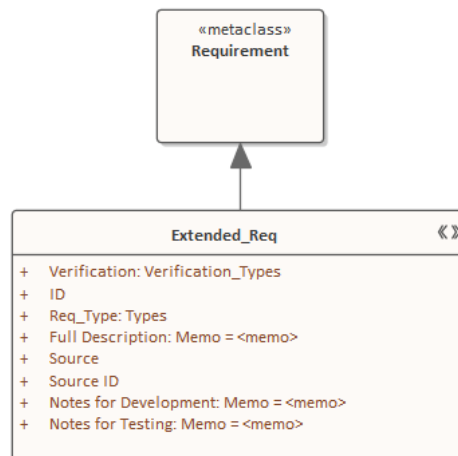


Extending the Requirement Type

An MDG Technology for adding attributes to manage requirements for systems and software engineering projects



Who Am I

- Systems Engineer
- Modeling Consultant
- Sparx representative to the OMG
- Member of the Requirements Working Group at INCOSE
 - A special thank you to Mark Harris and Lou Wheatcraft of the RWG for their reviews of this presentation

Abstract

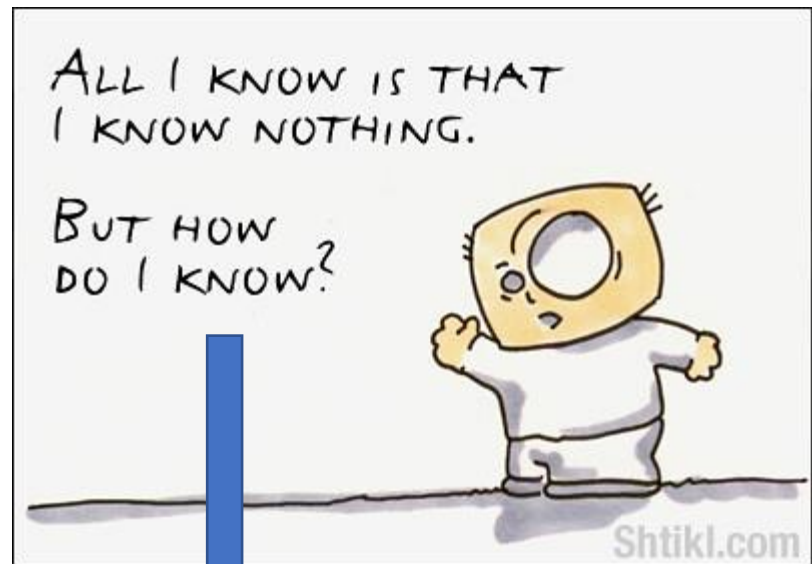
- Because UML[®] does not define a requirement element type, Enterprise Architect includes one in the Core Extensions set of elements. SysML[®] includes a requirement element type that expands the EA type with two attributes. In the Guide for Writing Requirements, the INCOSE Requirements Working Group has defined a further expansion of the numbers and types of attributes that need to be considered in requirements engineering. In the software arena, Karl Wiegiers has written extensively about software requirements and what you need to know about them. This presentation describes an MDG Technology that addresses the INCOSE recommendations and maps them to Wiegiers' recommendations for attributes to capture about your requirements. We will explore both the creation and the use of the extended requirement elements.

The UML Requirement Element

UML 1.x



UML 2.x



EA told me so

The EA Requirement Element

Properties

Element Tags

Name	MTTR < 1 hour
General	
Type	Requirement
Stereotype	
Alias	QOS-01
Keywords	
Status	Proposed
Version	1.0
Requirement	
Abstract	<input type="checkbox"/>
Active	<input type="checkbox"/>
Difficulty	Medium
Final Specialization	<input type="checkbox"/>
Leaf	<input type="checkbox"/>
Priority	Medium
Visibility	Public
Project	
Author	J.D. Baker
Package	Quality of Service
Phase	1.0
Complexity	Easy
Created	5/9/2020 9:55:51 AM
Modified	5/9/2020 9:55:51 AM
Language	<none>
Filename	
GUID	{297BCB47-4F5D-4844-80CC-4DF6...
WebEA	

Alias
Optional alias value

Core Extensions



Location: Internal Technology

Description








Requirements, maintenance, analysis, user interface, data modeling, documentation, business modeling and test domain diagrams.

Web Site

<http://www.sparxsystems.com>

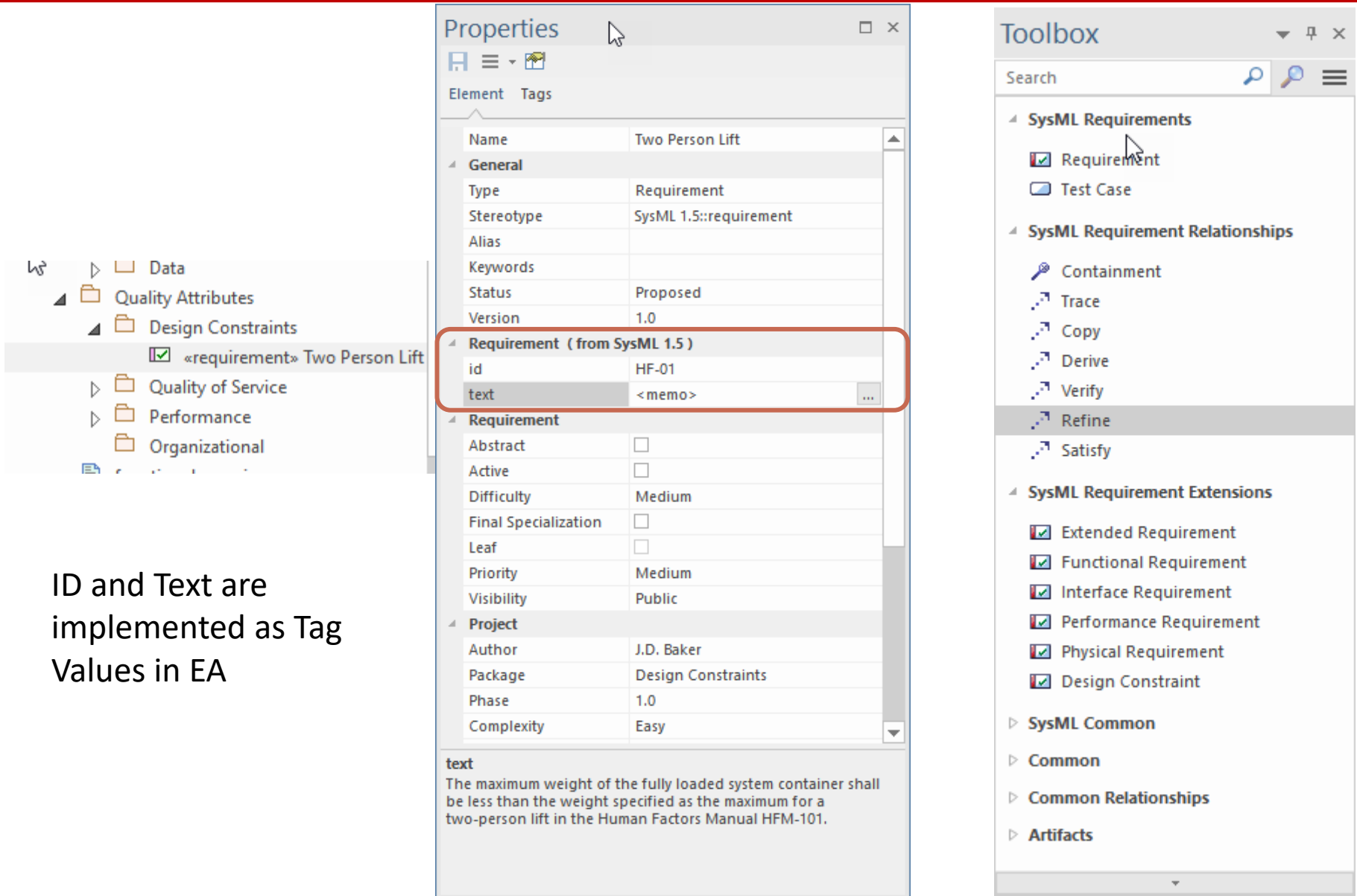
- Quality Attributes
- Design Constraints
- Quality of Service
 - MTTR < 1 hour
- Performance
- Organizational

Notes

B *I* U       

In the event of a loss of internet connectivity, the mean time to restore connectivity shall be less than one hour from the initial report.

SysML Requirements

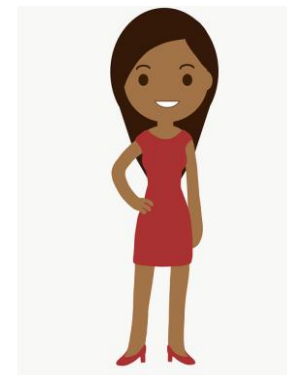
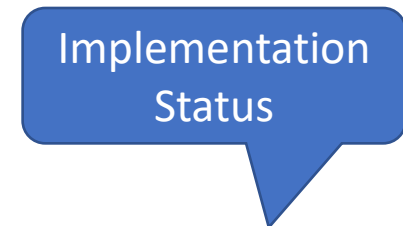
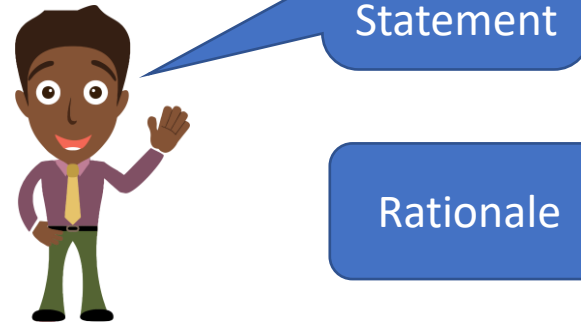
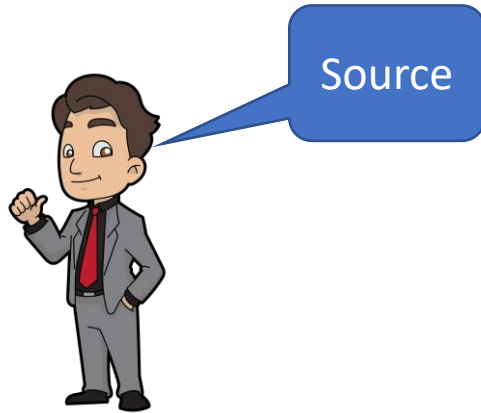


The screenshot displays the Enterprise Architect interface for configuring SysML requirements. On the left, a tree view shows the project structure, with '«requirement» Two Person Lift' selected under 'Design Constraints'. The central 'Properties' window shows the configuration for this requirement, with the 'Requirement (from SysML 1.5)' section highlighted by a red box. The 'id' is 'HF-01' and the 'text' is '<memo>'. The right 'Toolbox' window shows various SysML requirement types and relationships, with 'Requirement' and 'Test Case' checked under 'SysML Requirements'.

Element	Value
Name	Two Person Lift
General	
Type	Requirement
Stereotype	SysML 1.5::requirement
Alias	
Keywords	
Status	Proposed
Version	1.0
Requirement (from SysML 1.5)	
id	HF-01
text	<memo>
Requirement	
Abstract	<input type="checkbox"/>
Active	<input type="checkbox"/>
Difficulty	Medium
Final Specialization	<input type="checkbox"/>
Leaf	<input type="checkbox"/>
Priority	Medium
Visibility	Public
Project	
Author	J.D. Baker
Package	Design Constraints
Phase	1.0
Complexity	Easy

ID and Text are implemented as Tag Values in EA

But We Need to Know More



ATTRIBUTES TO HELP DEFINE THE REQUIREMENT AND ITS INTENT

- A1 - Rationale
- A2 - System of Interest (SOI) Primary Verification Method
- A3 - SOI Verification Approach
- A4 - Trace to Parent Requirement
- A5 - Trace to Source
- A6 - Condition of Use
- A7 - States and Modes
- A8 - Allocation

ATTRIBUTES ASSOCIATED WITH THE REQUIREMENT

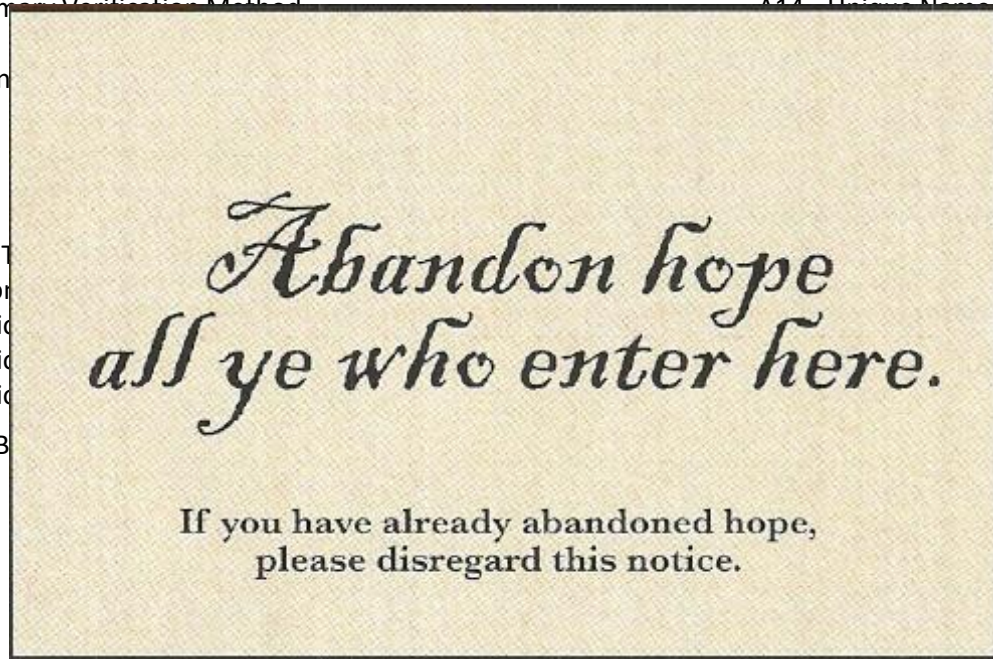
- A9 - SOI Verification or Validation Method
- A10 - SOI Verification or Validation Method
- A11 - SOI Verification or Validation Method
- A12 - SOI Verification or Validation Method

ATTRIBUTES TO SHOW APPLICABILITY

- A39 - Applicability
- A40 - Region
- A41 - Country
- A42 - State/Province
- A43 - Application
- A44 - Market Segment
- A45 - Business Unit
- A46 - Business (Product) Line

ATTRIBUTES TO HELP MAINTAIN THE REQUIREMENTS

- A13 - Unique Identifier
- A14 - Unique Name



- A15 - Priority
- A16 - Status
- A17 - Date Entered
- A18 - Date Modified
- A19 - Date Deleted
- A20 - Date Verified
- A21 - Date Validated
- A22 - Date Verified
- A23 - Date Verified
- A24 - Date Verified
- A25 - Date Verified
- A26 - Date Verified
- A27 - Date Verified
- A28 - Date Verified
- A29 - Date Verified
- A30 - Date Verified
- A31 - Date Verified
- A32 - Date Verified
- A33 - Criticality or Essentiality
- A34 - Risk (of implementation)
- A35 - Risk (Mitigation)
- A36 - Key Driving Requirement (KDR)
- A37 - Additional Comments
- A38 - Type/Category

THERE'S MORE!! *“This list is not exhaustive”*

What Else Does GfWR Say?



“It is not the intention that an organization should include all of these attributes when defining needs or requirement expressions.”

“As with the use of all information, a “lean” approach should be taken when deciding which attributes will be used - don’t include a specific attribute unless you, your team, or your management has asked for that attribute and will be using that attribute in some manner to manage the project and set of requirements.”

First Group

- **ATTRIBUTES TO HELP DEFINE THE REQUIREMENT AND ITS INTENT**
 - **A1 – Rationale**
 - A separate note in SysML
 - **A2 - System of Interest (SOI) Primary Verification Method**
 - **A3 - SOI Verification Approach**
 - **A4 - Trace to Parent Requirements**
 - An attribute implemented as a relationship in EA
 - **A5 - Trace to Source**
 - An attribute that could be implemented as a relationship in EA
 - **A6 - Condition of Use**
 - Still trying to figure out how this is an attribute
 - **A7 - States and Modes**
 - **A8 - Allocation**

Second Group

- ATTRIBUTES ASSOCIATED WITH THE SOI AND ITS VERIFICATION
 - A9 - SOI Verification Level
 - A10 - SOI Verification Phase
 - A11 - SOI Verification Results
 - A12 - SOI Verification Status



Baker sez – this information is better captured as a verification case, not isolated with the requirement element.

Third Group

- ATTRIBUTES TO HELP MAINTAIN THE REQUIREMENTS
- **A13 - Unique Identifier**
- **A14 - Unique Name**
- **A15 - Originator/Author**
- **A16 - Date Requirement Entered**
- A17 – Owner
 - *As long as it's not a person's name*
- A18 – Stakeholders
 - *RACI Matrix*
- A19 - Change Board
- A20 - Change Status
 - *Use a separate Change element*
- A21 - Version Number
- A22 - Approval Date
- A23 - Date of Last Change
- A24 - Stability
- A25 - Responsible Person
 - *No person's names*
- A26 – Need or Requirement Verification Status
- A27 – Need or Requirement Validation Status
- A28 - Status (of the need or requirement)
- A29 - Status (of implementation)
- A30 - Trace to Interface Definition
- A31 - Trace to Peer Requirements
- **A32 - Priority**
- **A33 – Criticality or Essentiality**
- **A34 – Risk (of implementation)**
 - *Not embedded in the requirement*
- A35 – Risk (Mitigation)
- A34 - Key Driving Need or Requirement (KDN/KDR)
- **A35 - Additional Comments**
 - *Notes in EA*
- **A36 - Type/Category**

Fourth (and Last) Group

- ATTRIBUTES TO SHOW APPLICABILITY AND ALLOW REUSE
 - A39 - Applicability
 - A40 - Region
 - A41 - Country
 - A42 - State/Province
 - A43 - Application
 - A44 - Market Segment
 - A45 - Business Unit
 - A46 - Business (Product) Line

Wiegiers Suggestions

- Date the requirement was created (A16)
- Current version number of the requirement (A21)
- Author who wrote the requirement (A15)
- Priority (A32)
- Status (A28)
- Origin or source of the requirement (A5)
- Rationale behind the requirement (A1)
- Release number or iteration to which the requirement is allocated (A29?)
- Stakeholder to contact with questions or to make decisions about proposed changes (A17 and 18)
- Validation method to be used or acceptance criteria (A3)
- “Selecting too many requirements attributes can overwhelm a team. They won’t supply all attribute values for all requirements and won’t use the attribute information effectively. Start with perhaps three or four key attributes. Add others only when you know how they will add value.”
- Chapter 27, Software Requirements 3rd ed. by Karl E Wiegiers and Joy Beatty Published by Microsoft Press, 2013

Our Requirement Metadata

- Date the requirement was created (A16)
 - Current version number of the requirement (A21)
 - Author who wrote the requirement (A15)
 - Priority (A32)
 - Status (A28)
 - Origin or source of the requirement (A5)
 - Rationale behind the requirement (A1)
 - Release number or iteration to which the requirement is allocated (A29?)
 - Stakeholder to contact with questions or to make decisions about proposed changes (A17 and 18)
 - Validation method to be used or acceptance criteria (A2)
- Created property
 - Version property
 - Author property
 - Priority property
 - Status property
 - extension
 - extension
 - Phase property
 - extension
 - extension



Where do we capture the attributes in EA?

Not Sufficient!



Our Requirement Metadata

- Requirement ID
- Requirement Name/Short Text
- Requirement Statement
- Verification
 - Analysis
 - Inspection
 - Demonstration
 - Test
- Type (e.g. FURPS+)
 - Functional
 - Usability
 - Reliability
 - Performance
 - Supportability
- Alias property is often used
- Name property
- Extension
- Extension
- Extension

7 Attributes Noted as “Extension”

- Rationale
 - A stereotyped comment in SysML
 - Not sufficient
- Source
- Stakeholders (RACI)
- Validation Method
- Verification Method
 - A Tag Value
 - A Relationship matrix
 - ?
 - Tag Value
 - The profile also includes the need for a verification requirement
- Requirement Statement
- Requirement Type
 - Tag Value
 - Tag Value

Requirement traceability

- The Requirements Traceability Matrix (RTM) is used to control & track system level, allocated and derived requirements.
- A Requirements Analysis Checklist and the Requirements Management Planning Template may describe the RTM and the RVTM.
- The RTM and RVTM are not distinct files. They are created as needed by EA
- Why use requirements traceability?
 - Ensure that the system does what it is supposed to do
 - Ensure that the system does only what it is supposed to do
 - Assess impact of change
 - Find related requirements
 - Inspect related requirements

Relationship Matrix

Start Page | Relationship Matrix x

Source: Functional ... Type: Requirement Link Type: Trace Profile: req_demo3
Target: Subsystems ... Type: Component Direction: Target -> Source Overlays: <None>

Target +	Alert Management	Data Acquisition and Processing	Data Exchange	Data Management	Maintenance	Quality Control
+ Source						
accept atmospheric condition data derived from atm		↑				
accept atmospheric condition data derived from atm		↑				
accept environmental data derived from images.			↑			
accept environmental data derived from images.			↑			
accept surface condition data derived from surface						
accept weather hazard reports containing the hazar		↑				
acquire and disseminate National Weather Service (↑				
allow access to new surface transportation related						
Based on CMMI						

Colors on the matrix highlight the elements which have no relationships of the designated Link Type and Direction. Other relationships could exist.

An alternate visualization of the requirements and one of their trace relationships

Stakeholder Matrix

Source: Functional ... Type: Requirement ... Link Type: Trace ... Profile: raci ...

Target: Actors ... Type: Actor ... Direction: Target -> Source ... Overlays: RACI ...

Target +	Data Collector	Environmental Sensing Station	Fleet Operations	Information Service Provider	Invehicle Sensing Station	Management Operations	NOAA ISOS	NWS Operator	Operations Supervisor	Operator	Weather Service Provider
+ Source											
accept atmospheric condition data derived from atm	R	A	C	I							
accept atmospheric condition data derived from atm	I	R	A	C							
accept environmental data derived from images.	C	I	R	A							
accept environmental data derived from images.	A	C	I	R							
accept surface condition data derived from surface											

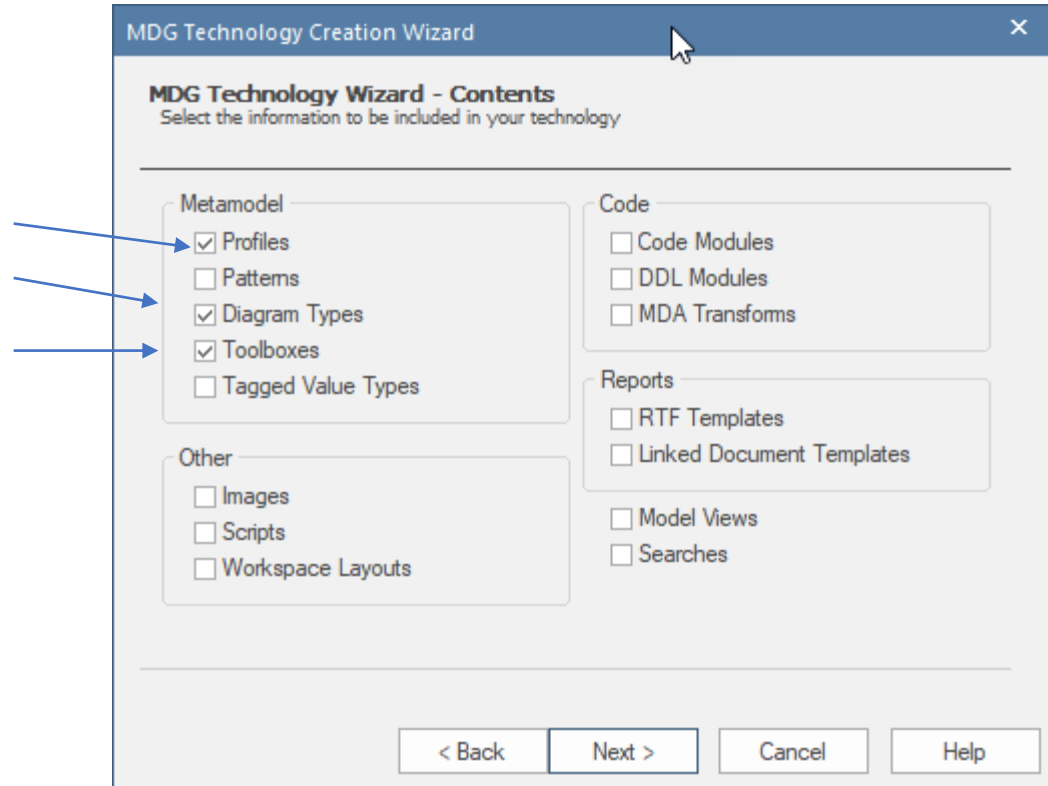
Real UML relationships exist behind the matrix overlay.

Other metadata

- Risks
 - IN EA these can be captured as elements
 - More flexibility in reporting
 - The same risk can be associated with multiple requirements
- Verification level
 - Adding test cases to the model can provide more than just a level identifier
- Tracking “Deleted” requirements could be a challenge since they need to be present in the model but flagged as deleted

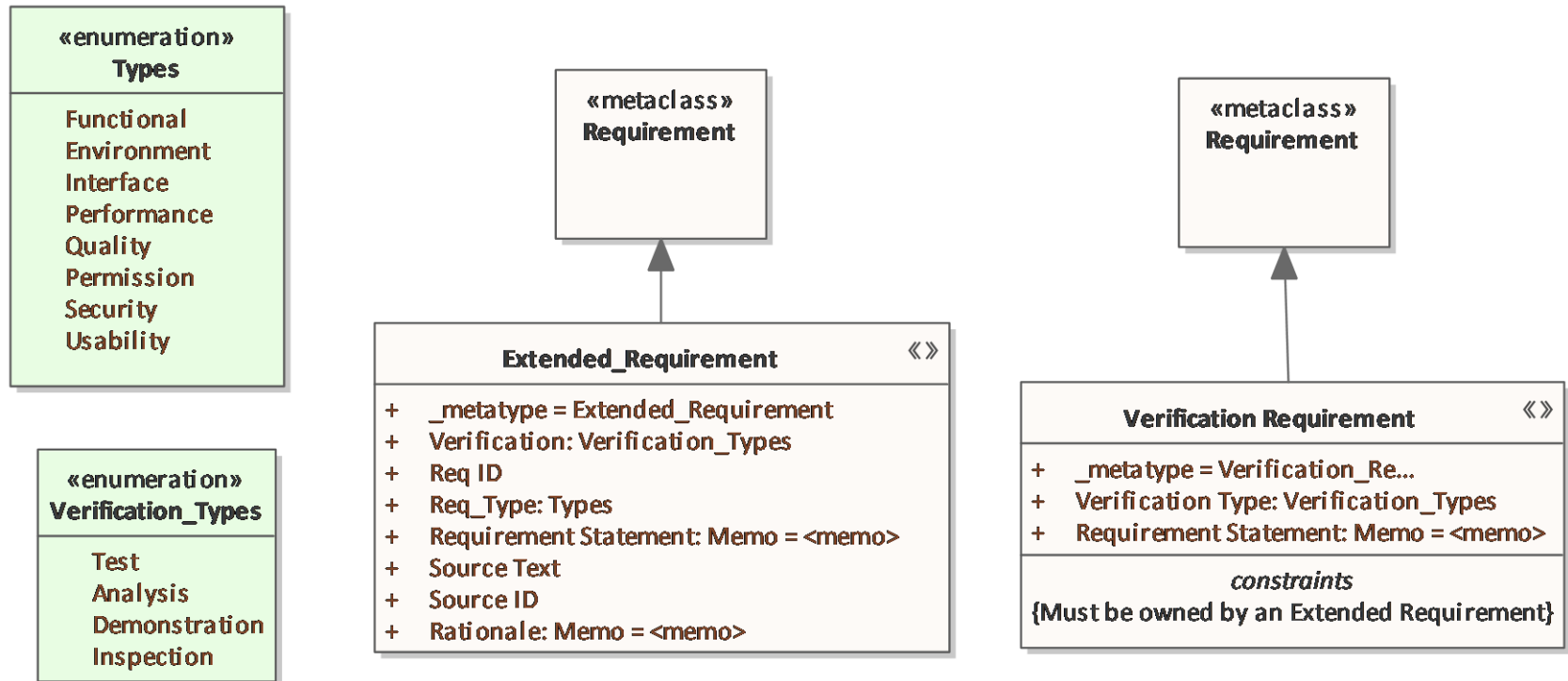
Model Driven Generation

An EA extension mechanism that is based on models and metamodels

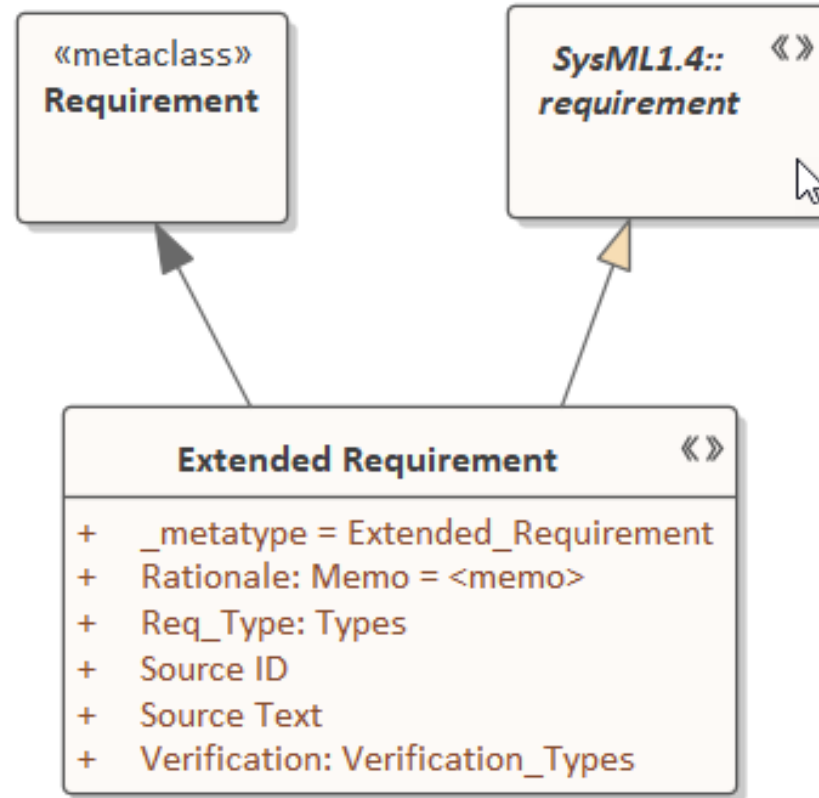


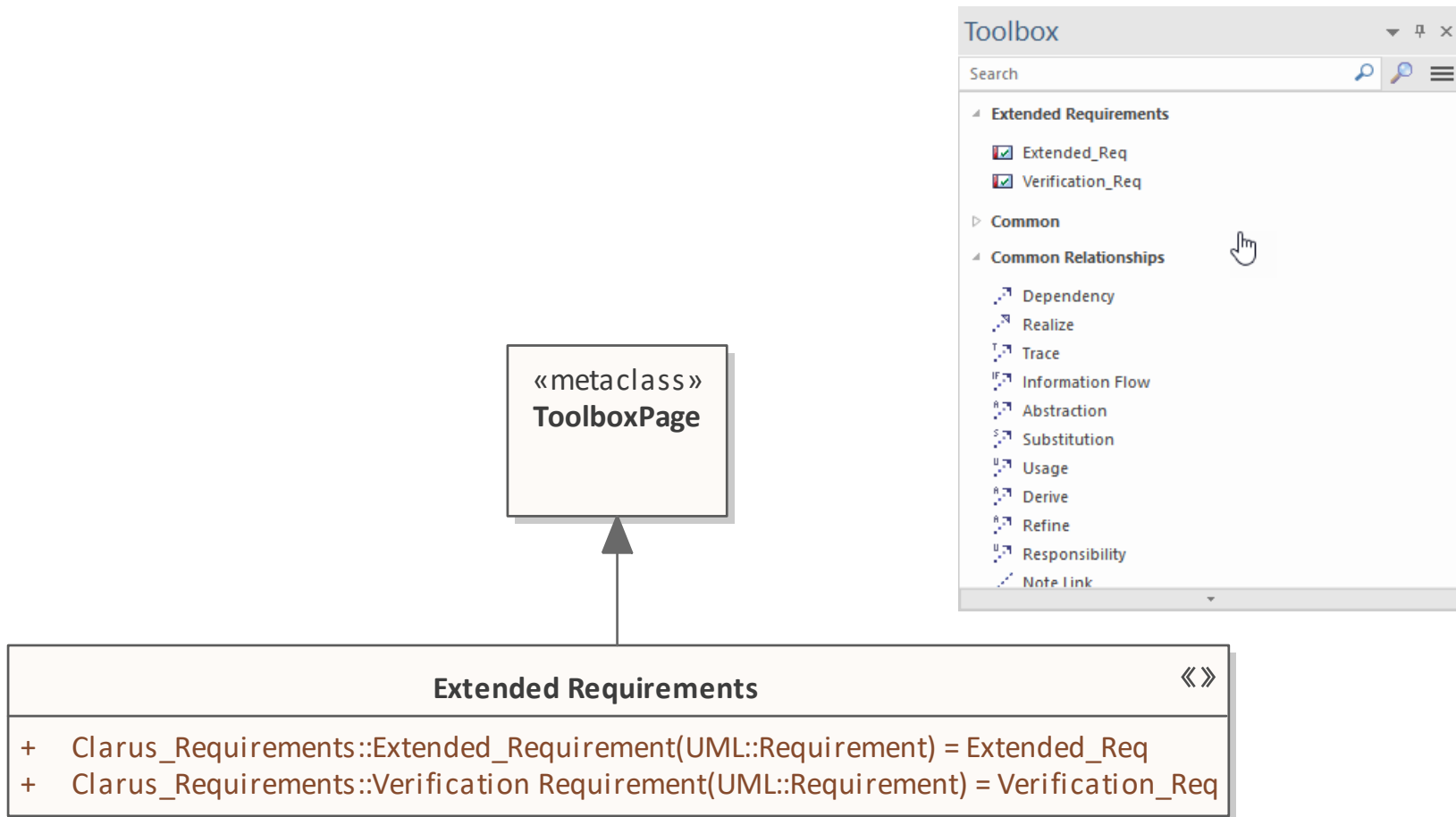
The MDG Technology Model

 [Help pages on developing UML Profiles](#)



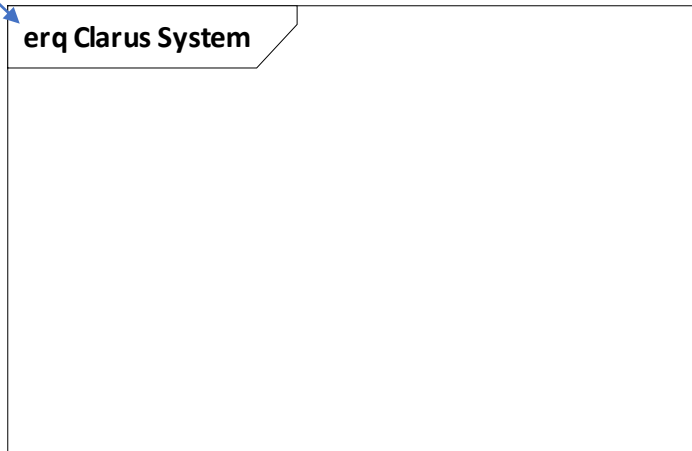
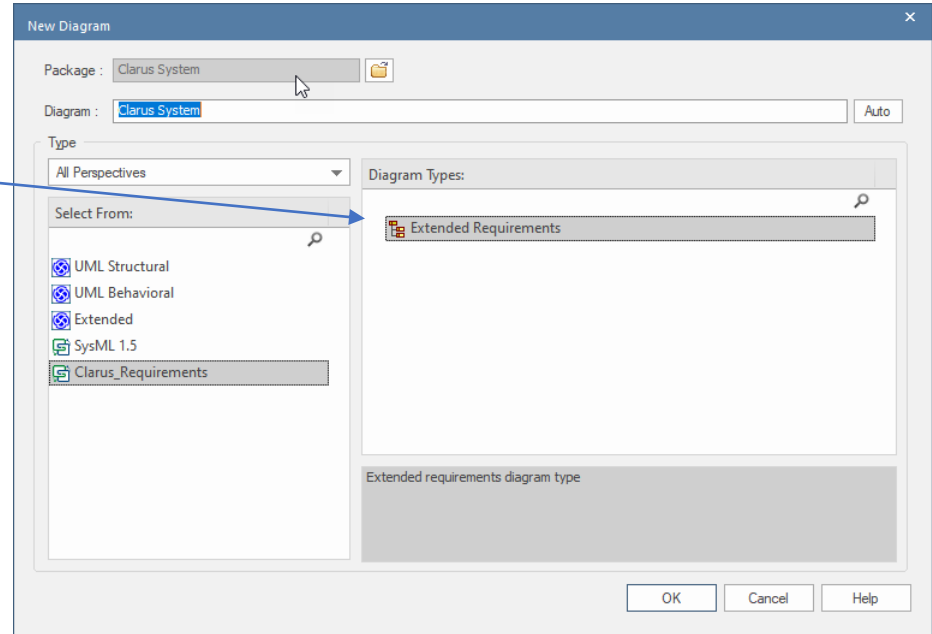
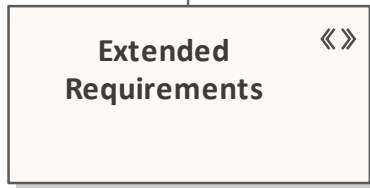
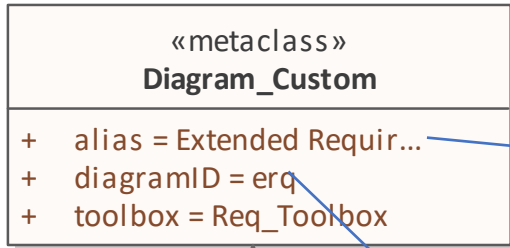
The SysML Variant



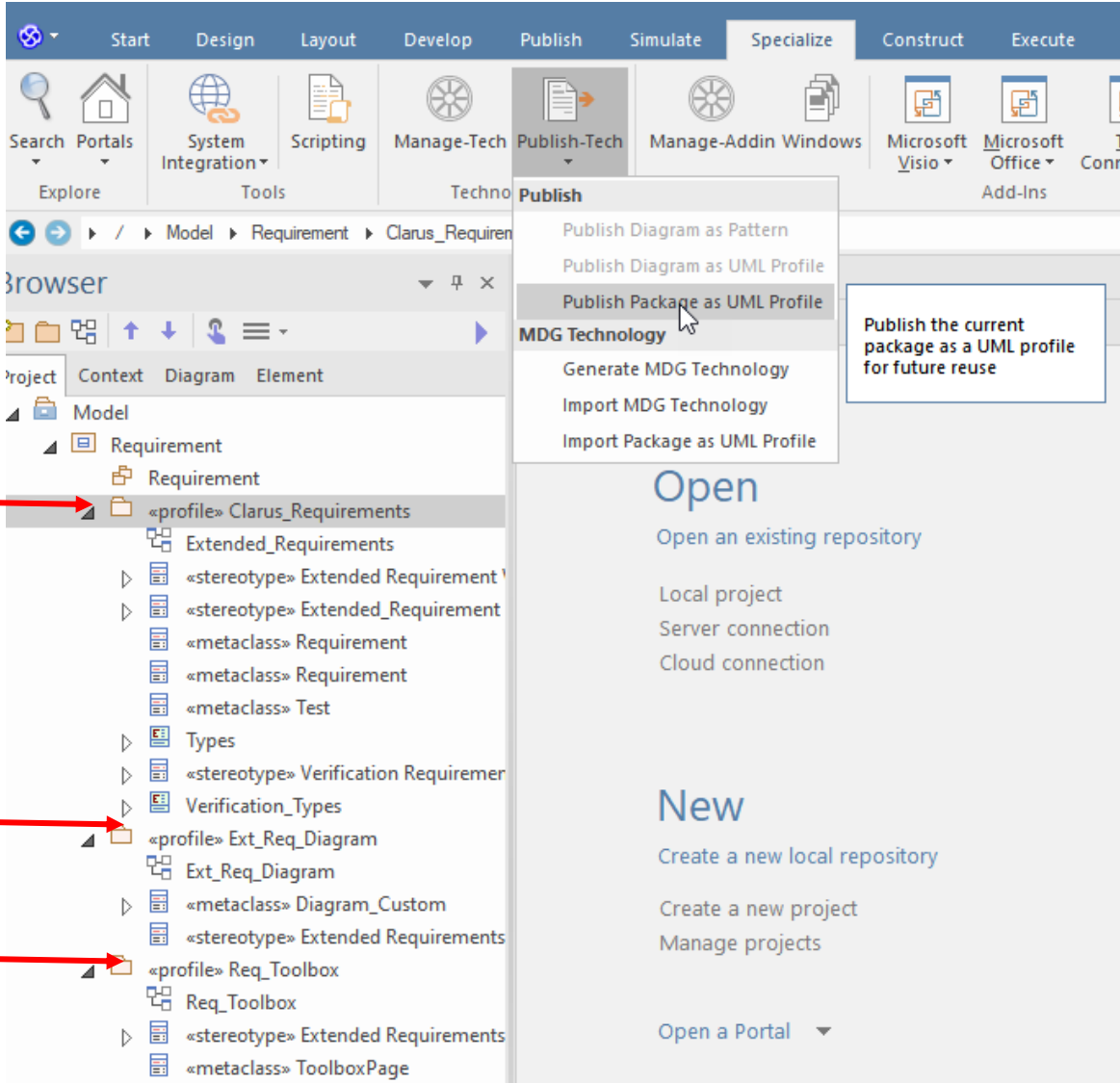


There are only two elements here, but we could add elements from UML or relationships to the toolbox page

The Diagram Profile



Creating the MDG Technology



The screenshot shows the Enterprise Architect interface. The 'Publish' menu is open, showing options like 'Publish Diagram as Pattern', 'Publish Diagram as UML Profile', 'Publish Package as UML Profile', 'MDG Technology', 'Generate MDG Technology', 'Import MDG Technology', and 'Import Package as UML Profile'. A callout box points to 'Publish Package as UML Profile' with the text: 'Publish the current package as a UML profile for future reuse'. The Project Browser on the left shows a hierarchy: Model > Requirement > Requirement > «profile» Clarus_Requirements. Red arrows point to 'UML' (pointing to the profile), 'Diagram' (pointing to the diagram package), and 'Toolbox' (pointing to the Req_Toolbox package).

UML → «profile» Clarus_Requirements

Diagram → «profile» Ext_Req_Diagram

Toolbox → «profile» Req_Toolbox

Publish menu options:

- Publish Diagram as Pattern
- Publish Diagram as UML Profile
- Publish Package as UML Profile
- MDG Technology**
- Generate MDG Technology
- Import MDG Technology
- Import Package as UML Profile

Callout for 'Publish Package as UML Profile': Publish the current package as a UML profile for future reuse

Open

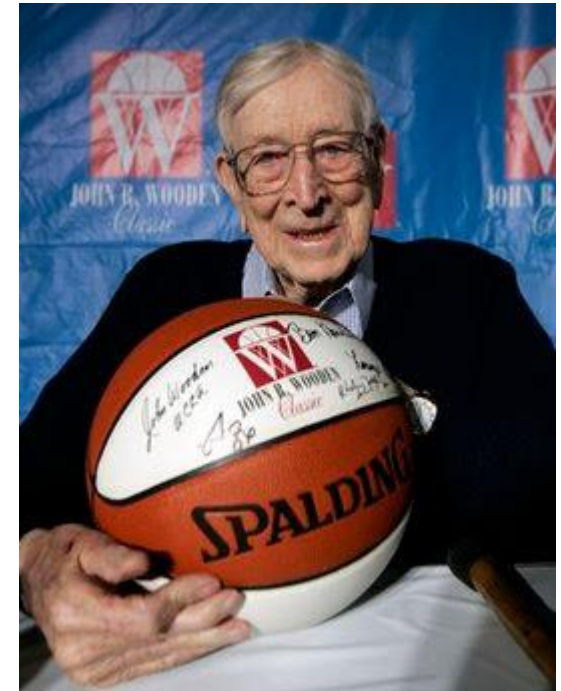
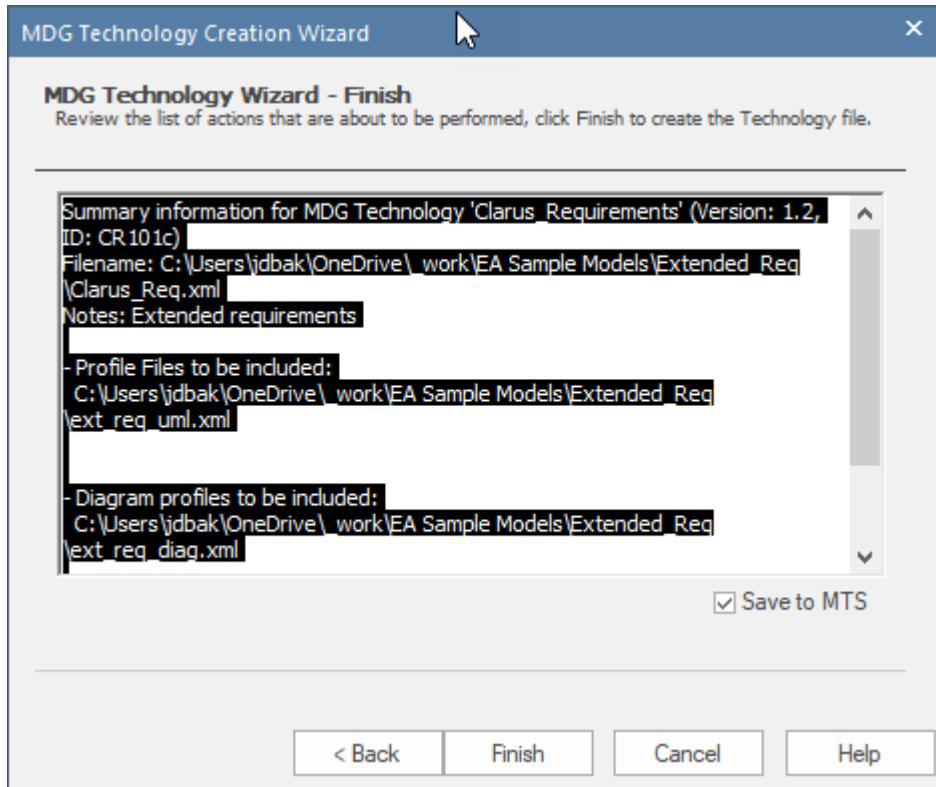
- Open an existing repository
- Local project
- Server connection
- Cloud connection

New

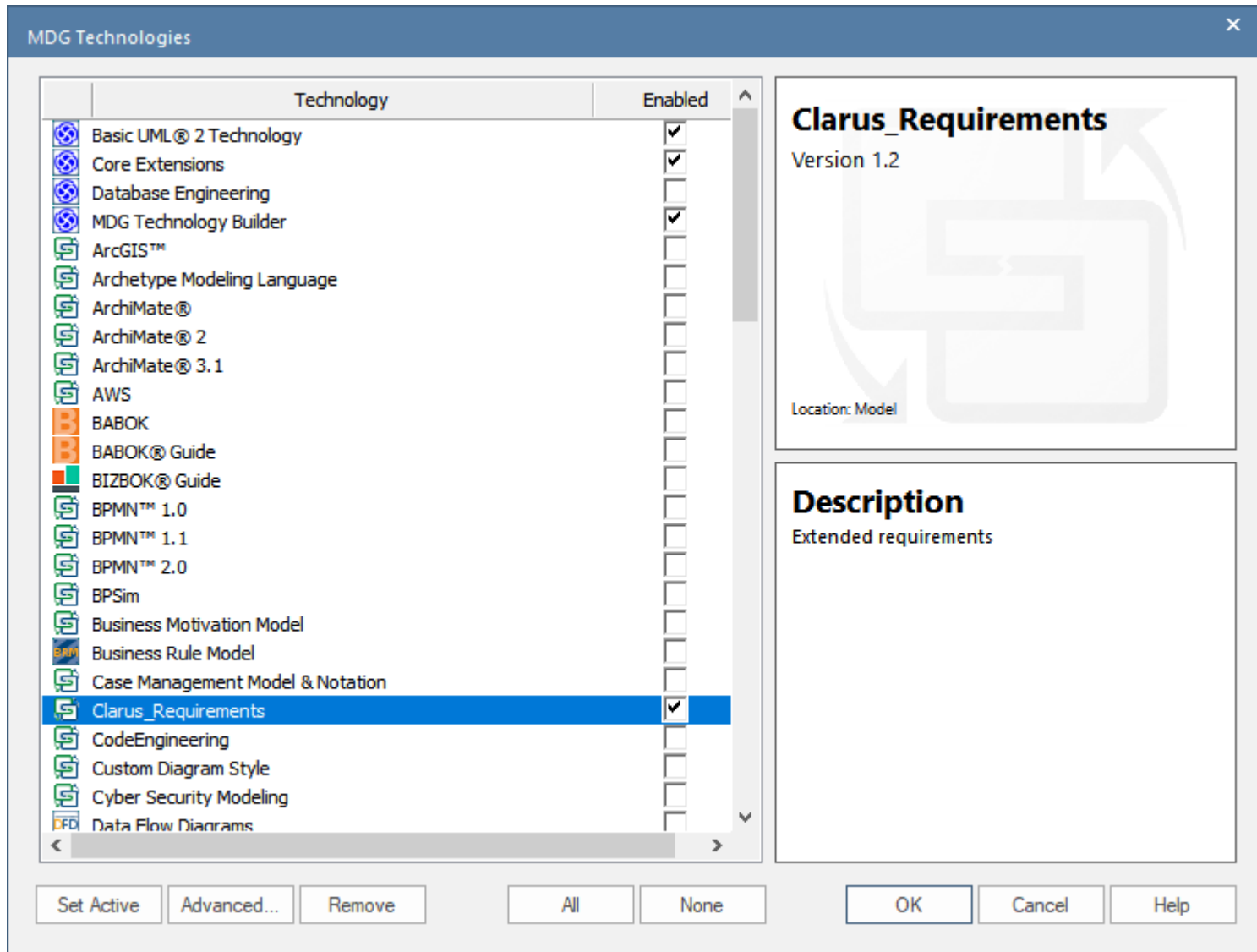
- Create a new local repository
- Create a new project
- Manage projects

Open a Portal ▾

MDG Technology Creation Wizard



Import the MDG Technology



An Example

Properties

Element Tags

Keywords	
Status	Proposed
Version	1.0
Extended_Requirement (from Clarus_Requirements)	
Verification	Test
Req ID	F-701
Req_Type	Functional
Requirement Statem...	<memo>* ...
Source Text	
Source ID	
Rationale	<memo>*
Requirement	
Abstract	<input type="checkbox"/>
Active	<input type="checkbox"/>

Requirement Statement
The Clarus system shall accept only observations that includes the minimum set of metadata. The minimum set of metadata for an observation is location, timestamp, and source information.

Observation metadata

tags

Rationale = <memo>
 Req ID = F-701
 Req_Type = Functional
 Requirement Statement = <memo>
 Verification = Test

VF-701

tags

Verification Statement = <memo>
 Verification Type = Test

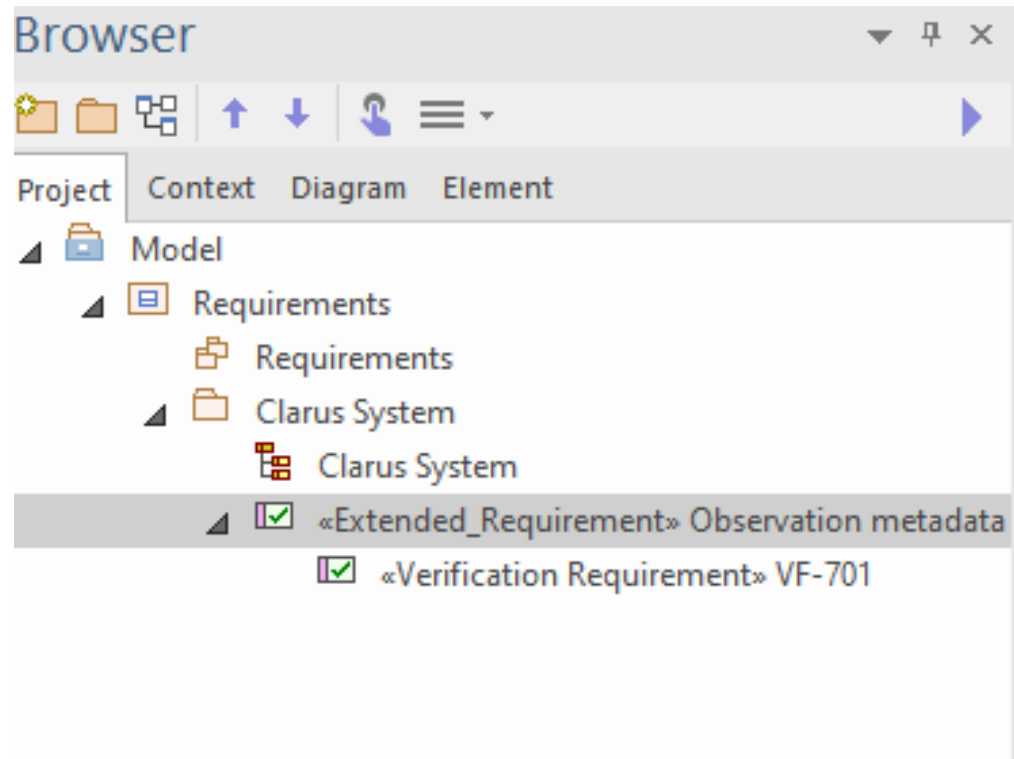
Need to determine the availability of the input simulator and ensure it has the desired capability

Traceability

Observation metadata

- owns
 - VF-701

Model Organization



Are We There Yet?

- Requirements have exactly the attributes we need
- Verification consideration is an upfront process
- Things are really coming together
- But I don't want to have to do all that clicking around. I miss the way my requirements used to look

There is no need to fear,
Underdog is here!!



Putting It All Together

Start Page Clarus System Specification Manager x

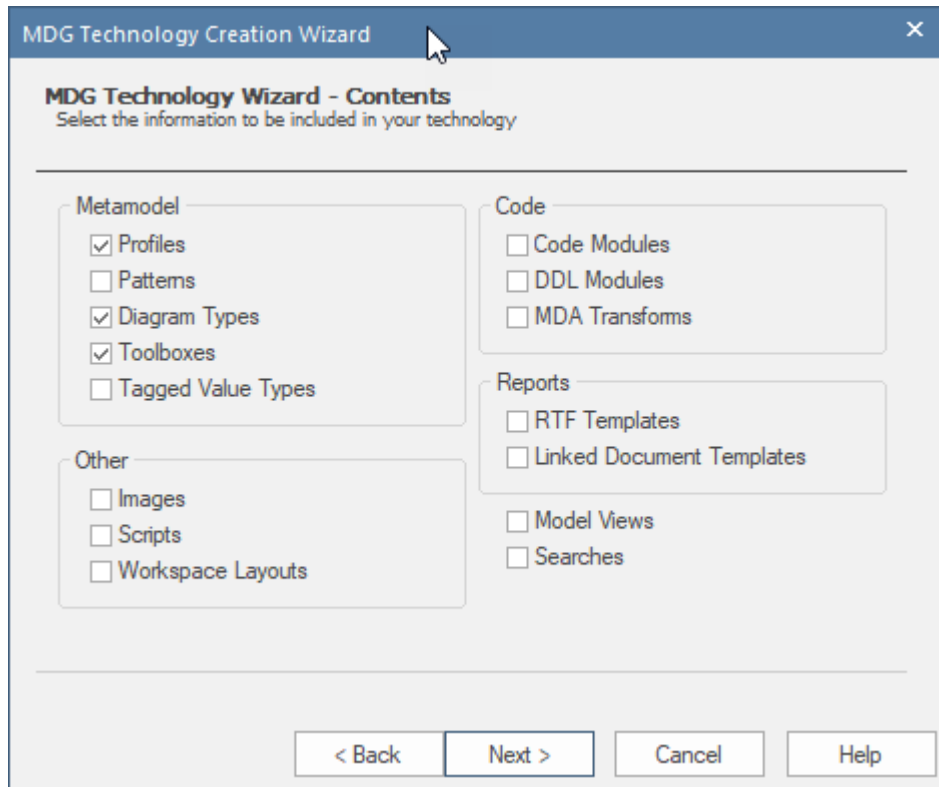
Model Requirements Clarus System Find Package

Item	Req ID	Requirement Statement	Rationale	Status	Priority
<input checked="" type="checkbox"/> Observation Metadata	F-701	The Clarus system shall accept only observations that includes the minimum set of metadata. The minimum set of metadata for an observation is location, timestamp, and source information.	Failure to provide the minimum set of metadata means the observations of multiple systems cannot be correlated.	Proposed	Medium
<input checked="" type="checkbox"/> VF-701		The Clarus system shall be connected to a data input simulator and triggered with a sequence of inputs that includes all required metadata, in addition to inputs that do not include one and two of the required metadata.		Proposed	Medium

Need to determine the availability of the input simulator and ensure it has the desired capability

The EA Specification Manager provides the capability to present the requirement expression in a traditional view while maintaining the information as model elements and associated attributes. Like everything else in EA, if you change the value of an attribute here, it is changed everywhere in the model

Going Forward




There's more to add to your productivity.

Create your own modeling language with just the right attributes and other modeling support.

Make EA work the way you need it to work.

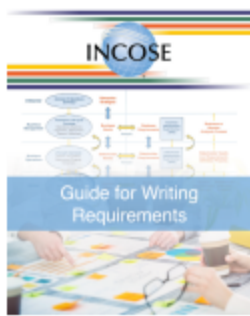
Q&A in the Teams Discussion Forum

MS Teams Location



The screenshot shows the Microsoft Teams interface. On the left is a navigation pane with icons for Activity, Chat, Teams, Calls, Files, and Apps. The main area displays a team chat for 'Sparx Systems North America'. The chat header includes 'Posts', 'Files', and 'Wiki' tabs. A blue arrow points to the 'Files' tab. The chat content features a large text overlay: 'PDF slides and Extended Requirements MDG' and 'Q&A in the Teams Discussion Forum'. Below this, a message from Manikandan Muthusamy (Guest) at 6:48 AM says 'Hi, Meeting started - Getting the best out of an MDG?'. A reply from Arshad at 7:03 AM says 'Hi Manikandan Muthusamy not yet . Will be starting at 7PM IST'. A blue arrow points to the 'Sparx Systems North America' team name in the left pane. At the bottom, there is a text input field for starting a new conversation and a toolbar with icons for text, links, emojis, GIFs, and other features.

References



Guide for Writing Requirements (Soft Copy)

Digital Download via e-mail link

Product Code:

TechGuideWR2019Soft
V3, updated 2019

Price: \$25.00

Member Price: \$0.00

ADD TO CART

DETAILS

Available at the INCOSE.ORG store



Software Requirements

★★★★★ 6 REVIEWS

by Karl E Wiegers and Joy Beatty

Publisher: Microsoft Press

Release Date: August 2013

ISBN: 9780735679658

Me

