



Sysnovation Tool Belt



No.	Systems Engineering Competency	Value Added (Why Important?)	Potential Systems Engineering Tools	INCOSE SEHSE
1	Understand problem/opportunity that needs to be addressed and clearly communicate the system purpose (Level n).	The system is not successful unless it fulfills its purpose by addressing a specific problem (or opportunity). If it does not have a viable purpose, it should not be pursued.	Problem/Opportunity Statement System Purpose Statement Five Whys Six Honest Serving Men - What and Why and When and How and Where and Who ConOps - Concept of Operations Project Charter SEMP - Systems Engineering Management Plan	BMA PP
2	Understand and analyze all relevant customer/user stakeholder needs and requirements and needs.	The system is not successful unless it fulfills its customer/acquirer and user/operator/maintainer/etc. needs. Many times the true customer/user needs are not known. Provides the basis for validation.	OpsCon - Operational Concept Use Cases/Scenarios User Stories Personas uc - Use Case Diagram [SysML] VOC - Voice of Customer StkR - Stakeholder Requirements req - Requirements Diagram [SysML]	SNRD
3	Understand and analyze all business and other stakeholder needs and requirements and needs.	There are more stakeholders than the customer/user. The system is not successful unless it fulfills all of its stakeholder needs. Provides the basis for validation.	Stakeholder Identification PESTAL - Political, Economic, Social, Technological, Environmental, Legal Other Life Cycle Concepts VOB - Voice of Business VOR - Voice of Regulator VOT - Voice of Technology StkR - Stakeholder Requirements (<i>for all stakeholders</i>) req - Requirements Diagram [SysML]	SNRD
4	Understand the system (Level n) context within its environment and its boundaries (Level n and Level n+1).	Understanding what is in and out of scope and how actions and decisions in one area affect another is critical.	Black Box/White Box Representations Context Diagram Boundary Diagram ERA - Entity, Relationship, Attribute Diagram Enabling Systems	SNRD SRD SAD
5	Identify, define, and control interfaces across the system boundaries (Level n) and between system elements (Level n+1).	Poor interface management can lead to incompatible systems elements and increased system integration time.	N ² - N-Squared Diagram/DSM - Design Structure Matrix Interface Standards (<i>for open/standard interfaces</i>) ICD - Interface Control Document (<i>for unique interfaces</i>) IWG/ICWG - Interface [Control] Working Group (<i>for new interfaces</i>)	SRD SAD
6	Define, analyze, and manage the system functionality/behavior/logic (Level n) (including nominal/off-nominal scenarios, corner conditions).	Functional/Behavioral/Logical) Analysis is a way to understand <i>what</i> the system has to do. Functions help refine requirements and the physical design.	FFBD - Functional Flow Block Diagram/act - Activity Diagram [SysML] sd - Sequence Diagram [SysML] stm - State Machine Diagram [SysML]	SRD
7	Ensure that the requirements for all lifecycle stages are addressed at the correct times.	Failure to address the lifecycle requirements [also know Quality Characteristics (QCs) and informally as the "ilities"] at the proper time can lead to features never being achieved or achieved at an escalated cost.	Affordability Analysis Agility Engineering Human Systems Integration (HSI) Interoperability Analysis Logistics Engineering Manufacturability/Producibility Analysis Reliability, Availability, and Maintainability (RAM) Engineering Resilience Engineering Sustainability Engineering System Safety Engineering System Security Engineering Loss-Driven Systems Engineering (LDSE)	QCs SNRD SRD SAD DD SA
8	Utilize modeling, analysis, and simulation to provide early indications of system performance, predict emergent properties, and ensure high confidence in the design.	Early modeling, analysis, and simulation can confirm integrated performance, reduce risk, and allow the exploration of alternate scenarios.	Modeling Analyses Simulation Prototyping and Mock-ups	MA&S
9	Define, analyze, and manage the system requirements (Level n).	System requirements provide a clear definition of <i>what</i> the system needs to do, <i>how well</i> , and <i>under what conditions</i> . Provides the basis for verification.	SysR - System Requirements, Including: - Requirements Patterns, Characteristics, and Attributes - Threshold/Objective Requirements - Reserve/Margin - Growth/Spare Requirements - Acceptance Criteria (Up-Front Definition) req - Requirements Diagram [SysML]	SRD



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10	Leverage bi-directional traceability (<i>up</i> to parents at Level n-1, <i>out</i> to peers at Level n, and <i>down</i> to children at Level n+1) to manage system development and changes.	Allows insight into top-down and bottoms-up impact assessment for potential changes and compliance issues.	StkRDB - Stakeholder Requirements Database SysRDB - System Requirements Database SERDB - System Element Requirements Database Horizontal and Vertical Traceability Mapping	TRACE SNRD SRD SAD
11	Measure and manage the integrated technical performance of the system (Level n).	Integrated technical performance must be monitored and controlled throughout development. The emergent properties must be measured and managed at the system level.	MOE - Measure of Effectiveness MOP - Measure of Performance TPM - Technical Performance Measure SE Leading Indicators Measurement Repository	MEAS SNRD SRD SAD DD
12	Ensure technical risk is at an acceptable level for the system (Level n). Manage the risks and opportunities throughout the development process.	Risks that are unaddressed may result in cost and/or schedule impacts, and may also result in expensive rework and/or non-compliances. Opportunities that are unaddressed may result in missed benefits.	ROMP - Risk & Opportunity Management Plan ROMB - Risk & Opportunity Management Board Risk & Opportunity Repository Technology Roadmaps (<i>if new technology involved</i>) TRL - Technology Readiness Level (<i>if new technology involved</i>) ImpACT - Importance/Availability/Capability/Timeframe (<i>if COTS involved</i>)	RM
13	Define/recommend balanced solutions via a formal decision making process.	The organization/project needs to make and support the tough decisions that give the best balanced system solution.	Trade-off Study (<i>including presentation of results & recommended decision</i>) Make vs. Buy Decision (<i>including presentation of results & recommended decision</i>) Decision Analysis Techniques (Decision Matrix, Pugh Concept Selection, AHP, etc.)	DM ACQ
14	Define, architect, design, analyze, and manage the system physical elements (Level n+1).	The physical design drives all of the lower-level system elements.	Views, Viewpoints, and Frameworks pkg - Package Diagram [SysML] Physical Hierarchy Diagram/bdd - Block Definition Diagram [SysML] Physical Block Diagram/ibd - Internal Block Diagram [SysML] par - Parametric Diagram [SysML] Morphological Box	SAD DD
15	Leverage technical reviews to focus on the integrated technical performance, compliance to requirements, and risk of the system (Level n).	Need to have meaningful technical reviews that focus on the integrated technical performance, compliance, and risks.	Peer Reviews/Formal Inspections TIM - Technical Interchange Meeting Technical/Formal Reviews (Requirements, Design, V&V, Production) Action Item Repository DHOAS - Dead Horse on a Stick	PAC
16	Define, analyze, and manage (derivation and allocation) the system element requirements (Level n+1).	The system element developers and suppliers need a clear understanding of what they need to design and implement. Provides the basis for system element verification.	Requirements Allocation Requirements Assignment/Derivation SER - System Element Requirements, Including: - Requirements Patterns, Characteristics, and Attributes - Threshold/Objective Requirements - Growth/Spare Requirements - Acceptance Criteria (Up-Front Definition) req - Requirements Diagram [SysML]	SRD SAD DD
17	Manage the system integrity . Ensure the overall coherence and cohesion of the evolving system (Level n) is maintained.	Failure to effectively manage configurations to deal with necessary changes can lead to cost overruns.	Baselines CR/PR - Change Report/Problem Report RFD/RFW - Request for Deviation/Request for Waiver TRB - Technical Review Board CCB - Change Control Board	CM
18	Integrate the system elements (Level n+1) together in a logical sequence to avoid wasted effort. Perform early integration on key/high risk elements.	Integration of the system component must be intentional to avoid unnecessary delays and overruns.	Integration Modeling, Analysis, & Simulation to Predict Compatibility Integration Techniques Horizontal and Vertical Integration	INT
19	Use verification early and often to ensure the system (Level n) as designed meets its system requirements.	Need to ensure "the artifact or entity has been built right" (meets its system requirements).	Verification Modeling, Analysis, & Simulation to Predict Compliance Verification Methods (IADT - Inspection, Analysis, Demonstration, Test)	VER
20	Use validation early and often to ensure the system (Level n) as designed meets the needs of the stakeholders.	Need to ensure "the right artifact or entity will be or was built" (meets its stakeholder needs and requirements).	Validation Modeling, Analysis, & Simulation to Predict Acceptance Validation Outcomes	VAL



Tool Belt provided by : Sysnovation, LLC
URL: www.sysnovation.com
Email: Info@sysnovation.com

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