INCOSE MBSE Patterns Working Group

Contributions to Reference Ecosystem for Collaborative Innovation

For Product Line Life Cycle Patterns & Configurations

INCOSE
International Council on Systems Engineering
MBSE Patterns Working Group

V1.2.11

Draft for review

Project Objectives

1. Specify, construct, and demonstrate a reference ecosystem of product life cycle tools, processes, and example content . . .
2. Illustrating a vision (or set of visions) of future approaches to collaboration between people and information systems, integrated across the ISO15288 system life cycle processes . . .
3. Leveraging the concepts of sound systems engineering, model-based representations and patterns, product line engineering, and agility in the face of risk, variability, and uncertainty . . .
4. Integrating the work and resources of multiple INCOSE Working Groups in related areas . . .
5. By providing this point of reference, accelerating the Model-Based Transformation described by INCOSE Vision 2025 and encouraged by the INCOSE Board of Directors adopted strategic objective.

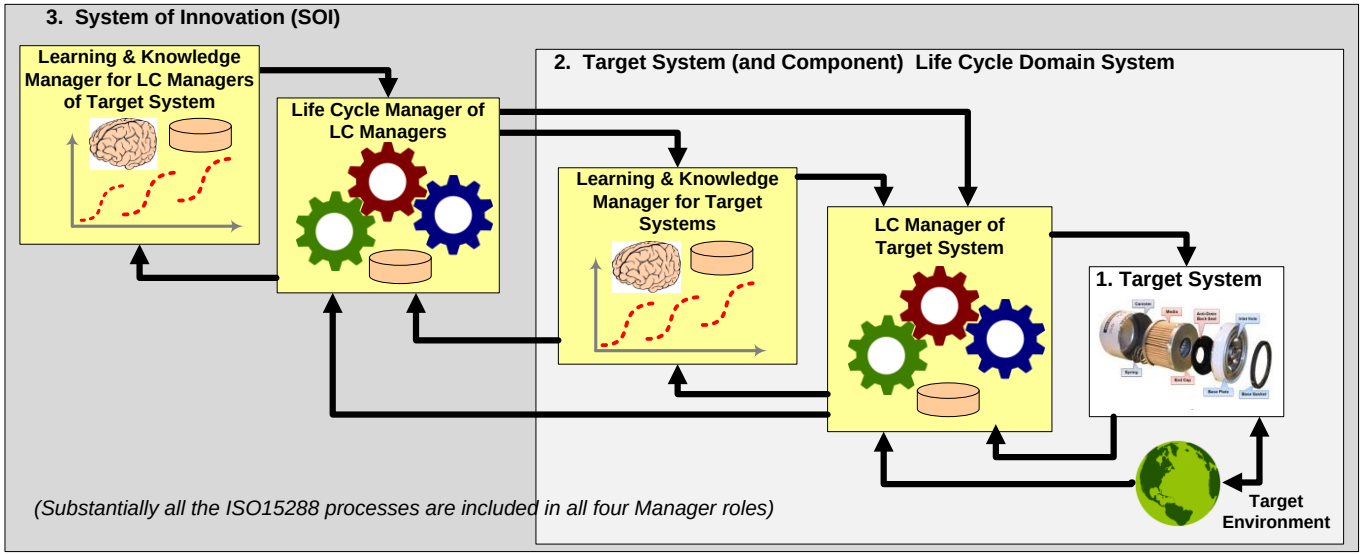
Working Groups Involved

- MBSE Patterns Working Group
- Product Line Engineering Working Group
- Tools Interoperability and Model Life Cycle Management Working Group (*)

(*) The following material represents Patterns WG and PLE WG joint activity underway, but does not yet reflect TIMLM WG activity also underway, which will be discussed in INCOSE IW2017.

Patterns Working Group Contributions to this Project

- ASELCM System 1 Patterns: S*Pattern-based representation of engineered systems, over their life cycle, including product line patterns and specific configurations thereof. (This is system 2 work.)
- ASELCM System 2 Patterns: S*Pattern-based representation of the systemic patterns of (human, machine) activity characterizing System 2 collaboration over System 1 life cycles; including general patterns and specific configurations thereof. (This is System 3 work.)



ASELCM Pattern

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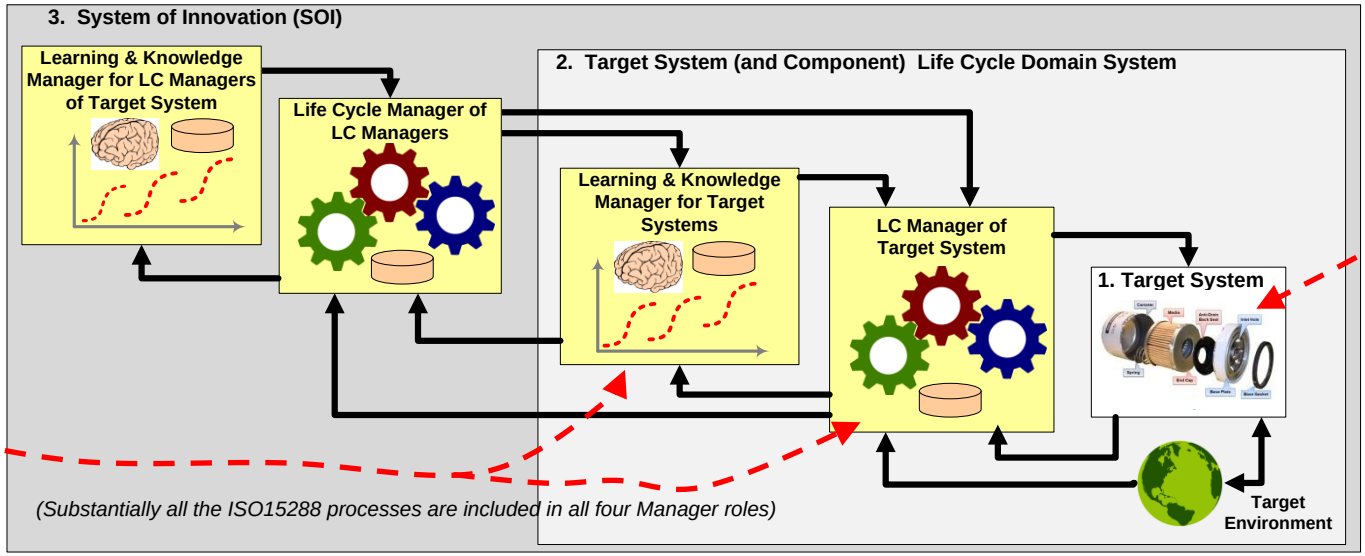

ASELCM Pattern

We expect this project will involve contributions of ideas, effort, or otherwise from multiple external sources

- Currently in very early stage, using ideas, products, information, effort from the following, with more expected to get involved over time . . .

More to follow, especially to cover ISO15288 Life Cycle Processes

System 1 Model Content

- Product Line Model S*Pattern—for Oil Filter Family Product Line:
  - And product configurations thereof, over their life cycles
- Related Manufacturing System S*Pattern—for Oil Filter Manufacturing Platform Product Line:
  - And system configurations thereof, over their life cycles
- Represented as S*Patterns and S*Models, in multiple COTS tools for model authoring, analysis, simulation, configuration management, and otherwise.

Preliminary System 1 Example Data

- Oil Filter S*Pattern:
  - Descriptive product line document samples
  - Modeled in multiple SysML modeling tools
  - Integrated with configuration agent capabilities, for creating configured S*Models from S*Patterns
- S*Examples of the above, in progress so far:
  - Magic Draw/CSM + Big Lever Gears
  - Enterprise Architect + Reference Configuration Agent
  - Other types of tools and information systems to follow

Descriptive Product Line Document Samples

System Requirements Document:
Global Oil Filter Product Line Family

Rev 1.2.2 December 4, 2009

Table 5: Interaction Definitions and Actors

Interaction Name	Interaction Definition	Oil Filter System	Service Person	Mounting System	Ambient Air	Removed Solid Contaminant	Lubricant In Filtration	Removed Water	Local Surface	Lubricated System	Lubricant In Distribution	Lubricant Distribution Pump	Lubricant Transport Containment	Waste Management System	Manufacturing System	Distribution System	Package	Buyer
Filter Lubricant	The interaction during which the oil filter system filters the lubricant in filtration.	X		X		X	X	X		X	X	X	X					
Impregnate Lubricant Additive	The interaction during which the manufacturing system impregnates the oil filter with lubricant additive.	X													X			
Fold	The interaction during which the														X			

2.3 System Domain (Scope)

A Domain Model describes the environment of a system, specific to a particular
Domains of interest in this case include the oil filter Manufacturing Domain, Di
Domain, and Application Domain. Each domain model describes the external d
h the subject system physically interacts, across its life cycl
f Figure 5 emphasizes the Application Domain, also briefly
in and Distribution Domain.

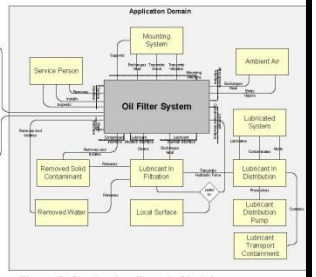

Figure 5: Application Domain Model

Table 4: Domain System Definitions

	Domain System Definition
	The system which removes suspended particulates and other conta
lubricant in an in-service mechanical system, to protect and exten
and enhance its performance.
	A person responsible for servicing the oil filter.
	A logical system responsible for mechanically supporting the oil f
	The air that directly surrounds the system.
	The particulate contaminant that is removed from the lubricant by
	The lubricant that is being filtered by the oil filter.
	The water that is removed by the oil filter.
	Nearby pavement or other surfaces that are at risk of leakage by th
	A logical system that is being lubricated.
	The lubricant that is being distributed throughout the lubricated sy
	The logical system responsible for hydraulic forces to transport th
lubricated system.
t	The logical system responsible for preventing lubricant leakage in
	The logical system responsible for production of the oil filter, in p
distribution.
	The logical system responsible for the distribution of the oil filter
manufacturing to retail.

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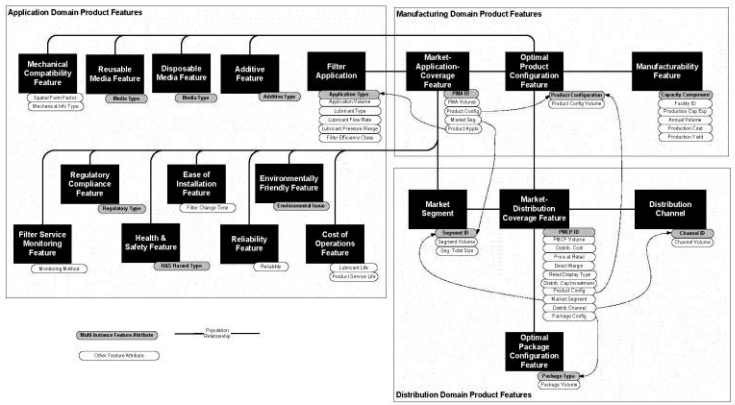

Figure 3: Feature Overview Diagram

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2.5 System Life Cycle State (Modes) Model

Figure 8 illustrates the system State Model. Each State is a condition of the system and the environment with which it acts, during which certain external Interactions (from the preceding sections) are expected to occur. These States may be thought of as situations or modes during which certain behavior is expected. The Life Cycle States Model is a summary of these states over the life cycle of an oil filter system.

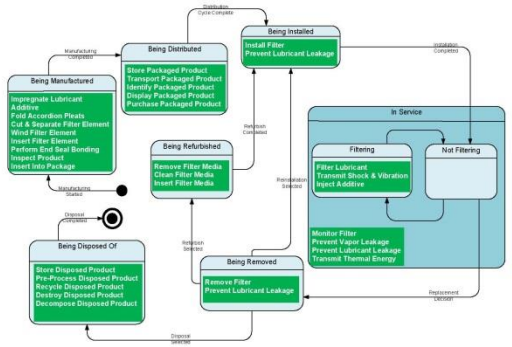

Figure 8: System State (Modes) Model

The Interactions are listed in the interior of each of the above States. The definitions of the States are provided in Table 6 State Definitions.

Table 6 State Definitions

State Name	State Definition
In Service	The state during which the oil filter is able to be used.
Filtering	The state during which the oil filter is filtering the lubricant.
Not Filtering	The state during which the oil filter is not filtering the lubricant, but is able to do so.
Being Removed	The state during which the oil filter is being removed from the machine in which it is installed.
Being Refurbished	The state during which the oil filter is being refurbished in order to be used again.

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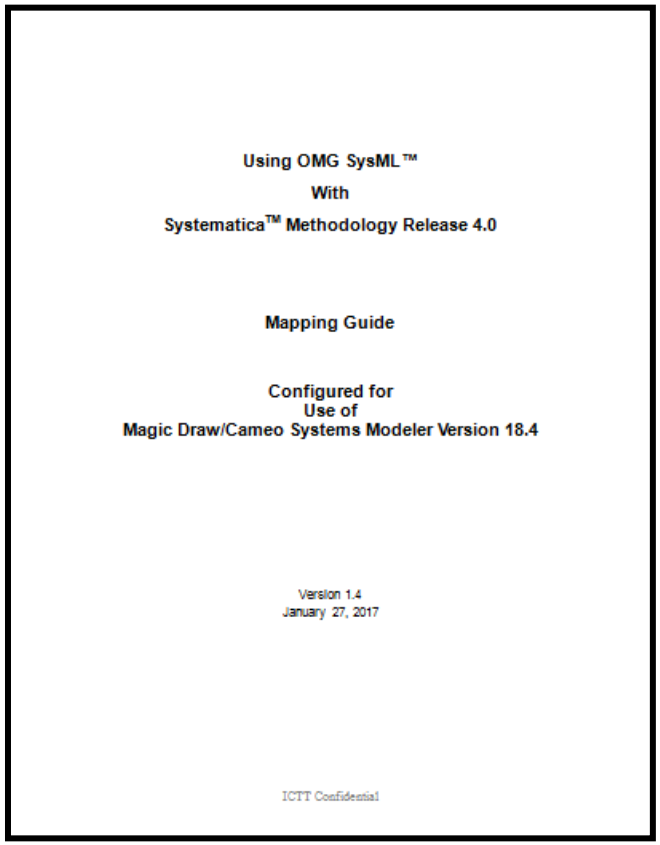
Magic Draw/CSM + Big Lever Gears

SysML Profile for S*Metamodel in Magic Draw/CSM:

- Specified by S*MTM Mapping Document



Using OMG SysML™

With

Systematica™ Methodology Release 4.0

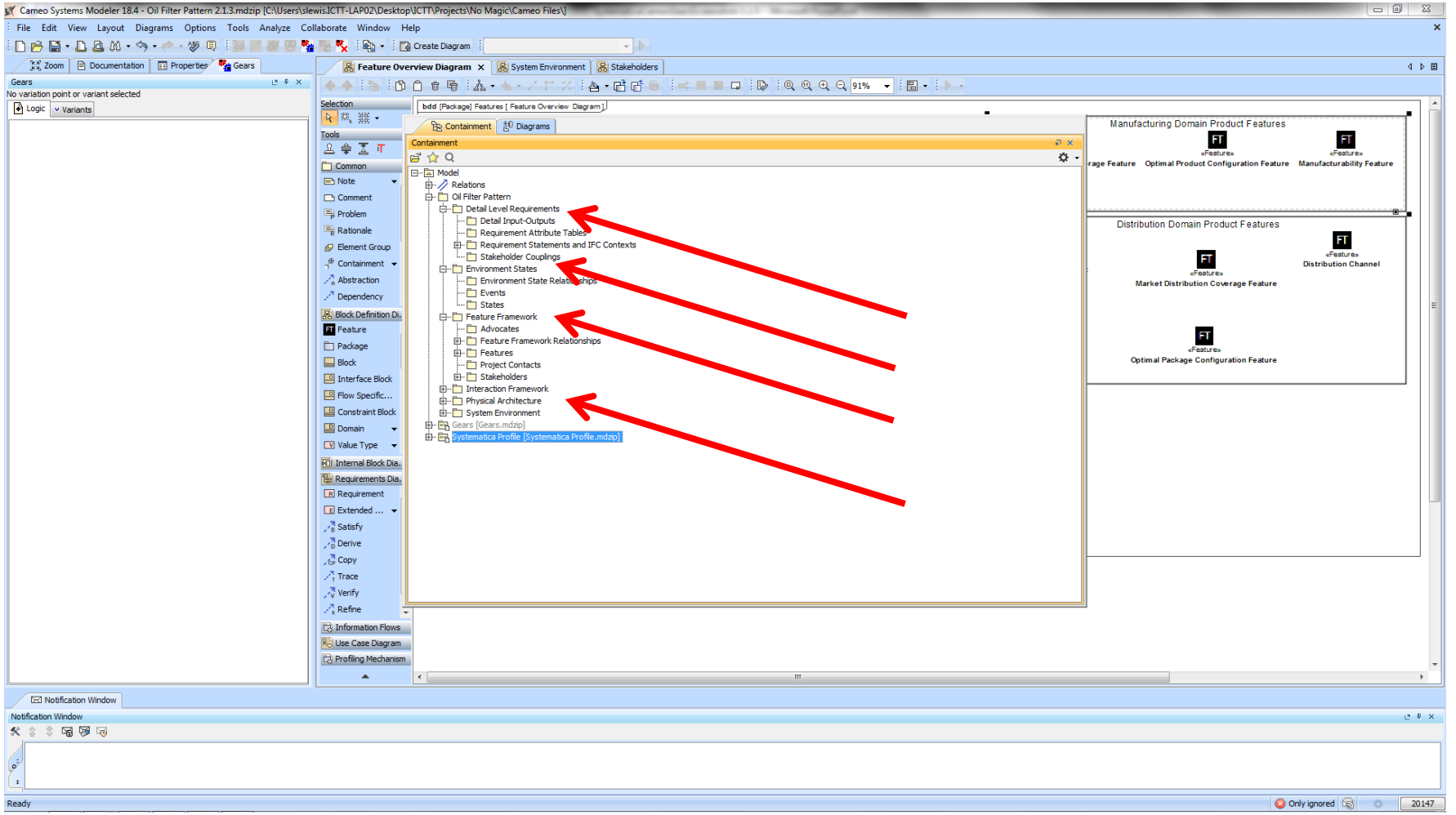
Mapping Guide

Configured for
Use of
Magic Draw/Cameo Systems Modeler Version 18.4

Version 1.4
January 27, 2017

ICTT Confidential

S*Metamodel Profile Folders in Containment Browser

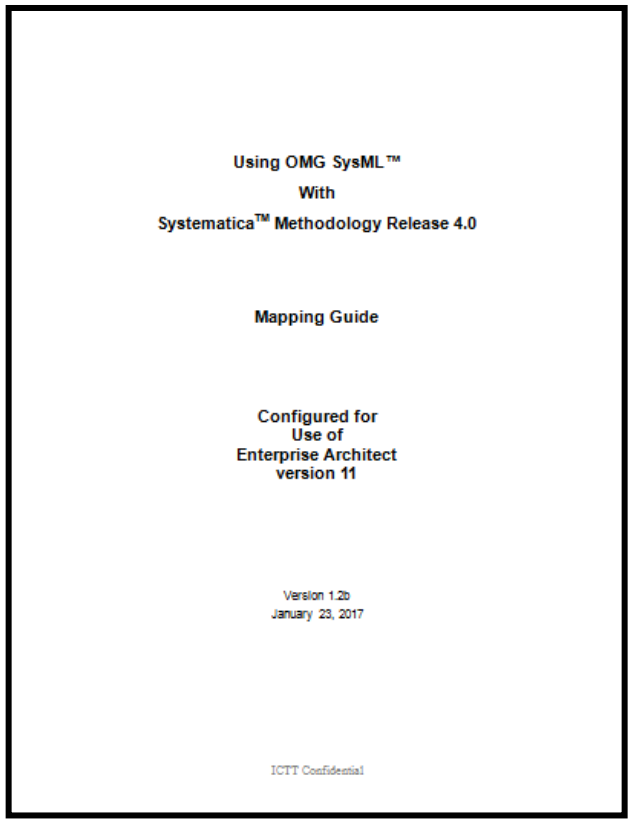


(In Magic Draw / CSM)

Enterprise Architect + Reference Configuration Agent

SysML Profile for S*Metamodel, Enterprise Architect:

– Specified by S*MTM Mapping Document



Using OMG SysML™

With

Systematica™ Methodology Release 4.0

Mapping Guide

Configured for
Use of
Enterprise Architect
version 11

Version 1.2b
January 23, 2017

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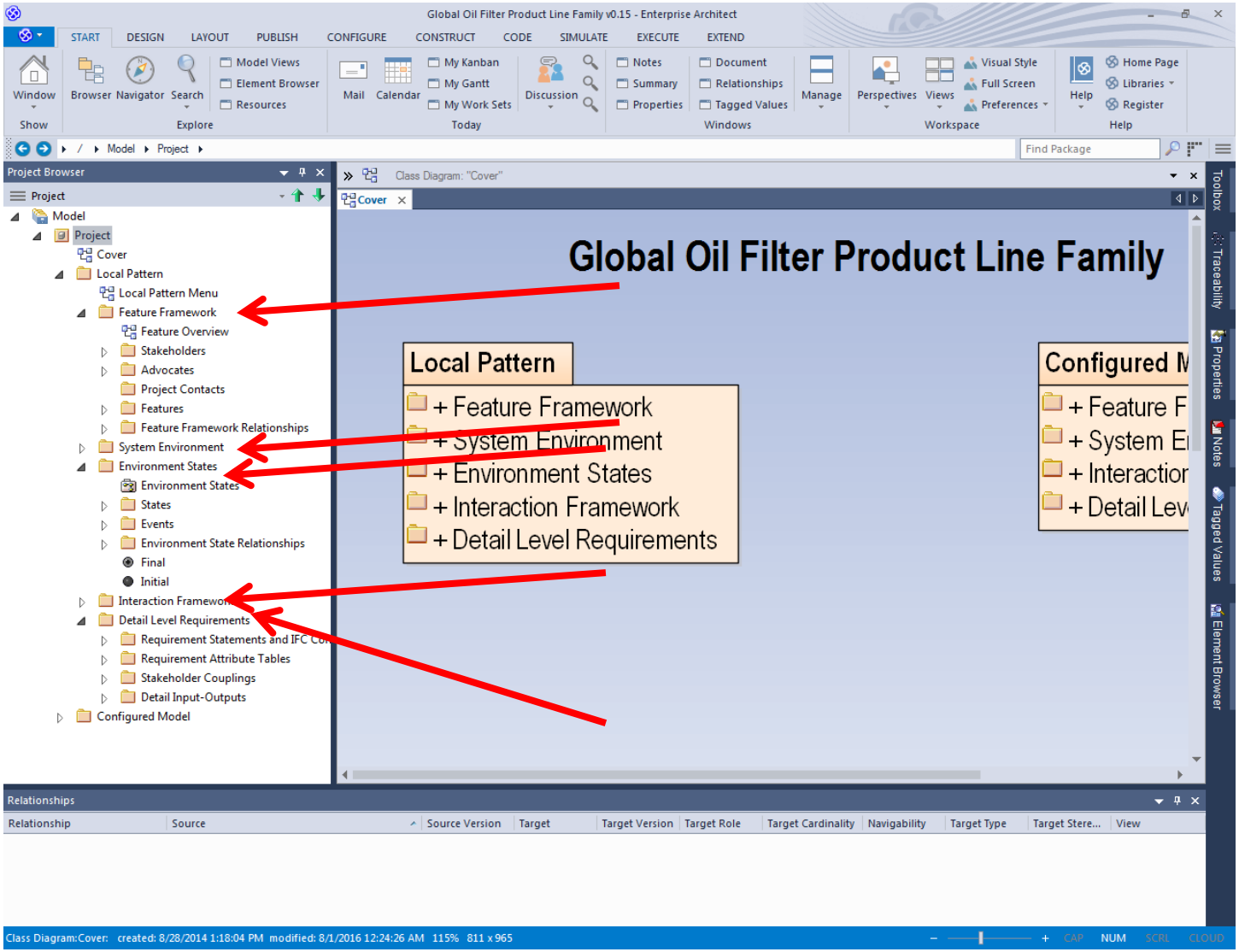
S* Metamodel Profile Folders in Project Browser



(In EA)