

NDIA 18th Annual Systems Engineering Conference

BUILT FOR
TODAY.

DESIGNED FOR
TOMORROW.

18080 - The Application of Systems Modeling in support of Trade Studies

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ENGILITY
Your Mission. Our Commitment.

- Premise
- Introduction/Definitions
- Case Study
- Value, Planning and Execution Considerations
- Concerns/Risks
- Power of the Approach

- Trade Studies require team interaction, sharing of data, information, and knowledge that must be collected, analyzed, and put into a form useful to support analysis, and decisions that need to be made.

Can System Modeling be used to help?

Problem:

- Traditionally in a trade study, data and understanding comes from IPT interaction, and interpreting source data (PowerPoint slides, drawings, documents, spreadsheets). This takes a lot of time.
- Each engineer attempts to use the right data, but there is still a good chance that it will be out of synch and different than what is being used by others.
 - Inaccurate and or incorrect analysis results
 - Loss of credibility
 - Increased effort to scrutinize everything

Solution:

- A Case Study was performed to develop and approach, and explore the utility of integrating a system model into analysis and trade study activities.

- A System Model is a cohesive, unambiguous representation of what the System is and does.
- It provides a traceable description of
 - Requirements
 - Technical Solution
 - Operational Scenarios
 - System Behavior (including I/O)
 - Physical Architecture (Structure, interfaces)
 - Parametric Analysis and Dynamic Simulation (model execution)
 - Verification Procedures
- It requires a Modeling Language that is computer interpretable and executable

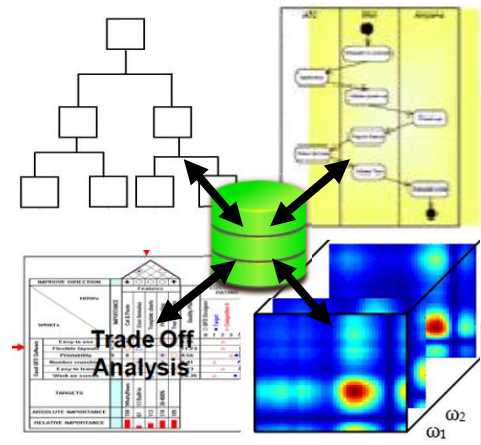
Architecture

Current



Stovepipes/Document & File Centric

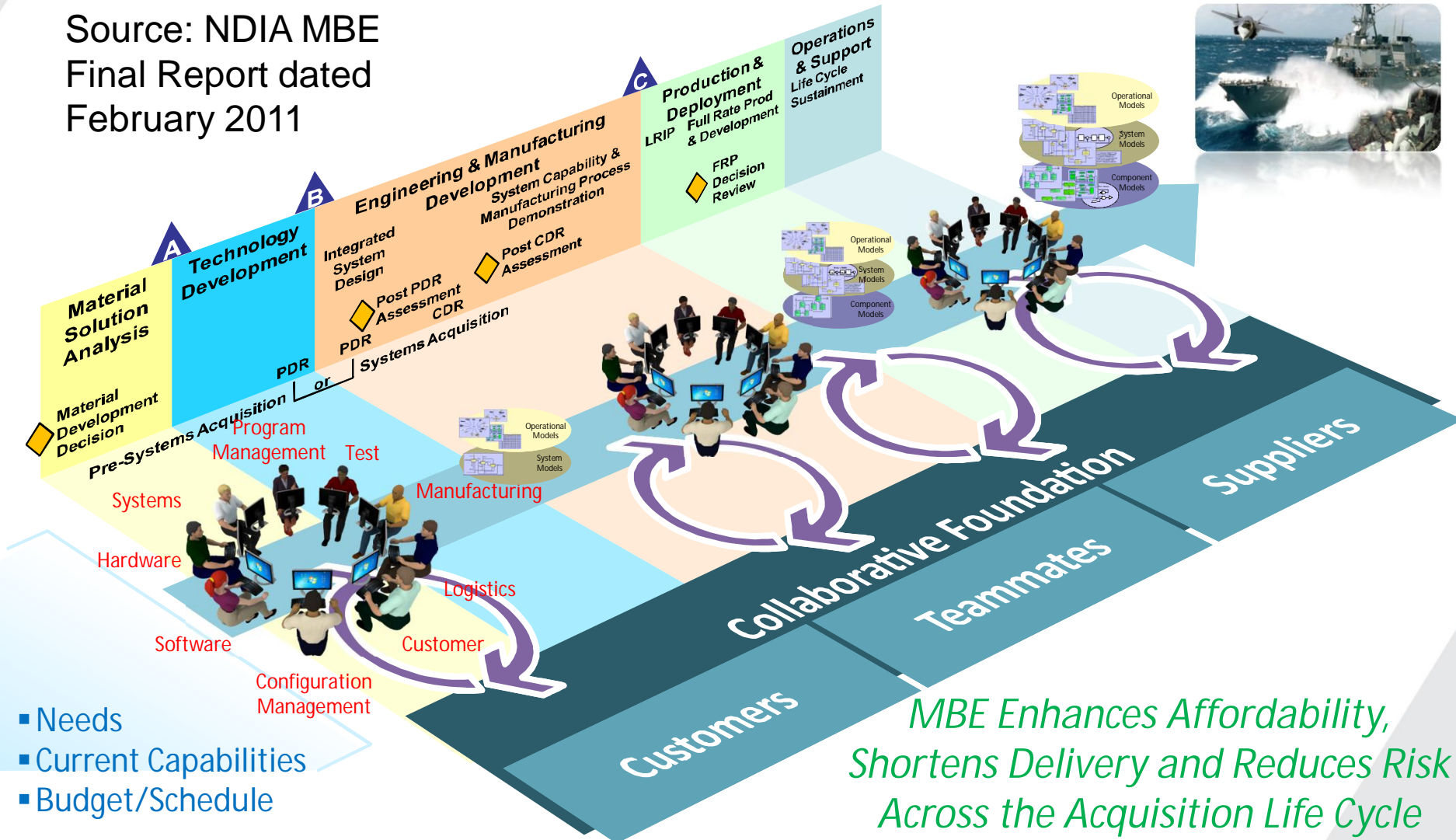
Future



Integrated / Model & Data Centric

MBE To-Be State

Source: NDIA MBE
Final Report dated
February 2011



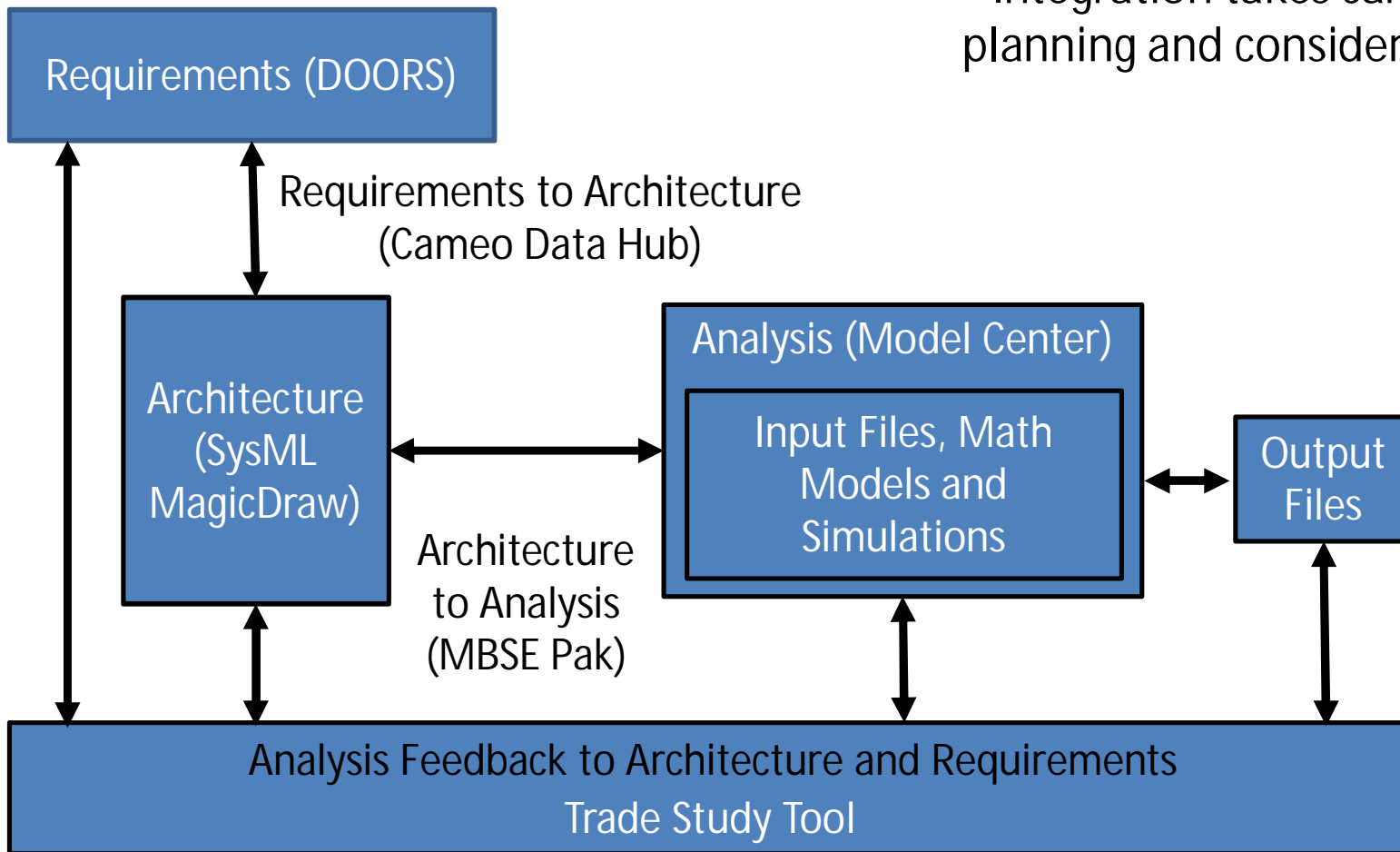
- Needs
- Current Capabilities
- Budget/Schedule

*MBE Enhances Affordability,
Shortens Delivery and Reduces Risk
Across the Acquisition Life Cycle*

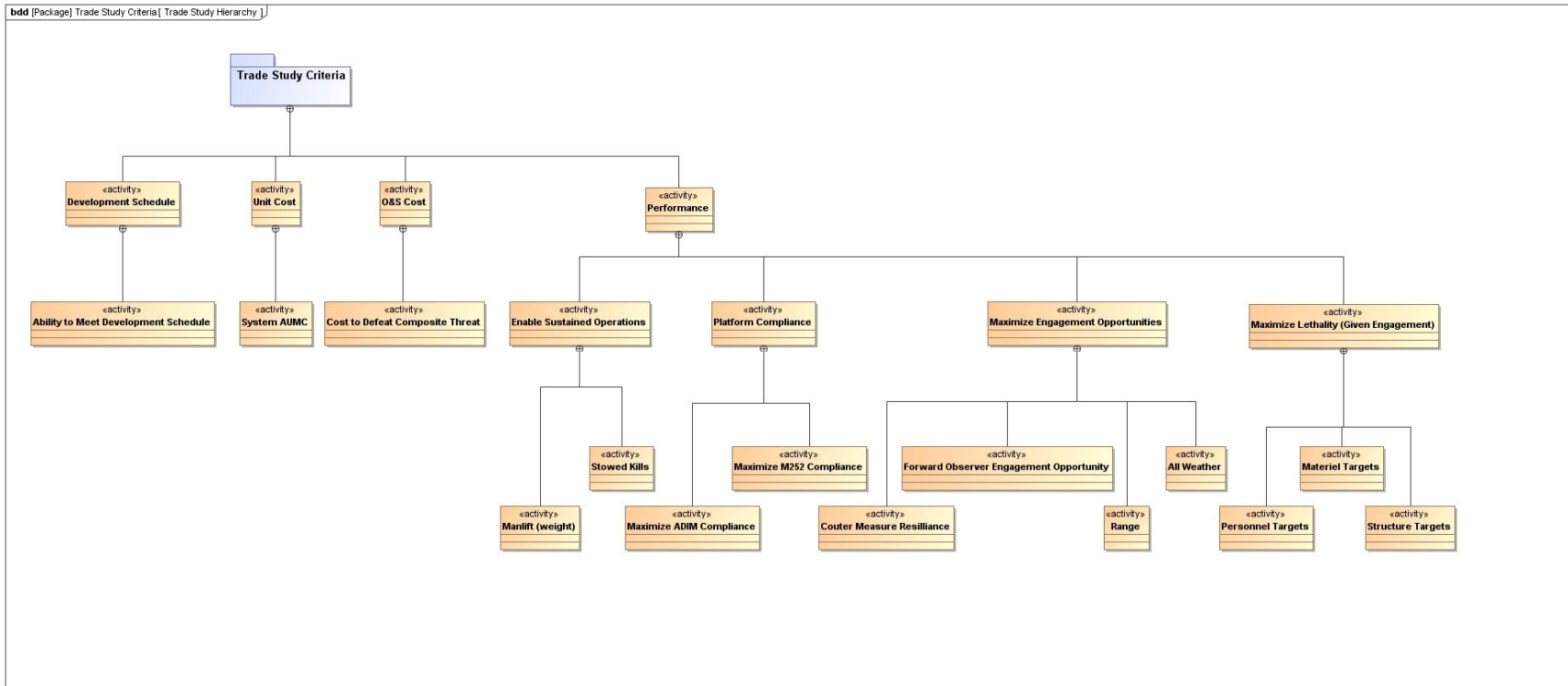
- Reduce Human Error thru use of consistent set of data and models
- Maintain history of changes
- Save time thru automating repeated manual steps and time to perform analyses
- Improve communication across the IPT and with Stakeholders
- Help keep engineering work synchronized throughout Project Lifecycle
- Provide a consistent understanding of System of Interest as well as the Analyses being performed
- Improve cross functional collaboration
- Faster and more direct insight into “what if” and impact/change analyses
- Accelerate time to make decisions and solve problems

- Requirements to Architecture and Trade Tool
 - Stakeholder and System Requirements feed the architecture and analyses
- Architecture to Analysis and Trade Tool
 - Architecture captures data (structure and parametrics) relevant to M&S and trade studies
 - Architecture captures intended use (behavior) of the system which feeds M&S
- Analysis Feedback From Trade Tool to Architecture and Requirements
 - M&S and Trade Studies execute to improve the team's understanding of the working of the system
 - Leads to improvements within the architecture, requirements and design

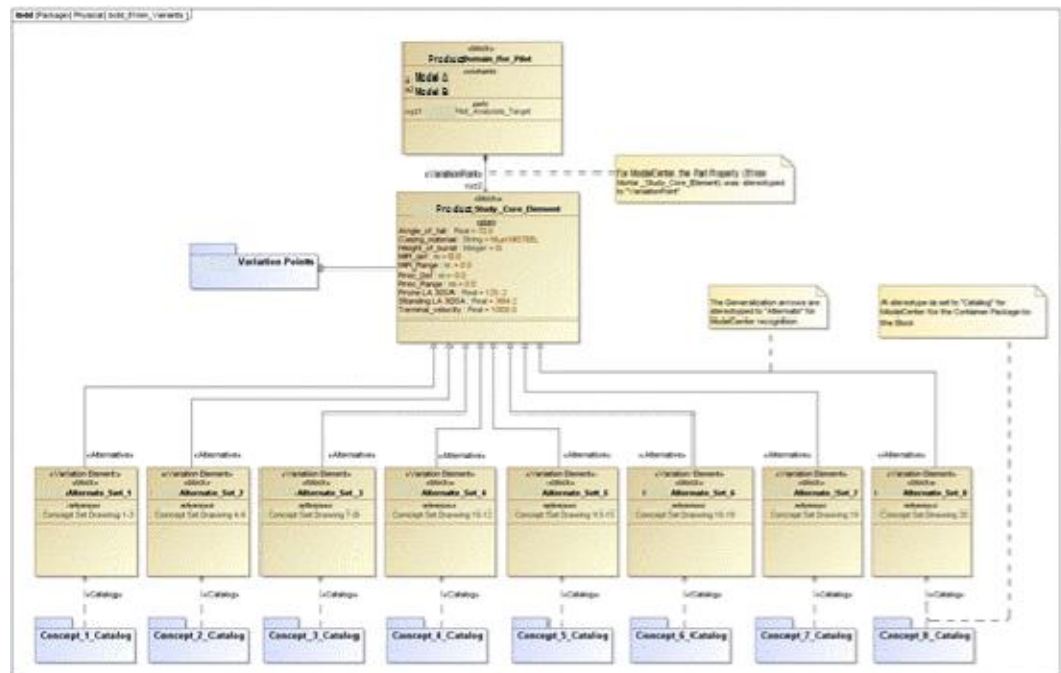
Integration takes careful
planning and consideration



- Used Block Definition Diagrams to capture Functional Decomposition which feeds Trade Study Criteria and is input into an Excel Based Trade Study Tool. Criteria are traced to Requirements and Solution Alternatives.

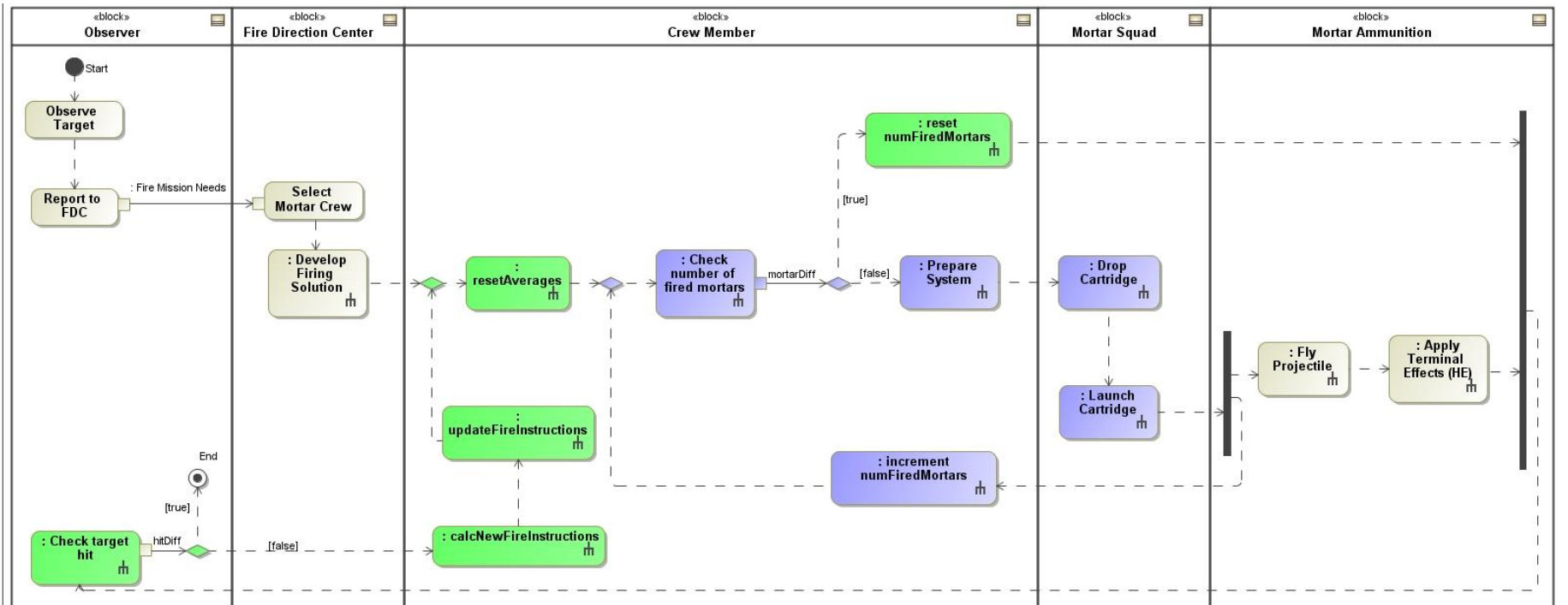


- Defined Alternatives with a series of BDDs in NoMagic MagicDraw for evaluation in a Trade Study.
- Used Phoenix Integration MBSE Pak and Model Center to traverse the defined set of alternatives and yield a full set of results.
- Alternative source drawings and values were captured in BDD to preserve a full audit trail and to define each concept



Operational Concept Scenario

- Using NoMagic MagicDraw, NoMagic Cameo Simulator, Phoenix Integration MBSE Pak, Model Center, Engineering and Physics Models, A full operational analysis can be set up with activity diagrams to create the workflow.



- Data needs of system analysis and trade studies require early consideration when developing requirements and architecture work products
- SE team executing the project must have a clear understanding how all the Systems Engineering specialties can work concurrently with one another
- Need to analyze tool integration opportunities , i.e. Ability to wrap tools, integration labor vs. timesaving automation, data inputs and outputs being used
- Data model/schema should be built and agreed to at the start

- Physical integration of the specialists tools can bring Infrastructure/Startup/Training burden and it may be best to take a “Data Use” approach for starters
- Stress to all members of the IPT that the system model must capture everyone’s data, information and knowledge. Encourage discussion on how it should be refined or corrected
- Some specialty data may not “live” in the system model, but at a minimum capture that it exists, what it is used for and the source (ex. 6 DOF model)
- Model and provide data in a digestible manner while keeping other users in mind
- A common methodology and model development style standard need to be put in place to gain the full value of the System Model

- When automating consider that analysis tools are not built to take the analyst/subject matter experts out of the loop.
 - Must minimize incorrect analysis and assumptions, loss of control of models and lost SME insights not preserved with results
 - Should not trivialize the need to validate data/models/analysis/interim outputs/final outputs
 - Still requires Modeling Specialists to make changes to models based on updates to requirements, architecture, design and methodology
- The integration approach and implementation must prevent security violations from aggregating unclassified data in a way that increases its classification level. “Need to Know” must also be preserved.
- Analysis models can be a dangerous weapon in the wrong hands) and we should not give access to those who aren’t qualified to use them.

- Provides a framework for early and on-going communication and integration across the IPT
- Facilitates multi-disciplinary trade-offs and design optimization
- Minimizes errors where a great deal of manual data entry is needed
- Provides full traceability from Requirements, Architecture, Design and Analysis