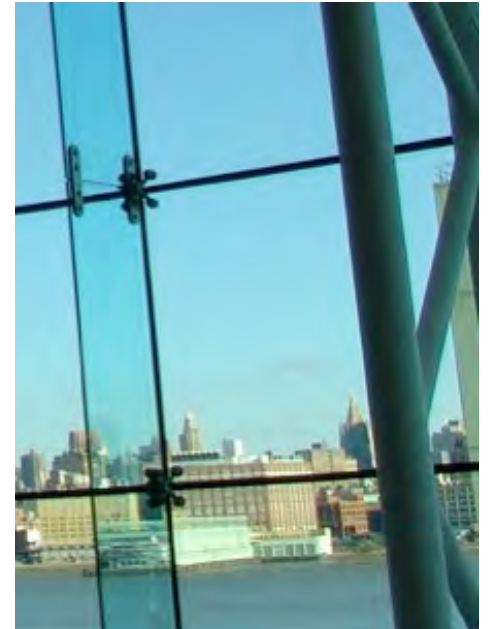




RT 24 - Architecture, Modeling & Simulation, and Software Design

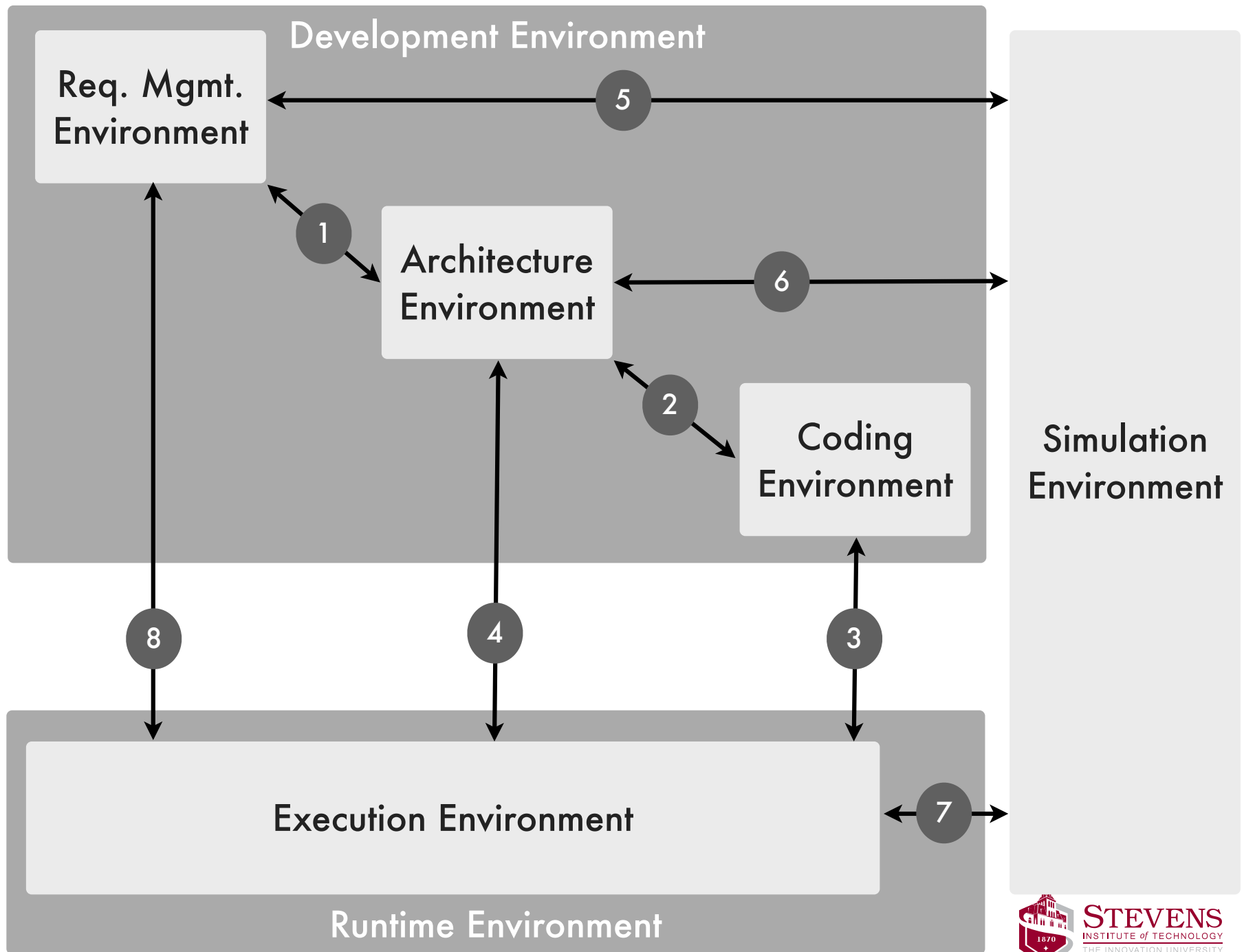
Dennis Barnabe, Department of Defense
Michael zur Muehlen & Anne Carrigy, Stevens Institute of Technology
Drew Hamilton, Auburn University
Russell Peak, Georgia Tech



Report Documentation Page				Form Approved OMB No. 0704-0188	
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Context

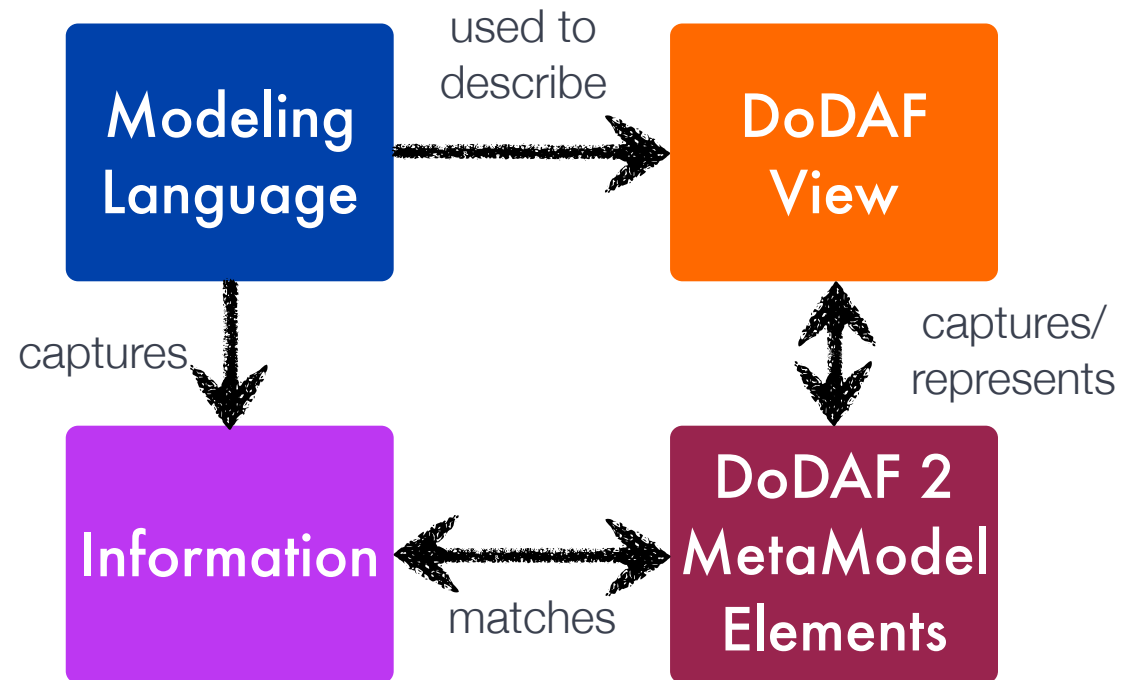
- ▶ The client is producing software-intensive, distributed systems in short development cycles (90 day increment spins)
- ▶ The DoD JCIDS process requires the documentation of systems in the form of certain DODAF products
- ▶ Occasionally this documentation is created after the fact and not as a basis for Modeling & Simulation or software development (notion: coding is faster than architecting)
- ▶ Effort spent on architecture development is essentially wasted, since architecture products are not used for value-added delivery, and architecture models and code evolve separate from each other



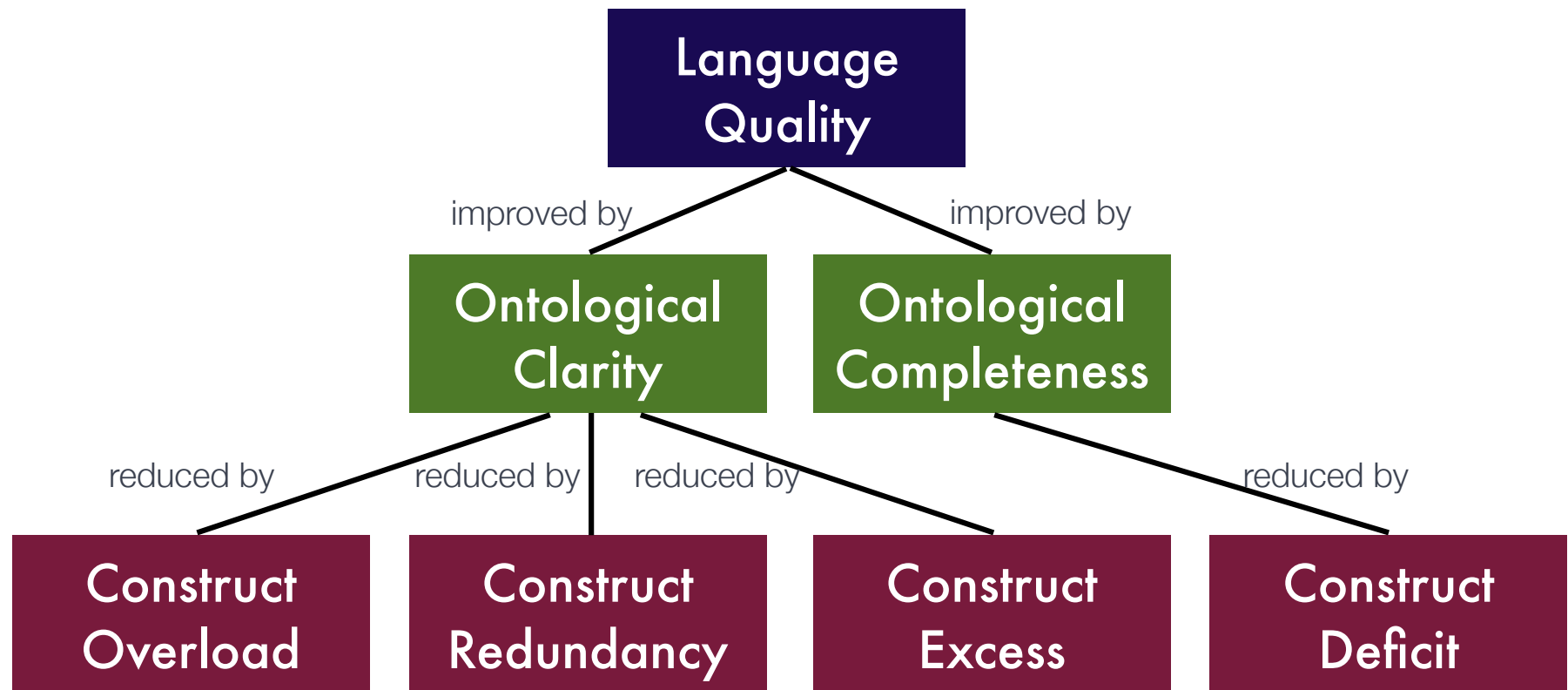
Challenge

- ▶ Investigate the **integration** of Architecture models in the Modeling & Simulation and Software Design and Development Process
- ▶ Develop a **methodology** that:
 - ▶ Identifies those architecture products that are relevant for the design of software-intensive systems
 - ▶ Provides guidance as to the sequence in which these models should be created
 - ▶ Provides guidance as to the methods that should be used when creating these models
 - ▶ Provides guidance as to the use of the recommended methods
- ▶ Evaluate the methodology against tool capabilities available to the client
 - ▶ Particular focus on tool extensions (UPDM, SysML, SoaML, BPMN)
 - ▶ Leverage “best of breed” architecture methodologies
- ▶ Provide tooling to support the methodology

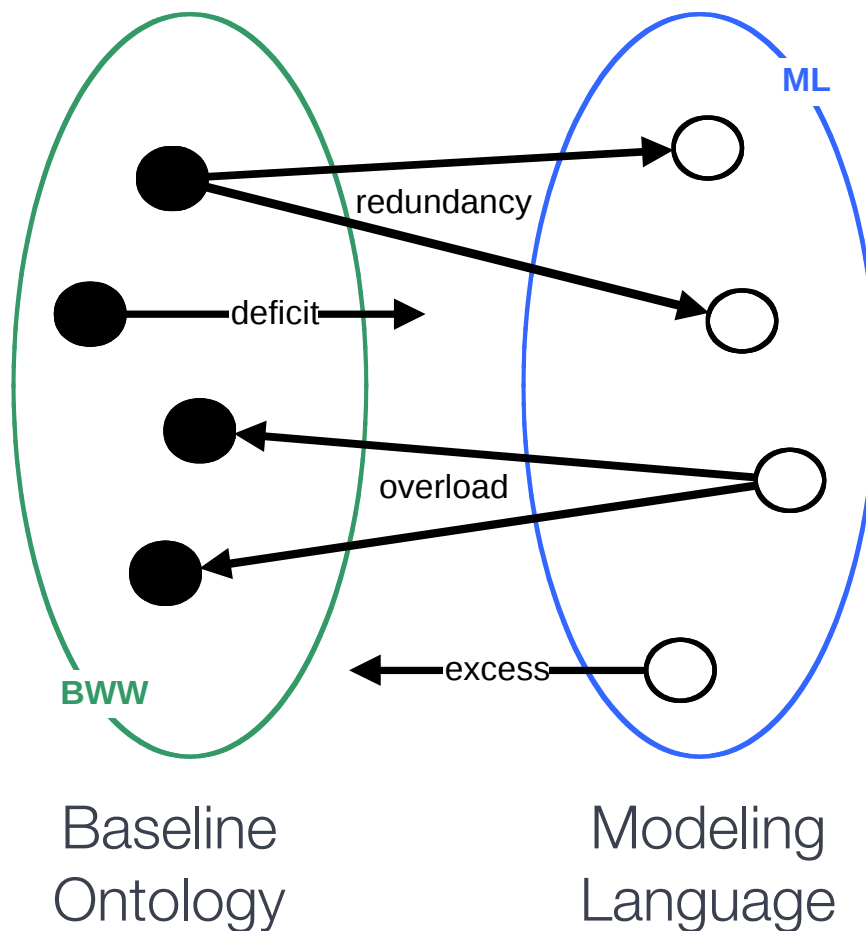
DoDAF 2.0



How Good is a Language?



Benchmarking a Language



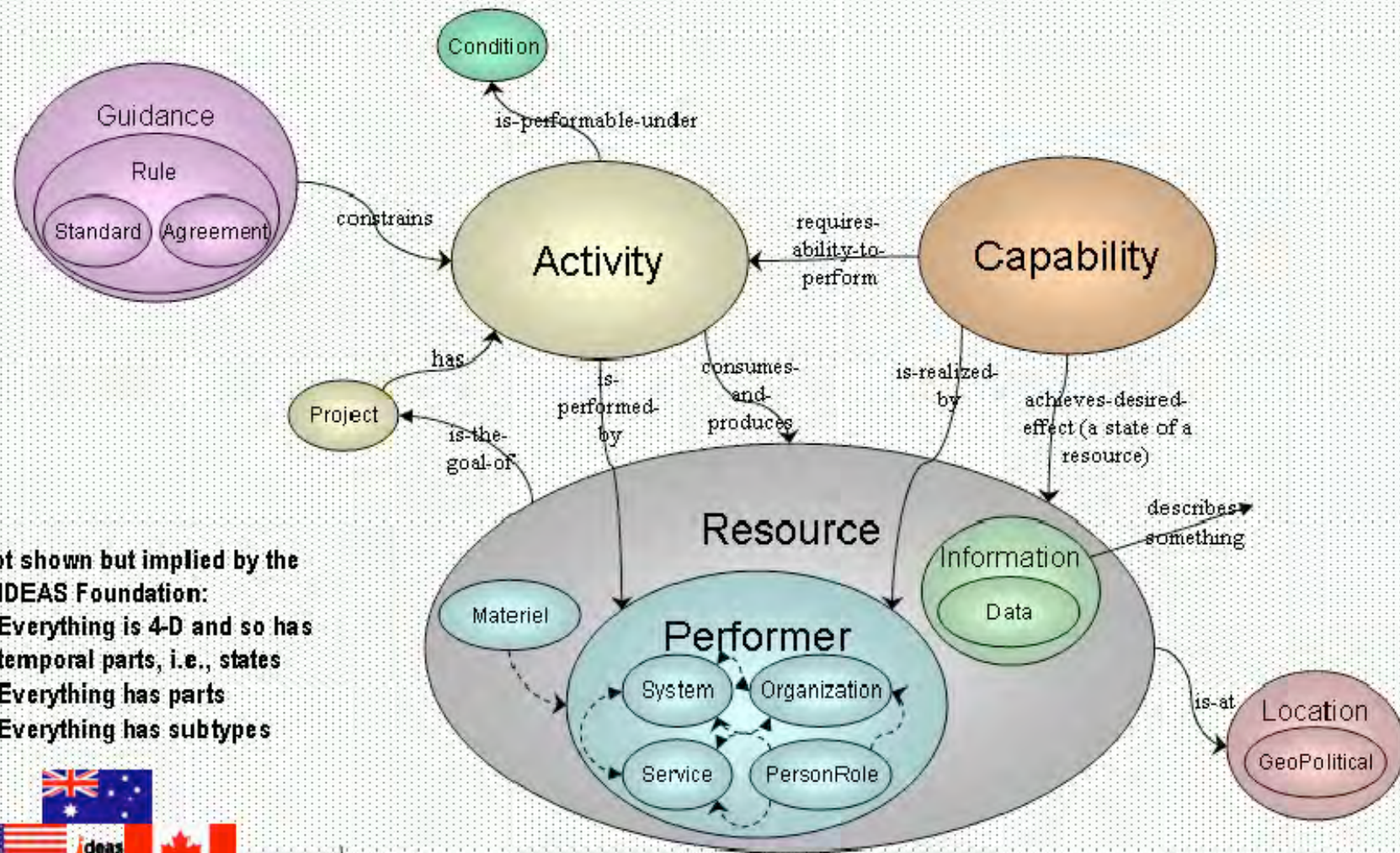
Key

BWW	Set of constructs described in the <i>BWW</i> model
ML	Set of constructs comprising the <i>Modelling Language</i>
●	Construct described in the BWW model
○	Modelling language construct

Mapping Options

- ▶ Modeling Language (i.e. Diagram Type) to DoDAF View
 - ▶ Coarse-grained
 - ▶ Good for initial assessment
- ▶ Modeling Language Construct to DoDAF 2.0 MetaModel Entry
 - ▶ Fine-grained
 - ▶ May help in tailoring language

DM2 Concepts



Not shown but implied by the IDEAS Foundation:

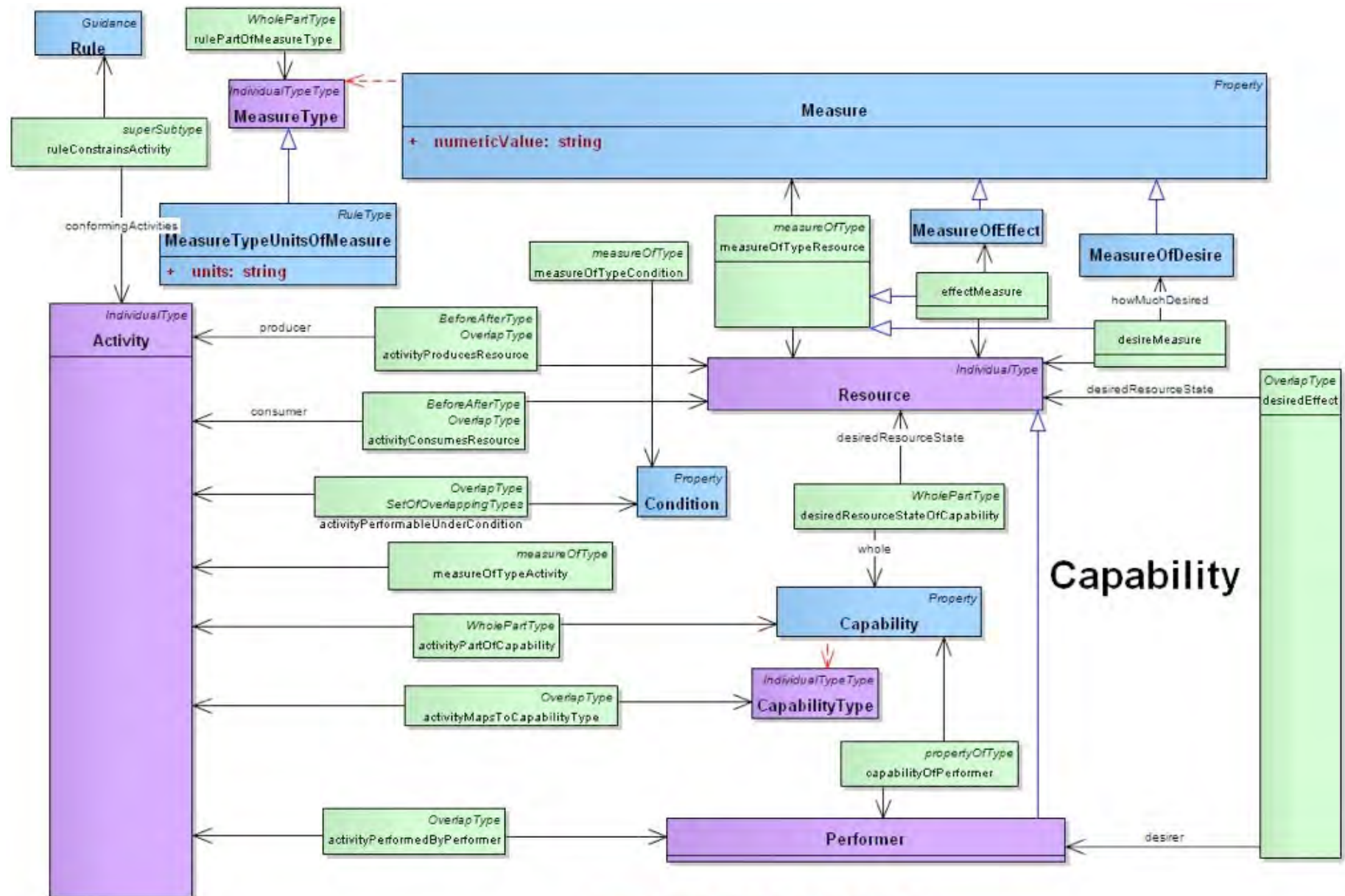
- Everything is 4-D and so has temporal parts, i.e., states
- Everything has parts
- Everything has subtypes



is-part-of

anything can have Measures

Example: DoDAF 2.0 Capability



Example: BPMN

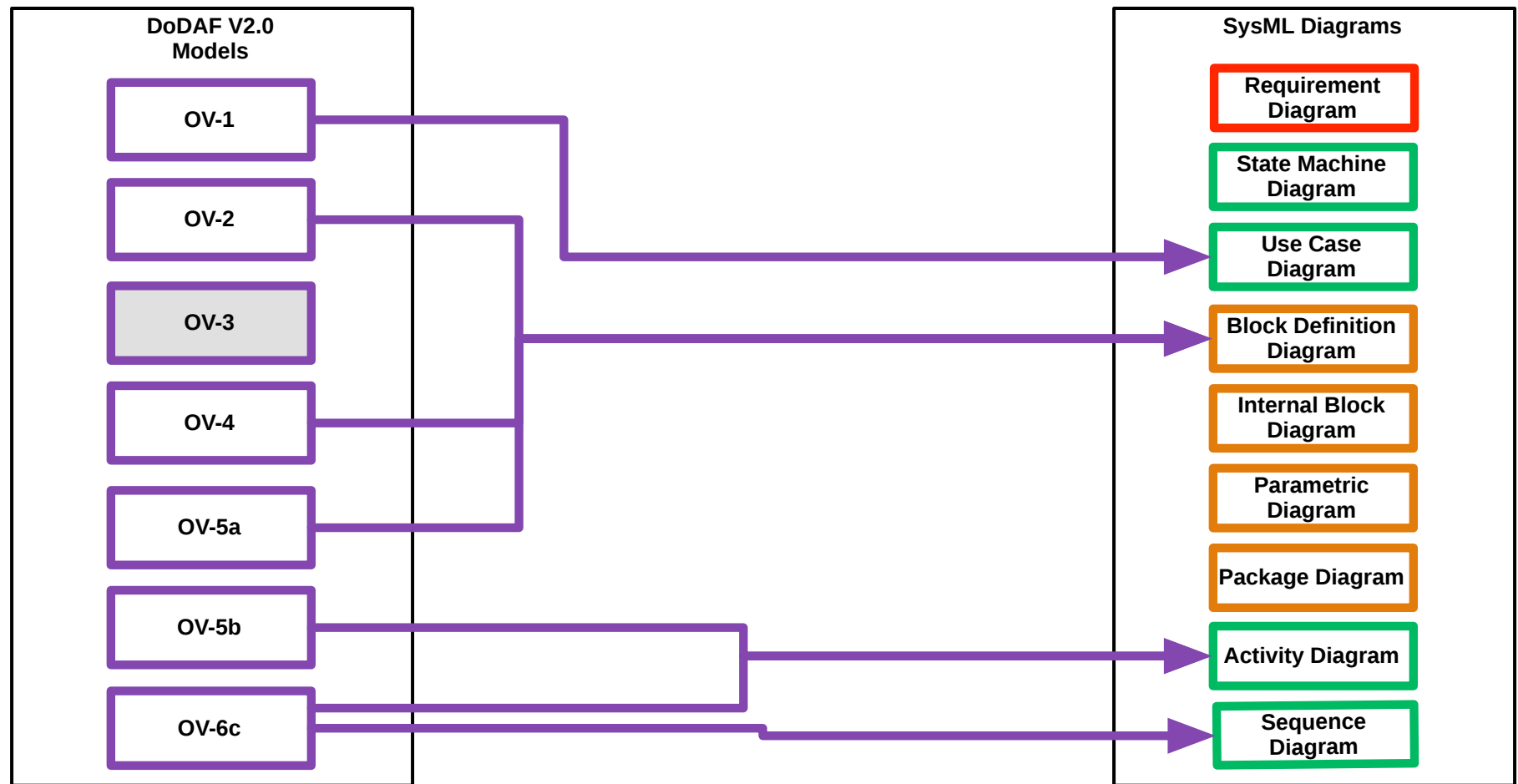
BPMN
MetaModel

DoDAF 2.0
MetaModel

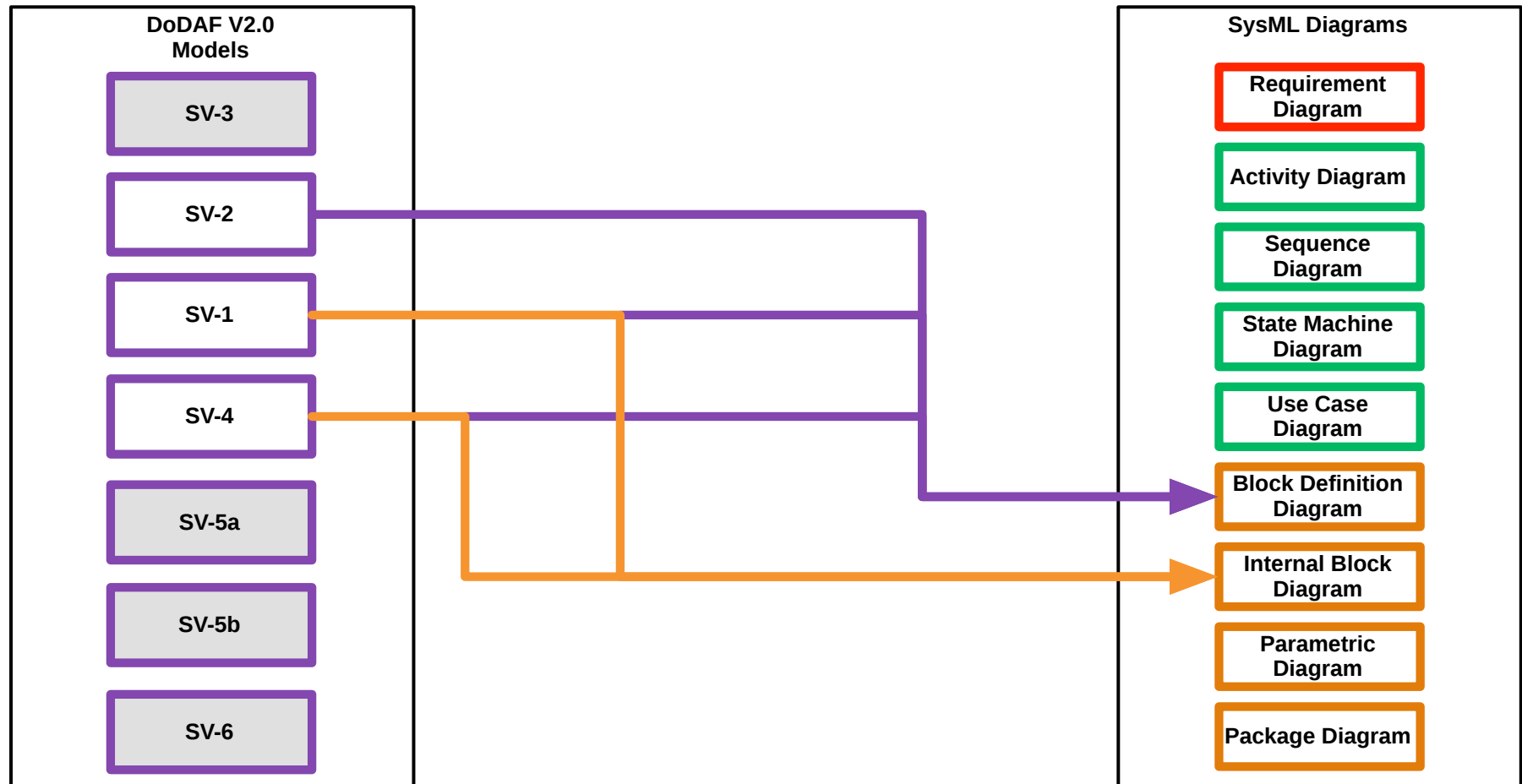
DAF 2.0 aModel		Accurate Mappings		Connecting Objects										Flow Objects													
				Interpretative Mappings																							
				Process	Business Process Diagram	Connecting Object	Normal Flow	Default Flow	Conditional Flow	Exception Flow	Message Flow	Association	Compensation Association	Flow Object	Sequence Flow Source	Sequence Flow Target	Message Flow Source	Message Flow Target	Association Source	Association Target	Activity	Task	Sub-Process (Collapsed)	Sub-Process (Expanded)	Ad-hoc Subprocess	Loop	Multiple Instance
Accurate Mappings		0	1	0	1	1	1	1	2	1	0	0	2	3	2	3	0	0	1	1	1	1	1	1	1		
Interpretative Mappings		0	0	0	0	2	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Inherited Mapping		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1		
Activity	1	0																	▲	▼	▼	▼	▼	▼	▼		
ActivityChangesEffectObject	0	1								■																	
ActivityConditionOverlap	0	0																									
ActivityPartOfCapability	0	0																									
ActivityPerformedByPerformer	0	0																									
ActivityPerformerOverlap	0	0																									
ActivityResourceOverlap	9	1		▲	▲	▲	▲	▲	▲	■		▲	▲	▲	▲												
ActivityResourceOverlapOverlappingPartOfResource	0	0																									
Address	0	0																									
Agreement	0	0																									
ArchitectureOverviewAndPurpose	0	0																									
Capability	0	0																									
Condition	0	0																									
Constraint	0	0																									
ConsumingPartOfActivity	3	1											▲		▲												
Data	1	1																									
DataAssociation	1	0								▲																	
DataPartOfInformation	0	0																									
DescribedBy	0	0																									
DesiredEffect	0	0																									
DesiredEffectDirectsActivity	0	0																									
DomainInformation	0	0																									
EffectObject	2	1											▲		▲												



Mapping SysML to DoDAF 2.0



Mapping SysML to DoDAF 2.0



Understanding JCIDS

Document	Supportability Compliance	DOD Enterprise Architecture Products (IAW DODAF) (see Note 5)																Data/Service Exposure Sheets	IA Compliance	GTG Compliance
		AV-1 /AV-2	OV-1	OV-2	OV-3	OV-4	OV-5	OV-6C	OV-7	SV-1	SV-2	SV-4	SV-5	SV-6	SV-11	TV-1	TV-2			
ICD			X																	
CDD	X	3	X	X	X	X	X	X			X	X	X	X		2	2	1	X	X
CPD	X	3	X	X	X	X	X	X	1		X	X	X	X	1	2	2	1	X	X
ISP	X	3	X	X	X	X	X	X	4		X	X	X	X	4	2	2	1	X	X
TISP	X	3	X		X		X	X		X			X	X		2	2	1	X	X
ISP Annex (Svcs/ Apps)	X	3	X				X				X	X	X	X		2	2	1	X	X
X	Required (PM needs to check with their Component for any additional architectural/regulatory requirements for CDDs, CPDs, ISPs/TISPs. (e.g., HQDA requires the SV-10c)																			
Note 1	Required only when IT and NSS collects, processes, or uses any shared data or when IT and NSS exposes, consumes or implements shared services,																			
Note 2	The TV-1 and TV-2 are built using the DISRonline and must be posted for compliance.																			
Note 3	The AV-1 must be uploaded onto DARS and must be registered in DARS for compliance																			
Note 4	Only required for Milestone C, if applicable (see Note 1)																			
Note 5	The naming of the architecture views is expected to change with the release of DODAF v2.0 (e.g., StdV, SvcV, StdV, DIV). The requirements of this matrix will not change.																			

Table E-1. NR-KPP Products Matrix

DoDAF 2.0 Product	Initial Capability Document (ICD)	Capability Development Document (CDD)	Capability Production Document (CPD)
OV-1 (Concept of Operations)	X	X	X
AV-1 (Project Overview)		X	X
AV-2 (Integrated Dictionary)		X	X
OV-2 (Operational Resource Flow Description)		X	X
OV-3 (Operational Resource Flow Matrix)		X	X
OV-4 (Organizational Relationship Chart)		X	X
OV-5a (Operational Activity Decomposition Tree)		X	X
OV-5b (Operational Activity Model)		X	X
OV-6c (Event-Trace Description)		X	X
SV-2 (Systems Resource Flow Description)		X	X
SV-4 (Systems Functionality Description)		X	X
SV-5a (Operational Activity to Systems Function Matrix)		X	X
SV-5b (Operational Activity to Systems Matrix)		X	X
SV-6 (Systems Resource Flow Matrix)		X	X
StdV-1 (Standards Profile)		X	X
StdV-2 (Standards Forecast)		X	X
DIV-2 (Conceptual Data Model)			X
DIV-3 (Conceptual Data Model)			X



DoDAF 2.0 Product	Initial Capability Document	Capability Development Document (CDD)	Capability Production Document (CPD)
OV-1 (Concept of Operations)		X	X
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OV-5b (Operational Activity Model)		X	X
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SV-5b (Operational Activity to Systems Matrix)		X	X
SV-6 (Systems Resource Flow Matrix)		X	X
StdV-1 (Standards Profile)		X	X
StdV-2 (Standards Forecast)		X	X
DIV-2 (Conceptual Data Model)			X
DIV-3 (Conceptual Data Model)			X

Need Org
Structure



DoDAF 2.0 Product	Initial Capability Document	Capability Development Document (CDD)	Capability Production Document (CPD)
OV-1 (Concept of Operations)		X	X
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OV-3 (Operational Resource Flow Matrix)		X	X
OV-4 (Organizational Relationship Chart)		X	X
OV-5a (Operational Activity Decomposition Tree)		X	X
OV-5b (Operational Activity Model)			X
OV-6c (Event-Trace Description)			X
SV-2 (Systems Resource Flow Description)			X
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SV-5a (Operational Activity to Systems Function Matrix)		X	X
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SV-6 (Systems Resource Flow Matrix)		X	X
StdV-1 (Standards Profile)		X	X
StdV-2 (Standards Forecast)		X	X
DIV-2 (Conceptual Data Model)			X
DIV-3 (Conceptual Data Model)			X

Need Org Structure

All based on Activities



DoDAF 2.0 Product	Initial Capability Document	Capability Development Document (CDD)	Capability Production Document (CPD)
OV-1 (Concept of Operations)		X	X
AV-1 (Project Overview)		X	X
AV-2 (Integrated Dictionary)		X	X
OV-2 (Operational Resource Flow Description)		X	X
OV-3 (Operational Resource Flow Matrix)		X	X
OV-4 (Organizational Relationship Chart)		X	X
OV-5a (Operational Activity Decomposition Tree)		X	X
OV-5b (Operational Activity Model)			X
OV-6c (Event-Trace Description)			X
SV-2 (Systems Resource Flow Description)			X
SV-4 (Systems Functionality Description)		X	X
SV-5a (Operational Activity to Systems Function Matrix)			X
SV-5b (Operational Activity to Systems Matrix)			X
SV-6 (Systems Resource Flow Matrix)			X
StdV-1 (Standards Profile)			X
StdV-2 (Standards Forecast)		X	X
DIV-2 (Conceptual Data Model)			X
DIV-3 (Conceptual Data Model)			X

Need Org Structure

All based on Activities

All derived from OV2 - OV4



DoDAF 2.0 Product	Initial Capability Document	Capability Development Document (CDD)	Capability Production Document (CPD)
OV-1 (Concept of Operations)		X	X
AV-1 (Project Overview)		X	X
AV-2 (Integrated Dictionary)		X	X
OV-2 (Operational Resource Flow Description)		X	X
OV-3 (Operational Resource Flow Matrix)		X	X
OV-4 (Organizational Relationship Chart)		X	X
OV-5a (Operational Activity Decomposition Tree)		X	X
OV-5b (Operational Activity Model)			X
OV-6c (Event-Trace Description)			X
SV-2 (Systems Resource Flow Description)			X
SV-4 (Systems Functionality Description)		X	X
SV-5a (Operational Activity to Systems Function Matrix)			X
SV-5b (Operational Activity to Systems Matrix)			X
SV-6 (Systems Resource Flow Matrix)			X
StdV-1 (Standards Profile)			X
StdV-2 (Standards Forecast)		X	X
DIV-2 (Conceptual Data Model)			X
DIV-3 (Conceptual Data Model)			X

Need Org Structure

All based on Activities

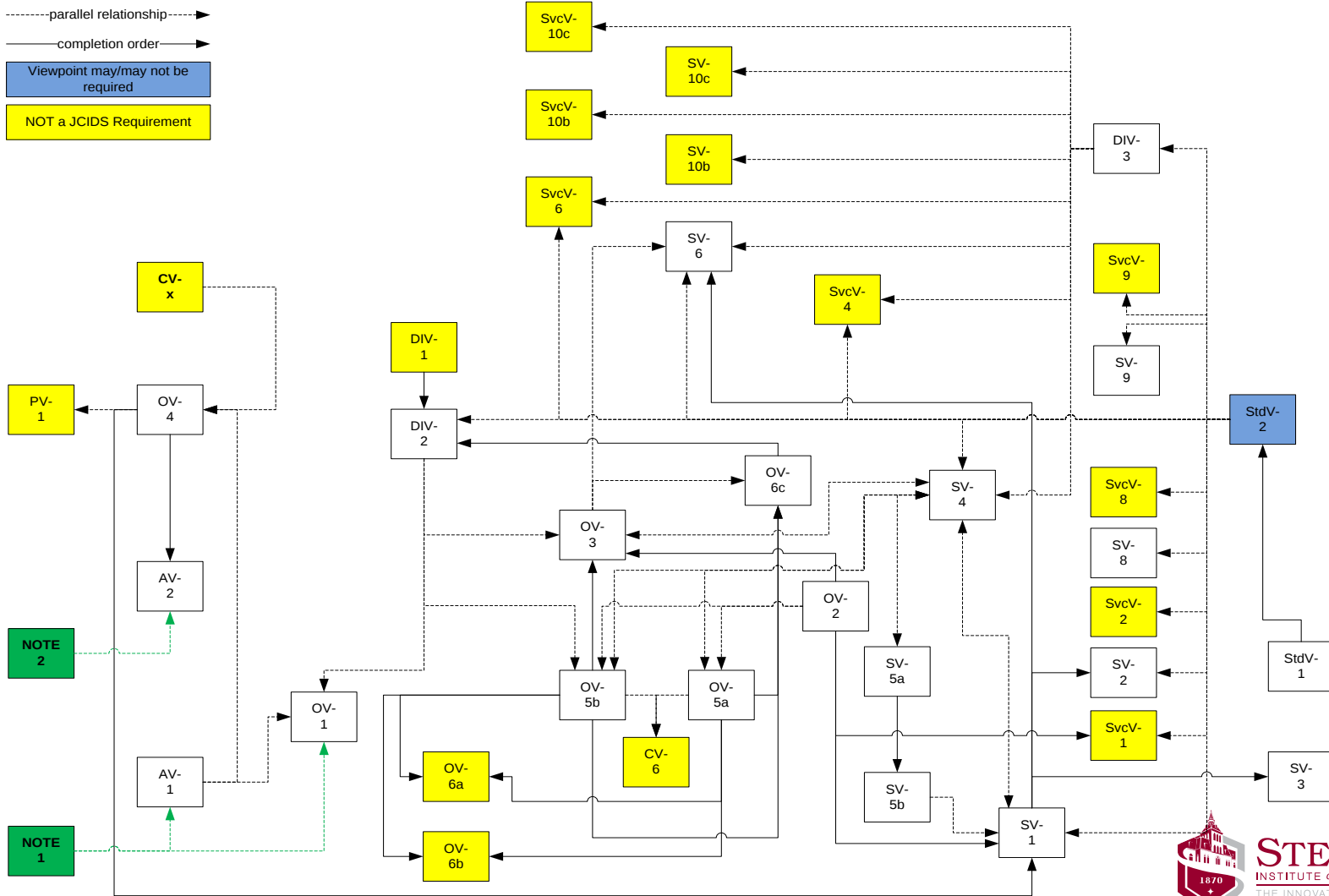
All derived from OV2 - OV4

Useful, but not required

Dependencies (DoDAF 2.0 Spec)

NOTE 1: Developed iteratively as the Architecture Description is developed.

NOTE 2: The AV-2 presents all the metadata used in an architecture. An AV-2 shows elements from the DoDAF Meta-model that have been described in the Architectural Description and new elements (i.e., not in the DM2) that have been introduced by the Architectural Description.



Basic Process



Create



Dispose



Process



Decide



Batch



Separate



Assign



Record



Attribute



Entity



Queue



Resource



Variable



Schedule



Set

Modeling & Simulation

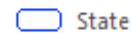
UML Activity (US units)



Action State



Decision



State



Swimlane



Initial State



Final State



Transition
(Fork)



Transition
(Join)



Control Flow



Object Flow



Object In
State



Signal
Receipt



Signal Send



Constraint



Note



2-element
Constraint



OR
Constraint

BPMN Basic Shapes (US units)



Task



Gateway



Intermediate
Event



End Event



Start Event



Collapsed
Sub-Process



Expanded
Sub-Process



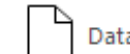
Sequence
Flow



Message
Flow



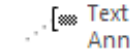
Association



Data Object



Pool / Lane



Text
Annotation

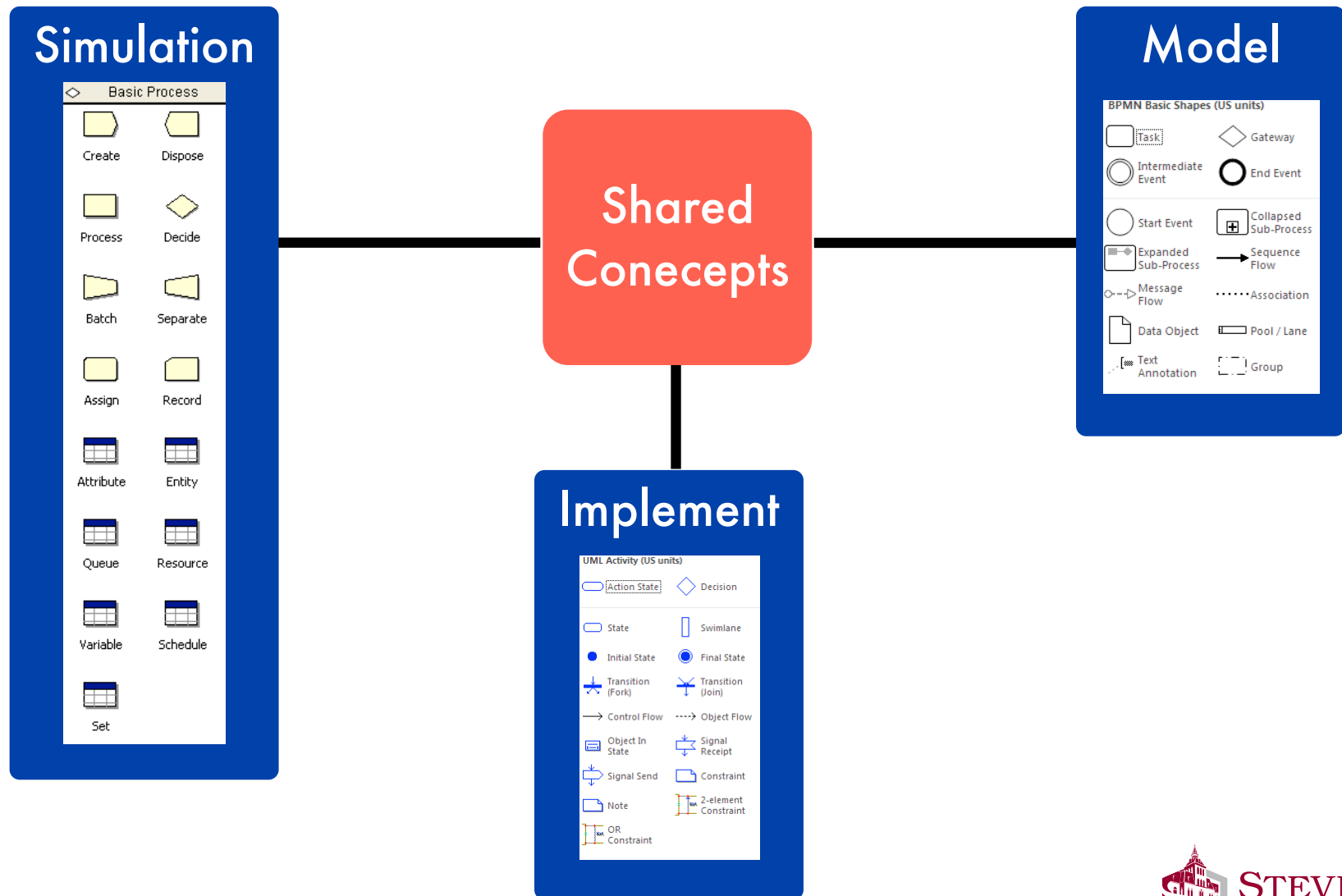


Group

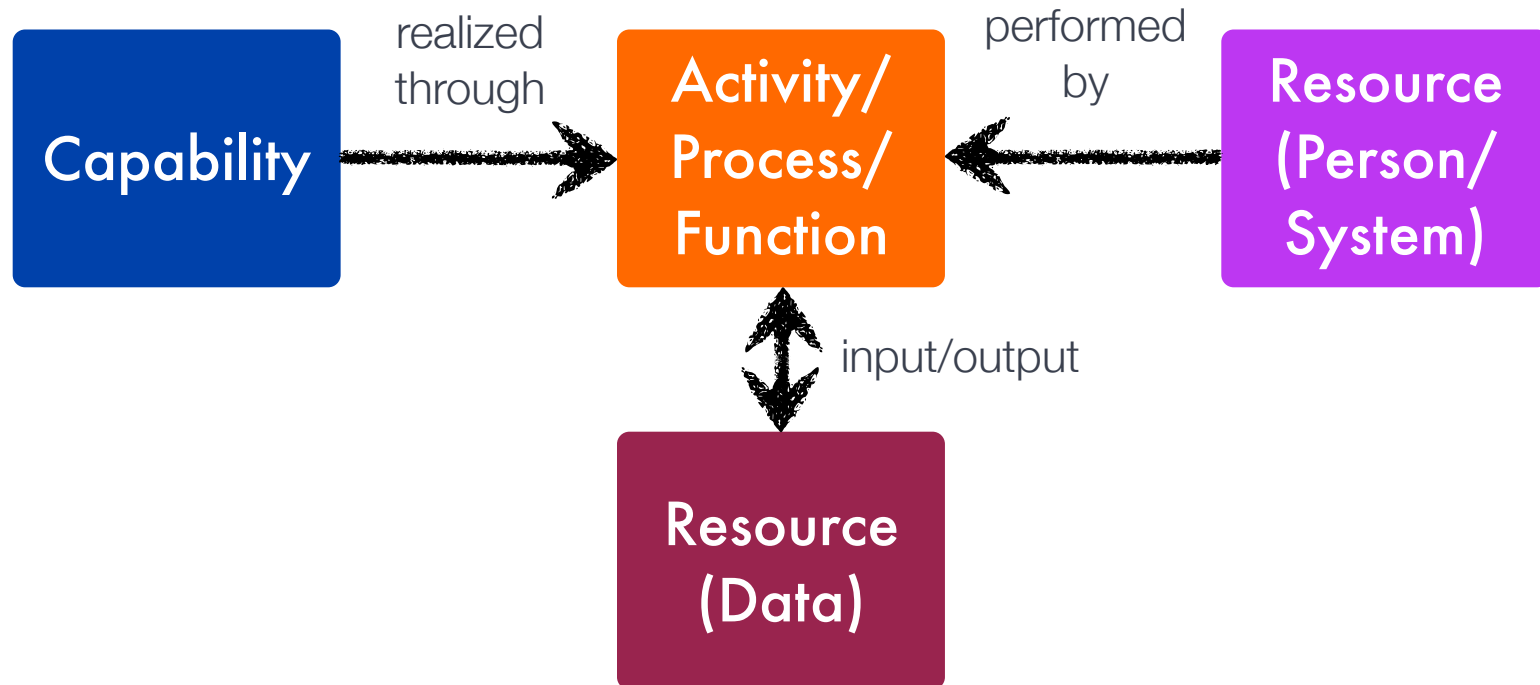


STEVENS
INSTITUTE of TECHNOLOGY
THE INNOVATION UNIVERSITY

Modeling & Simulation



Core Description



Big Picture

