Technical Characteristics
and Governance Processes
in Military M&S Standards

Mikel D. Petty, Ph.D.
Center for Modeling, Simulation, and Analysis
University of Alabama in Huntsville
Presentation outline

- Studying military M&S standards
  - Motivation
  - Methodology
  - Categories and attributes
- Survey of military M&S standards
  - Distributed simulation interoperability
  - Live training
  - Object modeling
  - Conceptual modeling
  - Synthetic environment
  - Simulation development
- Concluding remarks
  - Preliminary findings
  - Open questions
Studying military M&S standards
Motivation

• Overall project research questions
  ▪ What M&S standards exist?
  ▪ How effective are existing standards?
  ▪ How do governance processes affect their effectiveness?
  ▪ How should current and future standards be governed?

• Military M&S standards
  ▪ Standards as “data”: information about standards may help answer project’s research questions
  ▪ Military M&S standards important and well-documented
Methodology

- Process
  - Identify military M&S standards
  - Identify attributes of standards to examine
  - Collect information regarding standards
  - Analyze to determine correlation between governance and effectiveness

- Comments
  - “Standard” understood broadly
  - List of attributes evolving
Categories

- Distributed simulation
  - SIMNET
  - ALSP
  - DIS
  - HLA
  - TENA
- Live training
  - MILES
  - CTIA
- Object model
  - RPR FOM
  - Base Object Models
- Conceptual modeling
  - UML
  - DoDAF
- Synthetic environment
  - SEDRIS
- Simulation development
  - FEDEP
  - DSEEP
  - VV&A Overlay
  - VV&A RPG
- Enumerations
  - DIS Enumerations

Which standards should be added or deleted from this list?
Attributes

- Name; e.g., High Level Architecture
- Status; i.e., pending, active, inactive
- Category; e.g., distributed simulation
- Year first “standardized”
- Type; i.e., official (de jure), unofficial (de facto, proprietary)
- Form; i.e., rec practice, tech specification, product line
- Ubiquity; i.e., number of applications and users
- Investment; i.e., total and annual support spending
- Governance; i.e., standards body, management group
- Governance formality; formality of process to change
- Technical specificity; degree implementation prescribed
- Utility; usefulness and effectiveness

Are these the right attributes to study standards?
## Standards as data

<table>
<thead>
<tr>
<th>Name</th>
<th>Domain</th>
<th>Type</th>
<th>Form</th>
<th>Governance</th>
<th>Year</th>
<th>Status</th>
<th>Technical specificity</th>
<th>Governance formality</th>
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<td>DIS</td>
<td>Distributed simulation</td>
<td>Official</td>
<td>Technical specification</td>
<td>Standards body</td>
<td>1990</td>
<td>Active</td>
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<td>Product line</td>
<td>Architecture management group</td>
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<td>Active</td>
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<td>Product line</td>
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<td>Official</td>
<td>Recommended practice</td>
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<td>Pending</td>
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<td>2007</td>
<td>Active</td>
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Survey of military M&S standards: Distributed simulation interoperability
Distributed simulation standard overview

- **SIMNET**
  - Virtual; real-time; entity level; 1980s
- **DIS**
  - Virtual; real-time; entity level; 1990s
- **HLA**
  - General purpose; real- or logical-time; entity or aggregate level; 2000s
- **ALSP**
  - Constructive; logical-time; aggregate level; 1990s
- **TENA**
  - LVC; real-time; entity level; 2000s
Overview: DIS

- Real-time virtual distributed simulation
- Simulations exchange standard-defined data
- Standard defines message format, content, protocol
- Network and protocol interface not part of standard

SAF=Semi-Automated Forces
**Attributes: DIS**

- Name: Distributed Interactive Simulation
- Domain: Distributed simulation
- Type: Official
- Form: Technical specification
- Governance: Standards body (IEEE)
- Year: 1990
- Status: Active
- Technical specificity: 3
- Governance formality: 5
- Utility: ?
Overview: HLA

- General purpose distributed simulation
- Federates exchange federation-defined data
- Standard defines interface services
- RTI implementation not part of standard

RTI=Run-Time Infrastructure; LRC=Local RTI Component; FOM= Federation Object Model
Attributes: HLA

- Name: High Level Architecture
- Domain: Distributed simulation
- Type: Official
- Form: Technical specification
- Governance: Standards body (IEEE)
- Year: 1996
- Status: Active
- Technical specificity: 3
- Governance formality: 5
- Utility: ?
Overview: TENA

- Test and training range distributed simulation
- Applications exchange standard-defined data
- Standard includes middleware software
Attributes: TENA

- Name: Test and Training Enabling Architecture
- Domain: Distributed simulation
- Type: Unofficial
- Form: Product line
- Governance: Architecture management group
- Year: 1997
- Status: Active
- Technical specificity: 4
- Governance formality: 3
- Utility: ?
Survey of military M&S standards:
Live training
Overview: CTIA

- Live training
- Product-line software components and protocols
- Commonality promotes interoperability
Attributes: CTIA

- Name: Common Training Instrumentation Architecture
- Domain: Live training
- Type: Unofficial
- Form: Product line
- Governance: Architecture management group
- Year: 2001
- Status: Active
- Technical specificity: 4
- Governance formality: 3
- Utility: ?
Survey of military M&S standards: Object modeling
Overview: RPR FOM

- Entity-level HLA Object Model
- HLA “equivalent” to DIS PDU content
- Widely used and extended
**Attributes: RPR FOM**

- **Name:** Real-time Platform Reference FOM
- **Domain:** Object modeling (in distributed simulation)
- **Type:** Official
- **Form:** Technical specification
- **Governance:** Standards body (SISO)
- **Year:** 1999
- **Status:** Active
- **Technical specificity:** 3
- **Governance formality:** 5
- **Utility:** ?
Survey of military M&S standards: Conceptual modeling
Overview: UML

- Generalized diagrammatic “modeling language” for software engineering
- Standard governed by Object Management Group
- Often used in M&S for conceptual modeling
Attributes: UML

- Name: Unified Modeling Language
- Domain: Conceptual modeling
- Type: Unofficial
- Form: Technical specification
- Governance: Architecture management group
- Year: 1996
- Status: Active
- Technical specificity: 2
- Governance formality: 3
- Utility: ?
Survey of military M&S standards: Synthetic environment
Overview: **SEDRIS**

- Synthetic environment (terrain, ocean, air, space)
- Environmental data representation and interchange
- Software development kit available

Wizards of the Coast
Attributes: SEDRIS

- Name: Synthetic Environment Data Representation and Interchange Specification
- Domain: Synthetic environment
- Type: Official
- Form: Technical specification
- Governance: Standards body (ISO/IEC)
- Year: 2006
- Status: Active
- Technical specificity: 4
- Governance formality: 5
- Utility: ?
Survey of military M&S standards: Simulation development
Overview: DSEEP

- Systems engineering process for developing distributed simulation systems
- Evolved from earlier FEDEP
- Architecture (DIS, HLA, TENA) neutral
Attributes:  **DSEEP**

- **Name:** Distributed Simulation Engineering and Execution Process
- **Domain:** Simulation development
- **Type:** Official
- **Form:** Recommended practice
- **Governance:** Standards body (IEEE)
- **Year:** 2008
- **Status:** Pending
- **Technical specificity:** 2
- **Governance formality:** 5
- **Utility:** ?
Concluding remarks
Preliminary findings

- Methodological difficulties to date
  - Observational bias; all standards studied “successful”
  - Measurement ambiguity; measuring utility uncertain
  - Causation vs correlation; cause-and-effect unclear
  - Confounding events; e.g., Kaminski HLA mandate
- Nevertheless, some observations
  - Longevity and formality correlated
  - Investment and utility correlated
  - Technical inertia significant factor
  - Purchase cost vs development cost weights disproportionate
  - Significant overlaps among military M&S standards

What military M&S standards have not been successful?
How should the utility of a standard be measured?
Standards phase space, with data

Is a standard’s trajectory over time significant?
Open methodological questions

- Questions previously noted
  - What standards should be added/deleted from the study?
  - What standards attributes should be considered?
  - How should the utility of a standard be measured?
  - What military M&S standards have not been successful?
  - Is a standard’s trajectory in phase space over time significant?

- Additional questions
  - Which of the attributes are the “independent variables”?
  - Should successive generations of the same standard (e.g., HLA) be considered separately or together?
Final notes

• Further reading


• Contributions, corrections, critiques, compliments
  ▪ Mikel D. Petty, Ph.D.
  ▪ UAHuntsville Center for Modeling, Simulation, and Analysis
  ▪ 256-824-4368, pettym@uah.edu

• Slides available: http://cmsa.uah.edu/?downloads

• Questions?
End
Backup
**Special interest attributes**

- **Technical specificity**
  - Degree to which the standard defines or provides content which is implementable or executable as written
  - 5-point Likert scale: 5=compilable/executable code, 3=detailed technical specification, 1=descriptive text

- **Governance formality**
  - Degree to which the process of setting and changing the standard is controlled by formally prescribed processes
  - 5-point Likert scale, 5=official standards body, 3=unofficial management group, 1=arbitrary

- **Utility**
  - Usefulness, effectiveness, ubiquity of the standard
  - Benefit (financial, social) of using the standard
  - 5-point Likert scale: 5=?, 3=? 1=?
Special interest attributes Likert values

• Technical specificity
  ▪ 5=Universally used identical software (e.g., MS Word)
  ▪ 4=Compilable/executable code integrated with user code
  ▪ 3=Detailed technical specification
  ▪ 2=Mixture of technical specifications and descriptive text
  ▪ 1=Descriptive text

• Governance formality
  ▪ 5=Standard approved and controlled by official standards body with formal procedures (e.g. IEEE or SISO)
  ▪ 4=Standard pending with official standards body
  ▪ 3=Standard controlled by unofficial management group, with some procedures (e.g., HLA AMG or TENA AMT)
  ▪ 2=Unofficial management group with no procedures
  ▪ 1=Arbitrary control by organization or individual