Full Lifecycle Modeling: Capturing Evaluation and Performance Data in the Enterprise Architecture Knowledgebase

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Overview

- Lifecycle Modeling Language Overview
- Measure of Performance Testing Data Manipulation
- Discrete Time Testing Data Manipulation
- Summary
LIFECYCLE MODELING LANGUAGE (LML) OVERVIEW
Lifecycle Modeling Language (LML)

• LML combines the logical constructs with an ontology to capture information
  – SysML – mainly constructs – limited ontology
  – DoDAF Metamodel 2.0 (DM2) ontology only

• LML simplifies both the “constructs” and ontology to make them more complete, yet easier to use

• Goal: A language that works across the full lifecycle
LML Ontology* Overview

• Taxonomy**: 
  – 12 primary element classes
  – Many types of each element class
    • Action (types = Function, Activity, Task, etc.)

• Relationships: almost all classes related to each other and themselves with consistent words
  – Asset performs Action/Action performed by Asset
  – Hierarchies: decomposed by/decomposes
  – Peer-to-Peer: related to/relates

*Ontology = Taxonomy + relationships among terms and concepts
** Taxonomy = Collection of standardized, defined terms or concepts
LML Taxonomy

• Technical
  – Action
  – Artifact
  – Asset
  – Characteristic
  – Input/Output
  – Link
  – Statement

• Programmatic/Technical
  – Cost
  – Issue
  – Location
    • Physical, Orbital, Virtual
  – Risk
  – Time
    • Duration, Timeframe, Point-in-Time
<table>
<thead>
<tr>
<th>ACTION</th>
<th>Artifact</th>
<th>Asset</th>
<th>Characteristic</th>
<th>Cost</th>
<th>Input/Output</th>
<th>Issue</th>
<th>Link</th>
<th>Location</th>
<th>Risk</th>
<th>Statement</th>
<th>Time</th>
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<td>produces</td>
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<td>incurs</td>
<td>generates</td>
<td>receives</td>
<td>causes</td>
<td>resolves</td>
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<td>incurs</td>
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<td>specifies</td>
<td>specifications</td>
<td>connected</td>
<td>located at</td>
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<td>incurred by</td>
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<td>generated by</td>
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<td>decomposed by</td>
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<td>by</td>
<td>resolves</td>
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<td>by</td>
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<td>located at</td>
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<td>occurred by</td>
</tr>
</tbody>
</table>

- decomposed by/decomposes
- orbited by/orbits
- related to/relates
LML Logic

No constructs – only special types of Actions
MEASURE OF PERFORMANCE
TESTING DATA MANIPULATION
System Instantiation View

System Instantiation
Type = System Instantiation
System (SW/HW)

HW Instantiation
Type = Hardware
HW

SW Instantiation
Type = Software
SW

Assets

System
Type = System
System

System Function
Type = System Function
Function

tests /
tested by
1:M

allocated to /
performs
1:1

Actions

Characteristics

MOE 1
Measure of
Effectiveness (MOE)
Type = MOE
MOE 1

decomposed by /
decomposes
1:M

MOP 1.1
Measure of
Performance (MOP)
Type = MOP
MOP 1.1

MOP 1.2
Measure of
Performance (MOP)
Type = MOP
MOP 1.2

MOP 1.3
Measure of
Performance (MOP)
Type = MOP
MOP 1.3

MOP Test Result
Type = MOP Occurrence
MOP Test Result
Type = MOP Occurrence
MOP Test Result
Type = MOP Occurrence

MOP 1.1 [System (SW/HW)]

MOP 1.2 [System (SW/HW)]

MOP 1.3 [System (SW/HW)]

instantiates /
instanitiated by
1:M

instanitates /
instanitiated by
1:M

instanitates /
instanitiated by
1:M

specifies /
specified by
1:1

specifies /
specified by
1:1

specifies /
specified by
1:1
Measure of Performance (MOP) View
Determining Top Configuration for Measure of Performance Tests

1. Determine improvement direction
   - Measure of Performance (MOP) Type = MOP
   - MOP Test Result
     - MOP Test Result
       - System Instantiation
         - System Instantiation
           - HW Instantiation
             - HW Instantiation
               - SW Instantiation
                 - SW Instantiation
                   - SW Instantiation

2. Determine MOP Test Results mapped to Measure of Performance

3. Evaluate
   - Determine best value MOP Test Result

4. Determine systems mapped to MOP Test Results

5. Determine hardware / software configuration

Most Significant System Instantiation

Hardware / Software Configuration
Measure of Performance Summarization

1. Determine Measure of Performance name and description

2. Determine MOP Test Results mapped to Measure of Performance

3. Determine MOP Test Result value

4. Determine System Instantiation name

5. Determine hardware / software configuration

Measure of Performance (MOP)
Type = MOP
MOP 1.1

MOP Test Result
Type = MOP Occurrence
MOP 1.1 [System (SW1/HW1)]

determinates / instantiated by

MOP Test Result
Type = MOP Occurrence
MOP 1.1 [System (SW2/HW2)]

determinates / instantiated by

MOP Test Result
Type = MOP Occurrence
MOP 1.1 [System (SW3/HW3)]

determinates / instantiated by

System Instantiation
Type = System Instantiation
System (SW1/HW1)

determinates / instantiated by

System Instantiation
Type = System Instantiation
System (SW2/HW2)

determinates / instantiated by

System Instantiation
Type = System Instantiation
System (SW3/HW3)

determinates / instantiated by

SW Instantiation
Type = Software
SW1

determinates / instantiated by

SW Instantiation
Type = Software
SW2

determinates / instantiated by

SW Instantiation
Type = Software
SW3

determinates / instantiated by

HW Instantiation
Type = Hardware
HW1

determinates / instantiated by

HW Instantiation
Type = Hardware
HW2

determinates / instantiated by

HW Instantiation
Type = Hardware
HW3

determinates / instantiated by

Measure of Performance Summarization
System Instantiation Summarization

1. Determine System Instantiation name
   Type = System Instantiation System (SW/HW)

2. Determine hardware / software configuration
   HW Instantiation
   Type = Hardware
   HW
   SW Instantiation
   Type = Software
   SW

3. Determine MOP Test Results mapped to System Instantiation
   MOP Test Result
   Type = MOP Occurrence
   MOP 1.1 [System (SW/HW)]
   instantiates / instantiated by

   MOP Test Result
   Type = MOP Occurrence
   MOP 1.2 [System (SW/HW)]
   instantiates / instantiated by

   MOP Test Result
   Type = MOP Occurrence
   MOP 1.3 [System (SW/HW)]
   instantiates / instantiated by

4. Determine MOP Test Result value

5. Determine Measure of Performance name and description

System Instantiation Summarization
DCP MOP Test Results

Conduct Measure of Performance Tests

System A DCP MOP Test Results

Enter ➔ XLS ➔ Convert ➔ CSV
System A MOP Test Occurrence Excel Spreadsheet ➔ Import CSV File

System B DCP MOP Test Results

Enter ➔ XLS ➔ Convert ➔ CSV
System B MOP Test Occurrence Excel Spreadsheet ➔ Import CSV File

System n DCP MOP Test Results

Enter ➔ XLS ➔ Convert ➔ CSV
System n MOP Test Occurrence Excel Spreadsheet ➔ Import CSV File

Import MOP Test Occurrence Script ➔ EA Model
DCP Measure of Performance Document Creation

- **EA Model**
  - Extract
  - Measure of Performance Testing Scripts

- **MOE Summarization**
  - CSV File
  - Excel Spreadsheet
  - Convert to XLS

- **MOE Top System Instantiations by MOP**
  - CSV File
  - Word File
  - Convert to DOC

- **System Instantiation Summarization**
  - CSV File
  - Excel Spreadsheet
  - Convert to XLS

- **MOE for Fixed Element**
  - CSV File
  - Excel Spreadsheet
  - Convert to XLS

- **MOE for System Instantiations**
  - CSV File
  - Excel Spreadsheet
  - Convert to XLS

- **MOE Top System Instantiations by MOP**
  - CSV File
  - Excel Spreadsheet
  - Convert to XLS
DISCRETE TIME TESTING DATA MANIPULATION
Discrete Time Test View

**Assets**

- **System**
  - Type: System
  - System

- **System Instantiation**
  - Type: System Instantiation
  - System (SW/HW)

- **HW Instantiation**
  - Type: Hardware
  - HW

- **SW Instantiation**
  - Type: Software
  - SW

**Actions**

- **System Function**
  - Type: System Function
  - Function

**Characteristics**

- **Discrete Time Test**
  - Type: Discrete Time Test
  - DTT 1

- **Discrete Time Test Occurrence**
  - Type: Discrete Time Test Occurrence
  - DTT 1 [System (SW/HW)]

- **Result**
  - Type: Discrete Time Test Value
  - DTT 1 [System (SW/HW)]

- Discrete Time
  - Type: Relative or Absolute
  - DTT 1 [System (SW/HW)]

**Times**

- **Result**
  - Type: Discrete Time Test Value
  - DTT 1 [System (SW/HW)]

- **Result**
  - Type: Discrete Time Test Value
  - DTT 1 [System (SW/HW)]

- **Result**
  - Type: Discrete Time Test Value
  - DTT 1 [System (SW/HW)]
Extract Time-Value Pair Sequence

1. Determine DTT occurrence name and units
2. Determine system occurrence name
3. Determine hardware / software configuration
4. Determine DTT results mapped to DTT occurrence
5a. Determine result value
5b. Determine time value
6. Sequence Time-Value Pairs

- **System Instantiation**
  - Type = System Instantiation
  - System (SW/HW)

- **HW Instantiation**
  - Type = Hardware
  - HW

- **SW Instantiation**
  - Type = Software
  - SW

- **Discrete Time Test Occurrence**
  - Type = Discrete Time Test Occurrence
  - DTT 1 [System (SW/HW)]

- **Discrete Time Test Result**
  - Type = Discrete Time Test Value
  - DTT 1 [System (SW/HW)-1]

- **Discrete Time Test Result**
  - Type = Discrete Time Test Value
  - DTT 1 [System (SW/HW)-2]

- **Discrete Time Test Result**
  - Type = Discrete Time Test Value
  - DTT 1 [System (SW/HW)-3]

- **Discrete Time**
  - Type = Relative or Absolute
  - DTT 1 [System (SW/HW)-1]

  - DTT 1 [System (SW/HW)-2]

  - DTT 1 [System (SW/HW)-3]

  - **Time-Value Pairs**
Instantaneous Rate Determination

Time-Value Pairs

- Discrete Time Test Result (t0) vs. Discrete Time (t0)
- Discrete Time Test Result (t1) vs. Discrete Time (t1)
- Discrete Time Test Result (t2) vs. Discrete Time (t2)
- Discrete Time Test Result (t3) vs. Discrete Time (t3)
- Discrete Time Test Result (t4) vs. Discrete Time (t4)
- Discrete Time Test Result (tn-2) vs. Discrete Time (tn-2)
- Discrete Time Test Result (tn-1) vs. Discrete Time (tn-1)
- Discrete Time Test Result (tn) vs. Discrete Time (tn)

Instantaneous Rates

- Instantaneous Rate (t1)
- Instantaneous Rate (t2)
- Instantaneous Rate (t3)
- Instantaneous Rate (t4)
- Instantaneous Rate (tn-2)
- Instantaneous Rate (tn-1)
- Instantaneous Rate (tn)
Cumulative Rate Determination

Time-Value Pairs

Discrete Time Test Result \((t0)\) - Discrete Time \((t0)\)

Discrete Time Test Result \((t1)\) - Discrete Time \((t1)\)

Discrete Time Test Result \((t2)\) - Discrete Time \((t2)\)

Discrete Time Test Result \((t3)\) - Discrete Time \((t3)\)

Discrete Time Test Result \((t4)\) - Discrete Time \((t4)\)

Discrete Time Test Result \((tn-2)\) - Discrete Time \((tn-2)\)

Discrete Time Test Result \((tn-1)\) - Discrete Time \((tn-1)\)

Discrete Time Test Result \((tn)\) - Discrete Time \((tn)\)

Cumulative Rates

Cumulative Rate \((t1)\)

Cumulative Rate \((t2)\)

Cumulative Rate \((t3)\)

Cumulative Rate \((t4)\)

Cumulative Rate \((tn-2)\)

Cumulative Rate \((tn-1)\)

Cumulative Rate \((tn)\)
Instantaneous Acceleration Determination

Time-Value Pairs

Discrete Time Test Result \((t0)\)

Discrete Time \((t1)\)

Discrete Time Test Result \((t2)\)

Discrete Time \((t2)\)

Discrete Time Test Result \((t3)\)

Discrete Time \((t3)\)

Discrete Time Test Result \((t4)\)

Discrete Time \((t4)\)

Discrete Time Test Result \((t_{n-2})\)

Discrete Time \((t_{n-2})\)

Discrete Time Test Result \((t_{n-1})\)

Discrete Time \((t_{n-1})\)

Discrete Time Test Result \((t_n)\)

Discrete Time \((t_n)\)

Instantaneous Rates

Instantaneous Rate \((t1)\)

Instantaneous Rate \((t2)\)

Instantaneous Rate \((t3)\)

Instantaneous Rate \((t4)\)

Instantaneous Rate \((t_{n-2})\)

Instantaneous Rate \((t_{n-1})\)

Instantaneous Rate \((t_n)\)

Instantaneous Accelerations

Instantaneous Acceleration \((t2)\)

Instantaneous Acceleration \((t3)\)

Instantaneous Acceleration \((t4)\)

Instantaneous Acceleration \((t_{n-2})\)

Instantaneous Acceleration \((t_{n-1})\)

Instantaneous Acceleration \((t_n)\)
Discrete Time Test Results

Conduct Discrete Time Tests

System A Discrete Time Test Results
- Enter
- Convert
- Import CSV File

System B Discrete Time Test Results
- Enter
- Convert
- Import CSV File

System n Discrete Time Test Results
- Enter
- Convert
- Import CSV File

Import Discrete Time Test Occurrence Scripts

EA Model

SPEC INNOVATIONS
Discrete Time Test (DTT) Document Creation

Diagram showing the process of creating DTT documents from an EA Model, including extraction of scripts and conversion to CSV and Excel files.
Summary

- Evaluation and performance data can be captured in Enterprise Architecture (EA) models
- End-to-end traceability can be ensured by capturing the verification portion of the system development lifecycle
- Improved LML schema (next slides)
LML Taxonomy – Adjustments for T&E

- Technical
  - Action
  - Artifact
  - Asset
  - Characteristic
    - Technical Measurement
  - Input/Output
  - Link
  - Statement

- Programmatic/Technical
  - Cost
  - Issue
  - Location
    - Physical, Orbital, Virtual
  - Risk
  - Time
    - Duration, Timeframe, Point-in-Time
Technical Measurement Subclass

- Adds attributes to the Characteristic Class
  - Improvement Direction: indicates the direction of improvement
  - Objective Value: the goal for this element.
  - Projected Value: expected value to be achieved.
  - Threshold Value: minimum acceptable value
  - Tolerance: percentage of the value that forms the positive and negative tolerance bands.
  - Type: COI, Criteria, Discrete Time Test, Discrete Time Test Value, KPP, MOE, MOP, MOS, Technical Measurement, TPM, TPM Plan: describes various kinds of Technical Measurements