Modeling Information to Support Systems Engineering Technical Reviews Based on DoD Data Item Descriptions (DIDs)

Robert Wojcik
Julie Cohen
Tom Merendino

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

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Outline

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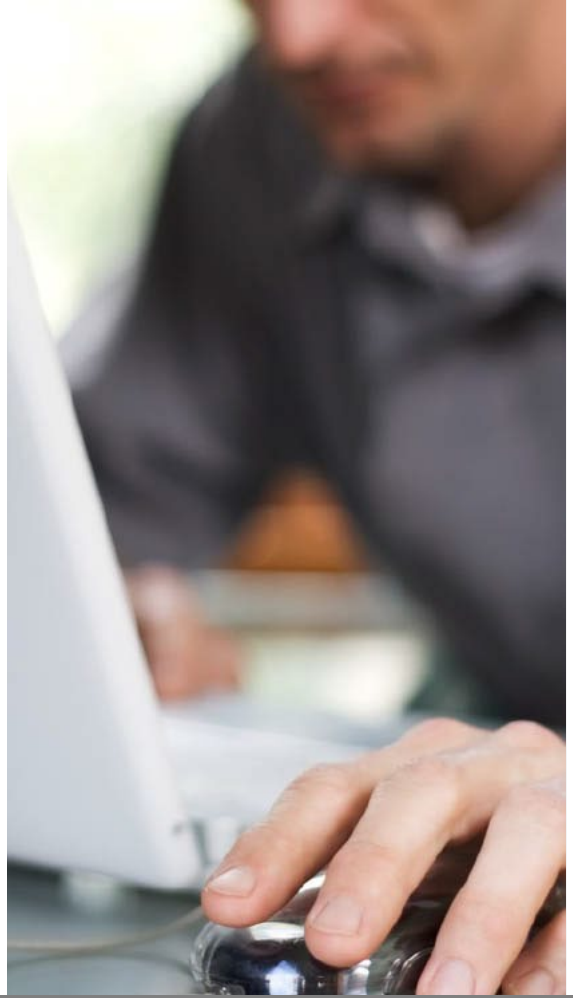
Background

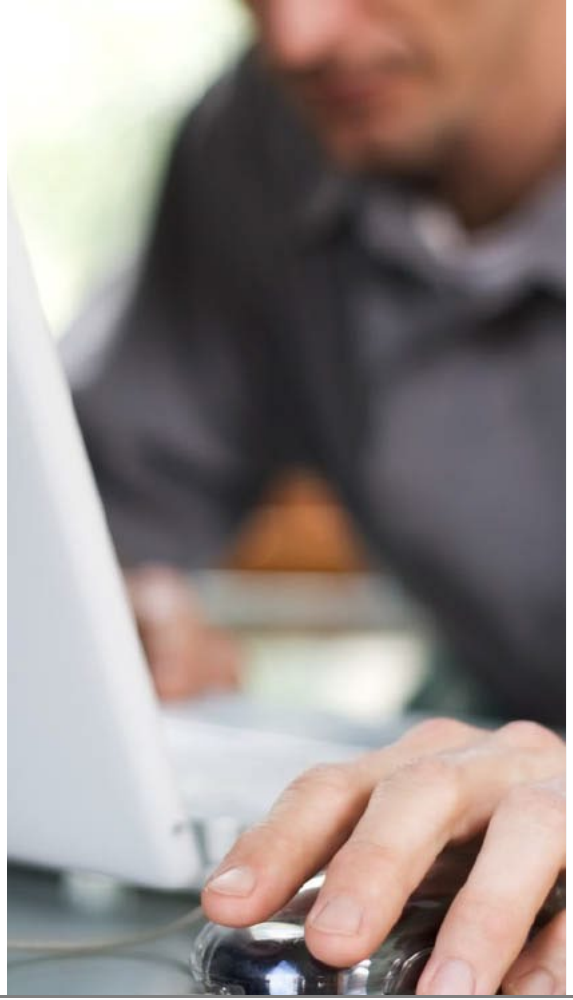


Background

The SEI conducted this effort as part of a work plan for the U.S. Army Combat Capabilities Development Command Aviation & Missile Center (DEVCOM AvMC) Integrated Mission Equipment (IME) project.

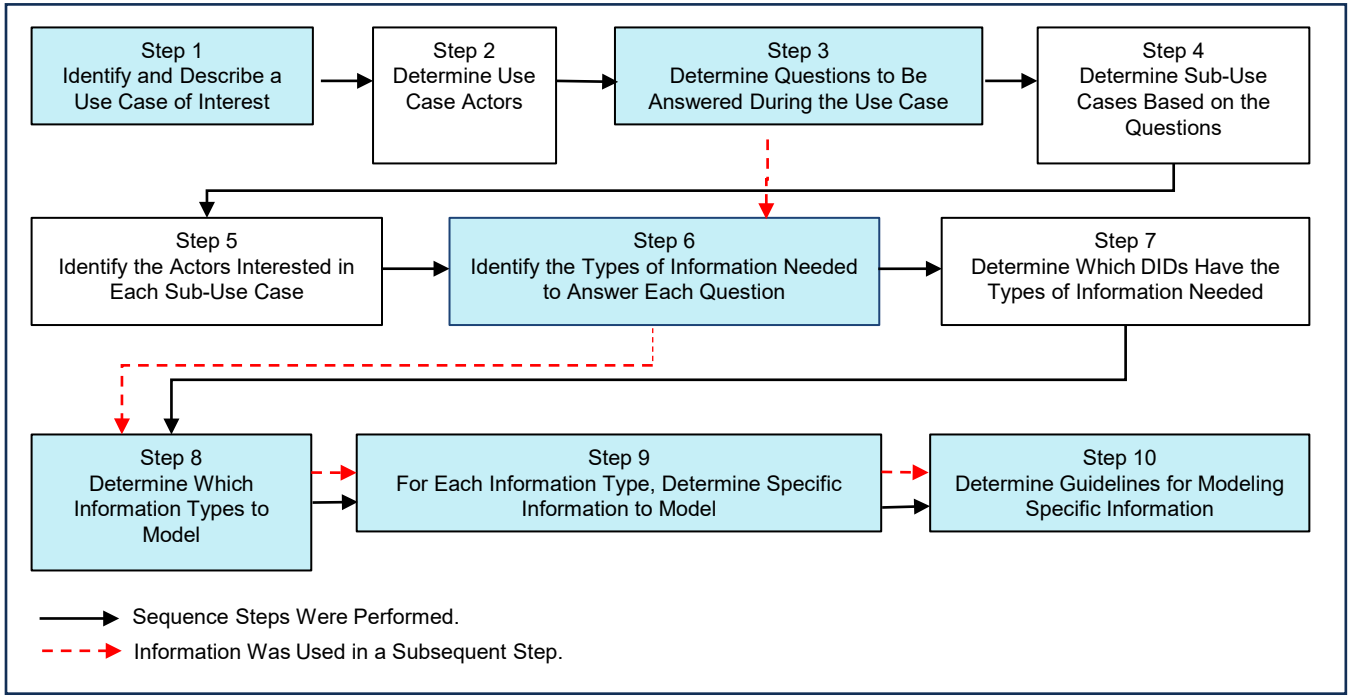
- Part of the job was to “develop and present the next steps in comprehensive model-based engineering (MBE) deliverables.”
- This work is based on a previous project that related existing data item descriptors (DIDs) to modeling efforts.
- This effort is based on the Navy Systems Engineering Technical Review (SETR) process.
- The resulting product provides guidelines for modeling information to support specific SETR reviews regardless of the DIDs used.

Approach/Process



Final Process

Changes were made during the project - final process:



The following slides discuss the steps in the blue boxes.

Step 1: Identify and Describe a Use Case of Interest

- 7 SETR reviews of potential interest were identified; due to time constraints, we only worked on SRR-II, SFR, SSR, PDR, and CDR.
- 5 primary use cases were developed for the 5 aforementioned SETR reviews that describe how models would be used during those events.
- 40 sub-use cases were developed across the 5 primary use cases, each focusing on specific areas of interest.

Step 1 Example: Primary/Sub-Use Cases for SETR Reviews

Primary Use Cases	Sub-Use Cases
UC-01 – Conduct SRR-II	• SRR-UC-01.a – Requirements Baseline • SRR-UC-01.b – Operational Effectiveness and Suitability • SRR-UC-01.c – Key Performance Areas/Key Performance Parameters • etc.
UC-02 – Conduct SFR	• SFR-UC-01.a – Functional Decomposition • SFR-UC-01.b – Capability Development Document • SFR-UC-01.c – Technology Readiness Level • etc.
UC-03 – Conduct SSR	• SSR-UC-01.a – Requirements Baseline • SSR-UC-01.b – Software Design Readiness • SSR-UC-01.c – Software Test Plan • etc.
UC-04 – Conduct PDR	• PDR-UC-01.a – Allocated Baseline/Interfaces/Architecture • PDR-UC-01.b – Test, Evaluation and Certification • PDR-UC-01.c – Analysis • etc.
UC-05 – Conduct CDR	• CDR-UC-01.a – Design/Specification/Traceability/Baseline • CDR-UC-01.b – Test, Evaluation and Certification • CDR-UC-01.c – Analysis • etc.

Step 3: Determine Questions to Be Answered During the Use Case

- The goal was to determine what questions might be asked during each use case that could be answered using models.
- For example, 94 SRR use-case questions were identified.
- The questions were derived from the SETR manual and other government sources.
- The questions were the basis for the following activities:
  - analyzing the types of information needed
  - identifying specific information needs
  - recommending what information to model to support SETR reviews
  - developing modeling guidelines

Step 3 Example: SRR Use-Case Questions

- Has the quality of GFE/GFI been verified?
- Is the developing contractor's (including subcontractors) requirements baseline traceable to the government's requirements baseline?
- Has the contractor appropriately decomposed the performance requirements to the scope of the effort under contract?
- Is there an approved system specification with sufficiently conservative requirements to provide for design trade space for the EMD phase?
- Is there a preliminary allocation of system requirements to hardware, human, and software subsystems?
- Are training requirements/objectives listed in the speciation?
- Have environment, safety, and occupational health requirements been addressed, as applicable?
- Have system constraints (interfaces, physical, electrical, etc.) been specified?
- Are the system requirements sufficiently detailed and understood to enable system functional definition and functional decomposition?
- Do the system requirements address system performance?
- Do the system requirements address reliability, availability, and maintainability (RAM)?
- Is there a reasonable expectation of providing an operationally effective and suitable final system?
- Does the contractor's technical baseline cover everything that is needed to satisfy the government's KPPs and KSAs?
- Are the system requirements testable? How will availability be measured?
- Have the tailorable, non-tailorable, derived, and correlated requirements been established within the framework of a candidate physical architecture?
- Has a technical risk assessment been executed to characterize the understanding of requirements and verification procedures, representing the ability of the contractor to comply with the government's performance baseline?
- Has a program execution risk assessment characterized the ability to achieve the CDD-specified capabilities within program budget and schedule?
- Is there an approved EMD phase SEP that addresses cost and critical path drivers?
- Is there an approved life cycle sustainment plan?
- Are the system requirements traced to higher level capability needs?
- etc.

Steps 6: Identify the Types of Information Needed to Answer Each Question

- For example, 128 information types were identified for the 94 SRR use-case questions identified in Step 3.
- Multiple information types were needed to answer most questions.

Step 6 Example: Information Types Needed to Answer SRR Questions

- Allocated Baseline Requirements
- CDD Requirements
- Derived Requirements
- Design Constraints
- Each Function's Inputs, Processing, Outputs
- External Interface Requirements
- Human Factors Considerations
- Interface Requirements
- Internal Development Baseline
- Mission Requirements
- Operational Environment/Mission Requirement Associations
- Program Staffing
- Requirements Allocation and Rationale
- Requirements Traceability
- Software Certification Plan
- Software Requirements
- System Functional Overview
- System Requirements
- Technical Performance Measures (TPM)
- Testing Method for Each Requirement
- Use Cases
- etc.

Step 8: Determine Which Information Types to Model

- While all the information types identified in Step 6 could be modeled, some seemed more worthwhile to model to support the use cases.
- For example, to support the SRR use case, it seemed worthwhile to model some information types but not others:
  - Requirements
  - Use cases
  - Functions
  - Interfaces
  - ~~Program staffing~~
- The focus was on information types that seemed most worthwhile to model to support the stated purpose of each use case.

Legend

- Information Types that Seemed Worthwhile to Model to Support the SRR Use Case
- ~~Information Types That DID NOT Seem Worthwhile to Model to Support the SRR Use Case~~

Step 8 Example: Information Types to Model for SRR

- ~~Allocated Baseline Requirements~~
- CDD Requirements
- Derived Requirements
- Design Constraints
- Each Function's Inputs, Processing, Outputs
- External Interface Requirements
- Human Factors Considerations
- Interface Requirements
- ~~Internal Development Baseline~~
- Mission Requirements
- Operational Environment/Mission Requirement Associations
- ~~Program Staffing~~
- ~~Requirements Allocation and Rationale~~
- Requirements Traceability
- ~~Software Certification Plan~~
- Software Requirements
- System Functional Overview
- System Requirements
- Technical Performance Measures
- ~~Testing Method for Each Requirement~~
- Use Cases
- etc.

Legend

- Information Types that Seemed Worthwhile to Model to Support the SRR Use Case
- ~~Information Types That DID NOT Seem Worthwhile to Model to Support the SRR Use Case~~

Step 9: For Each Information Type, Determine Specific Information to Model

- Determine specific information to model for each information type identified in Step 8.
- Only some of the specific information associated with the information types identified seemed essential to include in models to support the use cases. Other specific information seemed "nice to have" but non-essential.
- For example, to support the SRR use case, essential and non-essential specific information to model for the Requirement information type might be:
  - Requirement ID
  - Requirement description
  - ~~Author~~
  - ~~Creation date~~
  - ~~Planned increment~~

Legend

- Essential specific information to model for the Requirement information type
- ~~Non-Essential specific information to model for the Requirement information type~~

Step 9 Example: Specific Information for SRR Use-Case Models

Information Type to Model: Requirement

Specific Information to Model	Essential
Requirement ID	Yes
Requirement Description	Yes
Requirement Rationale	--
Requirement Categories	--
Owner	--
Qualification Provisions	--
Status	--
Risks	--
Other Requirement Attributes	--
Associations to Parent Requirements	Yes
Associations to Child Requirements	Yes
Associations to Other Requirements	Yes
Associations to Other Artifacts	--
Associations to Use Cases	Yes

Step 10: Determine Guidelines for Modeling Specific Information

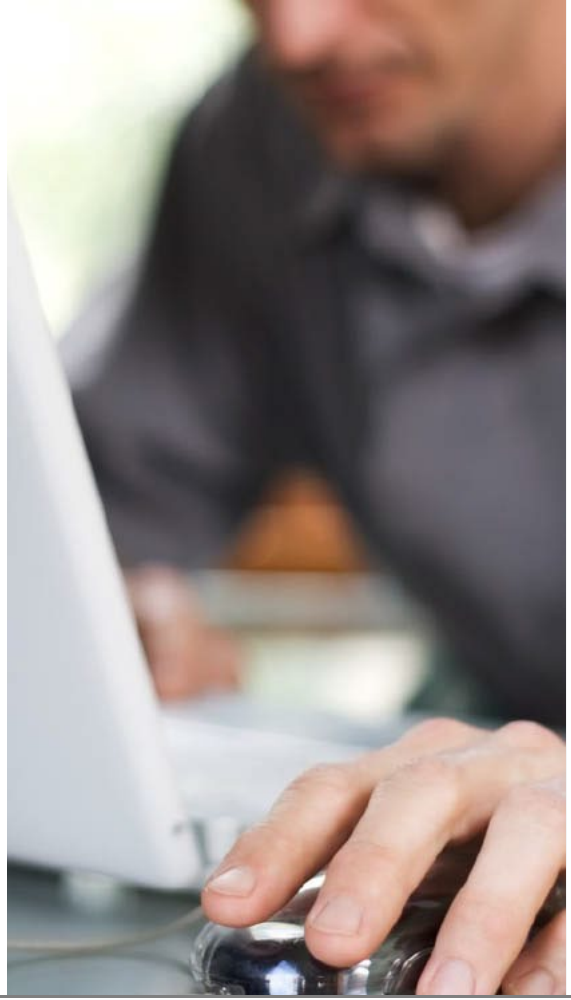
- Guidelines were developed regarding modeling specific information identified in Step 9:
  - modeling techniques
  - modeling languages/frameworks
  - modeling tools
- For the SRR and SFR use cases, guidelines were provided for the following information types:
  - Requirements
  - Use Cases
  - Functions
  - Interfaces

Step 10, Example 1: Modeling Guidelines for SRR

Models to Consider for Requirement Information

				Modeling Frameworks		Modeling Languages			Modeling Tools					
Modeling Categories	E	C	Modeling Techniques	DoDAF	UAF	SysML	UML	AADL	MS Office	Cameo EA	Enterprise Architect	Rhapsody	DOORS	OSATE/AADL
Behavioral		*	Activity diagrams			x	x			x	x	x		
		*	Communication diagrams				x			x	x	x		
		*	Dataflow diagrams								x			
		*	Interaction overview diagrams				x				x			
		*	Sequence diagrams			x	x			x		x		
		*	State machines			x		x		x	x			
Textual			Use cases											
		*	Quality attribute scenarios											
	*		Tables/matrices						x		x	x	x	
	*		Requirement databases										x	
	*		Descriptive paragraphs			x	x		x	x	x	x	x	
Associational	*		Allocation tables/matrices			x				x		x	x	
	*		Allocation diagrams					x				x		x

Benefits



Benefits

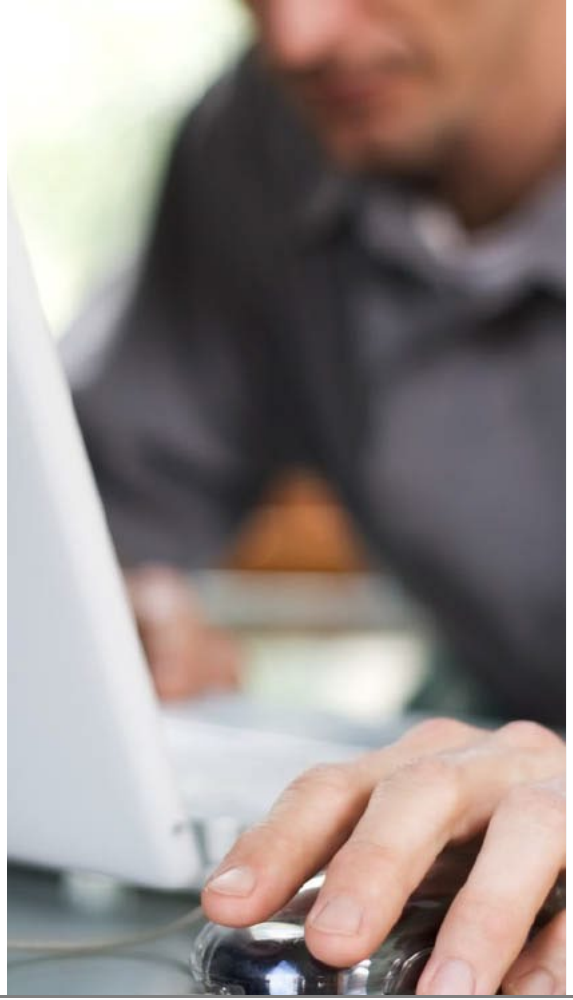
The Government Program Office receives the following benefits:

- guidance to help build government models
- information that can help assess models provided by contractors
- information that can be used in a Request for Proposal

Contractors receive the following benefits:

- guidance to help build system and software models
- information about potential modeling tools and languages

Next Steps



Next Steps

The next steps are to

- identify a program that can pilot using the information produced and provide feedback
- continue to perform process steps for additional SETR events
- develop guidance for model views to help government program offices and contractors

Two SEI reports will be published in the near future:

- Modeling to Support DoD Acquisition Lifecycle Events
- Guidance for Tailoring DoD Request for Proposals (RFPs) to Include Modeling