PROBLEM SPACE MODELING
A Dynamic Future For Requirements Analysis

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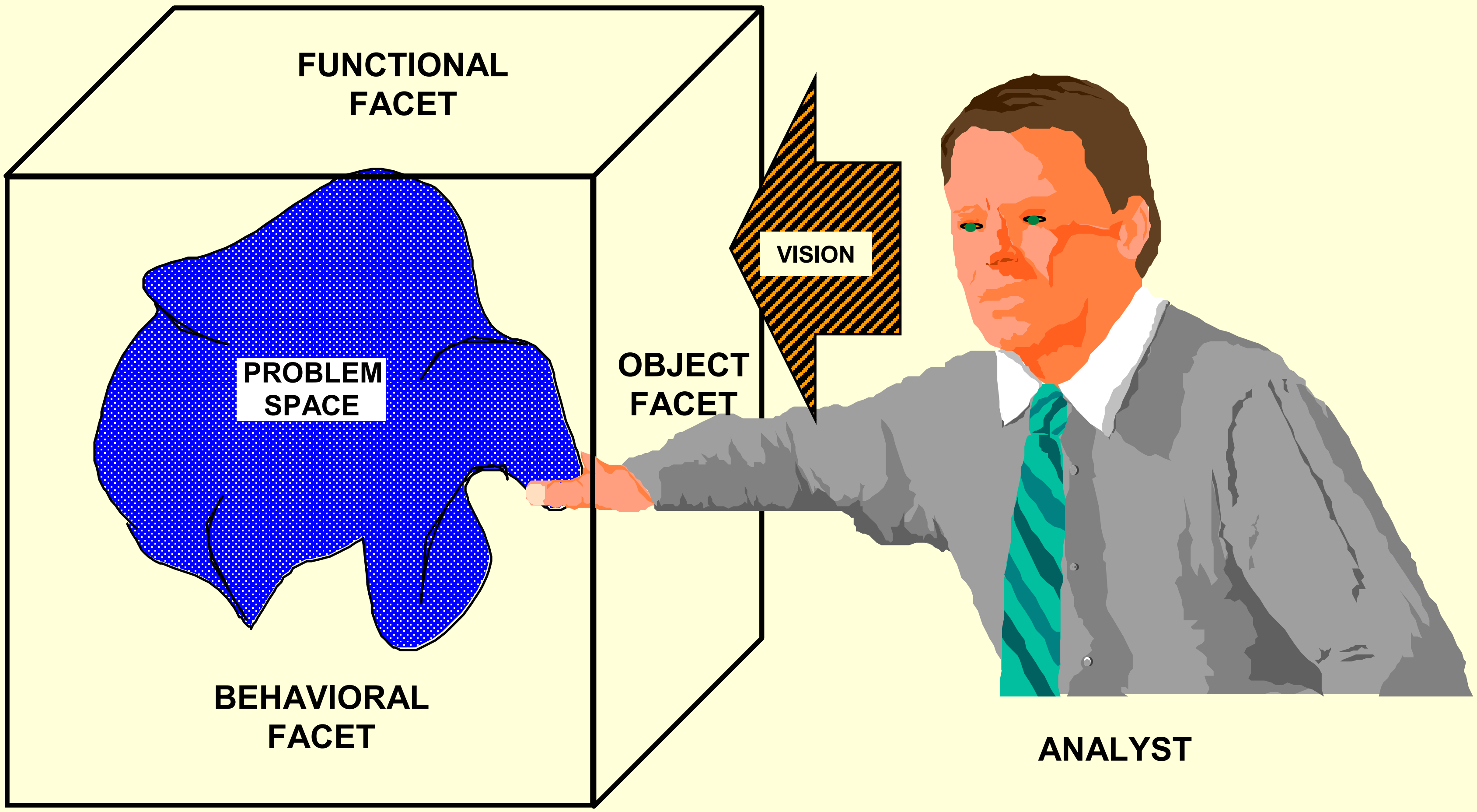
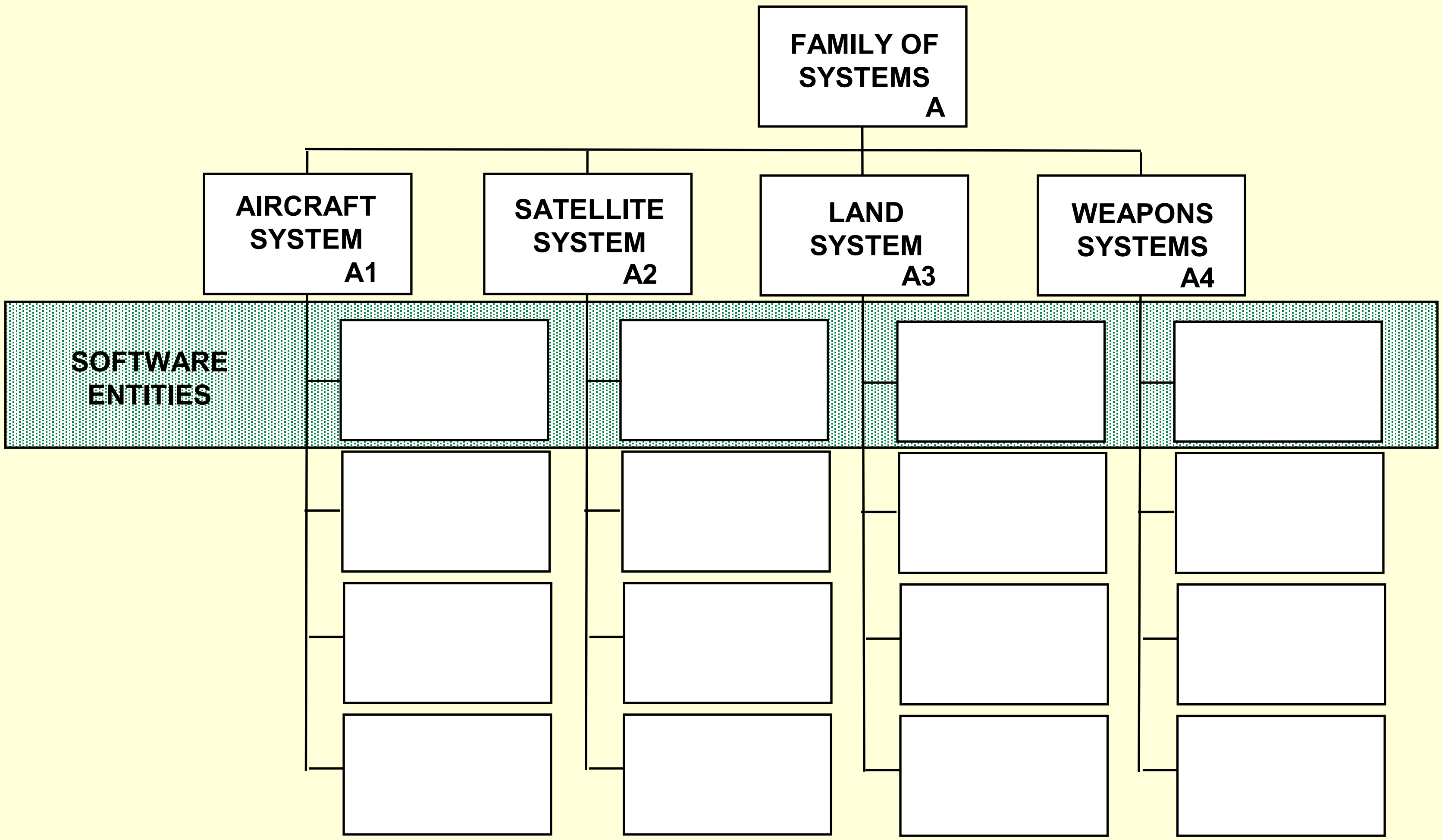
Agenda

- A current reality
- Program preparation
- Traditional structured analysis
- UML
- The future

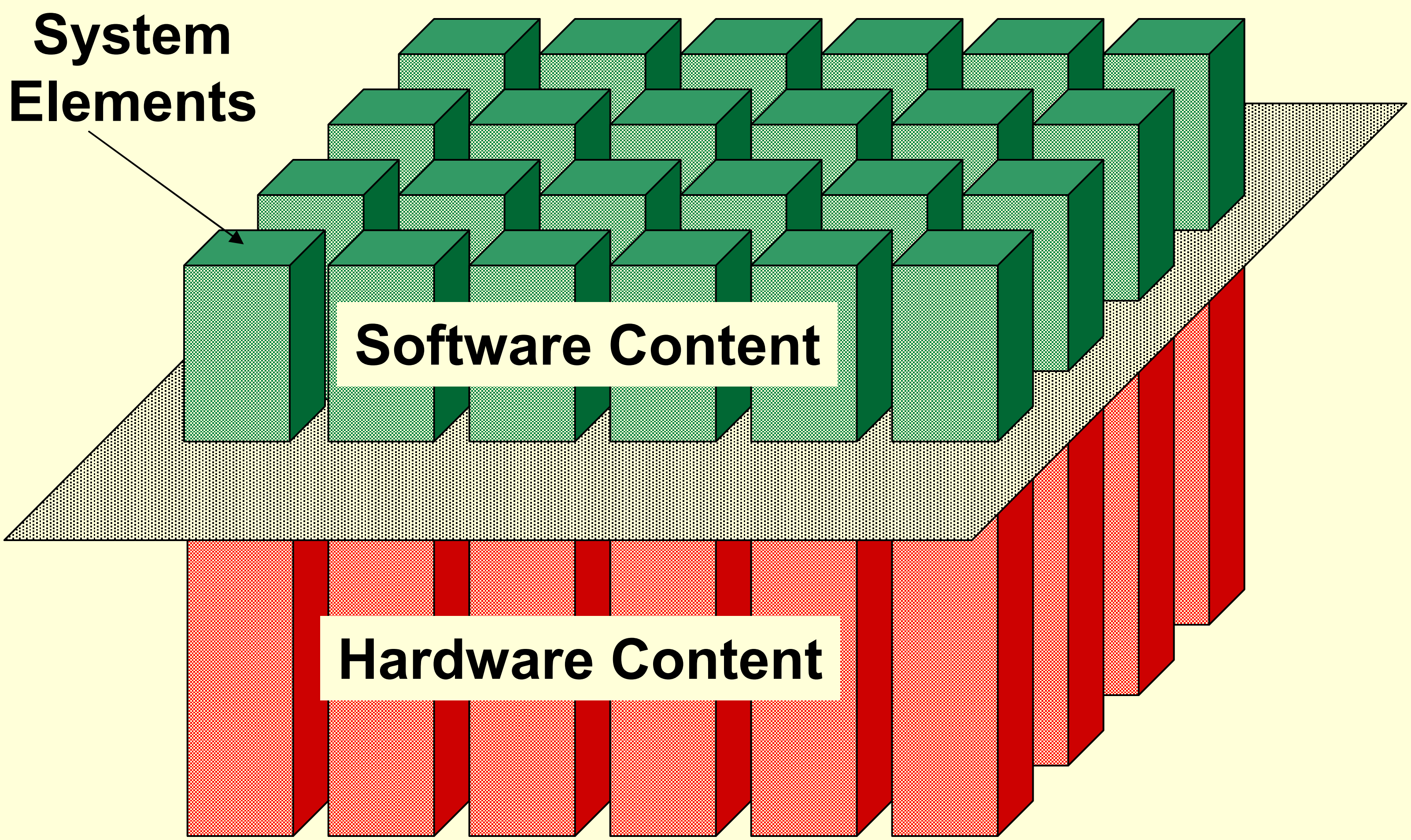
How Should the Engineer Approach Unprecedented Problem Space?



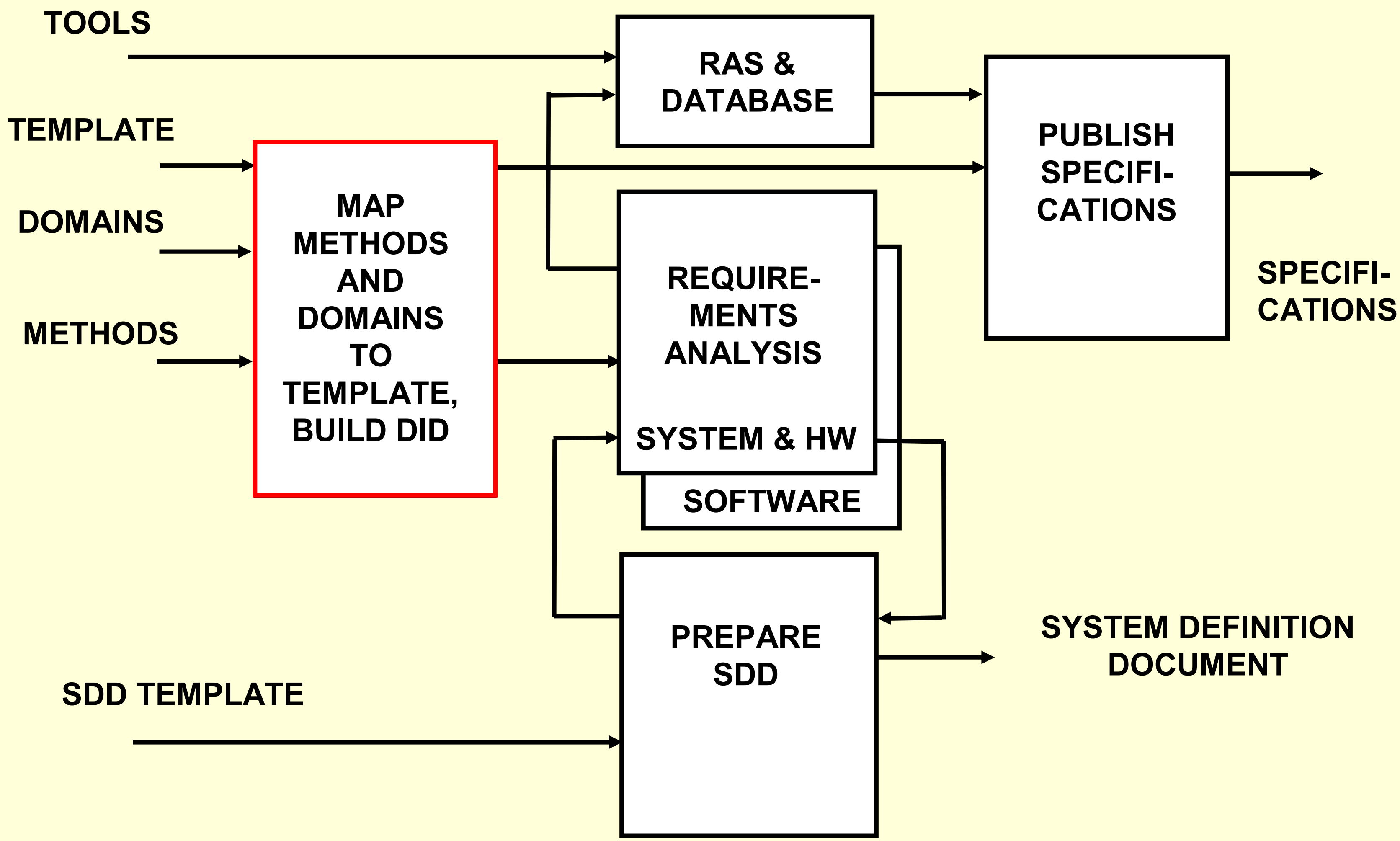
System Entities



A Single Model Will Not Work



Prepare the Enterprise



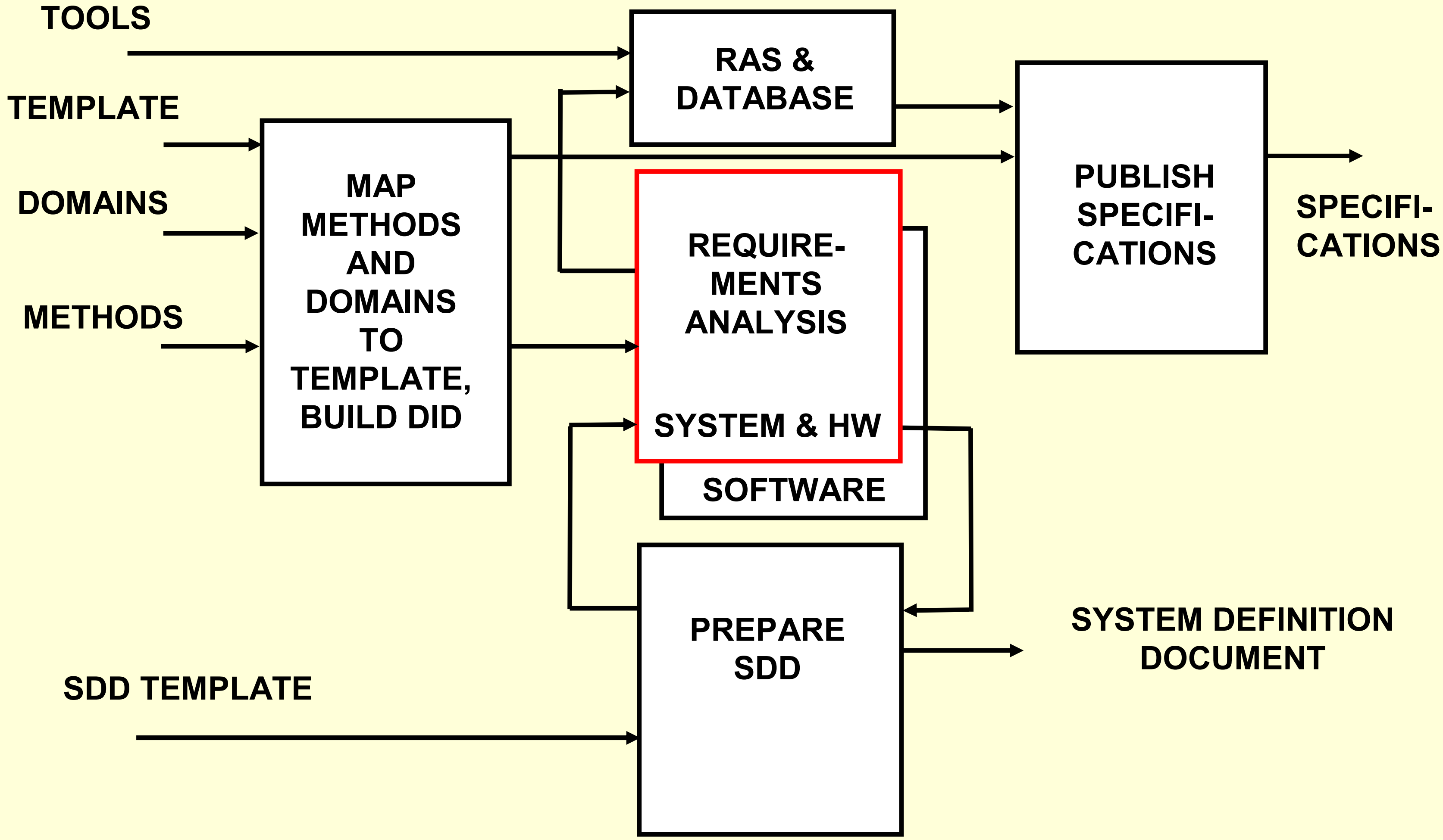
Prepare the Enterprise

- Select standards and corresponding templates
- Select preferred structured analysis models
- Tailor templates for alignment with models you choose to use to explore problem space
- Build data item description (DID) for each specification type/model application
  - System specification/TSA
  - Hardware performance specification/TSA
  - Software performance specification/UML
  - Software performance specification/DoDAF
  - Hardware ICD/TSA and software IRS/UML and DoDAF
- Map organization and models to template
- Apply SDD as a means to capture models products

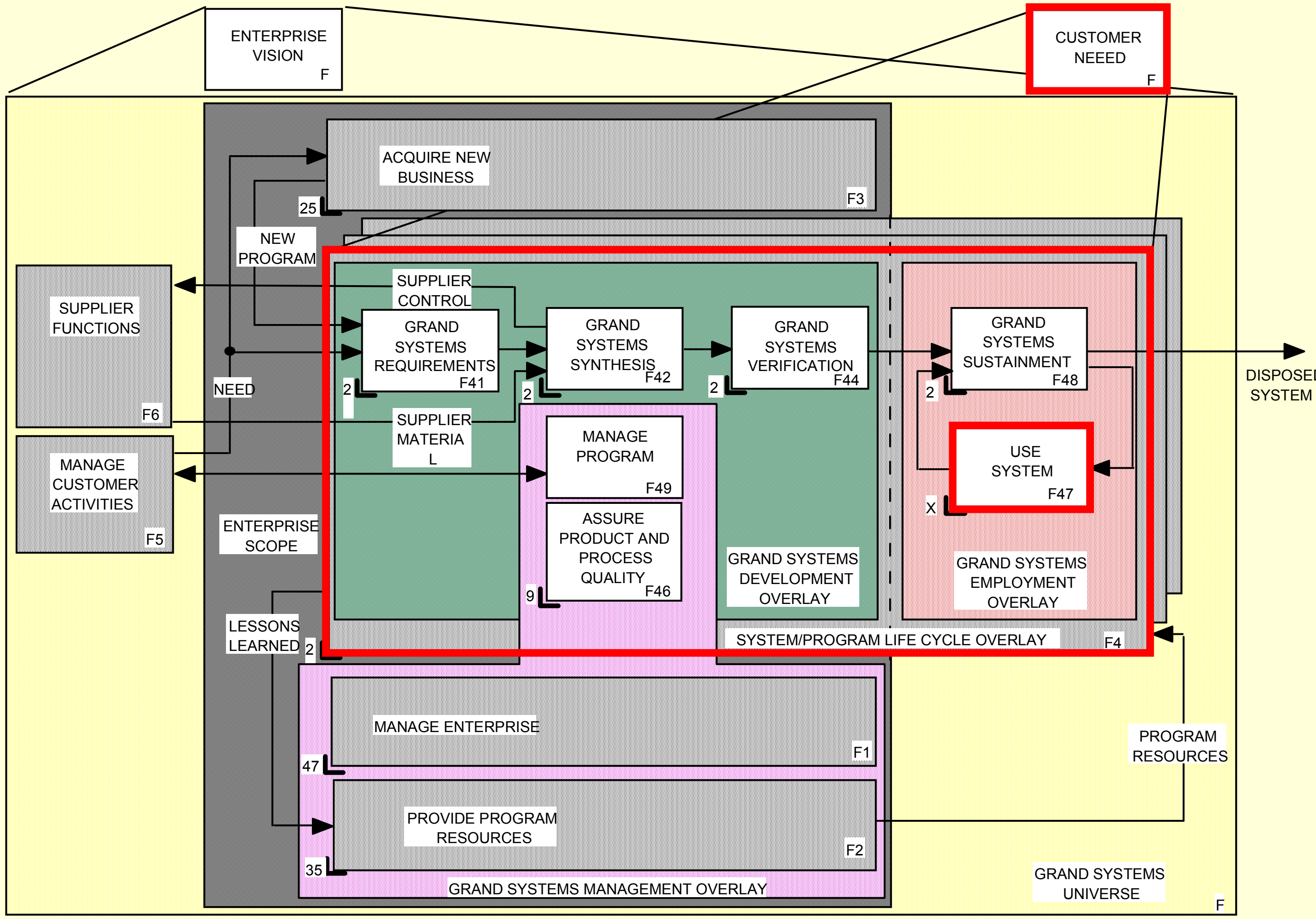
Generic Template

3.1	States and modes
3.2	Entity capabilities
3.2.m	Entity capability m
3.2.m.n	Entity capability m, requirements n
3.3	Interface requirements
3.3.1	External interfaces
3.3.1.m	External interface m
3.3.1.m.n	External interface m, requirement n
3.3.2	Internal interfaces
3.3.2.m	Internal interface m
3.3.2.m.n	Internal interface m, requirement n
3.4	Specialty engineering requirements
3.4.m	Specialty discipline m
3.4.m.n	Specialty discipline m, requirement n
3.5	Environmental requirements
3.6	Precedence and criticality considerations

Do the Analysis Work Using Preferred Models

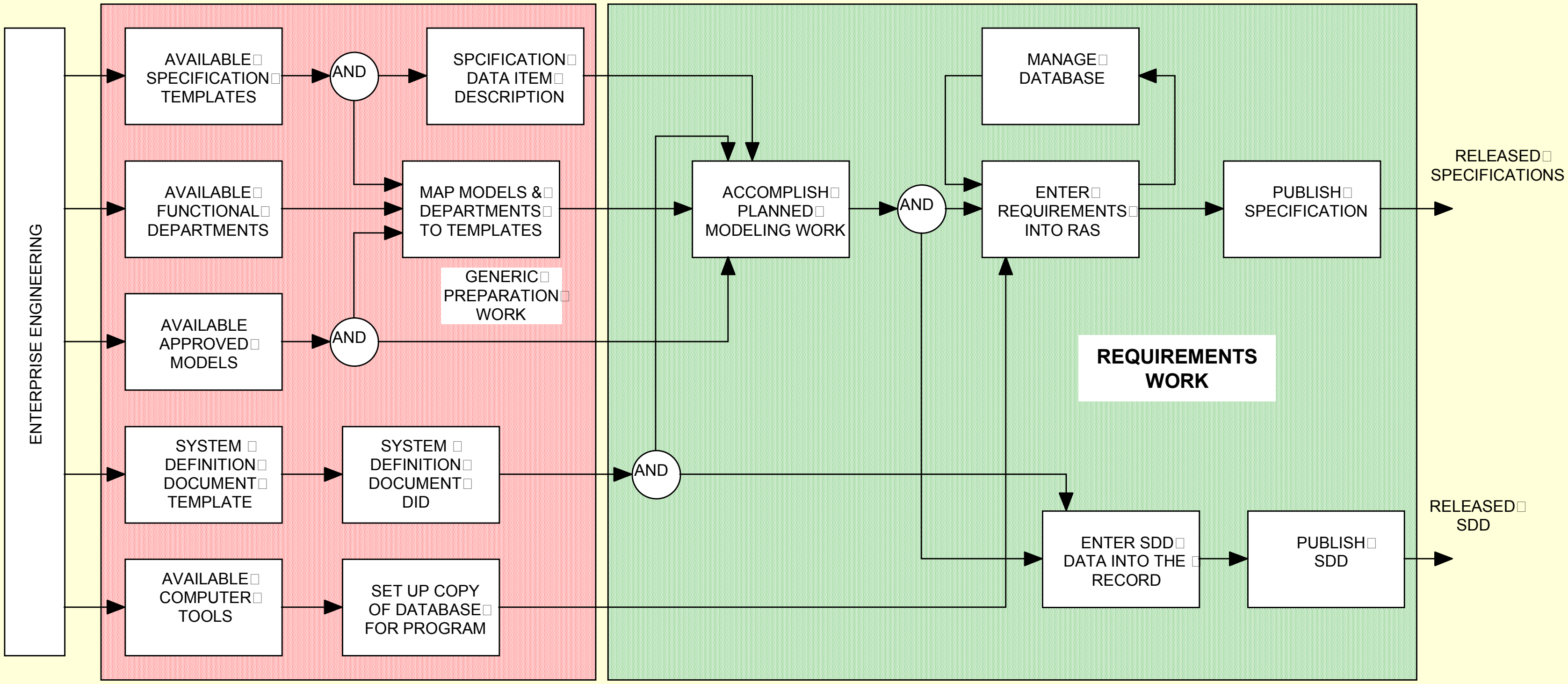


Ultimate Process Diagram

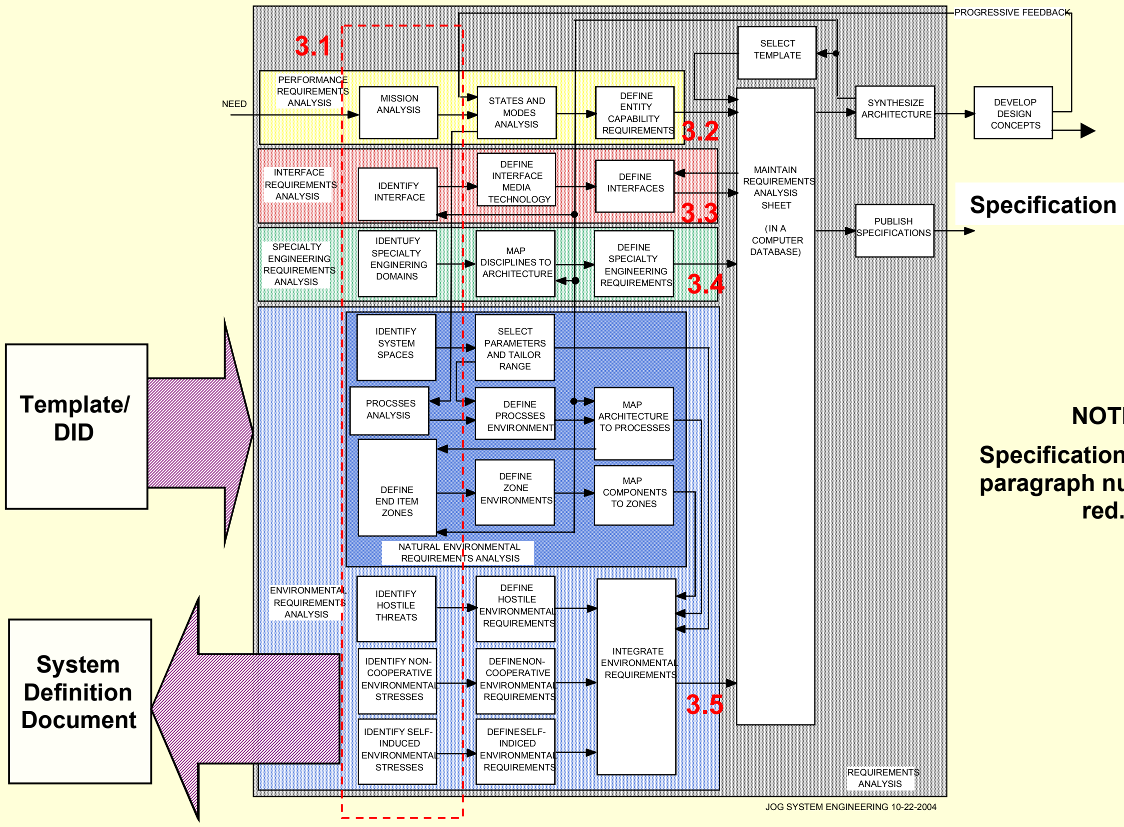


X: REFER TO PROGRAM SYSTEM DEFINITION DOCUMENT FOR EXPANSION

The Process


ENTERPRISE ENGINEERING
AVAILABLE SPECIFICATION TEMPLATES
AND
SPCIFICATION DATA ITEM DESCRIPTION
AVAILABLE FUNCTIONAL DEPARTMENTS
MAP MODELS & DEPARTMENTS TO TEMPLATES
GENERIC PREPARATION WORK
AVAILABLE APPROVED MODELS
AND
SYSTEM DEFINITION DOCUMENT TEMPLATE
SYSTEM DEFINITION DOCUMENT DID
AVAILABLE COMPUTER TOOLS
SET UP COPY OF DATABASE FOR PROGRAM
AND
ACCOMPLISH PLANNED MODELING WORK
AND
MANAGE DATABASE
ENTER REQUIREMENTS INTO RAS
PUBLISH SPECIFICATION
RELEASED SPECIFICATIONS
REQUIREMENTS WORK
ENTER SDD DATA INTO THE RECORD
PUBLISH SDD
RELEASED SDD

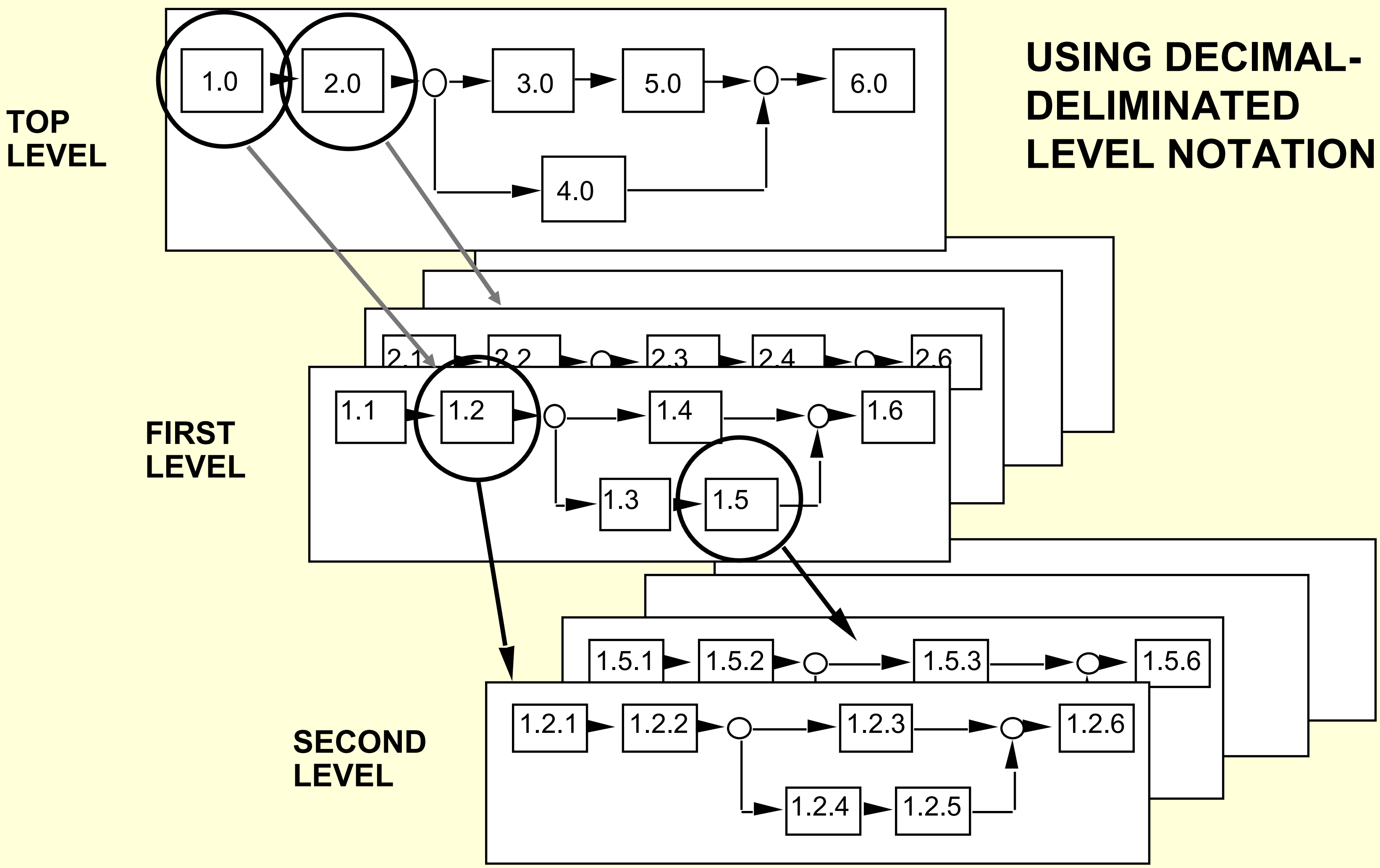
Traditional Structured Analysis



NOTE

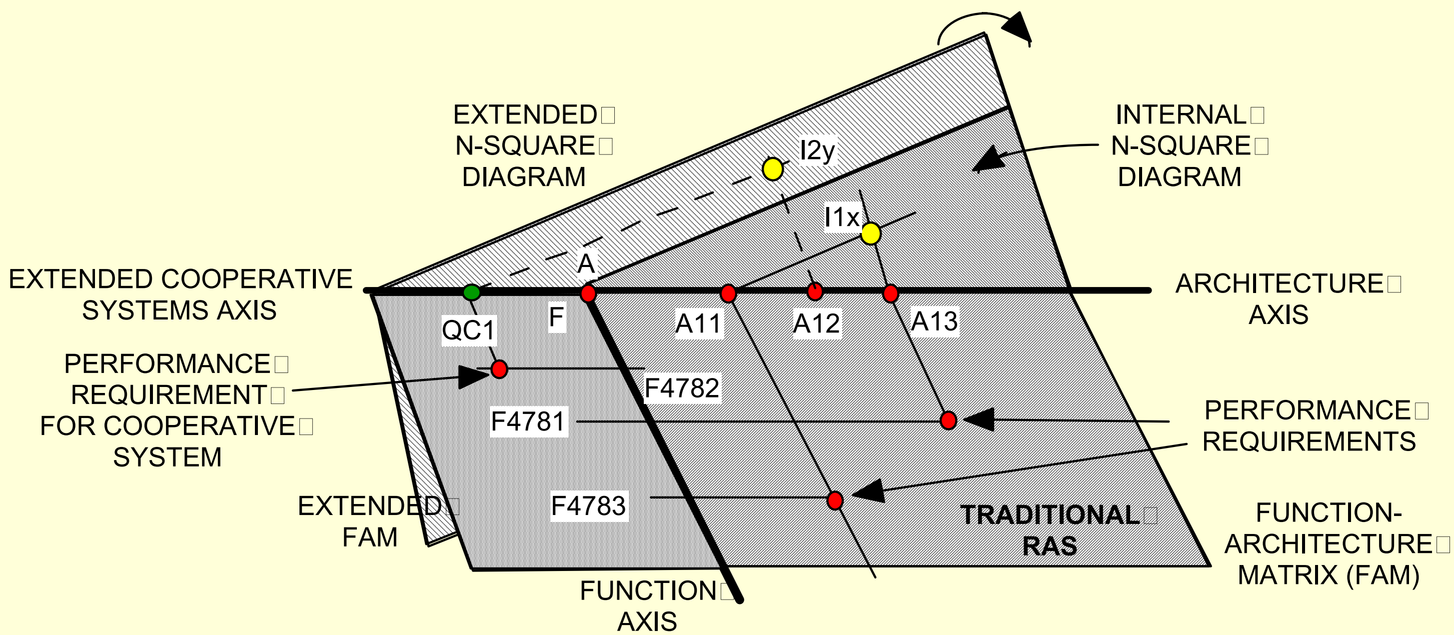
Specification template paragraph numbers in red.

Functional Decomposition



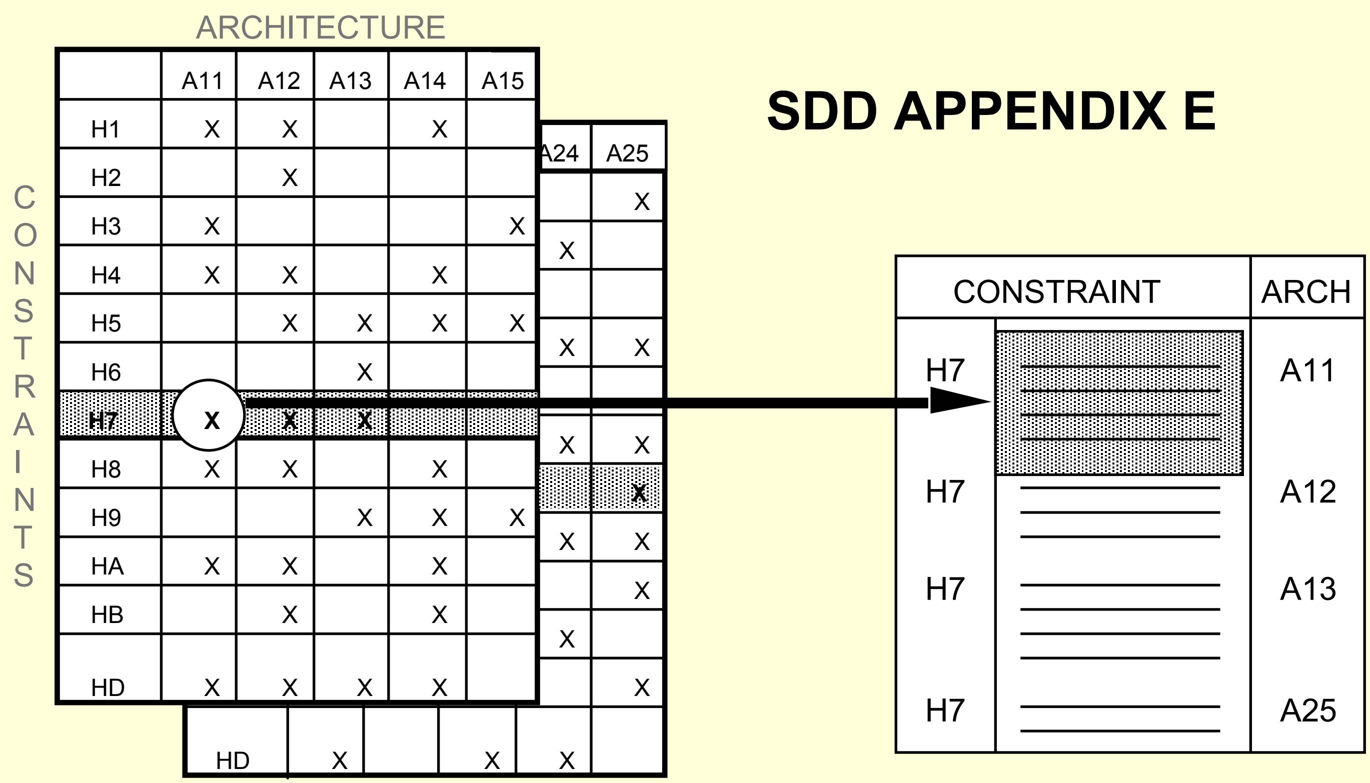
USING DECIMAL-DELIMINATED LEVEL NOTATION

Integrated RAS and N-Square Diagram For Internal and External Interface



Identification of Specialty Engineering Constraints

SDD APPENDIX E

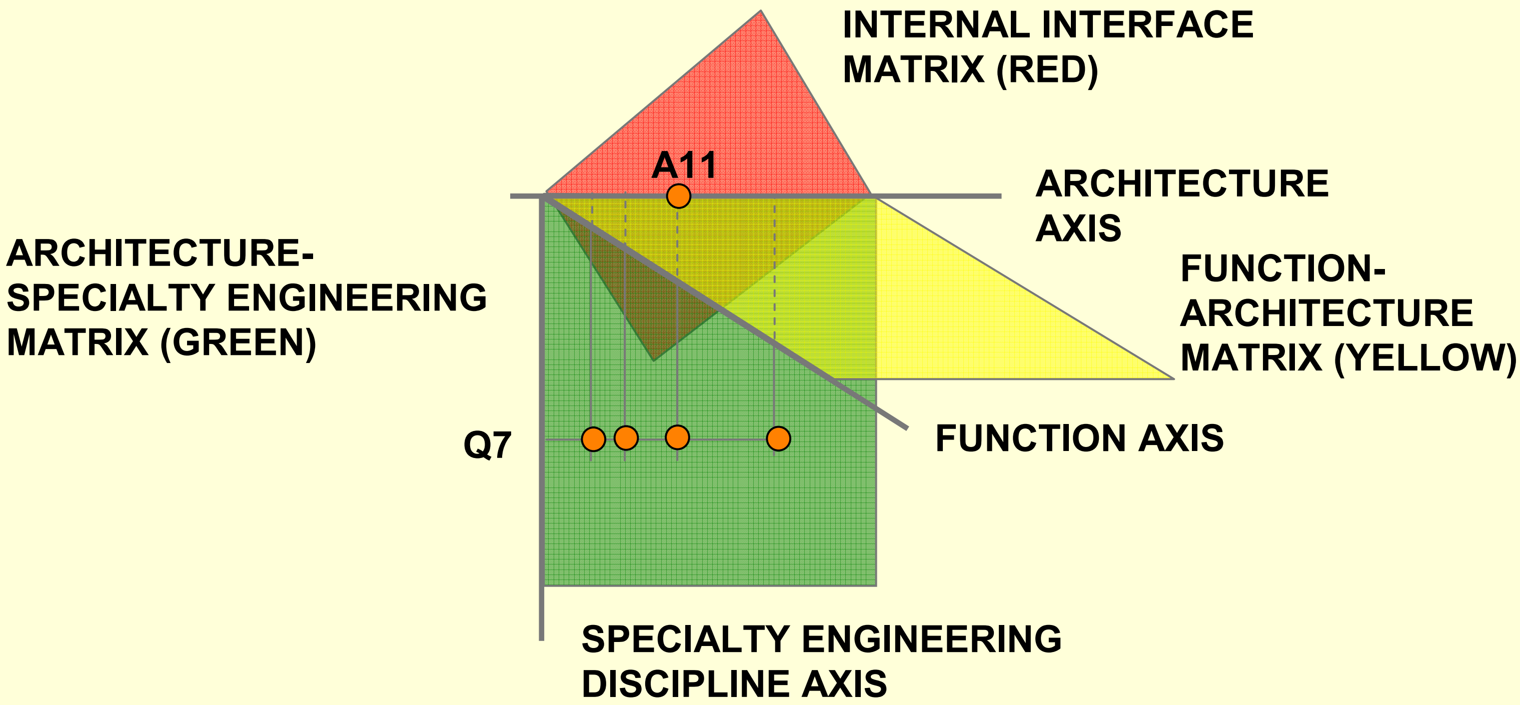


ARCHITECTURE-SPECIALTY ENGINEERING MATRIX
(DESIGN CONSTRAINTS SCOPING MATRIX)

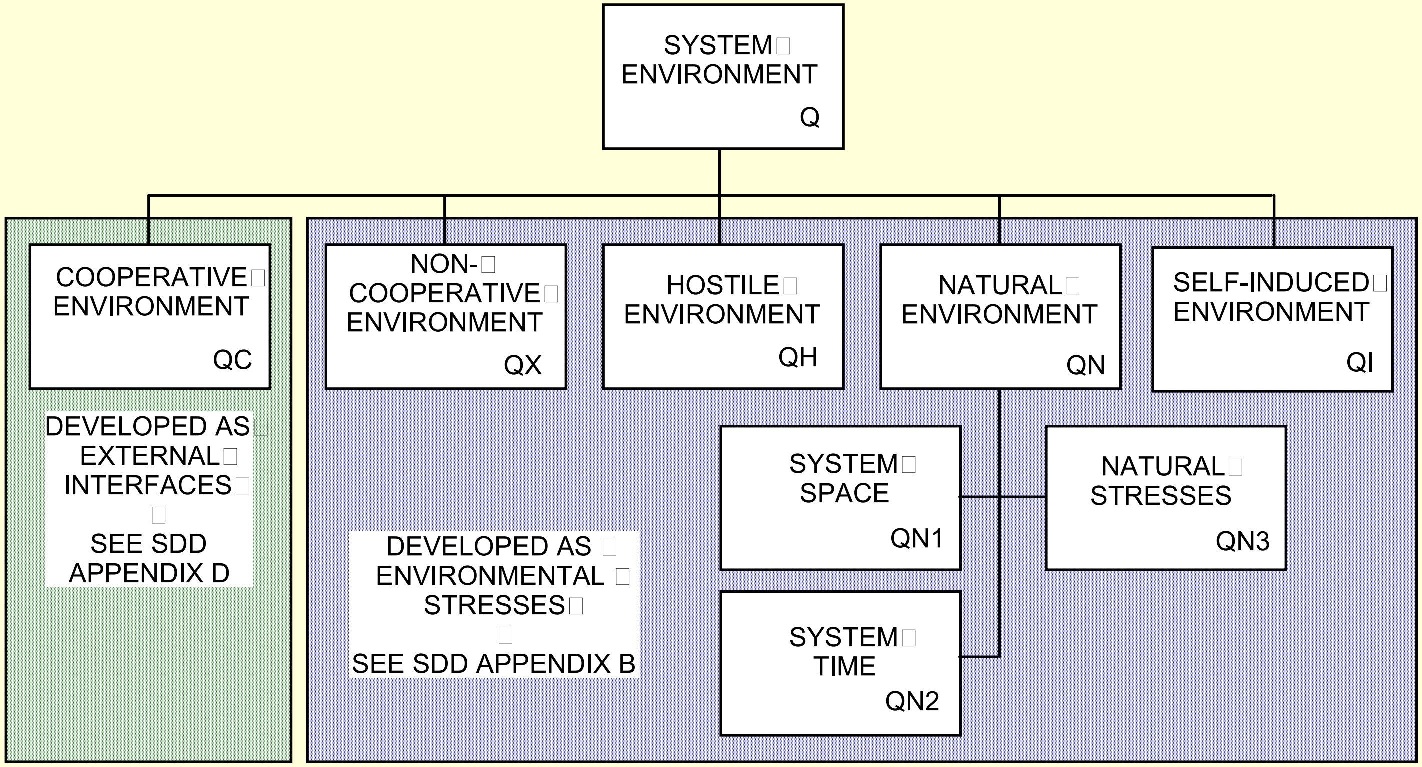
SPECIALTY ENGINEERING REQUIREMENTS FLOW INTO THE INDICATED SPECIFICATIONS THROUGH THE RAS

Specialty Engineering Allocation

Specialty Discipline Q7 Allocated to Architecture A11



Four System Environmental Classes



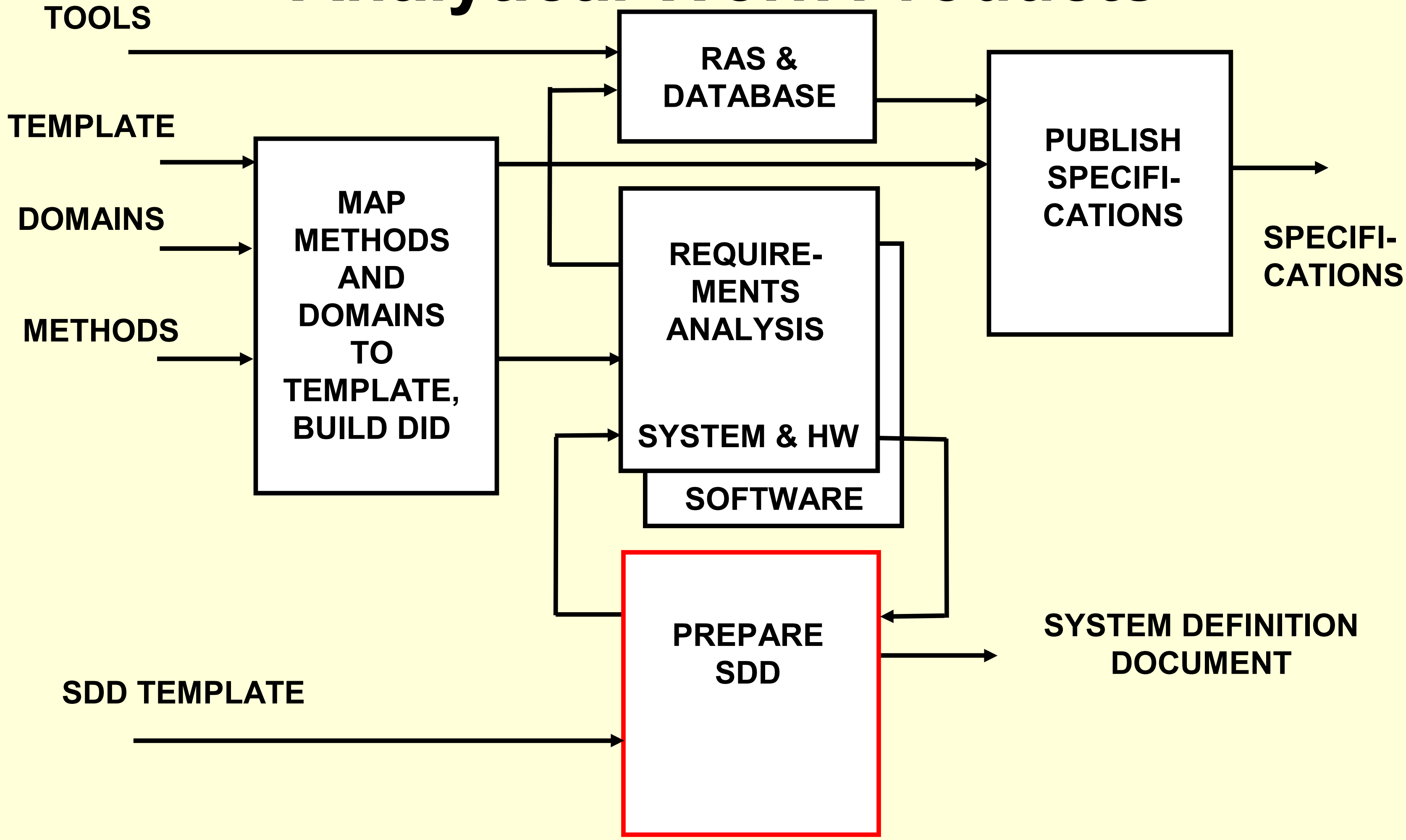
Three Environmental Requirements Layers

- **System**
  - Identify spaces within which the system will have to function
  - Select standards covering those spaces
  - For each standard, select parameters that apply
  - Tailor the range of selected parameters
- **End item**
  - Build three dimensional model of end items, physical processes, and process environments
  - Extract item environments
- **Component**
  - Zone end item into spaces of common environmental characteristics
  - Map components to zones
  - Components inherit zone environmental requirements

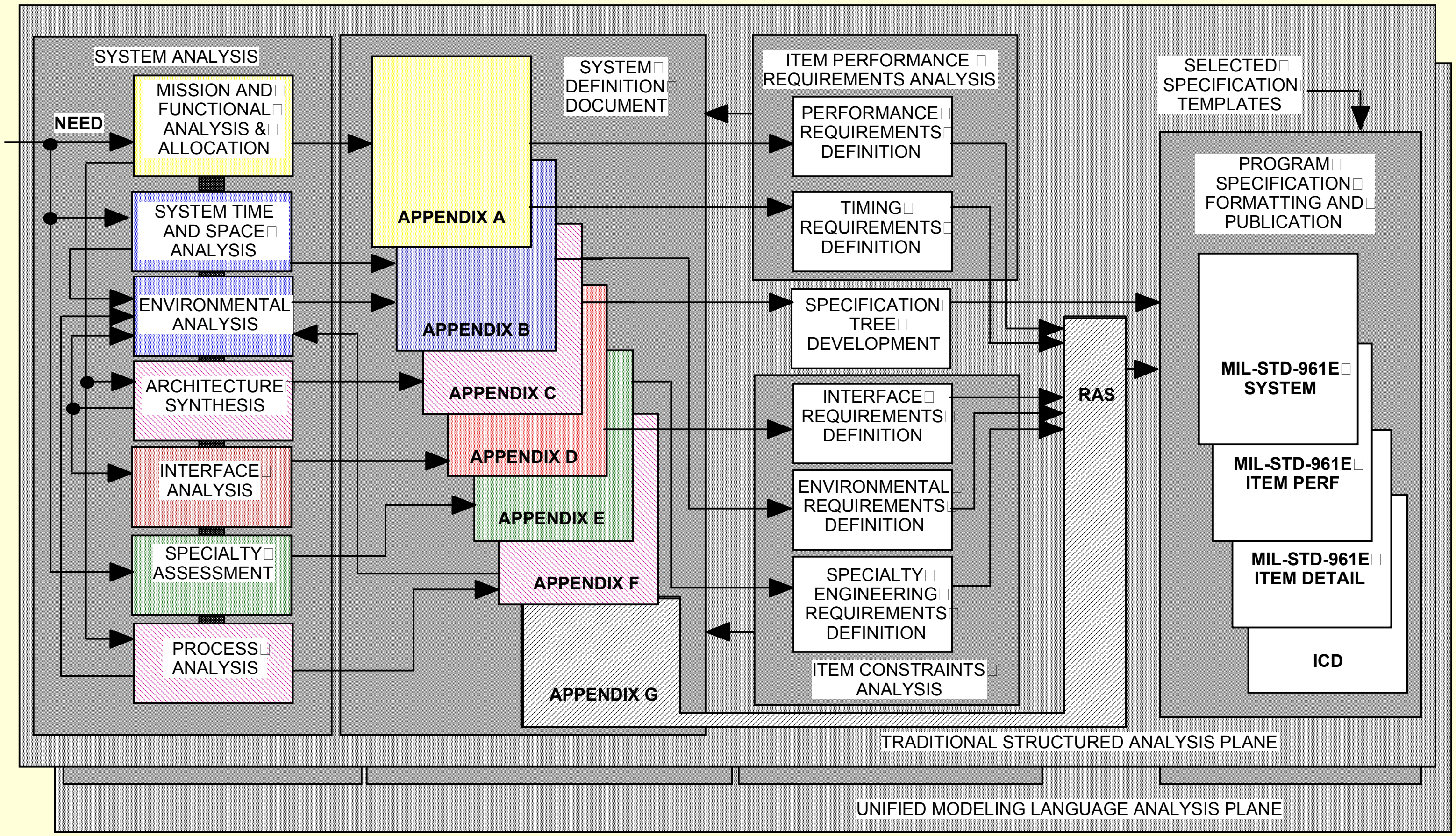
RAS-Complete In Table Form

MODEL ENTITY		REQUIREMENT ENTITY		PRODUCT ENTITY		DOCUMENT ENTITY	
MID	MODEL ENTITY NAME	RID	REQUIREMENT	PID	ITEM NAME	PARA	TITLE
F47	Use System			A	Product System		
F471	Deployment Ship Operations			A	Product System		
F4711	Store Array Operationally	XR67	Storage Volume < 10 ISO Vans	A1	Sensor Subsystem		
H	Specialty Engineering Disciplines			A	Product System		
H11	Reliability	EW34	Failure Rate < 10 x 10-6	A1	Sensor Subsystem	3.1.5	Reliability
H11	Reliability	RG31	Failure Rate < 3 x 10-6	A11	Cable	3.1.5	Reliability
H11	Reliability	FYH4	Failure Rate < 5 x 10-6	A12	Sensor Element	3.1.5	Reliability
H11	Reliability	G8R4	Failure Rate < 2 x 10-6	A13	Pressure Vessel	3.1.5	Reliability
H12	Maintainability	6GHU	Mean Time to Repair < 0.2 Hours	A1	Sensor Subsystem	3.1.6	Maintainability
H12	Maintainability	U9R4	Mean Time to Repair < 0.4 Hours	A11	Cable	3.1.6	Maintainability
H12	Maintainability	J897	Mean Time to Repair < 0.2 Hours	A12	Sensor Element	3.1.6	Maintainability
H12	Maintainability	9D7H	Mean Time to Repair < 0.1 Hours	A13	Pressure Vessel	3.1.6	Maintainability
I	System Interface			A	Product System		
I1	Internal Interface			A	Product System		
I11	Sensor Subsystem Innerface			A1			
I181	Aggregate Signal Feed Source Impedance	E37H	Aggregate Signal Feed Source Impedance= 52 ohms $\pm$ 2 ohms	A1	Sensor Subsystem		
I181	Aggregate Signal Feed Load Impedance	E37I	Aggregate Signal Feed Load Impedance= 52 ohms $\pm$ 2 ohms	A4	Analysis and Reporting Subsystem		
I2	System External Interface			A	Product System		
Q	System Environment			A	Product System		
QH	Hostile Environment			A	Product System		
QI	Self-Induced Environmental Stresses			A	Product System		
QN	Natural Environment			A	Product System		
QN1	Temperature	6D74	-40 degrees F< Temperature < +140 degrees F	A	Product System		
QX	Non-Cooperative Environmental Stresses			A	Product System		

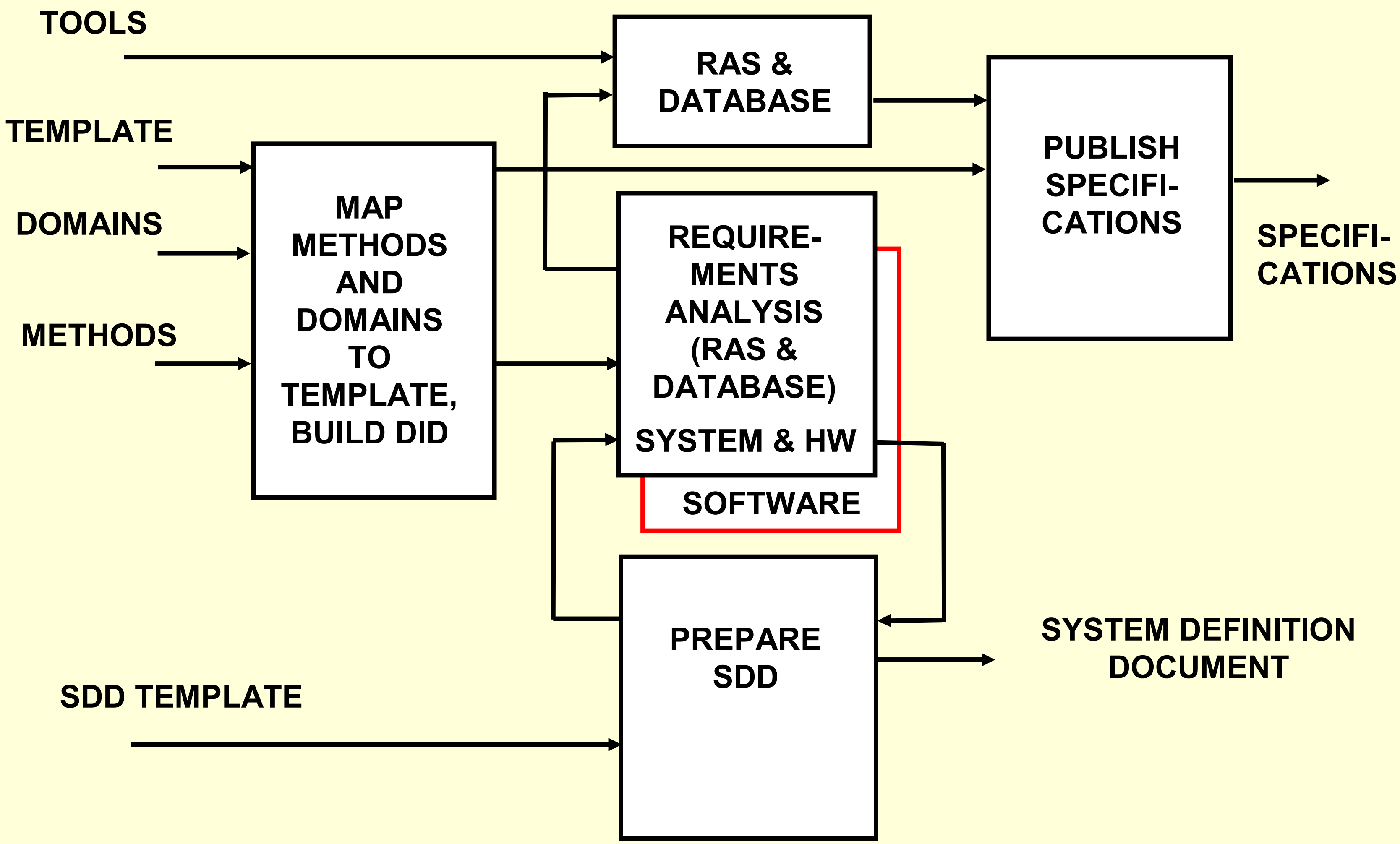
Prepare the SDD Capturing the Analytical Work Products



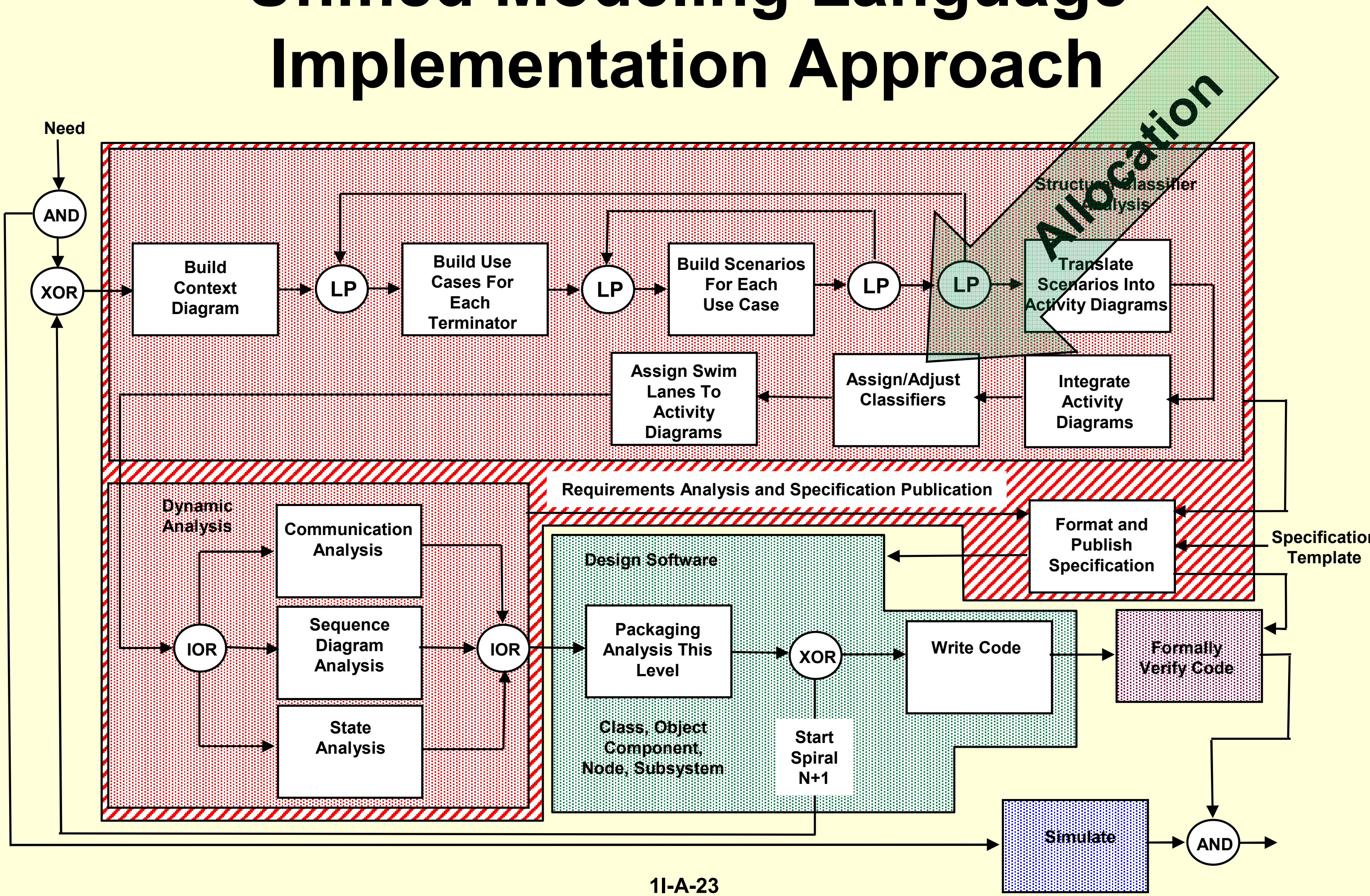
Structured Analysis Work Product Capture and Configuration Management



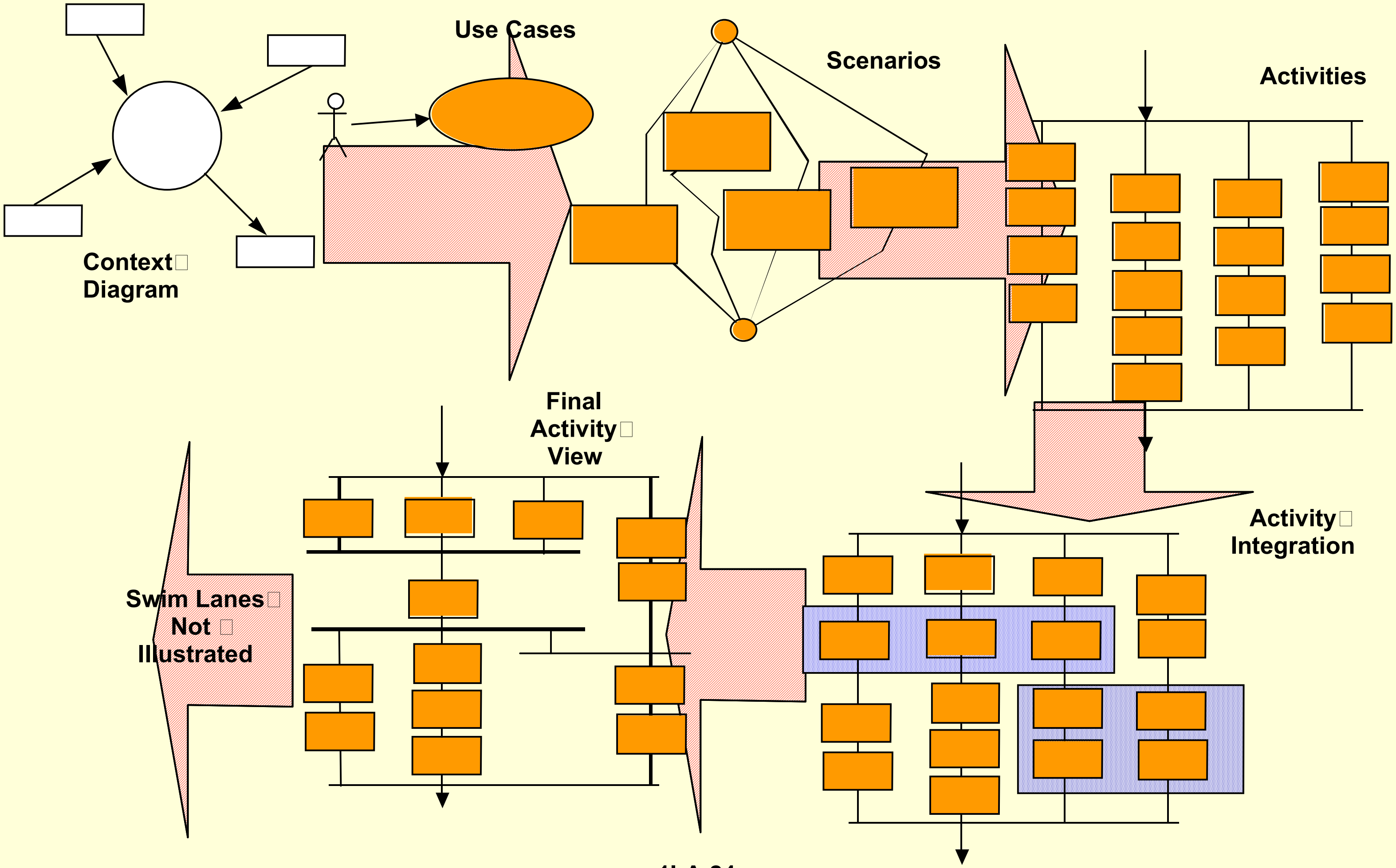
Accomplish the SW Analysis



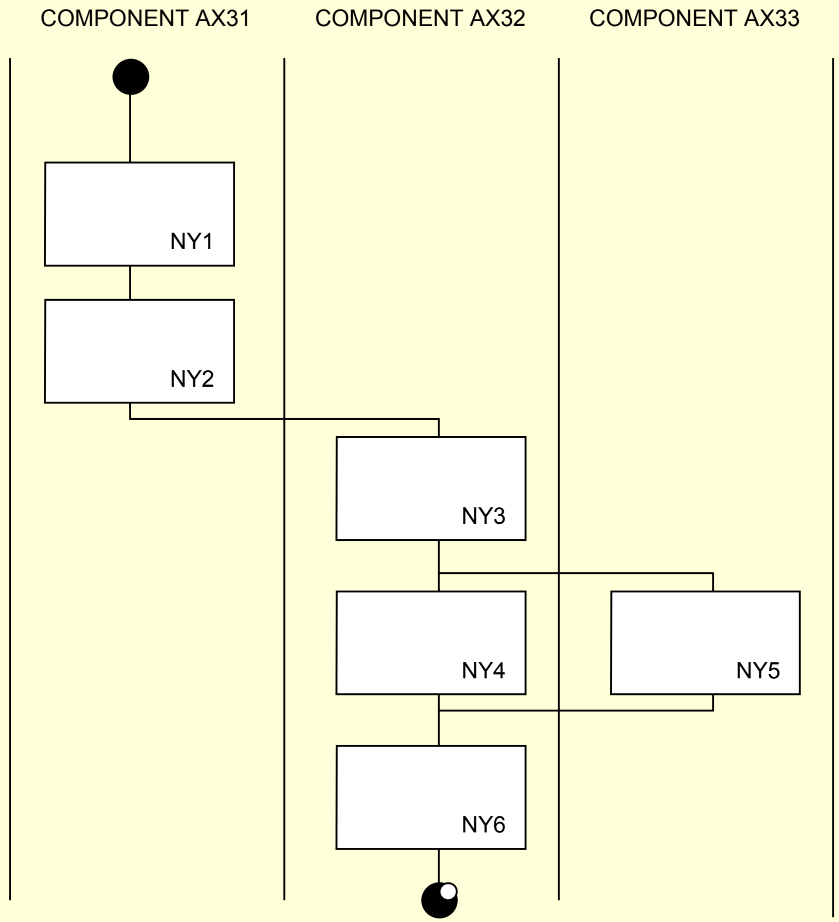
Unified Modeling Language Implementation Approach



Structural Classifier Analysis

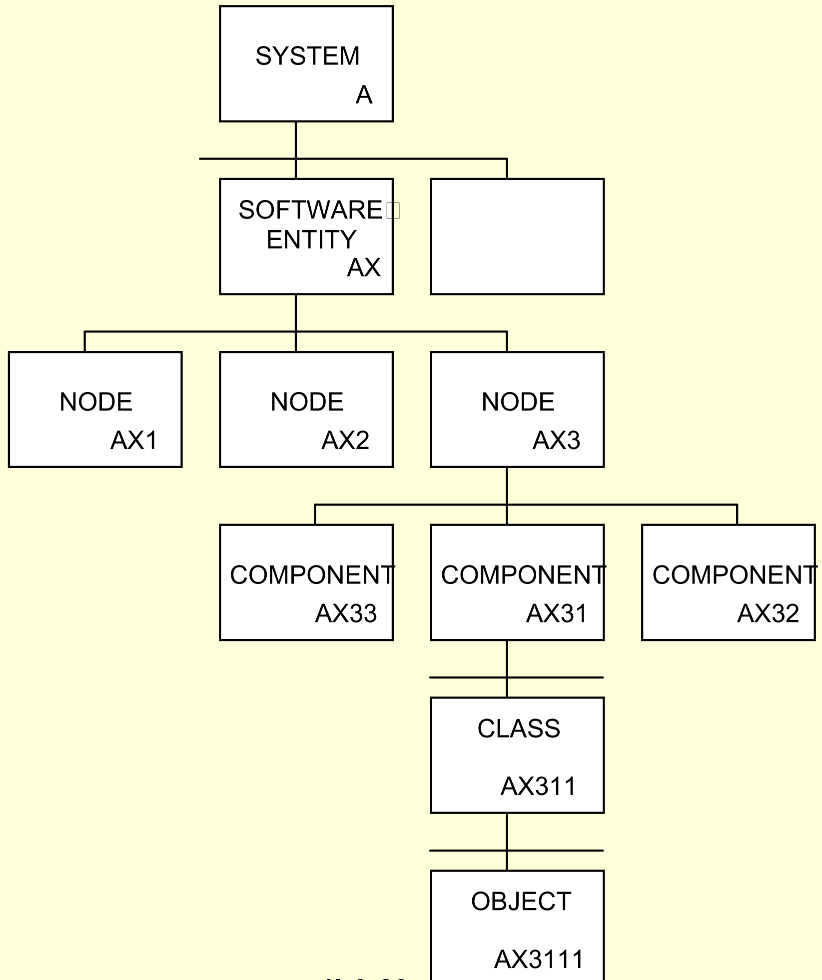


Swim Lanes for Allocation

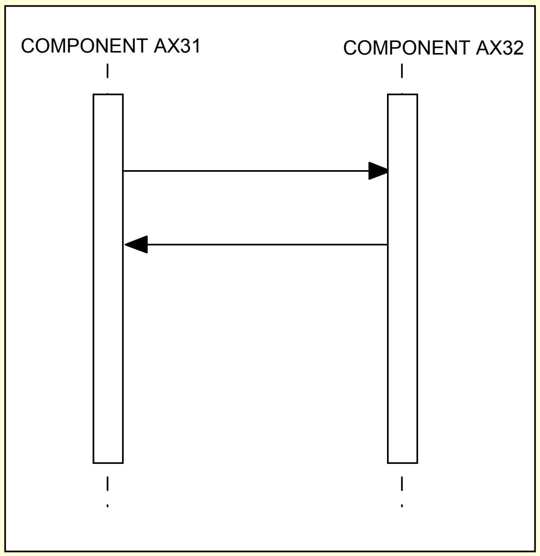


ACTIVITY DIAGRAM FOR NODE AX3

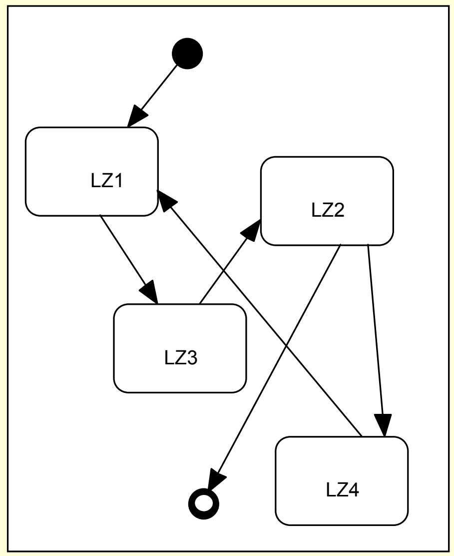
Progressive Identification of Product Entities



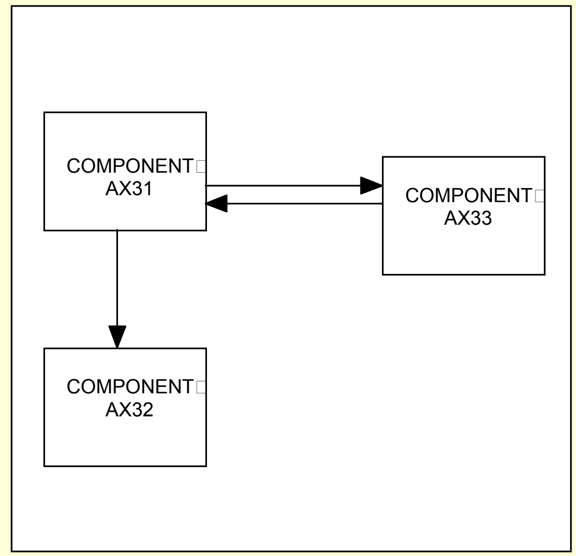
Dynamic Diagrams to Explore Product Entity Capabilities



Sequence Diagram



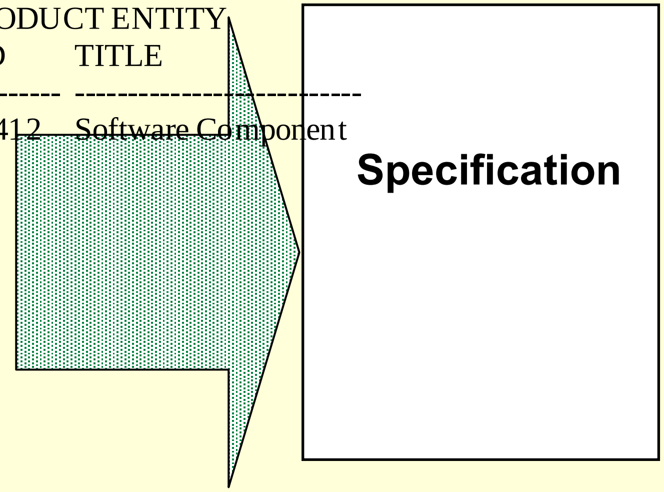
State Diagram



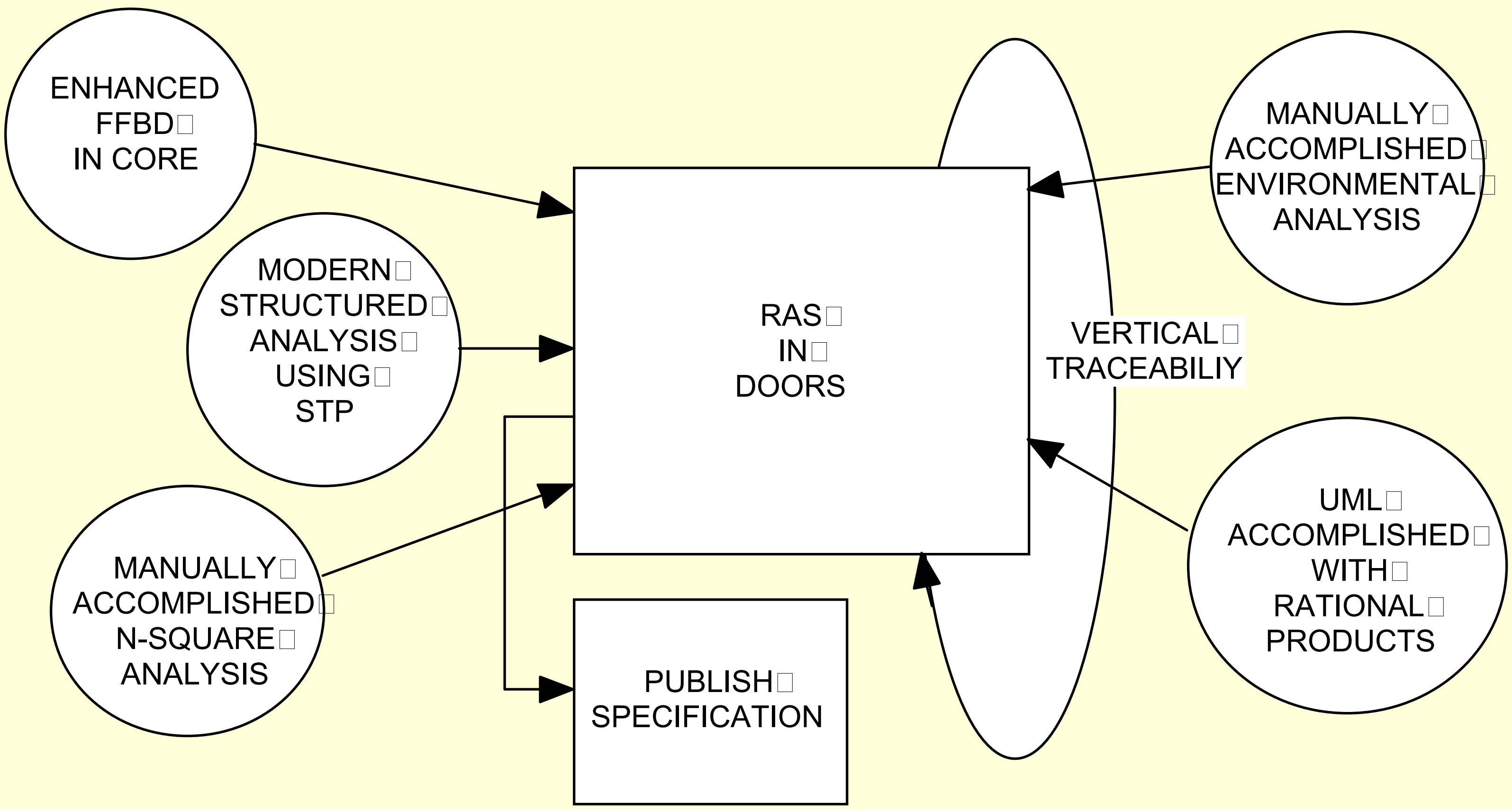
Communication Diagram

The Entity Capabilities Flow Into the Specification Through the RAS

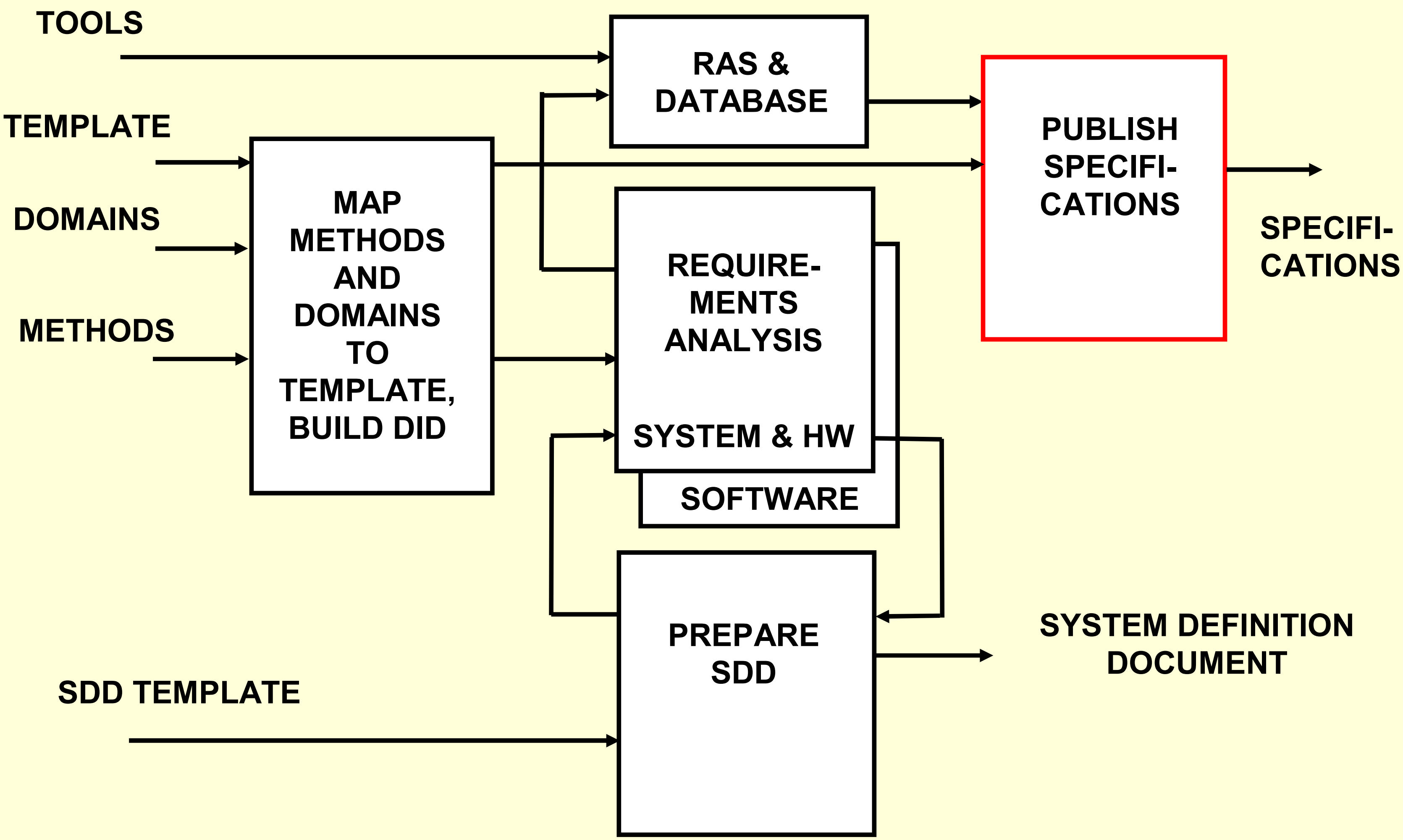
MODELING ENTITY		REQUIREMENT ENTITY		PRODUCT ENTITY	
MID	TITLE	RID	TITLE	PID	TITLE
---------	---------------------------	--------	---------------------------	----------	---------------------------
U452	Use Case	D4XT		A5412	Software Component
BU7Y	Activity Diagram				
L456	State Diagram				
R4367	Sequence Diagram				
C5RT	Communication Diag.				
O44324	Object/Class Diagram				
C4432	Component Diagram				
Z443	Deployment Diagram				



A Particular Implementation Today



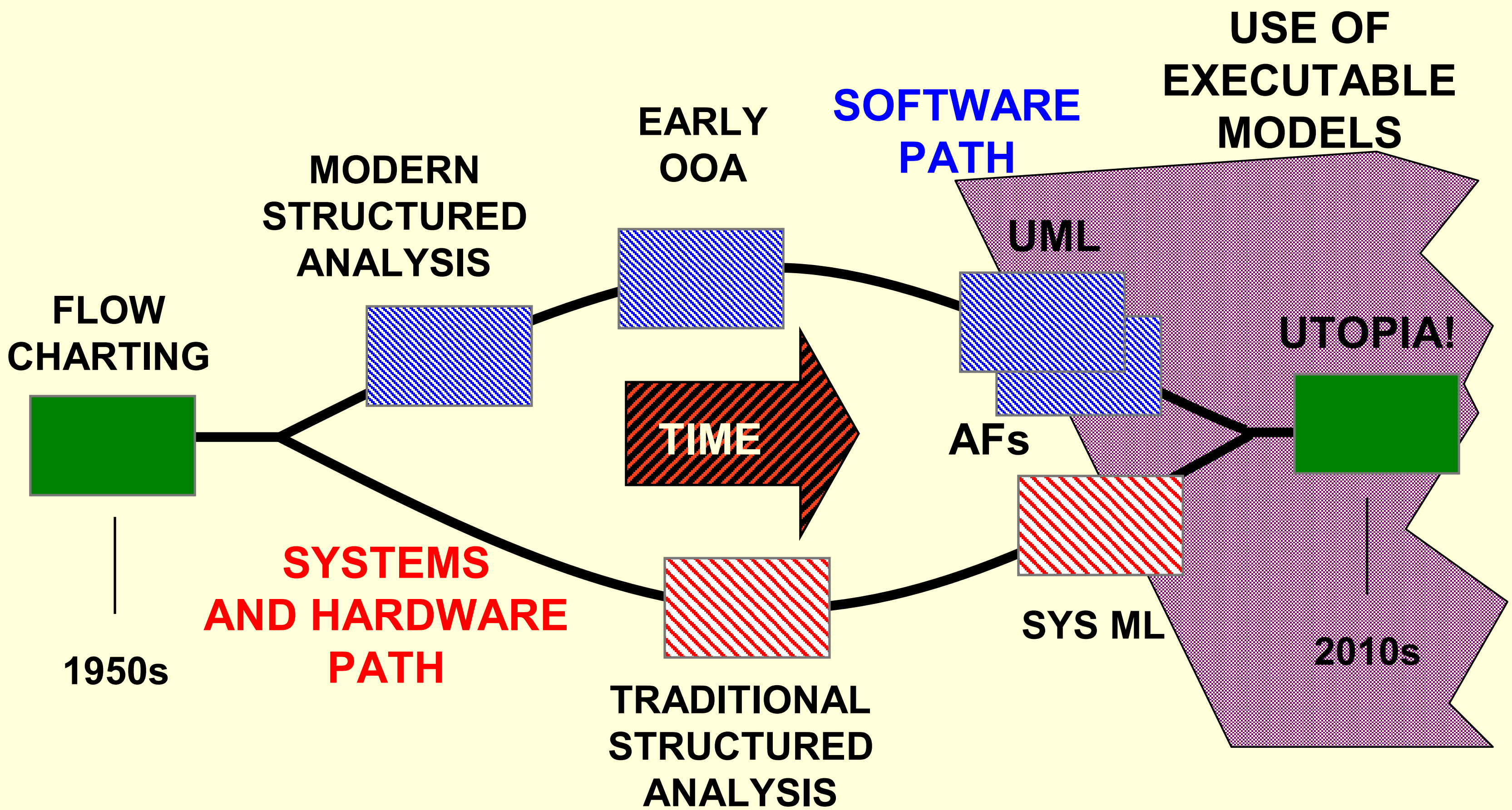
Publish the Results



Specification Review and Approval Process

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Toward Process Simplicity



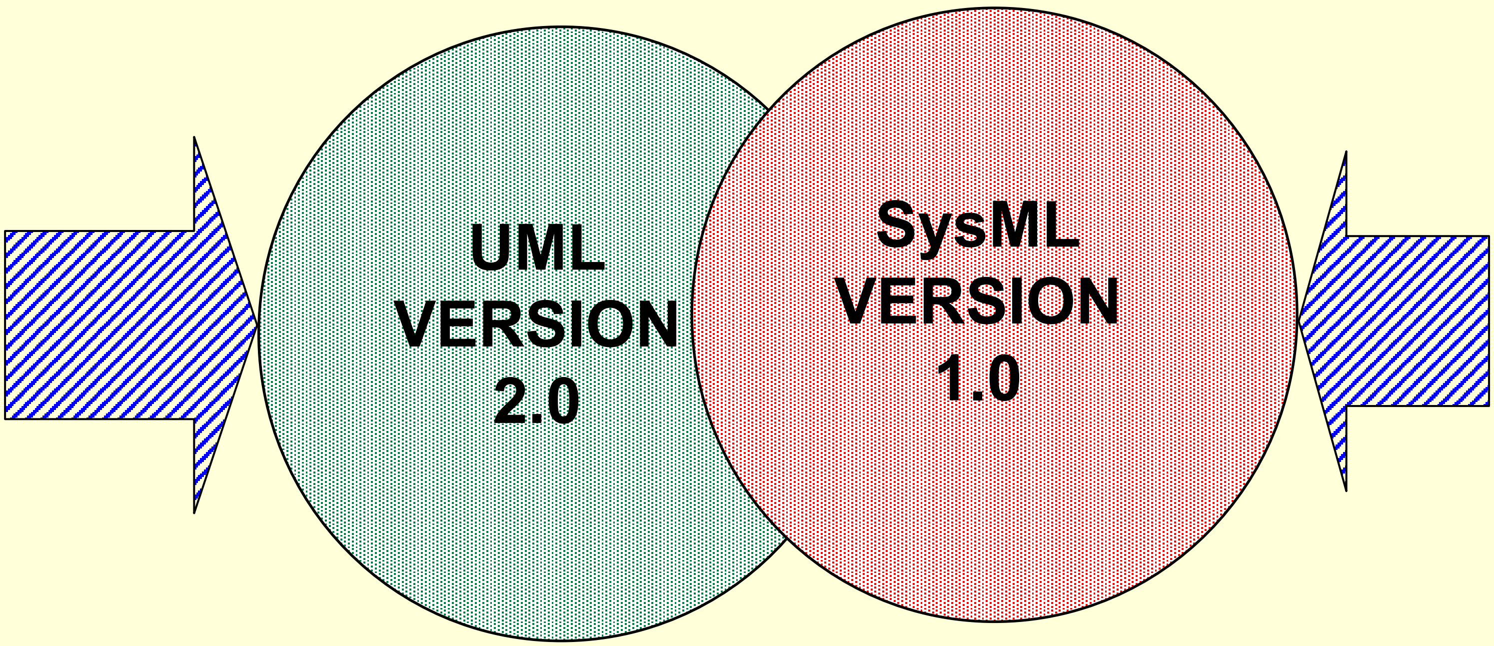
Evidence of an Approach Path UML and TSA

UNIFIED MODELING LANGUAGE (UML)

STATIC REPRESENTATION			DYNAMIC REPRESENTATION				
					INTERACTION DIAGRAMS		
DEPLOY-MENT DIAGRAM	COMPONENT DIAGRAM	OBJECT & CLASS DIAGRAMS	STATE CHART	USE CASE DIAGRAM	COLLABOR-ATION DIAGRAM	SEQUENCE DIAGRAM	ACTIVITY DIAGRAM
ARCHITECTURE BLOCK DIAGRAM			STATE DIAGRAM	SCHEMATIC BLOCK DIAGRAM		TIMELINE DIAGRAM	FUNCTIONAL FLOW DIAGRAM
PHYSICAL FACET			BEHAVIORAL FACET				FUNCTION-AL FACET

TRADITIONAL STRUCTURED ANALYSIS (TSA)

We Still Have to Push These Together Some More



Movement to Model-Driven Development