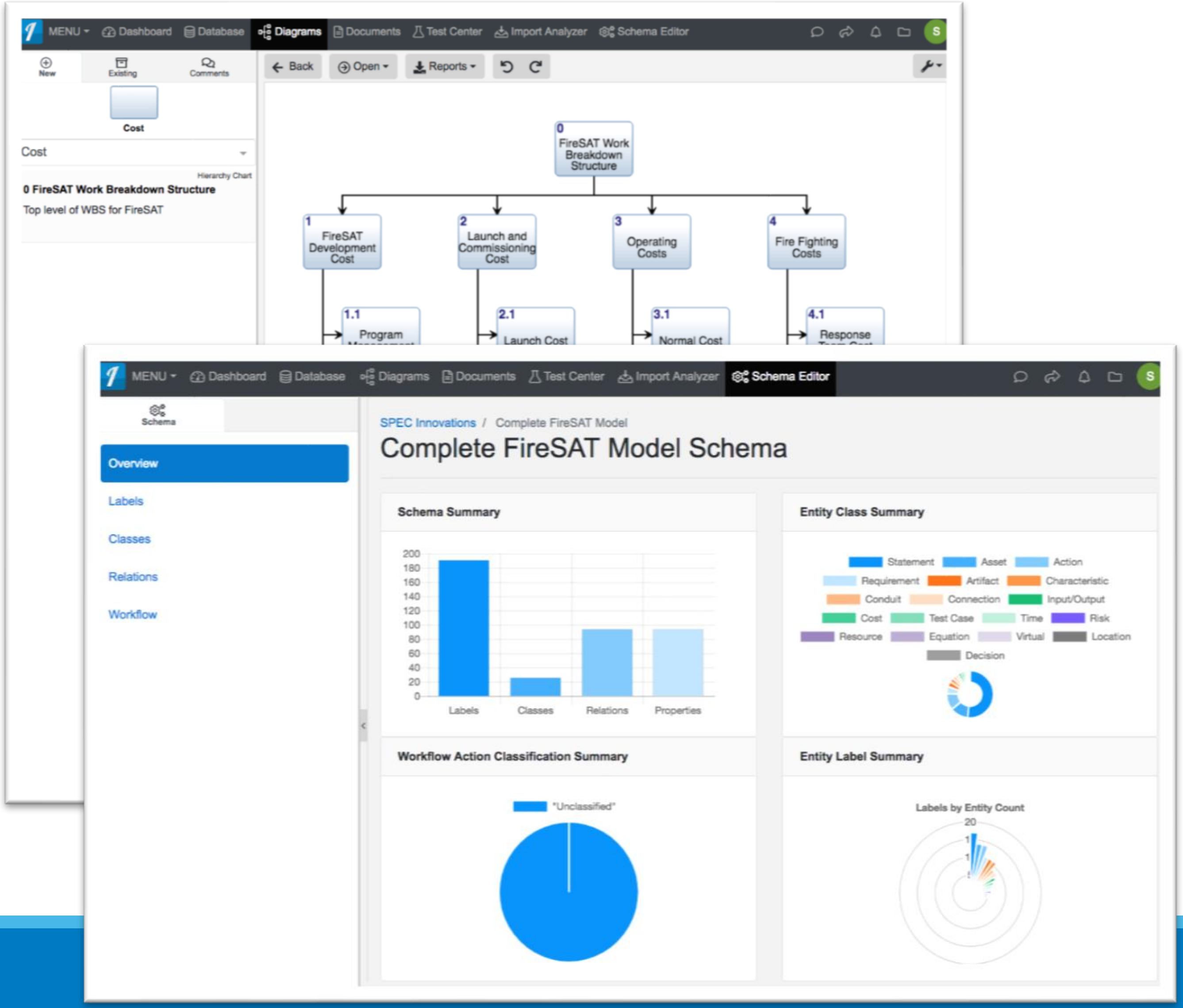
Better Manage Manufacturing Processes

- Model and verify processes using simulations
- Model states and modes
- Conduct FMECAs
- Interface with MPM tools using SDK/APIs
- Integrate with high fidelity tools



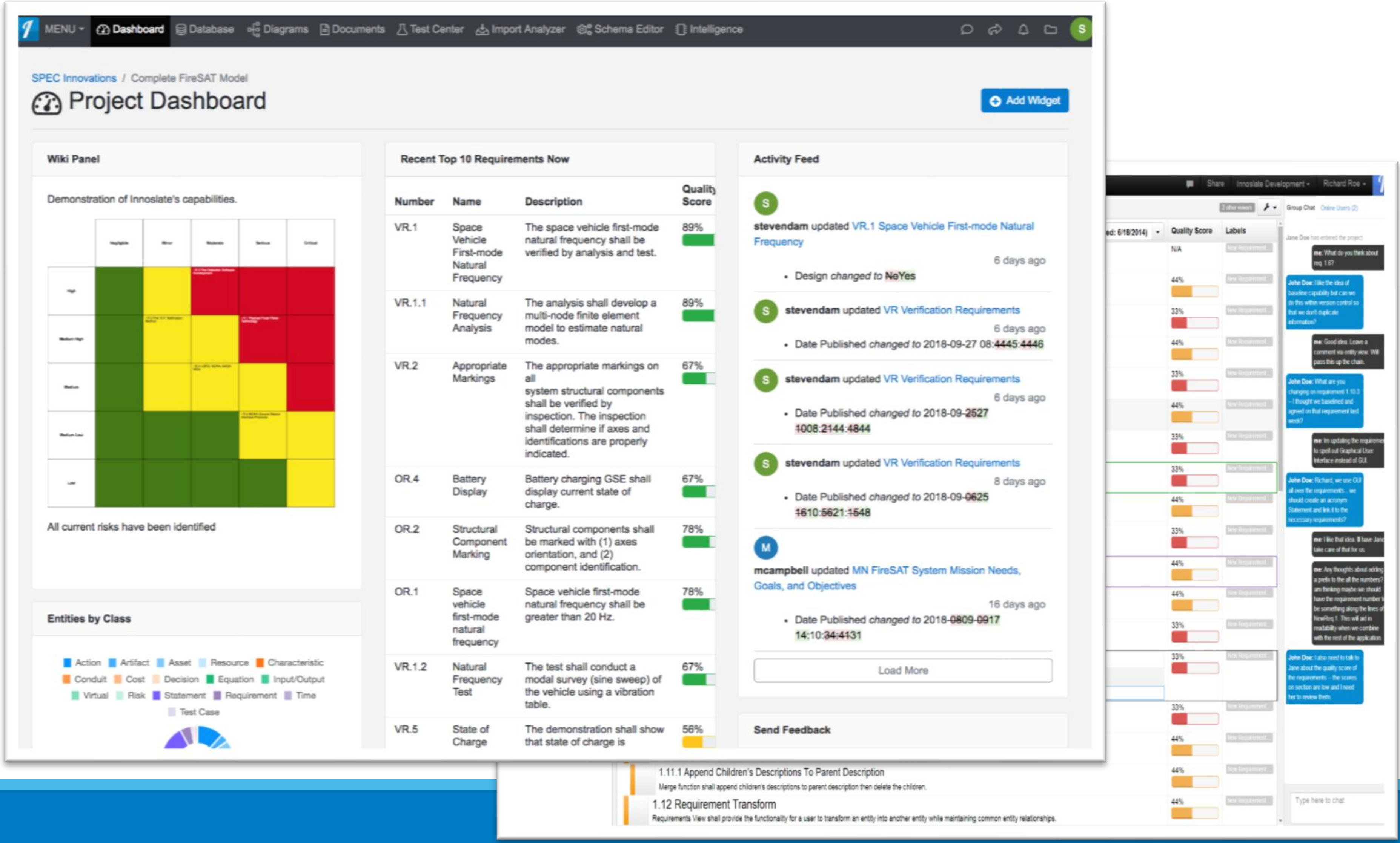
Improve Your Project Data Management

- Capture key attributes,
  - part numbers
  - part descriptions
  - supplier/vendor information
  - material data sheets ...
- Edit schema to meet special needs
- Manage electronic files using Artifacts
- Construct WBSs and BOMs



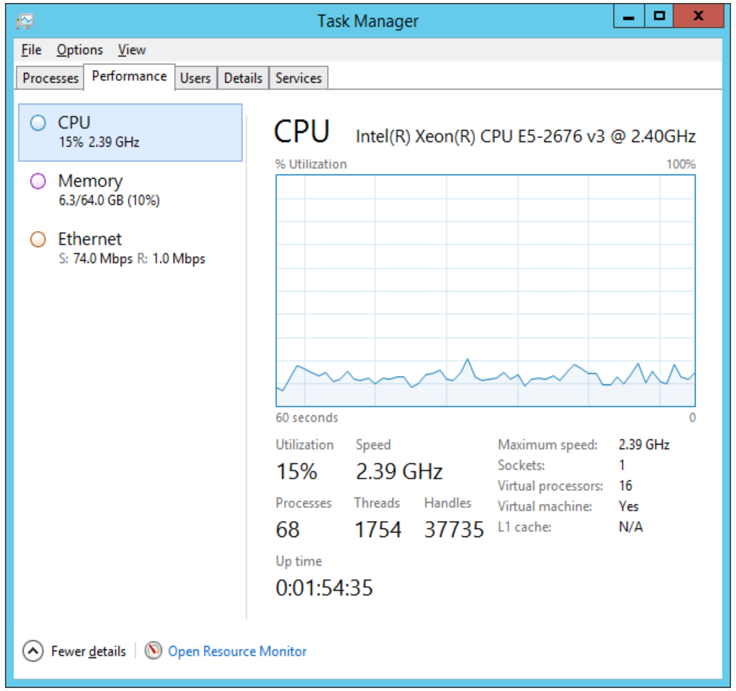
Real Time Collaboration

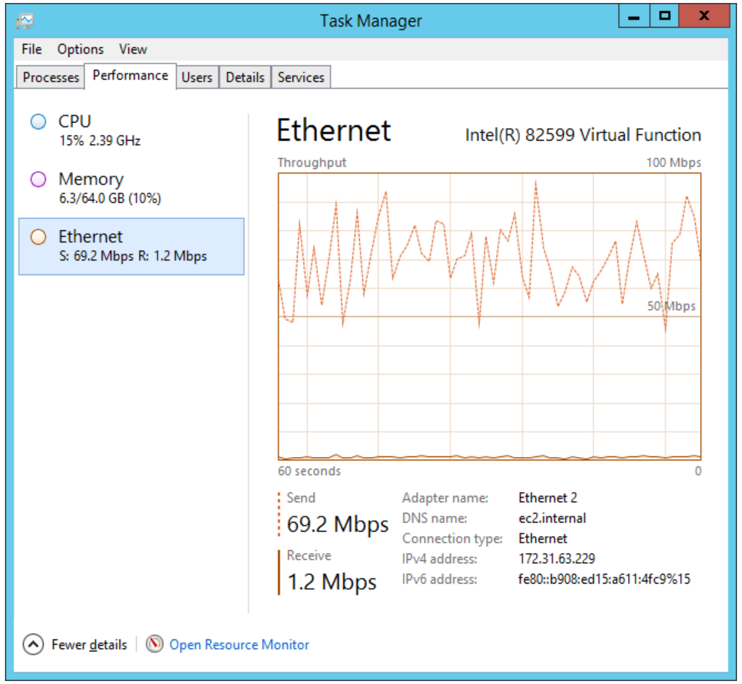
- Collaborate with your team members across multiple views
- Simultaneously shows real-time user status
- Group chat
- Project notifications



Scale to Meet the Need

- Test to millions objects and large number of simultaneous users
- Responsive, even with large databases
- Limited only by the hardware you run it on (cloud-computing)

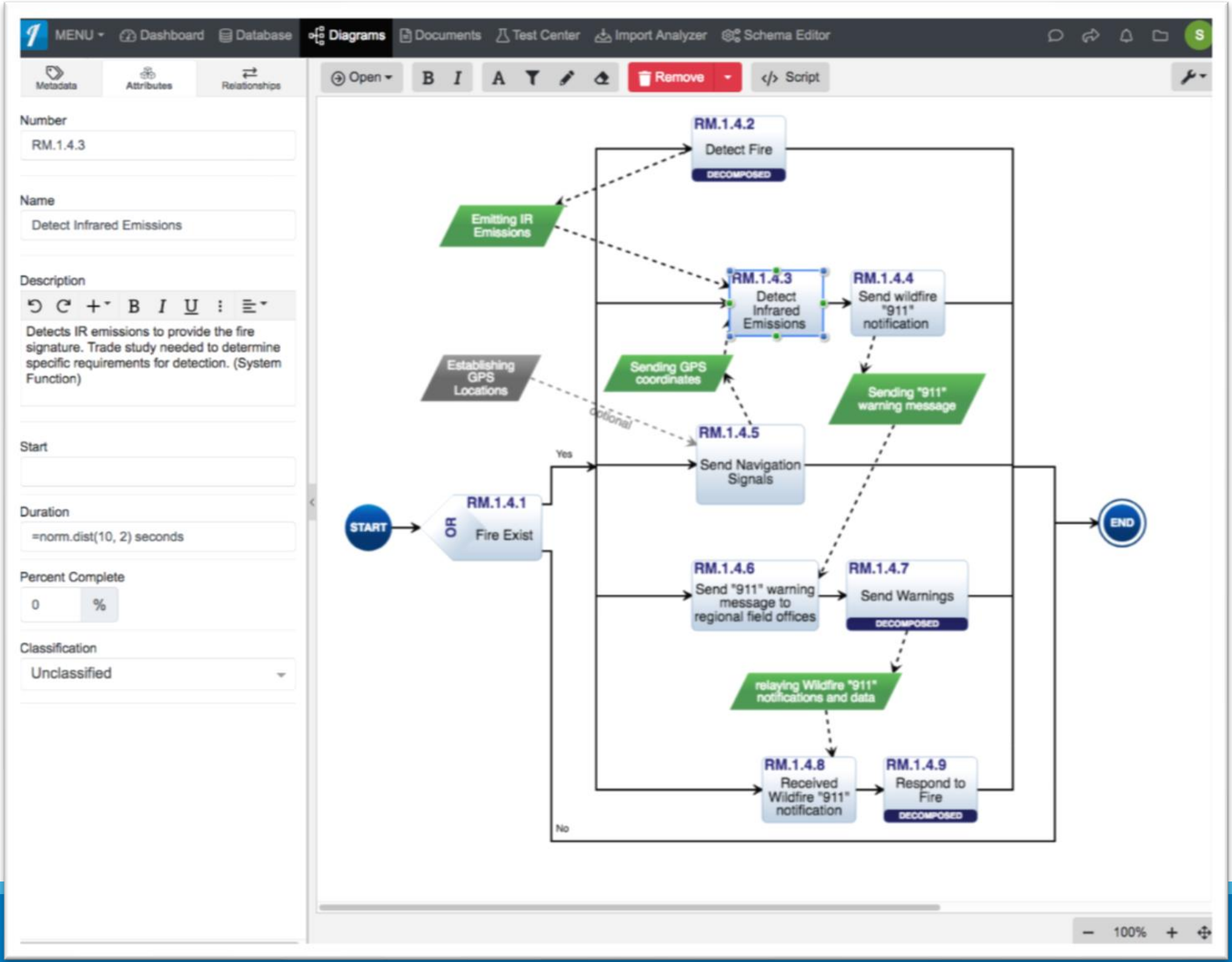




Entities in Project	Cold Start Server in Database View in Seconds (s)	Connections	Average Dashboard View in Milliseconds (ms)	Average Database View in Seconds (ms)	Average Simple Search Time in Seconds (ms)
10,000	0.63	33,540	102.04	250.50	234.54
100,000	0.78	334,980	108.60	294.84	260.81
500,000	0.78	1,674,180	156.26	240.00	260.39
1,000,000	0.69	3,348,180		204.71	211.22
2,000,000					
10 Mil		33,481,282	600.81	812.00	533.69

Easy to Use

- Drag and drop
- Sidebar for attributes, metadata and relationships
- Commenting capability
- Responsive
- All developed to the latest web software standards



Use APIs

- APIs provide a mechanism for sharing data between tools
- Older legacy tools may not have these APIs, but they also may no longer be necessary
  - Many modern tools have the capabilities already or can be easily modified
  - You may find that having an “air gap” is not that bad, as the higher fidelity tools can be summarized
- The key is the data

Summary

- PLM is critical for you to develop and manage your products throughout their lifecycles
- MBSE provides a formalized methodology for conducting PLM
- Innoslate® provides all the features you need to perform PLM and will help you attain your digital engineering goals today