# Packaging the Model Transformation Examples

An Exercise in Organizing Diversity



## Contents

- Purpose of this material
- The challenge
- Proposed approach
- Example
- Next steps

# Purpose of this material

Summarize an approach to "packaging" a diverse set of MBSE examples being assembled by the INCOSE MBSE Transformation





# The challenge

- The model examples being collected are <u>very diverse</u> in their content, style, purpose, nomenclature, and other aspects—they differ in many dimensions simultaneously.
- This is because of their different origins, purposes, illustrated concepts, domains, uses and users, and other aspects
- That diversity is in part positive, by representing a range of possible approaches to various aspects of MBSE—it can be informative
- But, that diversity can also make it harder for the intended audience to organize their impressions of what they are seeing, to understand the intentions of the individual examples, to recognize that some differences are domain-based, or less significant, etc.
- We don't want to "homogenize" the examples.
- So, how do we "organize their diversity"?

## Proposed approach

- Package each example in a "wrapper" of Model Metadata which is sufficiently broad to uniformly characterize them in their diversity.
- Use the INCOSE/ASME Model Stakeholder Features Pattern as that metadata wrapper—a metadata "signature" of each model, configured for each model.



## Proposed approach

- Models exist for purposes (intended uses) and users
- Models themselves have stakeholders—those with an interest in the success of the model
- A summary description of a model can be given in language of generic Model Stakeholders, describing the model's domain, intended use (purpose) and users , subject system, representation type, related media, and other aspects, without getting into all the technical details of the model itself.
- In fact, without that description, one can usually not even find out the answers to those important questions just by inspecting the model—just as a Martian could not discover the intended use of an automobile by examining one.
- So, "metadata" about a model is like the Universal Product Code stamped on a food package—it is description of what is inside.



# INCOSE/ASME Model Stakeholder Features Pattern

- Being created in the INCOSE supported ASME VV50 standards committee project, also in use in the INCOSE MB Transformation Project Products:
  - Metadata, in the form of a model itself, instead of a bar code, describing "what is in the package" (the model being described by the metadata)
  - 29 Model Features, spread across 6 Feature Groups:



#### INCOSE/ASME Model Stakeholder Features Pattern





						F	eature	e Stak	eholde	er		Mode	l Type
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	Mdl Deployer- Distributor	Model Use Supporter	Regulatory Authority	Mdl Investor- Owner	Physics Based	Data Driven
Identifies the	e main subject	or focus of the model											
M. J.111	Modeled System of Interest	Identifies the type of system this model describes.	System of Interest	Name of system of interest, or class of systems of interest	х					х	х	х	х
and Focus	Modeled Environmental Domain	Identifies the type of external environmental domain(s) that this model includes.	Domain Type(s)	Name(s) of modeled domains (manufacturing, distribution, use, etc.)	x					х	x	x	x



						ŀ	eatur	e Stak	eholde	r		Mode	l Type
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	Mdl Deployer- Distributor	Model Use Supporter	Regulatory Authority	Mdl Investor- Owner	Physics Based	Data Driven
Describes the	e intended use	, utility, and value of the model											
	Model Intended Use	The intended purpose(s) or use(s) of the model.	Life Cycle Process Supported	The intended life cycle management process to be supported by the model, from the ISO 15288 process list. More than one value may be listed.	x					x	x	х	x
			User Group Segment	The identify of using group segment (multiple)	х					x	х	х	х
Model Utility	Perceived Model Value and Use	The relative level of value ascribed to the model, by those who use it for its stated purpose.	Level of Annual Use	The relative level of annual use by the segment	х					Х	х	х	х
			Value Level	The value class associated with the model by that segment	х					Х	х	х	х
	Third Party Acceptance	The degree to which the model is accepted as authoritative, by third party regulators, customers, supply chains, and other entities, for its stated purpose.	Accepting Authority	The identity (may be multiple) of regulators, agencies, customers, supply chains, accepting the model	x					x	x	x	х
	Model Ease of Use	The perceived ease with which the model can be used, as experienced by its intended users	Perceived Model Complexity	High, Medium Low	x					X		х	х

		Model	Scope a	and Content									
		Modeled Moo Stakeholder Ex Value Bo STAKEHOLDER TYPE	deled System ternal (Black xx) Behavior	Explanatory Failur Decomposition and	e Moc Effect	les s							
		Parametric F Couplings C Fitness Dec	Parametric Couplings composition	Parametric Couplings Characterization									
		Trusted Configurable Pattern Ar CONFIGURATION ID Pattern Type	Physical chitecture	Managed Model Datasets DATASET TYPE									
						F	eatur	e Stak	eholde	er	•	Model	Туре
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	Mdl Deployer- Distributor	Model Use Supporter	Regulatory Authority	Mdl Investor- 0wner	Physics Based	Data Driven
Describes th	e scope of con	tent of the model											
	Modeled Stakeholder Value	The capability of the model to describe fitness or value of the System of Interest, by identifying its stakeholders and modeling the related Stakeholder Features.	Stakeholder Type	Classes of covered stakeholders (may be multiple)	х					х	х	х	x
Model Scope of	Modeled System External (Black Box) Behavior	The capability of the model to represent the objective external ("black box") technical behavior of the system, through significant interactions with its environment, based on modeled input-output exchanges through external interfaces, quantified by technical performance measures, and varying behavioral modes.			х					х		x	x
Content	Explanatory Decomposition	The capability of the model to represent the decomposition of its external technical behavior, as explanatory internal ("white box") internal interactions of decomposed roles, further quantified by internal technical performance measures, and varying internal behavioral modes.			x					x		x	
	Physical Architecture	The capabiliy of the model to represent the physical architecture of the system of interest. This includes identification of its major physical components and their architectural relationships.			х					x		x	

		Model	Scope a	nd Content									
		Modeled Mod Stakeholder Ext Value Bo STAKEHOLDER TYPE	eled System ernal (Black x) Behavior	Explanatory Failure Decomposition and Ef	/lodes fects								
		Parametric Pa Couplings Co Fitness Dec	arametric ouplings omposition	Parametric Couplings Characterization									
		Trusted Configurable Pattern CONFIGURATION ID Pattern Type	Physical chitecture	Managed Model Datasets DATASET TYPE									
						F	eature	e Stako	eholde	r		Mode	Туре
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	Mdl Deployer- Distributor	Model Use Supporter	Regulatory Authority	Mdl Investor- 0wner	Physics Based	Data Driven
Describes th	e scope of con	tent of the model											
	Parametric Couplings Fitness	The capability of the model to represent quantitative (parametric) couplings between stakeholder-valued measures of effectiveness and objective external black box behavior performance measures.			x					x		x	x
	Parametric Couplings Decomposition	The capability of the model to represent quantitative (parametric) couplings between objective external black box behavior variables and objective internal white box behavior variables.			x					х		x	x
	Parametric Couplings Characterization	The capability of the model to represent quantitative (parametric) couplings between objective behavior variables and physical identity (material of construction, part or model number).			x					х		x	
	Managed Model Datasets	The capability of the model to include managed datasets for use as inputs, parametric characterizations, or outputs	Dataset Type	The type(s) of data sets (may be multiple)	x		х			Х		x	х
	Trusted Configurable Pattern	The capability of the model to serve as a configurable pattern, representing different modeled system configurations across a common domain, spreading the cost of establishing trusted	Configuration ID	A specific system of interest configuration within the family that the pattern framework can represent.	x		x			х	x	x	x
		model frameworks across a community of applications and configurations.	Pattern ID	The identifier of the trusted configurable pattern.	х		х			Х	x	х	х



		Model	Scope an	nd Content									
		Modeled Mod Stakeholder Ext Value Bo	leled System ernal (Black x) Behavior	Explanatory Failure Mode Decomposition and Effects	25 5								
		Parametric Pa Couplings Co Fitness Dec	arametric ouplings composition	Parametric Couplings Characterization									
Of speci	al ance to th	Trusted onfigurable Pattern CONFIGURATION ID Pattern Type	Physical chitecture	Managed Model Datasets DATASET TYPE									
import	mics of L					F	eature	e Stak	eholde	er		Mode	І Туре
econc	WUQ .me	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	Mdl Deployer- Distributor	Model Use Supporter	Regulatory Authority	Mdl Investor- Owner	Physics Based	Data Driven
Describes th	e scope of con	tent of the model											
	Parametric Couplings Fitness	The capability of the model to represent quantitative (parametric) couplings between stakeholder-valued measures of effectiveness and objective external black box behavior performance measures.			х					X		x	x
	Parametric Couplings Decomposition	The capability of the model to represent quantitative (parametric) couplings between objective external black box behavior variables and objective internal white box behavior variables.			x					X		x	x
	Parametric Couplings Characterization	The capability of the model to represent quantitative (parametric) couplings between objective behavior variables and physical identity (material of construction, part or model number).			x					X		x	
	Managed Model Datasets	The capability of the model to include managed datasets for use as inputs, parametric characterizations, or outputs	Dataset Type	The type(s) of data sets (may be multiple)	х		x			х		х	х
	Trusted Configurable Pattern	The capability of the model to serve as a configurable pattern, representing different modeled system configurations across a common domain, spreading the cost of establishing trusted	Configuration ID	A specific system of interest configuration within the family that the pattern framework can represent.	x		x			x	x	x	x
	1 aut 11	model frameworks across a community of applications and configurations.	Pattern ID	The identifier of the trusted configurable pattern.	х		х			Х	х	х	х



						F	eatur	Stak	ehold	er		Mo Ty	del pe
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	MdI Deployer-	Model Use Supporter	Regulatory Authority	MdI Investor-	Physics Based	Data Driven
Describes th	e credibility o	f the model											
	Model Envelope	The capability of the model to meet its Model Credibility requirements over a stated range (envelope) of dynamical inputs, outputs, and parameter values.	Model Application Envelope	The range over which the model is intended for use.	x		x			x	x	x	x
			Quantitative Accuracy Reference	The specification reference describing the quantitative accuracy of the conceptual model compared to the system of interest.	x					x	x	x	x
	Validated Conceptual Model	The validated capability of the conceptual portion of the model to represent the System of	Function Structure Accuracy Reference	The specification reference describing the structural (presence or absence of behaviors) accuracy of the conceptual model compared to the system of interest.	x		x			x	x	x	x
	Credibility	interest, with acceptable Credibility.	Uncertainty Quantification (UQ) Reference	The specification reference describing the degree of uncertainty of the Credibility of the conceptual model to the system of	x		x			x	x	x	x
			Model Validation Reference	The reference documenting the validation of the conceptual model's Credibility to the system of	x		x			x	x	x	x

		Model	Credibil	lity									
		Envelope LAPPLICATION ENVELOPE Validated Conceptual Model Credibili Quantitative Ac Function Structure Uncertainty Quantifit Model Valida	ty curacy Reference Accuracy Reference ication (UQ) Reference tion Reference	Verified Executable Model Credibility Quantitative Accuracy Ref Function Structure Accuracy Uncertainty Quantification (UQ Speed Quantization Stability Model Validation Refer	erence Reference ) Referer ence								
		<b>•</b>				Fe	eature	e Stak	ehold	er		Mo Ty	del pe
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	MdI Deployer-	Model Use Supporter	Regulatory Authority	MdI Investor-	Physics Based	Data Driven
Model			Quantitative Accuracy Reference	The specification reference describing the quantitative accuracy of the executable model to the conceptual model.	x		x			x	x	x	x
Credibility			Structural Accuracy Reference	The specification reference describing the structural (presence or absence of elements) accuracy of the executable model to the conceptual model.	x		x			x	x	x	x
	Verified	The verified capability of the executable portion	Uncertainty Quantification (UQ) Reference	The specification reference describing the degree of uncertainty of the Credibility of the executable model to the conceptual model	x		x			x		x	x
	Executable Model Credibility	of the model to represent the System of Interest, with acceptable Credibility.	Speed	The specification reference describing the execution run time (speed) for the executable model.	x		x			x	x	x	x
			Quantization	The specification reference describing the quantization error of the executabl e model.	x		x			x	x	x	x
			Stability	The specification reference describing the level of stability of the accuracy and uncertainty of the executable model error characteristics.	x		x			x	x	x	x
			Model Validation Reference	The reference documenting the verification of the executable model's Credibility to the conceptual model.	x		x			x	x	x	x



						F	eatur	e Stak	eholde	er	•	Mode	Туре
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	Mdl Deployer- Distributor	Model Use Supporter	<b>Regulatory</b> Authority	Mdl Investor- 0wner	Physics Based	Data Driven
Describes rel	ated model life	e cycle management capabilities											
	Model Versioning and Configuration Management	The capability of the model to provide for version and configuration management.	CM Capability Type	The type(s) of CM capabilities included (may be multiple)	x		х			х		x	х
	Executable Model Environmental Compatibility	The capability of the model to be compatibly supported by specified information technology environment(s), indicating compatibility, portability, and interoperability.	IT Environmental Component	The type(s) of IT environments or standards supported	х		x			x		x	х
Model Life Cycle Management	Model Design Life and Retirement	The capability of the model to be sustained over an indicated design life, and retired on a planned basis.	Design Life	The planned retirement date	х		Х			х		х	х
	Model Maintainability	The relative ease with which the model can be maintained over its intended life cycle and use, based on capable maintainers, availability of effective model documentation, and degree of complexity of the model	Maintenance Method	The type of maintenance methodology used to maintain the model's capability and availability for the intended purposes over the intended life cycle.	x		x			x	x	x	x
	Model Deployability	The capability of the model to support deployment into service on behalf of intended users, in its original or subsequent updated versions	Deployment Method	The type of method used to deploy (possibly in repeating cycles) the model into its intended use environment.	x			х			x	x	х

		Mod	lel Life Cy	cle Management									
		Model Versioning and Configuration Management CM CAPABILIY TYPE	Model laintainability (Maintenance Method)	Model M Deployability Deployment Method	Developi Operation Maintena Deployn Retirem	OST ment Cos onal Cost ance Cost nent Cost inancial F							
		Executable Model Environmental Compatibility (IT ENVIRONMENTAL COMPONENT)	Model Design Life Cycle and Retirement Design Life	Model Availability First Availability Date First Availability Risk Life Cycle Availability Risk	VVUQ I Lear /VUQ PA1 Impacte VVUQ	Pattern ning TERN EX ed VVUQ F Pattern Vo Project Person	CEPTION eature ersion						
						F	eatur	e Stak	ehold	er	•	Model	Туре
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	Mdl Deployer- Distributor	Model Use Supporter	Regulatory Authority	Mdl Investor- Owner	Physics Based	Data Driven
Describes rel	ated model lif	e cycle management capabilities											
			Development Cost	The cost to develop the model, including its validation and verification, to its first availability for service date		x					х	x	x
		The financial cost of the model including	Operational Cost	The cost to execute and otherwise operate the model, in standardized execution load units	х						x	х	х
	Model Cost	development, operating, and maintenance cost	Maintenance Cost	The cost to maintain the model			х				х	х	х
Model Life Cycle			Deployment Cost	The cost to deploy, and redeploy				х			х	х	х
Management			Retirement Cost	The cost to retire the model from service, in a planned fashion	х						х	х	Х
			Life Cycle Financial Risk	Risk to the overall life cycle cost of the model							х	х	Х
		The degree and timing of availability of the model	First Availability	Date when version will first be	х						х	х	х
	Model Availabilitv	for its intended use, including date of its first availability and the degree of ongoing availability	First Availability Risk	Risk to the scheduled date of first availability	х						х	х	х
	~~	thereafter.	Life Cycle Availability Risk	Risk to ongoing availability after introduction	х						х	х	х



		<b>v</b>				F	eature	Stak	eholde	er		то Ту	del pe
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	MdI Deployer-	Model Use Supporter	Regulatory Authority	MdI Investor-	Physics Based	Data Driven
		The ability to accumulate new	VVUQ Pattern Exception	A summary of the exception noted to the current VVUQ Pattern (may be multiple exceptions)		x					x	x	x
	VVUQ Pattern	discoveries about model-based methods into the VVUQ Pattern, as it is applied over model life orcles. These discoveries	Impacted VVUQ Feature	The impacted existing, modified, or additional feature of the VVUQ Pattern.		x					x	x	x
	Learning	are exceptions to the existing VVUQ	VVUQ Pattern Version	The version of the VVUQ Pattern in current use before change.		х					x	x	x
		Pattern, and candidates for inclusion into future versions of that pattern.	Project	Identifies the project in which the exception was noted		х					x	x	x
			Person	Identifies the person describing the exception		x					x	x	x



						F	eature	e Stake	eholde	r		Mode	l Type
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model User	Model Developer	Model Maintainer	Mdl Deployer- Distributor	Model Use Supporter	Regulatory Authority	Mdl Investor- 0wner	Physics Based	Data Driven
Identifies the	e type of repre	sentation used by the model											
	Conceptual Model	The capability of the conceptual portion of the model to represent the system of interest, using a	Conceptual Model Representation Type	The type of conceptual modeling language or metamodel used.	x		x			x		x	x
Model	Representation	specific type of representation.	Conceptual Model Interoperability	The degree of interoperability of the conceptual model, for exchange with other environments	х		х			x		x	x
Representation	Executable Model	The capability of the executable portion of the model to represent the system of interest, using a	Executable Model Representation Type	The type of executable modeling language or metamodel used.	x		x			x		x	x
	Representation	specific type of representation	Executable Model Interoperability	The degree of interoperability of the executable model, for exchange with other environments	х		х			x		x	x

#### Example

- Chosen example: An MBSE representation used for <u>Stakeholder Requirements Definition</u> and <u>System</u> <u>Requirements Analysis</u>
- For a configurable global product line (family) of lubricant filtration systems



System Requirements Document: Global Oil Filter Product Line Family
Rev 1.2.1 December 4, 2009
Automotive Corp.

# Example (continued)

(to be filled in with configured Model Stakeholder Feature metadata)

G	1	• = × ·	✓ <i>f</i> <sub>x</sub> Model Features Patter	n Configurati	on Planning Form				۲
4	Α	В	с	D	E	FG	Н	J K	
L						Model Features Pattern Co	nfiguration Planning Form		
2	Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model 1	Model 2		
3	Identifies t	he main subject (	or focus of the model						
4	Model Identity and Focus	Modeled System of Interest	Identifies the type of system this model describes.	System of Interest	Name of system of interest, or class of systems of interest	Global Oil Filter Product Line Family			
5		Modeled Environmental Domain	Identifies the type of external environmental domain(s) that this model includes.	Domain Type(s)	Name(s) of modeled domains (manufacturing, distribution, use, etc.)	Oil Filter Application Operation & Maintenance Domain; Oil Filter Global Distribution Domain; Oil Filter Global Manufacturing Domain			
5	Describes t	he scope of cont	ent of the model						
7	Model Scope of Content	Modeled Stakeholder Value Modeled System External (Black Box) Behavior	The capability of the model to describe fitness or value of the System of Interest, by identifying its stakeholders and modeling the related Stakeholder Features. The capability of the model to represent the objective external ("black box") technical behavior of the system, through significant	Stakeholder Type	Classes of covered stakeholders (may be multiple)	Machine Operator, Machine Maintainer, Enterprise Shareholder, Product Distribution Channel, Machine Owner, Machine Supplier, Regional Community NOT POPULATED			-
3			interactions with its environment, based on modeled input-output exchanges through external interfaces, quantified by technical performance measures, and varying behavioral modes.						
		Explanatory Decomposition	The capability of the model to represent the decomposition of its external technical behavior, as explanatory internal ("white box") internal interactions of decomposed roles, further			NOT POPULATED			¥
	<	Model Stakeho	older Features Worksheet Man	agement	<b>(+)</b>				[
	🦻 [	e I	> 🚺 😰 🔿	w] O	2 🔼		_ <b>P• ∏</b>	9:45 AM 1/2/2018	

••• 🛧 🗡

Α	В	С	D	E F	G	н	I J K
					Model Features Pattern Cor	figuration Planning Form	
Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model 1	Model 2	
	Explanatory Decomposition	The capability of the model to represent the decomposition of its external technical behavior, as explanatory internal ("white box") internal interactions of decomposed roles, further quantified by internal technical performance measures, and varying internal behavioral modes.			NOT POPULATED		
	Physical Architecture	The capability of the model to represent the physical architecture of the system of interest. This includes identification of its major physical components and their architectural relationships.			NOT POPULATED		
	Parametric Couplings Fitness	The capability of the model to represent quantitative (parametric) couplings between stakeholder- valued measures of effectiveness and objective external black box behavior performance measures.			NOT POPULATED		
	Parametric Couplings Decomposition	The capability of the model to represent quantitative (parametric) couplings between objective external black box behavior variables and objective internal white box behavior variables.			NOT POPULATED		
	Parametric	The capability of the model to	acmont		NOT POPULATED		
P	would staken	vorksneet Walla	gement	+	: 4		

G	1	$\star$ = $\times$ .	$\checkmark f_x$	Model Features Pattern	Configuratio	on Planning Form				٣
	А	В		с	D	E	F G	H I J	к	
1							Model Features Pattern Co	onfiguration Planning Form		
2	Feature Group	Feature Name	Fea	ature Definition	Feature Attribute	Attribute Definition	Model 1	Model 2		
14		Managed Model Datasets	The capabil include man inputs, para or outputs	lity of the model to naged datasets for use as ametric characterizations,	Dataset Type	The type(s) of data sets (may be multiple)	Oil Filter End User & Machine Population Global Dataset 4; Oil Filter Global Distributors Dataset 13A; Oil Filter Global Manufacturing Dataset 8			
15		Trusted Configurable Pattern	The capabil as a configu representin system confi common do	lity of the model to serve urable pattern, ng different modeled figurations across a omain, spreading the cost	Configuration ID	A specific system of interest configuration within the family that the pattern framework can represent.	Oil Filter Configuration 165R			
16			of establish framework applications	ing trusted model is across a community of s and configurations.	Pattern ID	The identifier of the trusted configurable pattern.	Global Oil Filter Family Pattern 1.3.5			
17		Failure Modes and Effects	The capabil include ider system failu effects, caus occurrence	lity of the model to ntification and analysis of ure modes, their impact ses, and liklihoods of			NOT POPULATED			
18	Describes th	he credibility of	the model	•						
19	Model Credibility	Model Envelope	The capabil its Model Co over a state dynamical i parameter	lity of the model to meet redibility requirements ed range (envelope) of inputs, outputs, and values.	Model Application Envelope	The range over which the model is intended for use.	Oil Filter Service Envelope Family 6			
20		Validated Conceptual Model Credibility	The validate conceptual represent t with accept	ed capability of the portion of the model to he System of Interest, table Credibility.	Quantitative Accuracy Reference	The specification reference describing the quantitative accuracy of the conceptual model compared to the system of interest				
20					Function	The specification				
	< •	Model Stakeho	। older Featu	Ires Worksheet Mana	igement	(+)				<b>–</b>
	وَنَ الْ	l 🖉 I		1 😰 🧿	w] O				9:46 AM 1/2/2018	

G1		• : × ·	✓ <i>f</i> x Model Features Pattern	n Configurati	on Planning Form			v
	А	В	с	D	E	FG	н	I J K
2	Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model Features Pattern C Model 1	onfiguration Planning Form Model 2	
20		Validated Conceptual Model Credibility	The validated capability of the conceptual portion of the model to represent the System of Interest, with acceptable Credibility.	Quantitative Accuracy Reference	The specification reference describing the quantitative accuracy of the conceptual model compared to the system of interest.			
21				Function Structure Accuracy Reference	The specification reference describing the structural (presence or absence of behaviors) accuracy of the conceptual model compared to the system of interest.			
22				Uncertainty Quantification (UQ) Reference	The specification reference describing the degree of uncertainty of the Credibility of the conceptual model to the system of interest.	Oil Filter Model VVUQ Reference 4C		
23				Model Validation Reference	The reference documenting the validation of the conceptual model's Credibility to the system of interest.			
24		Verified Executable Model Credibility	The verified capability of the executable portion of the model to represent the System of Interest, with acceptable Credibility.	Quantitative Accuracy Reference	The specification reference describing the quantitative accuracy of the executable model to the concentual model			
		Model Stakeho	older Features Worksheet Man	agement	+	: •		Image: state sta
	<b>)</b>		🔰 🚺 😰 🔿	w] O	2 2		- P (†	all ()) 9:47 AM 1/2/2018

G1		• : × ·	$\checkmark$ $f_x$ Model Features Pattern	n Configurati	on Planning Form				۲
	А	В	с	D	E	FG	Н	I J K	
1						Model Features Pattern 0	onfiguration Planning Form		
2	Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model 1	Model 2		
		Verified	The verified capability of the	Quantitative	The specification				
		Executable	executable portion of the model to	Accuracy	reference describing the				
		Model	represent the System of Interest,	Reference	quantitative accuracy of				
-		Credibility	with acceptable Credibility.		the executable model to				
24				Observations 1	the conceptual model.	Ol Shee Martel MUO Reference 40			
				Accuracy	The specification	Oli Filter Model VVOQ Reference 4C			
				Reference	structural (presence or				
				Reference	absence of elements)				
					accuracy of the executable				
					model to the conceptual				
25					model.				
				Uncertainty	The specification	Oil Filter Model VVUQ Reference 4C			H
				Quantification	reference describing the				
				(UQ)	degree of uncertainty of				
26				Reference	the Credibility of the				
				Speed	The specification				
					reference describing the				
					(speed) for the executable				
27					model.				
				Quantization	The specification				
				-	reference describing the				
					quantization error of the				
28					executabl e model.				
				Stability	The specification				
					reference describing the				
					level of stability of the				
					of the executable model				
20					or and executable model		<u> </u>		-
	•	Model Stakeho	Vorksheet Man	agement	(+)	: 4			
	)		> 🗶 😰	w] O	3 2			9:48 AM 1/2/2018	

G	L	• : × ·	✓ <i>f</i> x Model Features Pattern	n Configuratio	on Planning Form			×
	А	В	с	D	E	FG	н	J K
1						Model Features Pattern C	onfiguration Planning Form	
2	Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model 1	Model 2	
31	Identifies t	he type of repres	entation used by the model	-				
32	Model Representa tion	Conceptual Model Representation	The capability of the conceptual portion of the model to represent the system of interest, using a specific type of representation.	Conceptual Model Representatio n Type	The type of conceptual modeling language or metamodel used.	SysML		
33				Conceptual Model Interoperabilit y	The degree of interoperability of the conceptual model, for exchange with other environments	XMI Non-Graphical Content Interchance		
34		Executable Model Representation	The capability of the executable portion of the model to represent the system of interest, using a specific type of representation	Executable Model Representatio n Type	The type of executable modeling language or metamodel used.	MATLAB		
35				Executable Model Interoperabilit y	The degree of interoperability of the executable model, for exchange with other environments	FMI 1.0		
36	Describes tl	he intended use,	utility, and value of the model					
37	Model Utility	Model Intended Use	The intended purpose(s) or use(s) of the model.	Life Cycle Process Supported	The intended life cycle management process to be supported by the model, from the ISO15288 process list. More than one value may be listed.	Stakeholder Needs and Requirements Definition ProcessISO15288		
38		Perceived Model Value	The relative level of value ascribed to the model, by those who use it	User Group Segment	The identify of using group segment (multiple)	Product Manager		
		and Use	Ior its stated purpose.	Level of	The relative level of	High		
				w] O			- P• 🕅	9:48 AM 1/2/2018

				-						
-	A	В	С	D	E	G	Н	IJ	К	-
1						Model Features Pattern Cont	figuration Planning Form			-
	Feature	Feature Name	Feature Definition	Feature	Attribute Definition					
	Group			Attribute		Model 1	Model 2			
2	<b>D</b> 11 11									-
36	Describes th	he intended use,	utility, and value of the model							-
	Model	Model Intended	The intended purpose(s) or use(s)	Life Cycle	The intended life cycle	Stakeholder Needs and Requirements				
	Utility	Use	of the model.	Process	management process to be	Definition ProcessISO15288				
				Supported	from the ISO15288					
					process list. More than					
					one value may be listed.					
77					,					
57		Perceived	The relative level of value ascribed	User Group	The identify of using	Product Manager				-
38		Model Value	to the model, by those who use it	Segment	group segment (multiple)	i i oddet i i oddet i				
		and Use	for its stated purpose.	Level of	The relative level of	Hiah				-
				Annual Use	annual use by the segment					
39										
				Value Level	The value class associated	Essential				1
					with the model by that					
40					segment					
		Third Party	The degree to which the model is	Accepting	The identity (may be	Internal Executive Management, US FTC,				
		Acceptance	accepted as authoritative, by third	Authority	multiple) of regulators,	Distribution Channel Management				
			party regulators, customers, supply		agencies, customers,					
			chains, and other entities, for its		supply chains, accepting					
41		Model Face of	stated purpose.	Porcoived	High Modium Lour	Low Comployity				-
		Houer Lase of	model can be used as experienced	Model	ingn, Meulum Low	Low Complexity				
42		030	by its intended users	Complexity						
43	Describes re	elated model life	cycle management capabilities	1 9						-
	Model Life	Model	The capability of the model to	CM Capability	The type(s) of CM	Version Management				
	Cycle	Versioning and	provide for version and	Туре	capabilities included (may	, in the second s				
	Manageme	Configuration	configuration management.		be multiple)					
	nt	Management								
44										
	<	Model Stakeho	Worksheet Man	agement	(+)	E 4			Þ	

G	1	• = × ·	✓ <i>f</i> x Model Features Pattern	n Configurati	on Planning Form			٣
	А	В	с	D	E	G	н І	J K
1						Model Features Pattern Co	onfiguration Planning Form	
2	Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model 1	Model 2	
43	Describes r	elated model life	cycle management capabilities					
44	Model Life Cycle Manageme nt	Model Versioning and Configuration Management	The capability of the model to provide for version and configuration management.	CM Capability Type	The type(s) of CM capabilities included (may be multiple)	Version Management		
45		Executable Model Environmental Compatibility	The capability of the model to be compatibly supported by specified information technology environment(s), indicating compatibility, portability, and interoperability.	IT Environmenta l Component	The type(s) of IT environments or standards supported	SysML 1.0 Toolset		
46		Model Design Life and Retirement	The capability of the model to be sustained over an indicated design life, and retired on a planned basis.	Design Life	The planned retirement date	31-Dec-30		
47		Model Maintainability	The relative ease with which the model can be maintained over its intended life cycle and use, based on capable maintainers, availability of effective model documentation, and degree of complexity of the model	Maintenance Method	The type of maintenance methodology used to maintain the model's capability and availability for the intended purposes over the intended life cycle.	Quarterly Review Against Market Inputs		
48		Model Deployability	The capability of the model to support deployment into service on behalf of intended users, in its original or subsequent updated versions	Deployment Method	The type of method used to deploy (possibly in repeating cycles) the model into its intended use environment.	Fixed Views DeploymentView Set 12		
		Model Cost	The financial cost of the model, including development, operating, and maintenance cost	Development Cost	The cost to develop the model, including its validation and verification,	2 staff months instantiation; 3 staff months VVUQ		
	< ->	Model Stakeho	Worksheet Mana	agement	(+)			Þ
	📄 🦉	e I	🔰 🚺 😰 🤦	w] O	2 2		- P• ÎŤ	all () 9:49 AM 1/2/2018

G1		• = × ·	$\checkmark f_x$ Model Features Pattern	n Configurati	on Planning Form			~
	А	В	с	D	E	G	н	J K
1						Model Features Pattern Co	onfiguration Planning Form	
2	Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model 1	Model 2	
10		Model Cost	The financial cost of the model, including development, operating, and maintenance cost	Development Cost	The cost to develop the model, including its validation and verification, to its first availability for service date	2 staff months instantiation; 3 staff months VVUQ		
50				Operational Cost	The cost to execute and otherwise operate the model, in standardized execution load units			
51				Maintenance Cost	The cost to maintain the model	2 staff months annually		
52				Deployment Cost	The cost to deploy, and redeploy updates, per cycle	1.2 staff months annually		
53				Retirement Cost	The cost to retire the model from service, in a planned fashion			
54				Life Cycle Financial Risk	Risk to the overall life cycle cost of the model			
55		Model Availability	The degree and timing of availability of the model for its intended use, including date of its first availability	First Availability Date	Date when version will first be available	1-Jan-19		
56			and the degree of ongoing availability thereafter.	First Availability Risk	Risk to the scheduled date of first availability			
57				Life Cycle Availability Risk	Risk to ongoing availability after introduction			
		Model Stakeho	Ider Features Worksheet Mana	agement	+	: •		
6	)		> 💶 📀	w] O			- Pr 🕅 a	11 ♠) 9:49 AM 11 ♠) 1/2/2018

	А	В	с	D	E	F G	н	I J K
1						Model Features Pattern Con	figuration Planning Form	
2	Feature Group	Feature Name	Feature Definition	Feature Attribute	Attribute Definition	Model 1	Model 2	
58		VVUQ Pattern Learning	The ability to accumulate new discoveries about model-based methods into the VVUQ Pattern, as it is applied over model life cycles. These discoveries are exceptions to	VVUQ Pattern Exception	A summary of the exception noted to the current VVUQ Pattern (may be multiple exceptions)	Early Market Calibration Stage		
59			the existing VVUQ Pattern, and candidates for inclusion into future versions of that pattern.	Impacted VVUQ Feature	The impacted existing, modified, or additional feature of the VVUQ Pattern.	Validated Conceptual Model Credibility		
60				VVUQ Pattern Version	The version of the VVUQ Pattern in current use before change.	V1.1.3		
61				Project	Identifies the project in which the exception was noted	Market Penetration Planning Project		
62				Person	Identifies the person describing the exception	Robert Handlebar		
63								
64								
65								
66								
67								
68								
69								
70								
71								
72								
73								
74								
75								
		Model Stakeho	Ider Features Worksheet Mana	agement	(+)	i - 4		

••• 🛧 🗙

#### Next steps

- Complete the example
- Try out on other submitted examples
- Show to other team members for their use on other examples
- •
- •
- •