

INCOSE SE Handbook v3.2 IV&V via DSM Analysis of Context Diagrams Set

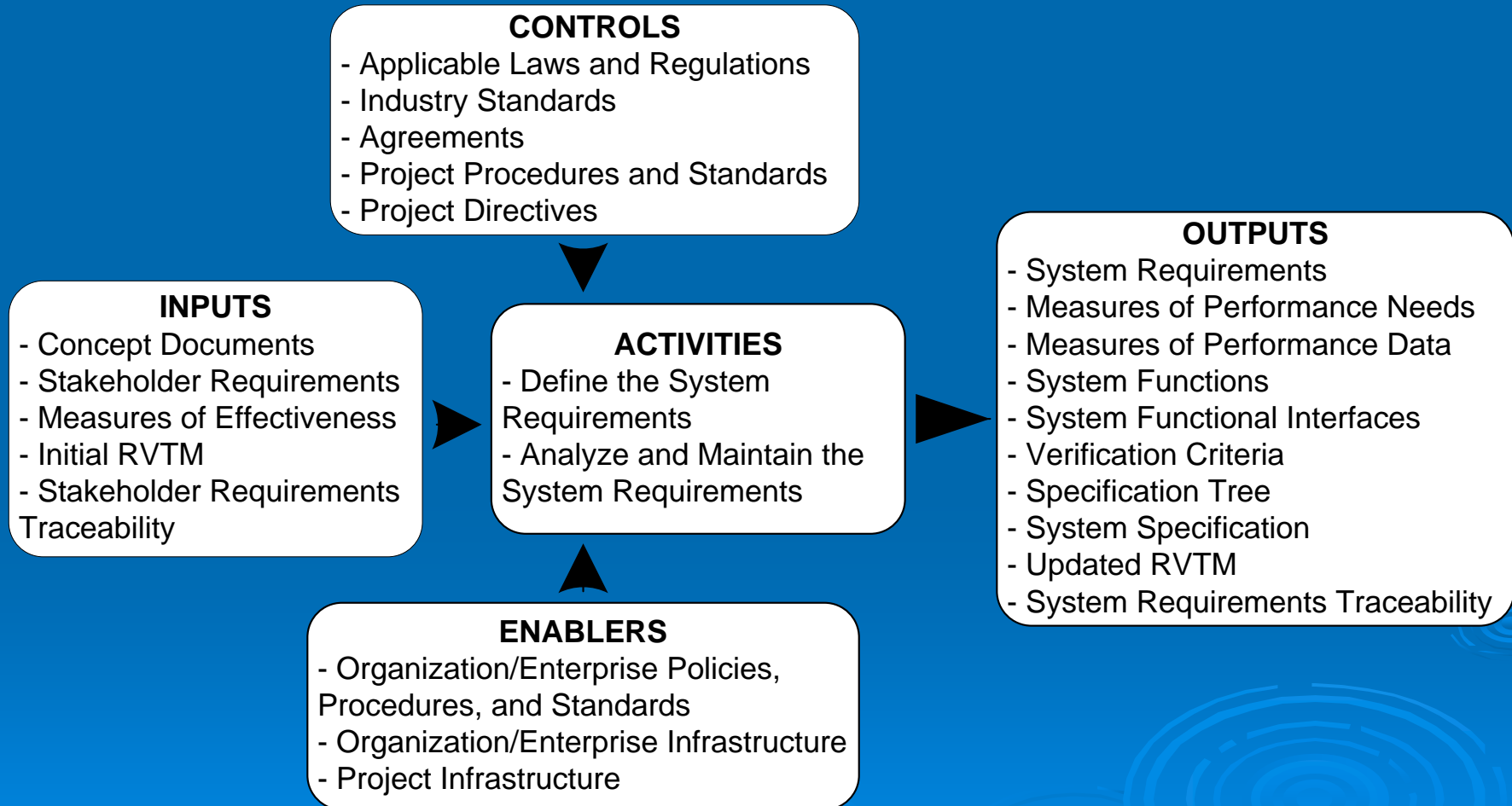
Aditya Akundi and Eric D. Smith

IMSE: Industrial, Manufacturing & Systems Engineering Dept.

Abstract

- Integration, Verification & Validation (IV&V) analysis of the
- **Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities** was conducted by examining only the
- **Context Diagram figures**, each of which depicts a set of Activities (a Process) that transforms inputs (“Inputs,” “Controls,” and “Enablers”) into outputs (“Outputs”).

ex Context Diagram: Requirements Analysis Process



DSM: Design Structure Matrix

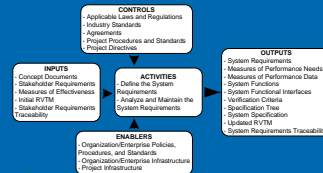
- Design Structure Matrix (DSM) methods were utilized to collect and pre-process the collection of input-output relationships among the system life cycle processes described in the SE Handbook, leading to the creation of an empirical N2 diagram that is substantially sparse in comparison the N2 diagram in version 3.2 of the SE Handbook.

Writing of the SE Handbook

- Text writing N2 chart
- Text ...(disjointed from) ... Context Diagrams
- Context Diagrams → **empirical N2 chart**

Text,
Text,
Text,
Text,
Text

Context Diagrams



N2 Chart

Processes' Inputs, Controls, Enablers and Outputs

	Concept Documents	Configuration Management Strategy	Industry Standards	Project Directives	Project Procedures & Standards	System Functions	System Requirements	System Specification
4 Technical Processes								
4.1 SRD Stakeholder Requirements Definition	O		C	C	C			
4.2 RA Requirements Analysis Process						O	O	O
4.3 AD Architectural Design Process	I		C	C	C	I	I	I
4.4 IMPL Implementation Process	I		C	C	C			
4.6 VER Verification Process			C	C	C			
4.7 TRAN Transition Process	I		C	C	C			
5 Project Processes								
5.1 PP Project Planning Process			C	C	O, I			
5.2 PAC Project Assessment and Control			C	O	C			
5.5 CM Configuration Management Process		O						
6 Agreement Processes								
6.2 SUP Supply Process			C	C	C			
7 Organizational Project-Enabling Processes								
7.2 INFRAM Infrastructure Management			C					
8 Tailoring Processes								
8.1 TLR Tailoring Process			I	C	C			

Context diagram information pre-processed for DSM analyses

	Concept Documents	Configuration Management Strategy	Industry Standards	Project Directives	Project Procedures & Standards	System Functions	System Requirements	System Specification
6.2 SUP Supply Process								
5.1 PP Project Planning Process					o,			
5.2 PAC Project Assessment and Control				o				
5.5 CM Configuration Management Process		o						
4.1 SRD Stakeholder Requirements Definition	o							
4.2 RA Requirements Analysis Process						o	o	o
4.3 AD Architectural Design Process								
4.4 IMPL Implementation Process								
4.6 VER Verification Process								
4.7 TRAN Transition Process								
7.2 INFRAM Infrastructure Management								
8.1 TLR Tailoring Process								

Partial DSM matrix of the SE Handbook context diagram data

INCOSE SE HANDBOOK Analysis															
Task Name and Number		1	2	3	4	5	6	7	8	9	10	11	12	13	14
EXT	1	■													
6.2 SUP Supply Process	2		■		1	1									
6.1 ACQ Acquisition Process	3			■	1	1									
5.1 PP Project Planning Process	4		1		■	1									
5.2 PAC Project Assessment and Control	5				1	■		1	1						
5.3 DM Decision Management Process	6				1	1	■								
5.4 RM Risk Management Process	7				1	1		■							
5.5 CM Configuration Management Process	8				1	1			■						
5.6 INFOM Information Management Process	9				1	1				■					
5.7 MEA Measurement Process	10				1	1					■	1	1	1	
4.1 SRD Stakeholder Requirements Definition	11				1	1						■			
4.2 RA Requirements Analysis Process	12				1	1						1	■		
4.3 AD Architectural Design Process	13				1	1						1	1	■	
4.4 IMPL Implementation Process	14				1	1						1	1	1	■

N2 Diagram & empirical N2 Diagram

EXT	0	0	0						0											0		0		0	0
0	SUP		X	0	0	0	0	0														X			X
0		ACQ	0	0	0	0	0	0						X											X
	X	X	PP	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X
	X	X	X	PAC	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X
			0	0	DM	0	0	0																	
			0	X	0	RM	0	0																	
			0	X	0	0	CM	0																	
0			0	0	0	0	0	INFOM																	
0			0	0	0	0	0	MEAS													X				
				0	0	0	0	X	SRD	X	X	X	0	0	X	X	X	X	X						
				0	0	0	0	X		RA	X	X		X											
				0	0	0	0	X			AD	X	X	X											
		0	0		0	0	0	0			0	IMPL	X		X		X	X							
		0	0	0	0	0	0	0			0		INT	X	X										
		0	0	0	0	0	0	0			0			VER	X	X									
		0	0	0	0	0	0	0			0				TRAN	X									
		0	0	0	0	0	0	0			0					VAL	X	X	X						
		0	0	0	0	0	0	0			0						OPER	0							
		0	0	0	0	0	0	0			0							MAINT	0						
0		0	0	0	0	0	0	0			0								DISP						
	X*	X*	X	X*	X	X	X	X	X	X*	X*	X*	X*	X*	X*	X*	X*	X*	X*	LCMM	X*	X*	X*	X	X*
	X*	X*	X*	X	X	X	X	X	X*	X*	X*	X*	X*	X*	X*	X*	X*	X*	X*	X	INFRAM				X*
	0		X		0	0	0	0												X	X	PPM	X	X	X
0			X		0	0	0	0															HRM		
0			X		0	0	0	0												X				QM	
			X*		0	0	0	0												X					TLR

revised N2 Diagram (detail)

											X					
SRD	X	X	X	o	o	X	X	X	X	X						
	RA	X	X		X											
		AD	X	X	X											
		o	IMPL	X		X		X	X							
		o		INT	X	X										
		o			VER	X	X									
		o				TRAN	X									
		o					VAL	X	X	X						
		o						OPER	o							
		o							MAINT	o						
		o								DISP						
X*	X*	X*	X*	X*	X*	X*	X*	X*	X*	X*	LCMM	X*	X*	X*	X	X*
X*	X*	X*	X*	X*	X*	X*	X*	X*	X*	X*	X	INFRAM				X*
											X	X	PPM	X	X	X
														HRM		
											X				QM	
											X					TLR

output-input Relations in SE Handbook and Context Diagram Set

Symbol and presence of relation in:	Context Diagram Set in SE Handbook v.3.2	N ² Diagram in SE Handbook v.3.2
X	present	present
X*	present	
0		present

Hard or Soft Sequence DSM analysis decision

	(2a) Hard Sequence constraint	(2b) Soft Sequence constraint
(1a) Inputs = Inputs, Controls, or Enablers	Rigid, “Throw it over the wall” approach	<i>Realistic, Parallel & Iterative Systems approach</i>
(1b) Inputs = Inputs only		

Block of Iterative Set of SE Handbook Processes

Task Name	Level		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
6.2 SUP Supply Process	1	1			2	2							2	2				
6.1 ACQ Acquisition Process	1	2			2	2							2	2				
5.1 PP Project Planning Process	1	3	2			2							2	2	2	2	2	2
5.2 PAC Project Assessment and Control Process	1	4			2		2	2					2	2				
5.4 RM Risk Management Process	1	5			2	2							2	2				
5.5 CM Configuration Management Process	1	6			2	2							2	2				
5.7 MEA Measurement Process	1	7			2	2				2	2	2	2	2				
4.1 SRD Stakeholder Requirements Definition Process	1	8			2	2							2	2				
4.2 RA Requirements Analysis Process	1	9			2	2				2			2	2				
4.3 AD Architectural Design Process	1	10			2	2				2	2		2	2				
7.1 LCMM Life Cycle Model Management Process	1	11							2					2	2		2	2
7.2 INFRAM Infrastructure Management Process	1	12			2								2		2			
7.3 PPM Project Portfolio Management Process	1	13	2			2							2					
7.4 HRM Human Resource Management Process	1	14			2	2							2		2			
7.5 QM Quality Management Process	1	15			2	2							2		2			
8.1 TLR Tailoring Process	1	16	2	2	2	2							2	2	2			

Non-Block Processes that Occur After the Initial Block

Task Name	Level		1	2	3	4	5	6	7	8	9	10	11
Block1:	1	1											
5.3 DM Decision Management Process	2	2	2										
5.6 INFOM Information Management Process	2	3	2										
4.4 IMPL Implementation Process	2	4	2										
4.5 INT. Integration Process	3	5	2			2							
4.6 VER Verification Process	4	6	2				2						
4.7 TRAN Transition Process	5	7	2			2	2	2					
4.8 VAL Validation Process	6	8	2					2	2				
4.9 OPER Operation Process	7	9	2			2				2			
4.10 MAINT Maintenance Process	7	10	2			2				2			
4.11 DISP Disposal Process	7	11	2							2			

Conclusion

- The SE Handbook context diagram set does currently define and document the sufficiently varied interrelations among project and program processes that are within the purview of general project and program processes.