

HARMONIZATION OF KEY SYSTEMS ENGINEERING RESOURCES

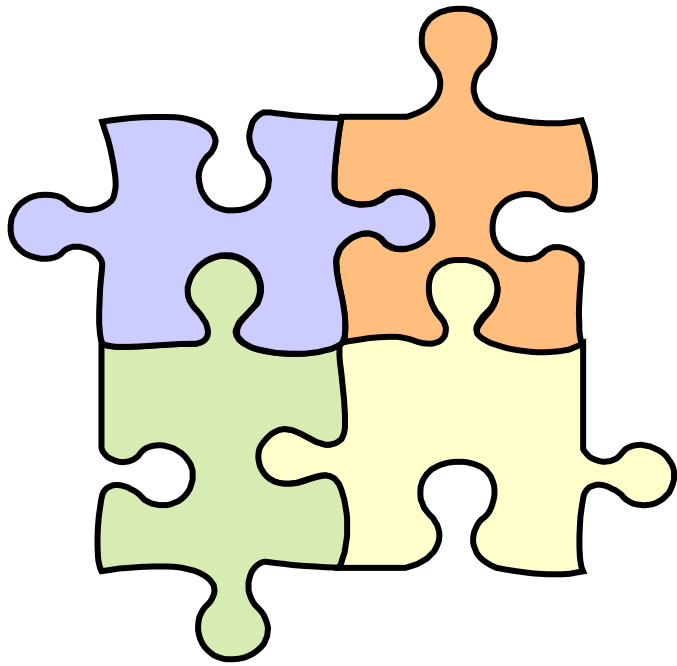
Garry Roedler, ESEP
LM Fellow

**15th Annual NDIA Systems Engineering Conference
San Diego, CA | October 25, 2012**

Note: This presentation is being given from the perspective of the industry association roles held by the presenter.

AGENDA

- **SE Standards Background**
- **Steps Taken Towards Harmonization**
- **Current Key SE Resources and Projects**
- **Planned Changes for Further Harmonization**
- **Application and Tailoring of Standards for Very Small Entities**



SE STANDARDS BACKGROUND

Framing the Situation

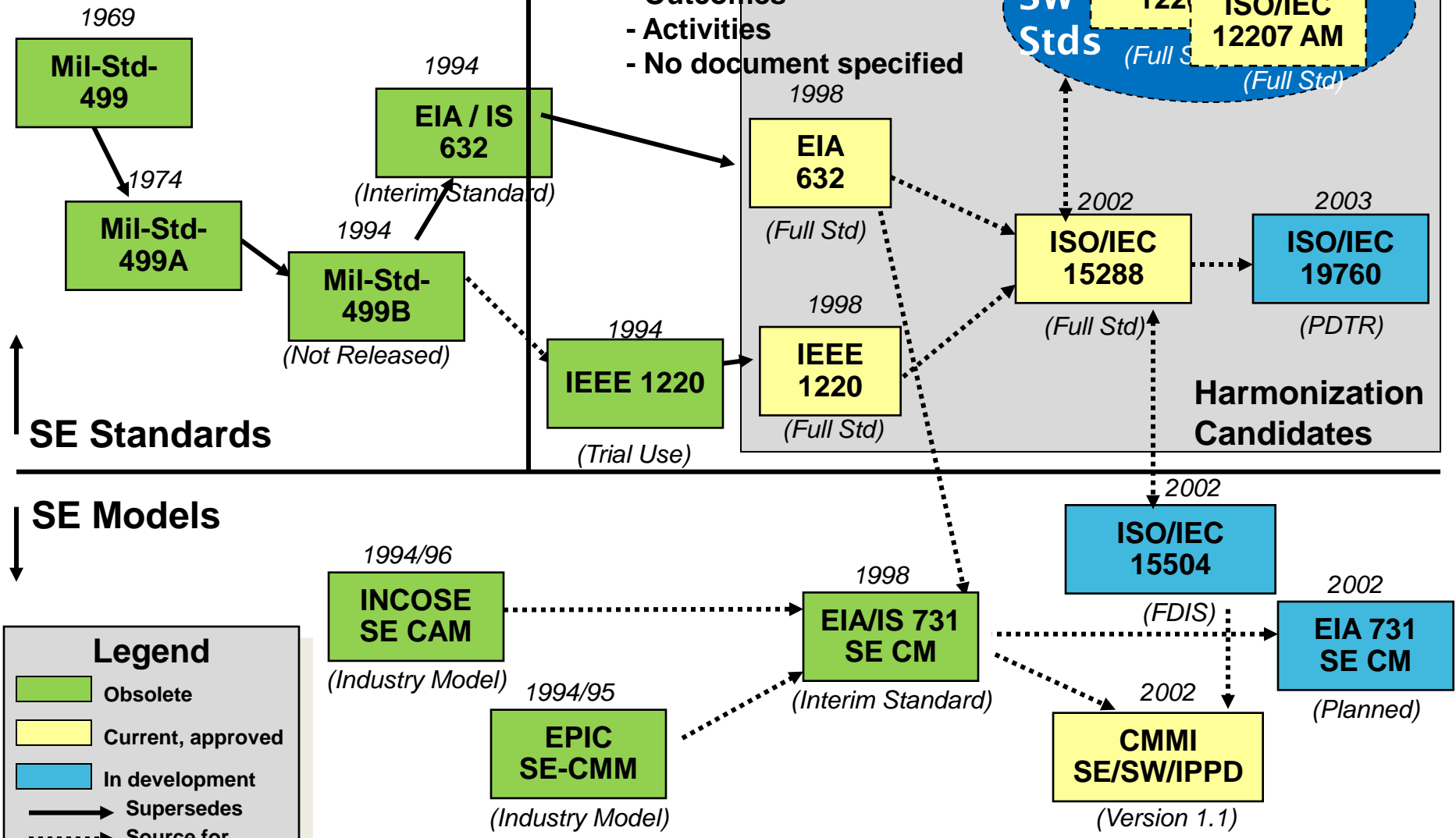
HERITAGE OF SE STANDARDS & MODELS AS OF 2002

"Life cycle" approach

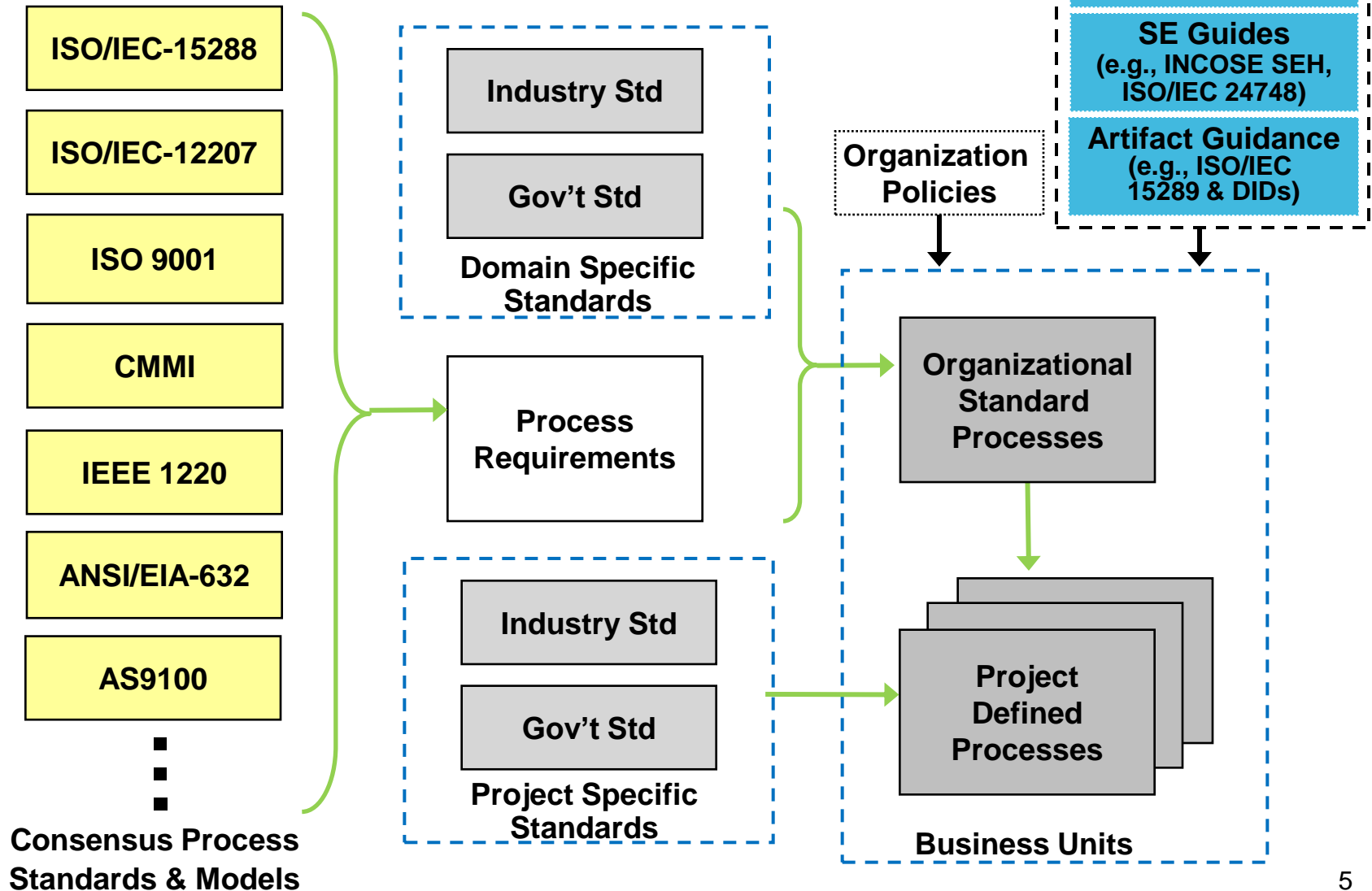
- Fixed phases / time
- Document contents

Process approach

- Objectives / purpose
- Outcomes
- Activities
- No document specified

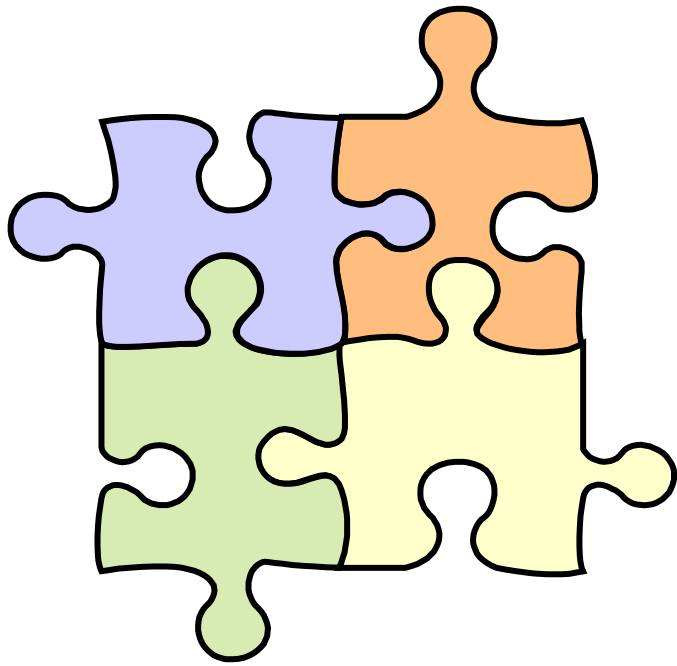


STATE OF STANDARDS - POTENTIAL STANDARDS INFLUENCE OF ORG/PROJECT PROCESSES



PAST PROBLEMS

- **Systems and Software standards have had different:**
 - Terminology
 - Process sets
 - Process structures
 - Levels of prescription
 - Audiences
- **These differences have been both between Systems and Software, and to some extent within each**
- **The problem has been exacerbated by competing standards, in whole or part**

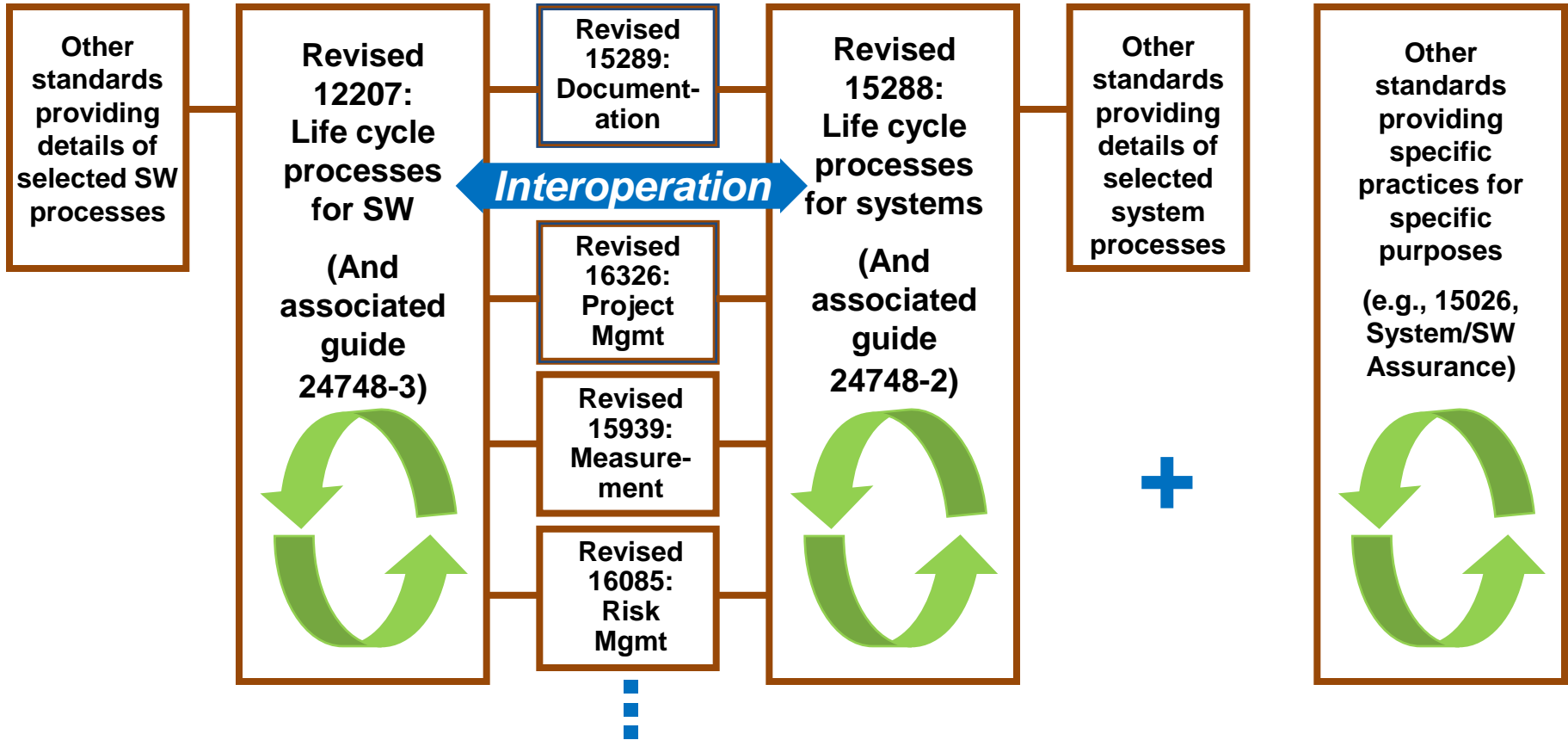


STEPS TAKEN TOWARDS HARMONIZATION

***A Look at the Journey for
a Highly Effective Set of
Standards***

INTENDED RELATIONSHIPS OF KEY SYSTEM & SOFTWARE ENGINEERING PROCESS STANDARDS AFTER ALIGNMENT

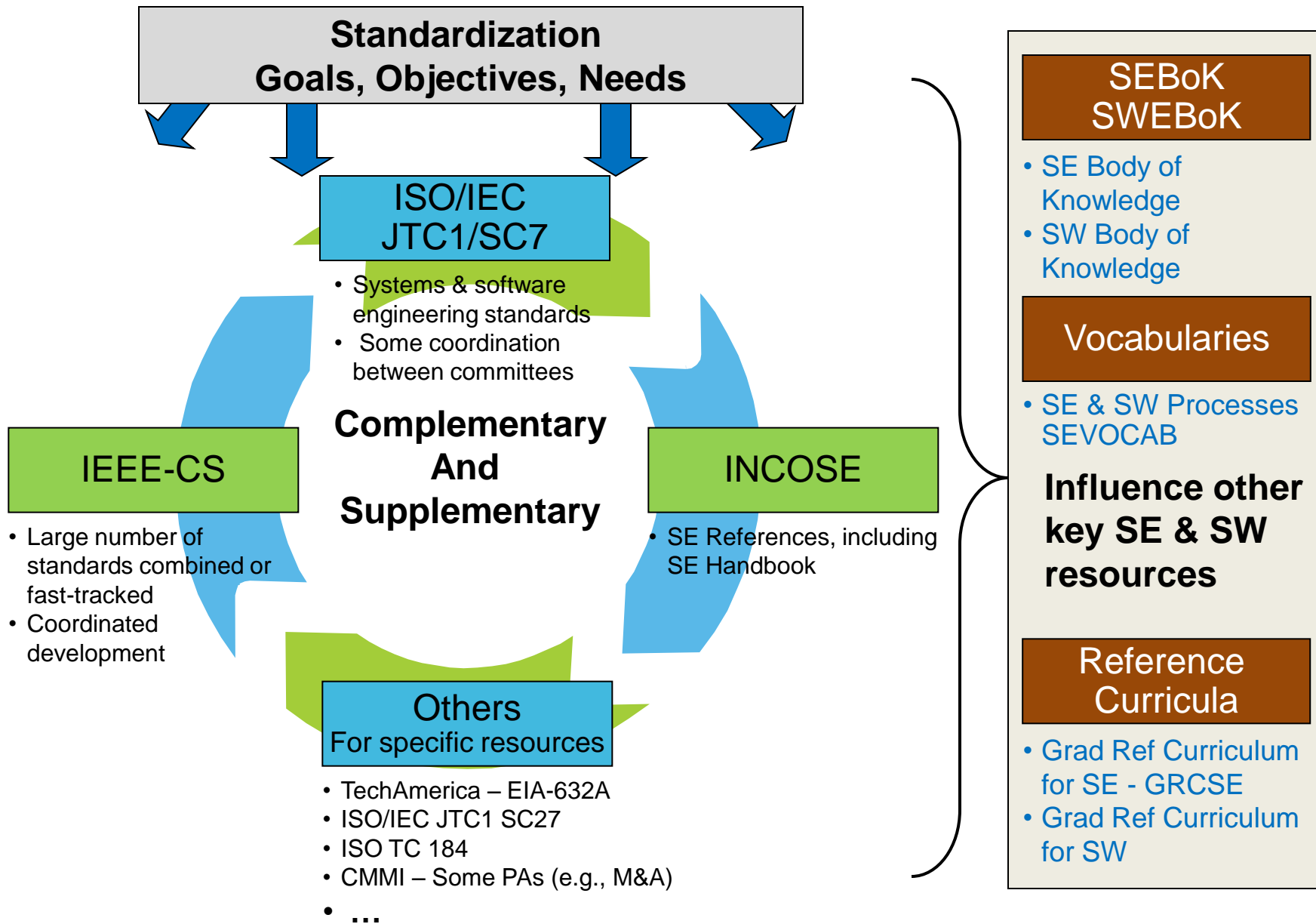
24748-1: Guide to Life Cycle Management



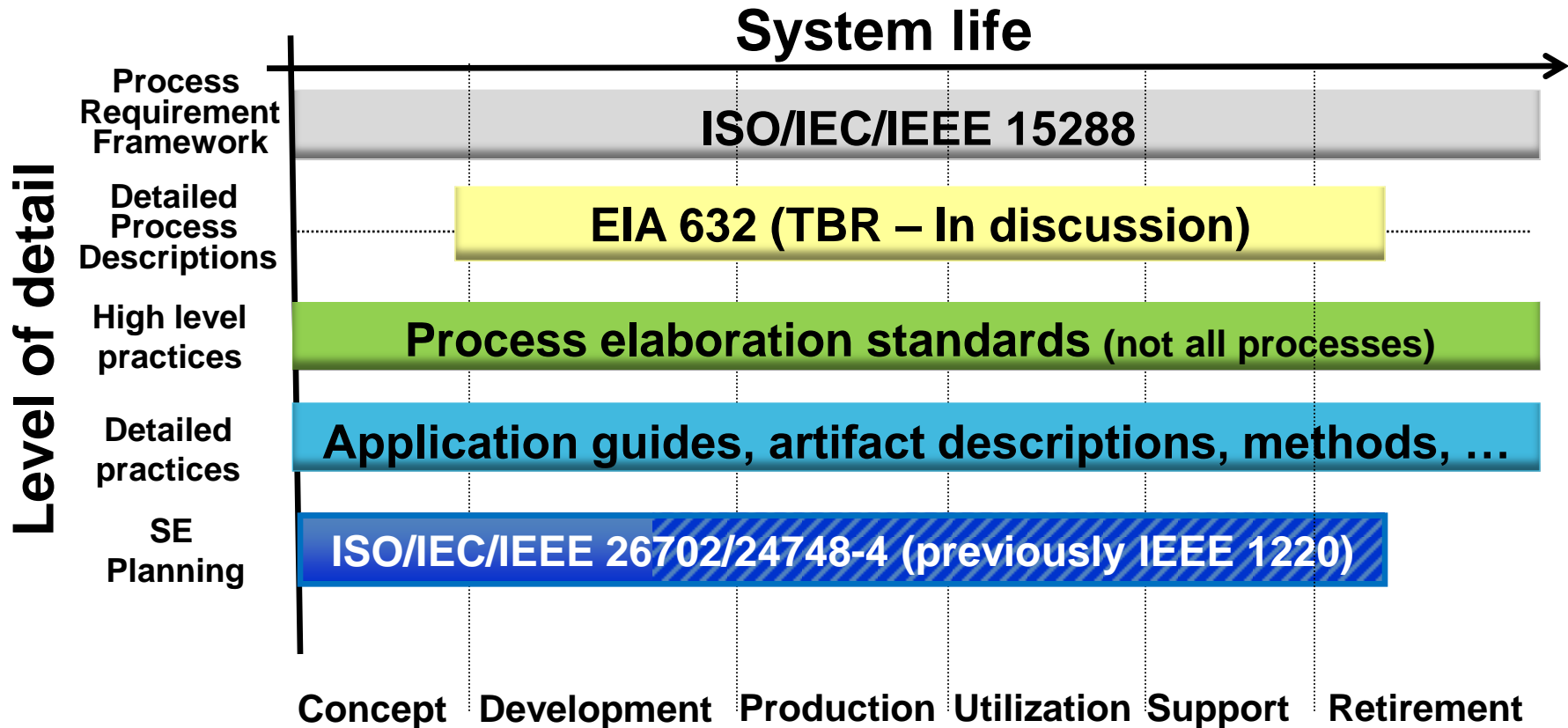
Common vocabulary, process architecture, and process description conventions

Process Assessment (ISO/IEC 15504) and Quality Mgmt (ISO 9001, ISO/IEC 90003/24783)

GROWING INDUSTRY COLLABORATION



BREADTH AND DEPTH OF KEY SE STANDARDS - 2012



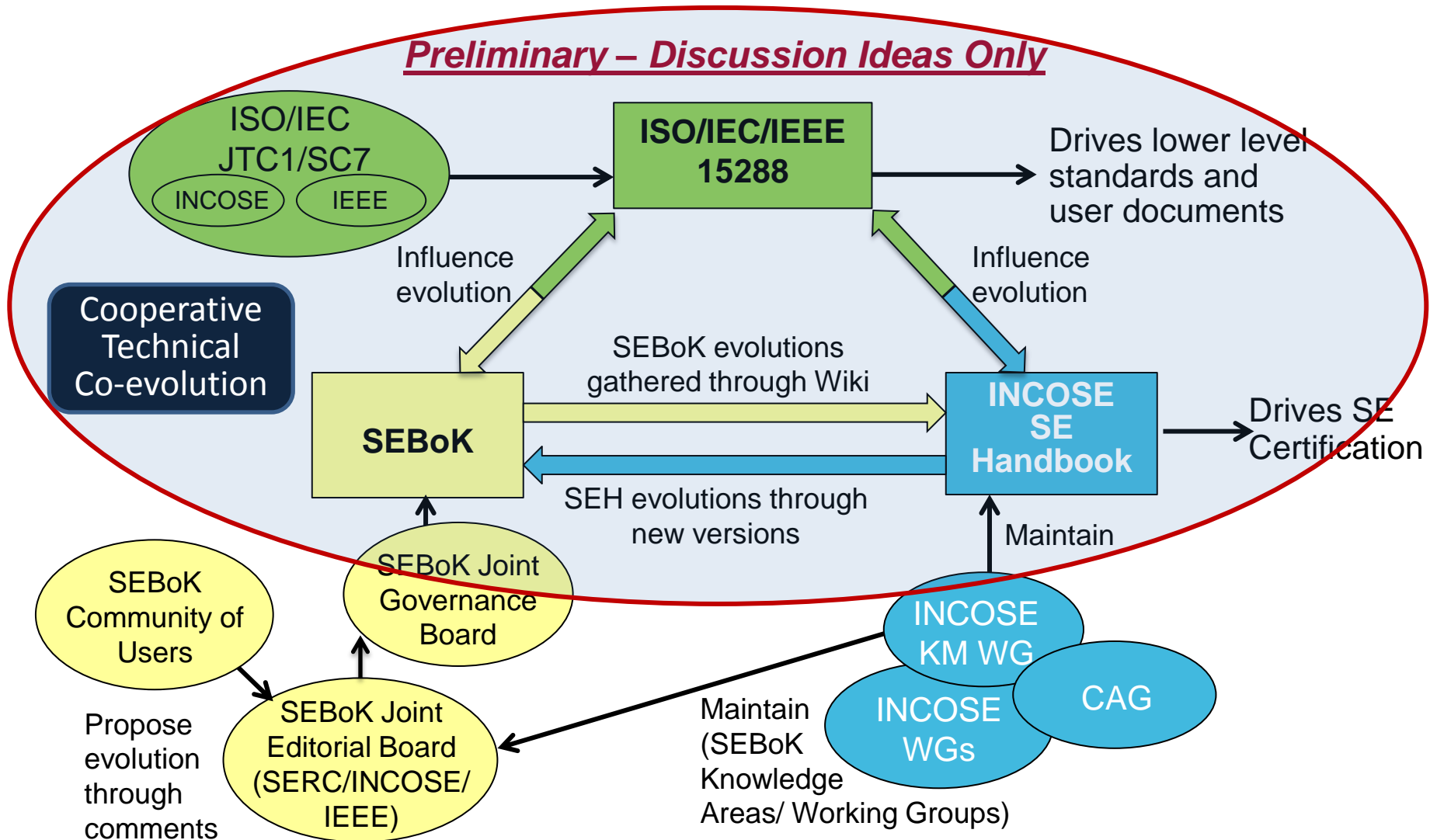
Working to ensure a set of complementary and supplementary standards and resources

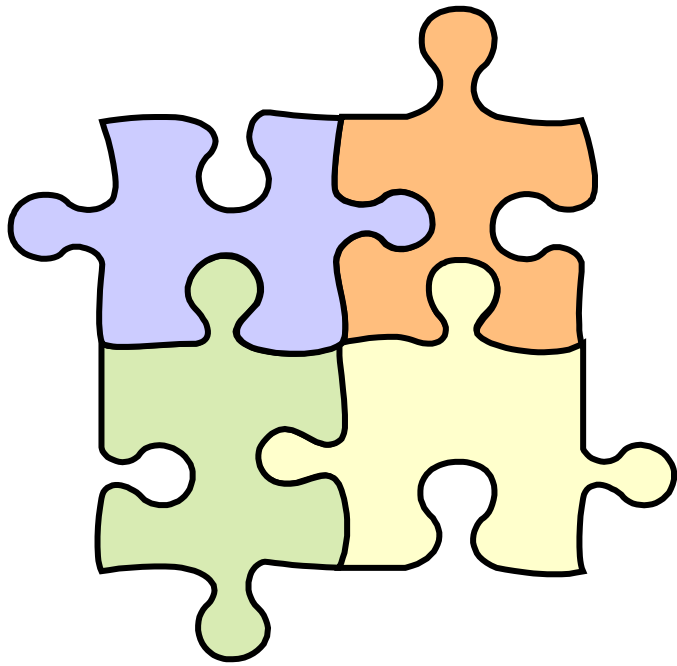
Alignment / Integration Status (2012-09-01)

	Legend			
Foundation	24765 Vocabulary (ISO/IEC, IEEE-CS, and PMI)	24748-1 Guide to Life Cycle Mgt	19759 SW Body of Knowledge	TBD SE Body of Knowledge
	Terminology	Overarching Framework	BoK	
Life Cycle Processes	12207 Software Life Cycle Processes	15288 System Life Cycle Processes	24748-4 SE Planning	24748-5 SW Planning
	16326 Project Management	14764 SW Maint	15939 Measurement	250xx SW Quality
Process Elaborations	16085 Risk Management	29148 Reqs Engineering	15026 Sys/SW Assur.	29119 SW Test
	15504/330xx Process Assessment	ISO 9000 Series Quality Management	Tools	24766 RE Tool Reqts
Assessment/ Governance	TR 24748-2 Guide to 15288	TR 24748-3 Guide to 12207	16337 SE Handbook Guide for System LC Processes & Activities	90005 Appl ISO 9000 to Systems
	42010 Architecture Description	15289 Documentation		90003 Appl ISO 9000 to Software
Artifact Descriptions				24774 Process Definition

RELATIONSHIP OF KEY SE RESOURCES

Possible interaction/relationships between SEBoK, INCOSE SEH, and ISO/IEC/IEEE 15288





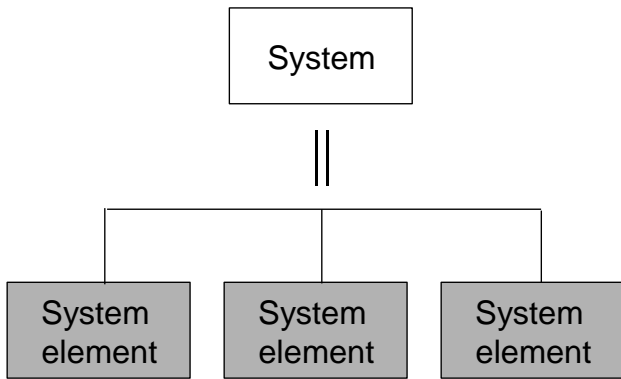
***CURRENT KEY SE
RESOURCES AND
PROJECTS***

KEY SE RELATED STANDARDS & GUIDES

Document ID	Document Title	Comment
ISO/IEC/IEEE 15288	System Life Cycle Processes	Wide adoption including NATO, DoD, INCOSE ...
ISO/IEC/IEEE 12207	Software Life Cycle Processes	SW viewed as System Element
ISO/IEC/IEEE 42010	Architecture Description	42030 in development – Architecture Evaluation
ISO/IEC/IEEE 24765	Systems and Software Engineering Vocabulary	Includes terms and definitions from ISO/IEC, IEEE, PMI
ISO/IEC/IEEE 24728-1	Guide for life cycle management	Framework Document – free at www.jtc1.org
ISO/IEC/IEEE 24748-2	Guide to 15288	Part 3 is Guide to 12207
ISO/IEC/IEEE 15026	System Assurance	4 part standard
ISO/IEC 2700x	SW Security Standards	E.g., 27001 – Security Mgt System
SEH	INCOSE SE Handbook	Serves as guide to 15288 & basis for SE Cert.
SEBoK	SE Body of Knowledge	Released in Sep 2012
DAG	Defense Acquisition Guidebook	Especially Chapter 4
ISO/IEC/IEEE 26702 (will be 24748-4)	Management of the Systems Engineering Process	Aka IEEE Std 1220 – under revision – SE Planning and SEMP focus
EIA 632	Engineering of a System	Under revision
CMMI	Capability Maturity Model – Integ.	
ISO/IEC TR 2655x	Tools & Methods for Product Lines	Tech Rpt series under development
Various others for elaboration/guidance	Subset of lower level process stds, document descriptions and guides	E.g., ISO/IEC/IEEE15939, 29148, 16085, ...; NATO AAP-48

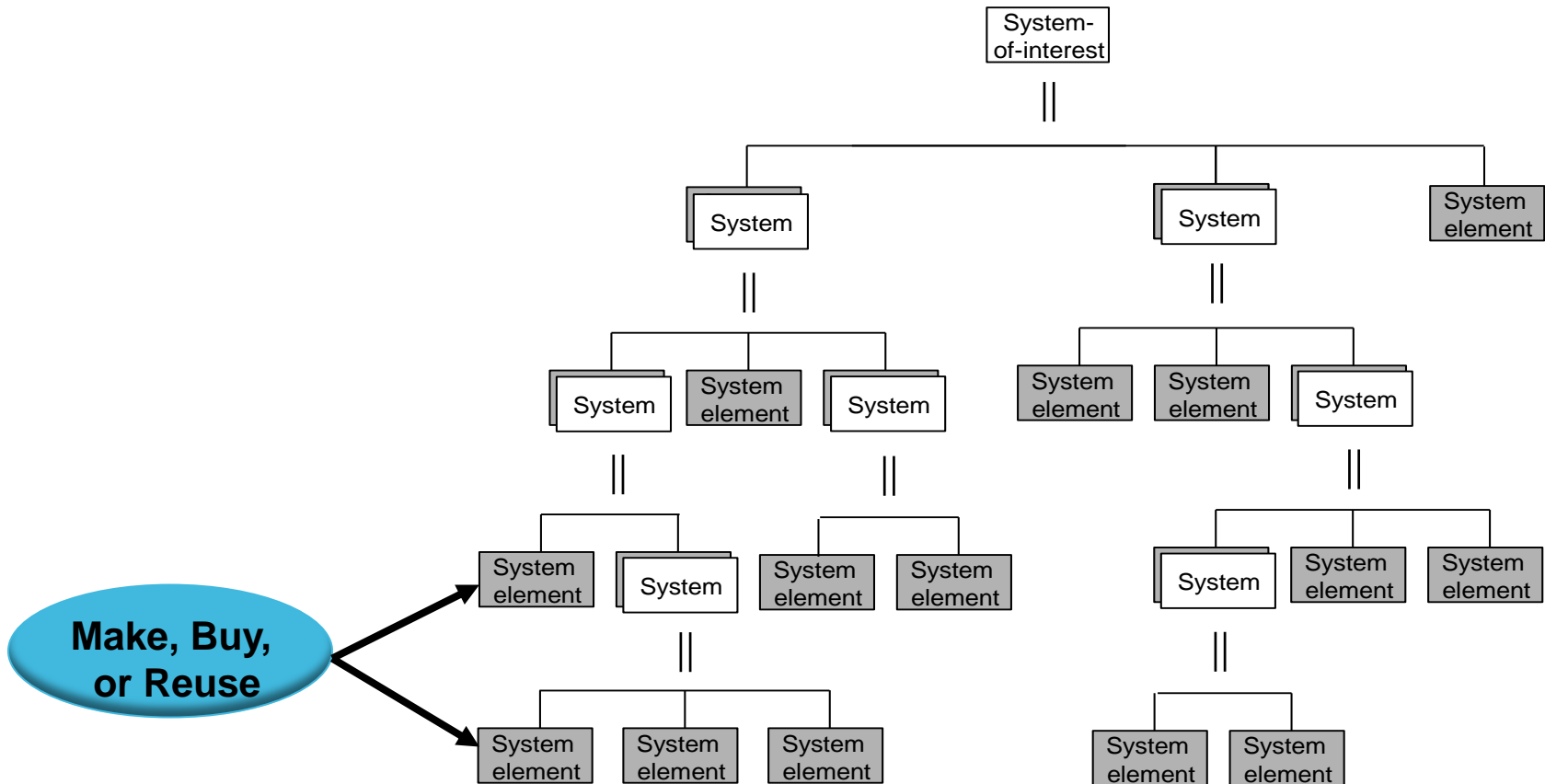
ISO/IEC/IEEE 15288 SCOPE

- **Provides a common, comprehensive & integrated framework for describing and managing the full life cycle of systems for:**
 - Small, medium and large organizations
 - Internal self-imposed use, as well as providing a basis for contractual arrangements (i.e., any agreement)
 - Applicable to most domains
- **Defines a set of processes and associated terminology**
 - Can be applied at any level in the hierarchy of a system across its life cycle
- **Applies to man-made systems configured with one or more of the following:**
 - Hardware, software, humans, or processes

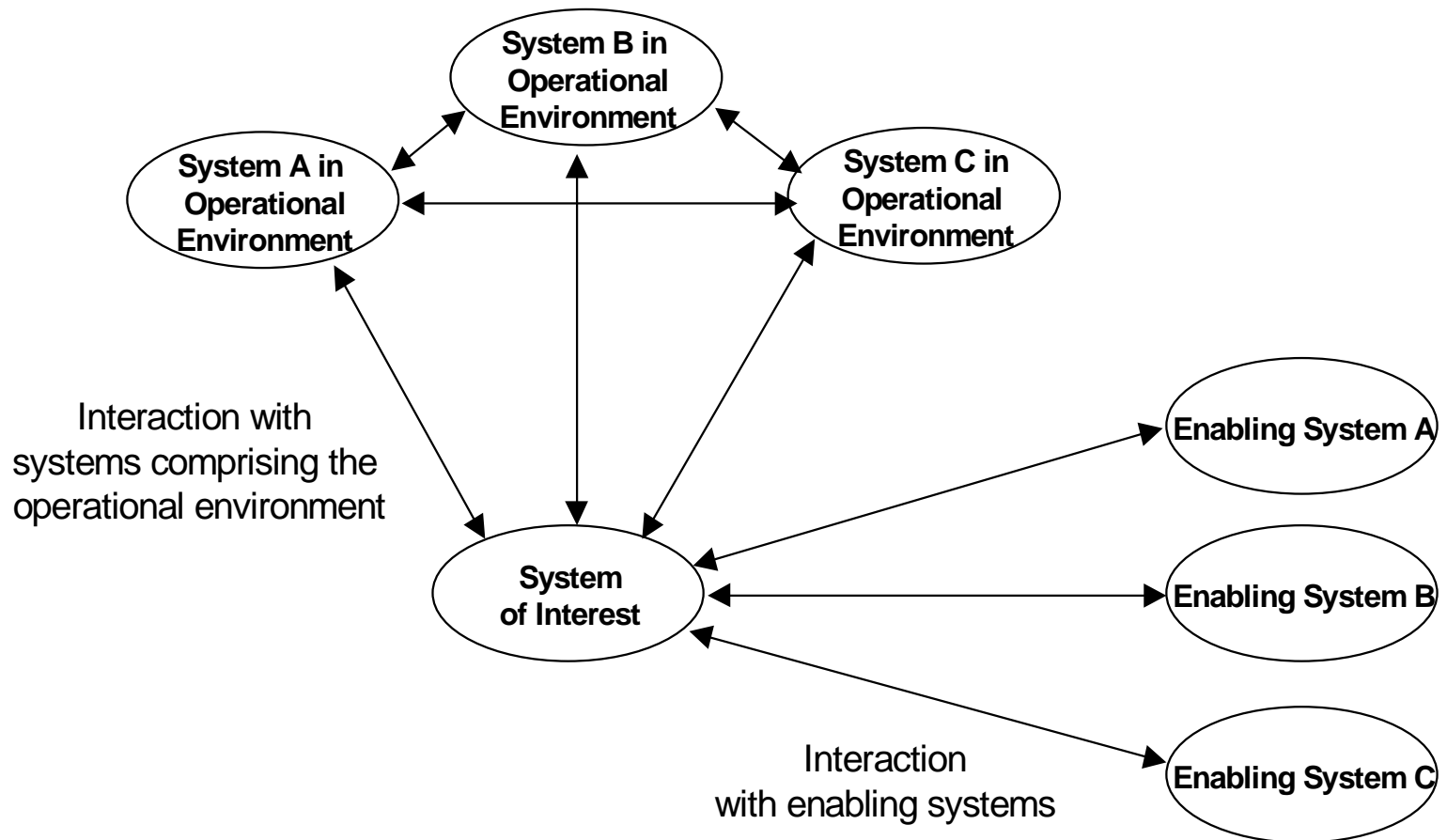


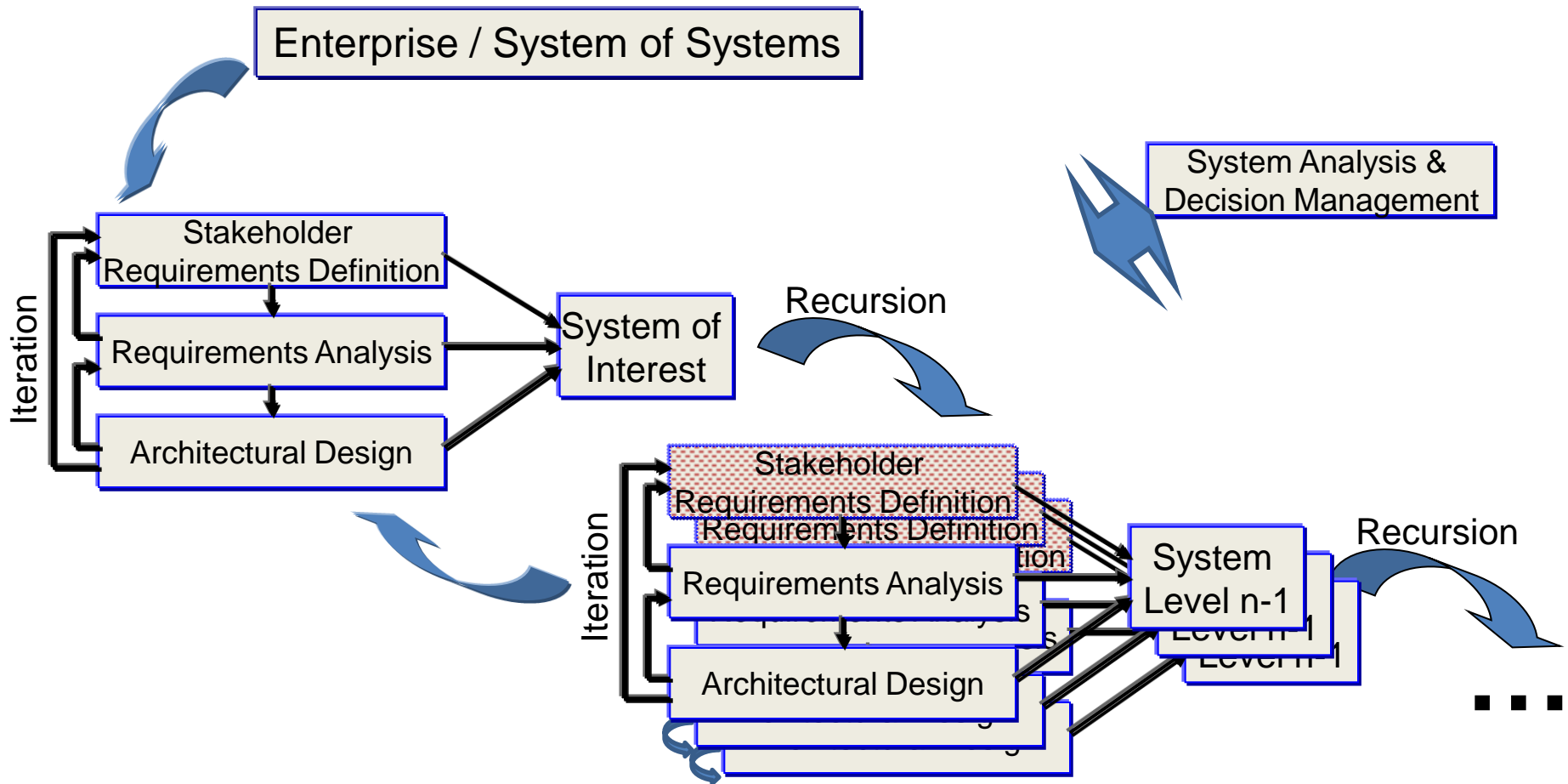
- ← A system
- ← is completely composed of
- ← a set of interacting
- ← system elements

SYSTEM-OF-INTEREST STRUCTURE



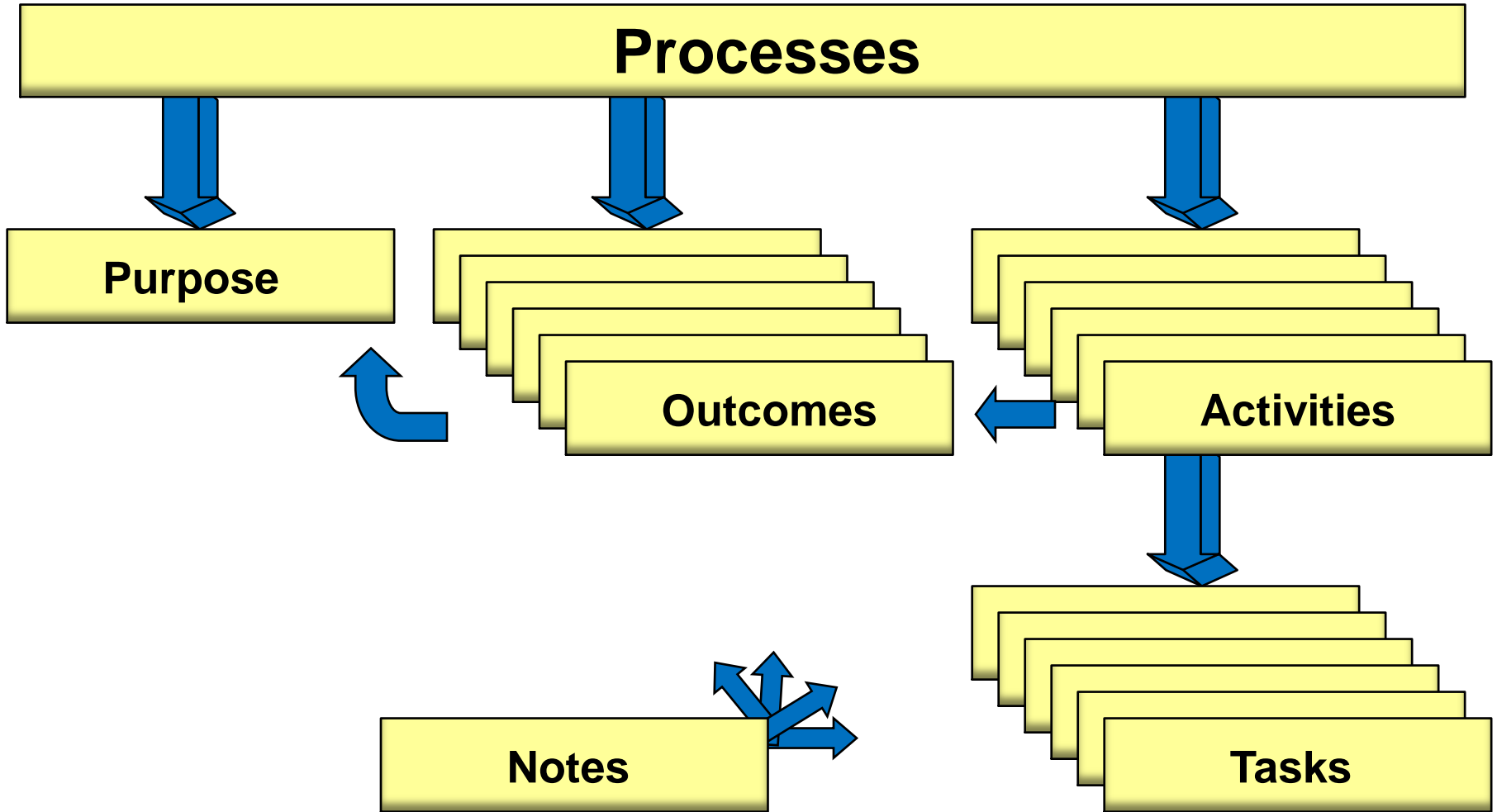
SYSTEM-OF-INTEREST, OPERATIONAL ENVIRONMENT, AND ENABLING SYSTEMS



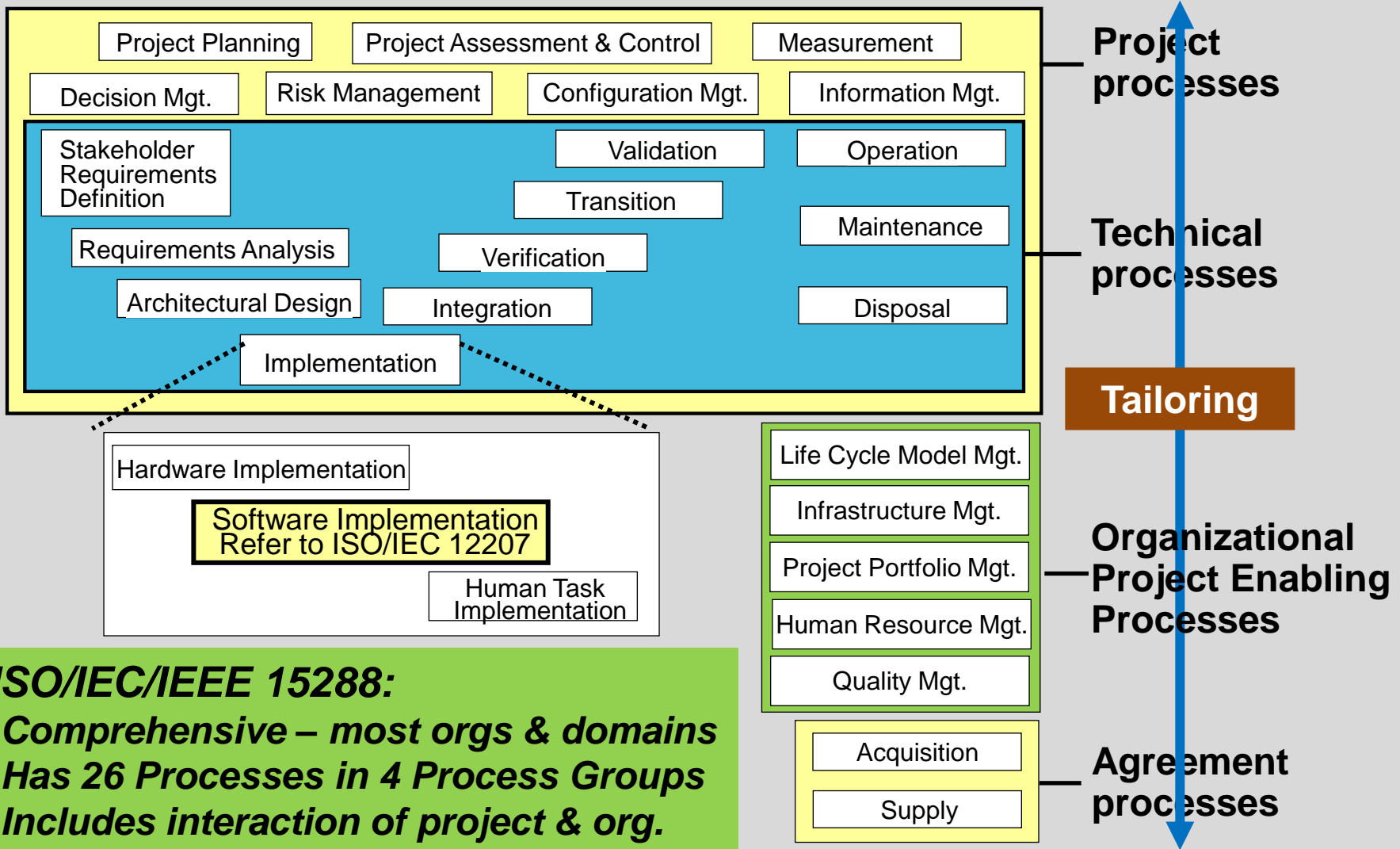


- **Iteration needed to:**
 - Accommodate stakeholder decisions and evolving understanding
 - Account for architectural decisions/constraints
 - Resolve trades for affordability, adaptability, feasibility, resilience, etc.
- **Recursive application for each lower level of the system hierarchy**

ISO/IEC/IEEE 15288 PROCESS STRUCTURE



ISO/IEC/IEEE 15288 PROCESSES AND STRUCTURE



ISO/IEC/IEEE 15288:

- **Comprehensive** – most orgs & domains
- **Has 26 Processes in 4 Process Groups**
- **Includes interaction of project & org.**
- **Full life cycle** – stages – **holistic view**
- **Based on proven practices**

Source: Adapted from ISO/IEC JTC1/SC7/WG7 presentation on ISO/IEC 15288.

INDUSTRY ADOPTION OF 15288 AND ALIGNED PRODUCTS

- **ISO/IEC/IEEE 15288, System Life Cycle Processes**
 - **INCOSE**
 - Adoption for processes and organization of SE Handbook
 - Referred to for SE Certification
 - **US DoD**
 - Adoption of ISO/IEC 15288 as acceptable standard for system life cycle processes
 - Defense Acquisition Guide (chap 4) aligns to and leverages
 - **NATO**
 - Adopted as an acceptable standard; created addendum AAP-48
 - **US Dept of Transportation / CA Dept of Transportation**
 - Referenced and leveraged in Systems Engineering Guidebook for Intelligent Transportation Systems
 - **Swedish Defence Material Administration and Swedish Armed Forces**
 - Process standard for their value added production
 - **Dutch Dept of Transportation**
 - **Defense companies**
 - Adopted by many defense companies
 - Used to form process requirements
 - **Many others**
 - Many presentations on usage from various type and size companies

WHAT IS BKCASE™?

- **Project to create:**
 - **Guide to Systems Engineering Body of Knowledge (SEBoK)** – scope is engineered and socio-technical systems; implemented as a wiki
 - **Graduate Reference Curriculum in Systems Engineering (GRCSE™)**
- **Started Sept 2009; publications expected in Sep/Dec 2012**
- **Intended for world-wide use – all products free**
- **Community-based authorship and review**

Location	Number
United States	44
Europe (UK, France, Sweden)	11
Asia-Pacific (Singapore, Japan, China, Australia)	7
Latin America (1 country)	1

Segment	Number
Academia	30
Industry	24
Government	3
Professional Societies	6

**Sponsors /
Investigators**



STEVENS
INSTITUTE of TECHNOLOGY
THE INNOVATION UNIVERSITY



**Supporters /
Stewards**



**Other
Supporters**



SEBoK TABLE OF CONTENTS

- Part 1: A guide to the SEBoK itself; e.g., Why does it exist? What is in it? How will different people use it?
- Part 2: A guide to knowledge about systems; e.g., What types of systems exist? What fundamental principles help explain systems?
- Part 3: A guide to knowledge about generic SE practice; e.g., How is SE performed? What are typical SE activities?
- Part 4: A guide to knowledge about the application of SE in products, services, enterprises, and systems of systems; e.g., how is the generic information in Part 3 tailored when applying to different system types?
- Part 5: A guide to knowledge about enabling SE; e.g., When is SE performed? Who performs it? How does culture affect it?
- Part 6: A guide to knowledge about related disciplines and specialties; e.g., How are software engineering, industrial engineering, and project management related to SE? How do safety, reliability, and other “ilities” relate to SE?
- Part 7: Implementation examples; e.g., What do existing case studies and vignettes reveal about SE knowledge and practice? How does SE practice vary by domain and system type?

WWW.SEBOKWIKI.ORG



Quicklinks

- Main Page
- Download SEBoK PDF
- Note to Reviewers
- Reading the SEBoK
- Acknowledgements
- Copyright Information

Outline

- Table Of Contents
- Part 1: SEBoK 0.75 Introduction
- Part 2: Systems
- Part 3: SE and Management
- Part 4: Applications of Systems Engineering
- Part 5: Enabling Systems Engineering
- Part 6: Related Disciplines
- Part 7: SE Implementation Examples

Navigation

- Knowledge Areas
- Topics
- Use Cases
- Case Studies

Vignettes

- Glossary of Terms
- Acronyms
- Primary References

Toolbox

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Category:Use Case > Category:Case Study > Category:Glossary of Terms > Category:Primary Reference > Guide to the Systems Engineering...

Guide to the Systems Engineering Body of Knowledge (SEBoK) v. 0.75

(Redirected from [Main Page](#))

Welcome to the *Guide to the Systems Engineering Body of Knowledge (SEBoK)*, version 0.75.



The growing maturity of any discipline is marked by many milestones; e.g., university degree programs that teach it, professional societies that nurture it, and scholarly journals that report advances in it. One important milestone is establishing an authoritative guide to a discipline's body of knowledge. This wiki site is that guide for systems engineering. Version 0.75 of the Guide to the Systems Engineering Body of Knowledge (SEBoK) is a work in progress, intended for early adopters. The aspiration of the sponsors and the several dozen authors who have worked tirelessly since September 2009 is to create an extremely useful, widely accessible, and easily updated authoritative guide to the systems engineering body of knowledge.

This wiki contains information on 120 topics in systems engineering, written by experts from around the world. The process being used is transparent with a third round of community review now underway. Yet, the SEBoK is far from complete. In fact, if the SEBoK effort is successful, it will never be "complete" because it will continue to evolve and grow from broad use. A wiki implementation was chosen precisely because it facilitates rapid feedback from the community and easy updates to reflect that feedback and advances in the field.

The Quicklinks on the left-hand side of this page are a good starting point for you to approach the wiki. Three of those links are especially valuable to highlight:

- [Reading the SEBoK](#), which explains the formatting of the wiki and how different pages are structured
- [Copyright Information](#), which explains what you can do with useful information you find here
- [Acknowledgements](#), which gives credit to the many many people who have contributed to the SEBoK

Also on the left-hand side of this page is the table of contents. [Part 1](#) explains the motivation for the SEBoK, the history of the systems engineering discipline, the planned evolution of the SEBoK, how to use the SEBoK, etc. We recommend that all reviewers begin by reading through [Part 1](#).

Please explore the wiki, use the content, and send us feedback on how to make it better. **We are accepting SEBoK 0.75 review comments until April 15, 2012.** Click [Note to Reviewers](#) for detailed review instructions.

To download a PDF of the SEBoK, please [click here](#). Please note that this is a large file (~50 MB) and so may take several minutes to download.



- Navigate outline via left menu
- Can download PDF version
- “Note to reviewers” in the left menu

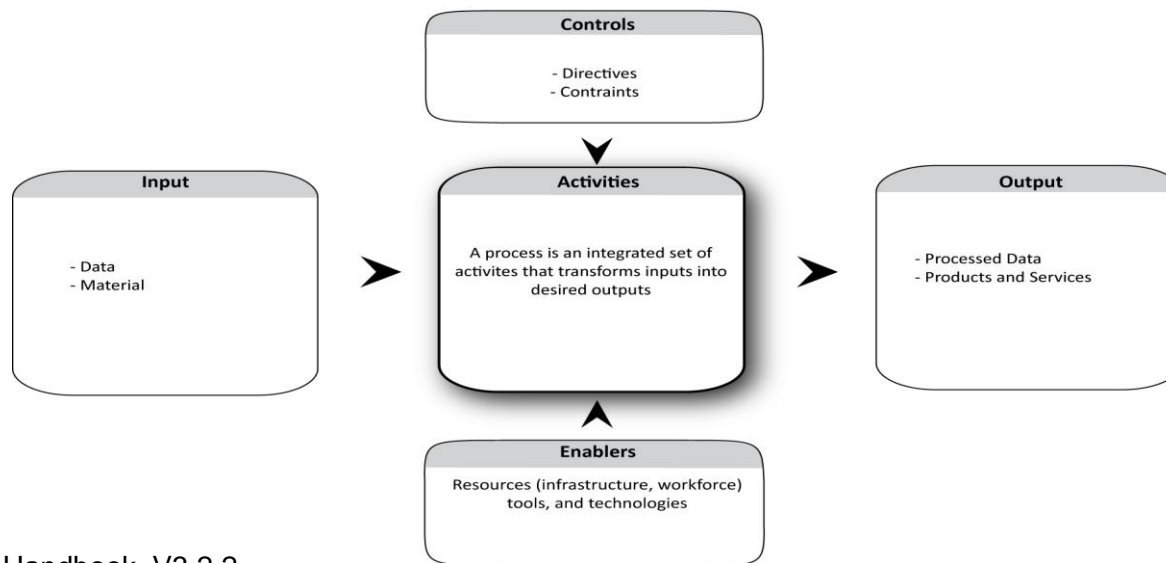
INCOSE SE HANDBOOK (SEH)

OVERVIEW

- **Purpose**
 - Defines the discipline and practice of systems engineering (SE)
 - Provides an authoritative reference
- **Application**
 - Consistent with ISO/IEC 15288:2008 – Systems and software engineering – System life cycle processes
 - Further elaborates the processes and activities to execute the processes
 - Ensures usefulness across a wide range of application domains – man-made systems and products, as well as business and services
 - Serves as a reference to practices and methods that have proven beneficial to the SE community at large
 - Tailoring guidelines provided

INCOSE SEH - PROCESS CONTENTS

- **Process Overview**
 - **Purpose (from 15288)**
 - **Description**
 - **Inputs**
 - **+Controls & Enablers**
 - **Outputs**
- **Process Activities**
 - **Common approaches and tips**
 - **Process Elaboration**
 - **Detail on topics related to the process**
 - **Endnotes w/additional readings**



Source: INCOSE SE Handbook, V3.2.2

INCOSE SEH - OTHER CONTENTS

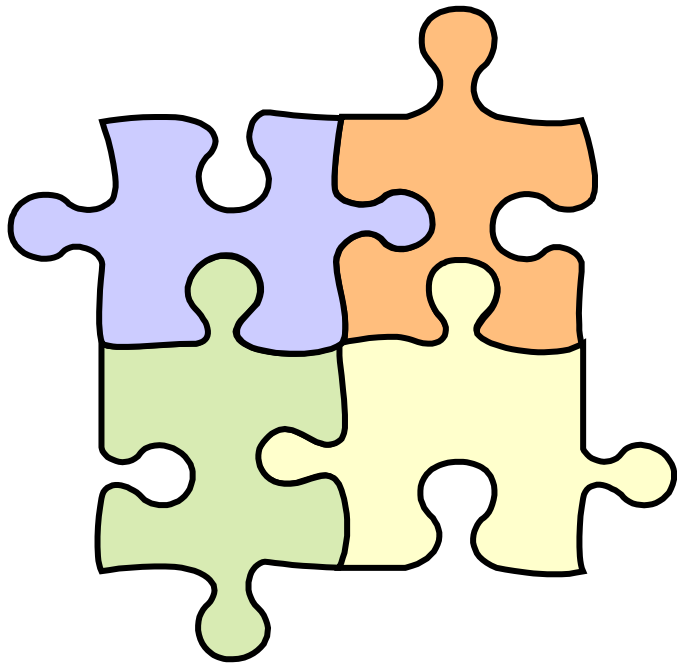
- **Life Cycle Model Concepts and Guidance**
- **Analysis Techniques**
- **Process Mappings to Key SE-related Standards & References**
 - **ISO/IEC/IEEE 15288**
 - **ISO/IEC/IEEE 26702**
 - **EIA 632**
 - **CMMI**

NATO – DESCRIPTION OF AAP-48

- **AAP-48 created to provide supplemental guidance for 15288**
 - Steps through 15288 clauses without repeating text
 - Indicates what clauses or parts apply
 - Provides additions and discussion for clauses
 - Identifies other NATO references that apply
 - Provides 2 additional processes (Through-life Traceability and Support)
- **Purpose**
 - “The NATO Policy for Standardisation calls for the use of civil standards to the maximum practicable extent. ISO/IEC 15288:2008, “Systems Engineering – System Life Cycle Processes”, is already in use in several Nations and provides a general framework that is neutral to existing individual Nations’ Acquisition Processes. Following this guidance, NATO will use ISO/IEC 15288:2008 as the basis for implementing SLCM. This allows for traditional acquisition or iterative developments and procurement cycles for the realisation of required capabilities.”

OTHER RESOURCES WORTH NOTING

- **ISO/IEC/IEEE 24748 series**
 - **Part 1: Guide to Life Cycle Management**
 - Freely available at:
 - http://standards.iso.org/ittf/PubliclyAvailableStandards/c050502_ISO_IEC_TR_24748-1_2010.zip
 - **Part 2: Guide to ISO/IEC/IEEE 15288, System Life Cycle Processes**
 - **Part 3: Guide to ISO/IEC/IEEE 15288, Software Life Cycle Processes**
 - **Part 4: System Engineering Planning**
 - Will replace IEEE 1220/ISO/IEC 26702
- **ISO/IEC/IEEE 24765, System/Software Engineering Vocabulary**
 - Also online as SEVOCAB at:
http://pascal.computer.org/sev_display/index.action



***PLANNED CHANGES
FOR FURTHER
HARMONIZATION***

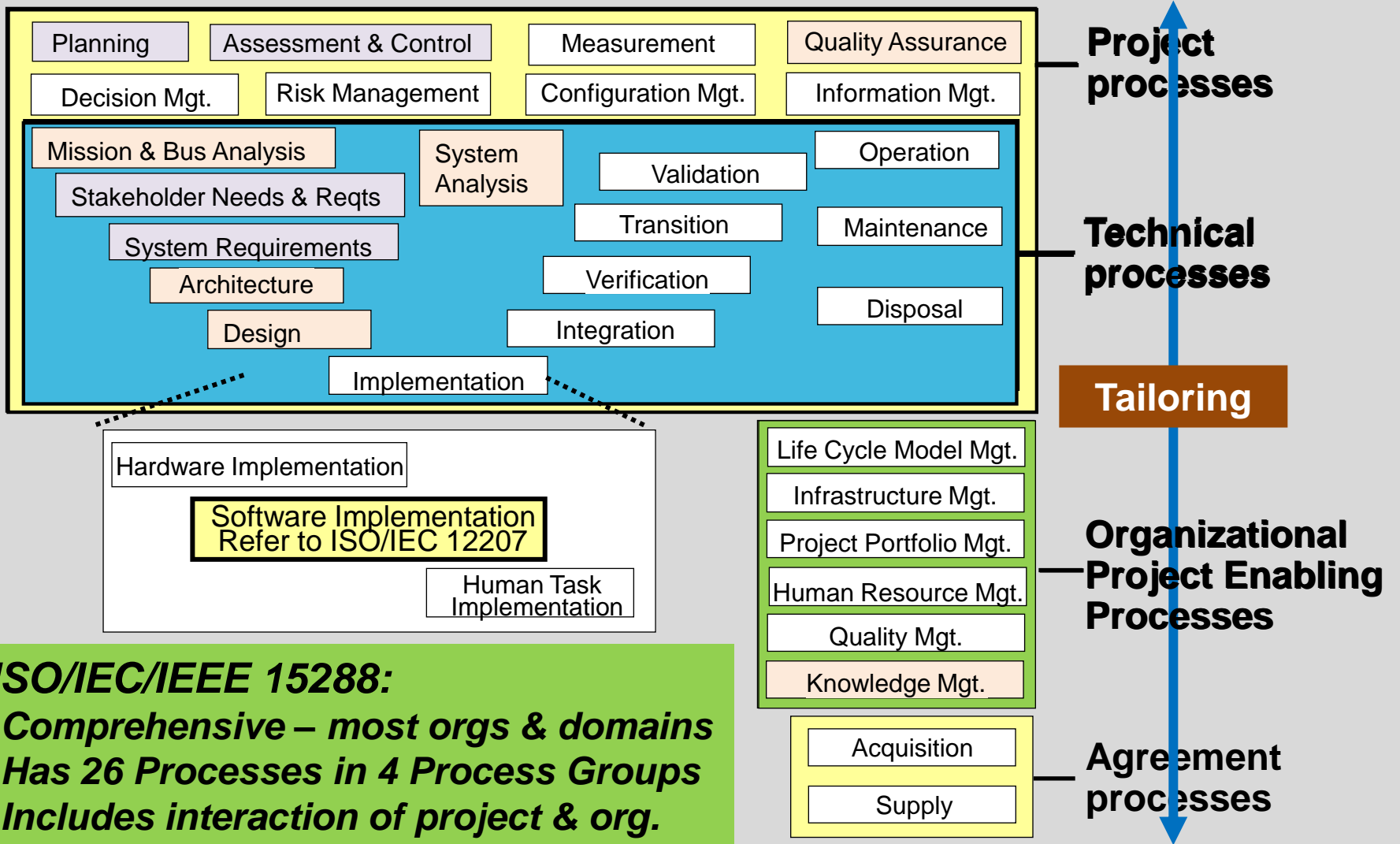
APPROACH FOR NEXT PHASE OF HARMONIZATION

- **Conduct Study Group within ISO/IEC JTC1/SC7**
 - **Collect information from other Standards Dev Orgs and Industry Associations**
 - **Establish common objectives**
 - **Determine common core process set, terminology and concepts**
 - **Develop and process revisions**
- **Coordinate concurrent revisions across multiple key resources**
 - **ISO/IEC/IEEE 15288 and 12207**
 - **EIA 632A**
 - **INCOSE SE Handbook**
 - **SEBoK**

DRIVERS OF PROPOSED CHANGES TO 15288 (AND 12207)

- **Considered the following:**
 - **V&V Study Group Report**
 - **Feedback from Users**
 - **Current direction of related industry guidance (e.g., SEBoK, INCOSE SEH, 632, ...)**
 - **Modeling of 15288 and 12207**
 - **SWG5 Common Process Set spreadsheet**
 - **Related ISO/IEC/IEEE Standards**
 - **Various discussions, including with WG42**
- **Next several charts include describe the planned scope of change for 15288**

ISO/IEC/IEEE 15288 PROCESSES AND STRUCTURE



ISO/IEC/IEEE 15288:

- **Comprehensive** – most orgs & domains
- **Has 26 Processes in 4 Process Groups**
- **Includes interaction of project & org.**
- **Full life cycle** – stages – **holistic view**
- **Based on proven practices**

Source: Adapted from ISO/IEC JTC1/SC7/WG7 presentation on ISO/IEC 15288.

PLANNED REVISION OF ISO/IEC/IEEE 15288

- **Most Significant Change is in Technical Processes**
 - **Improve focus on Concept Definition**
 - **New Business and Mission Process**
 - **Clarify Development and Transformation of Needs and Requirements**
 - **Improve Requirements Process – transformation and management**
 - **Split single Architectural Design process into separate Architecture and Design processes**
 - **Add new System Analysis process**
 - **Improve IV&V processes per study group findings**
 - **Add detail to Transition, Maintenance, and Operations**
 - **Throughout – address Trusted Supply Chain issues (e.g., ties to assurance, security and anti-counterfeit)**
- **Enabling Processes (name change)**
 - **Add Knowledge Management Process – include Domain Engineering and Reuse**
 - **Expand scope of Portfolio Management**
- **Minor improvements to Project Processes**
- **No significant changes to Agreement processes**

OPPORTUNITIES FOR INFLUENCE AND CHANGE

- **ISO/IEC/IEEE 15288, System Life Cycle Processes and 12207, Software Life Cycle Processes are planning revision**
 - Opportunity to influence processes, requirements, structure and content
- **DoD work with SDOs for application guide of industry standards for defense contracts**
 - Focused on information requirements and analysis, not specific formatting
- **INCOSE SE Handbook (SEH) is planning revision**
 - Opportunity to influence processes, structure and content
 - SEH serves as guide for 15288 and is basis of SE Certification
- **EIA 632, Engineering of a System is currently in revision**
 - Opportunity to influence processes, requirements, structure and content
- **SEBoK is about to release final draft for review**
 - Opportunity to influence processes, structure and content

NATO – HARMONIZATION WITH AAP-48

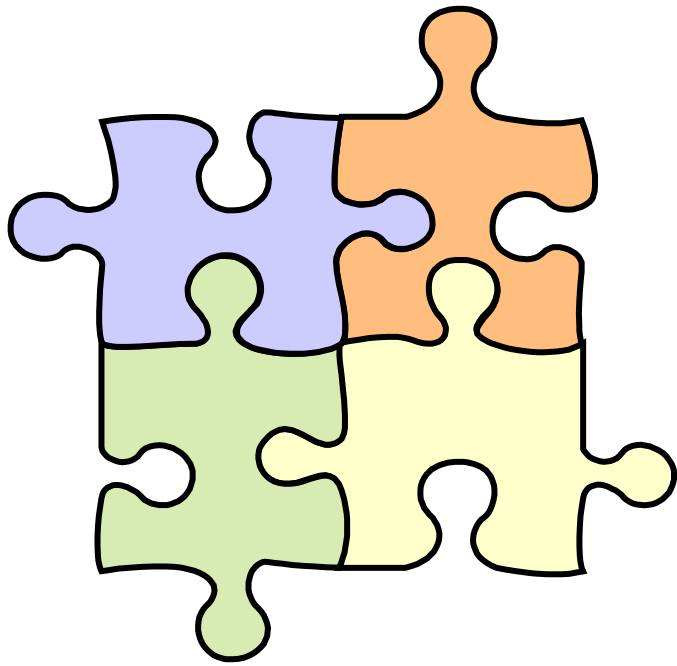
- **Discussion has started regarding revision to 15288**
- **Continued harmonization is a joint goal**
- **Approach may be a possibility for DoD**

TECHAMERICA – STATUS OF HARMONIZATION BETWEEN ISO/IEC/IEEE 15288 AND EIA 632

- **Recent engagements**
 - Met with TechAmerica Team in June
 - Conducted briefing and discussion session in September
 - Reviewed details of planned revision to 15288, including changes for alignment
- **Progress**
 - Very positive engagements and desire to work towards better alignment to allow concurrent usage
 - Convergence on many terms and concepts
 - Still some differences to resolve
- **Next Steps**
 - Review current draft of EIA 632 and provide additional recommendations
 - Provide draft of ISO/IEC/IEEE 15288 revision to TechAmerica team following ISO/IEC SC7 meeting in November

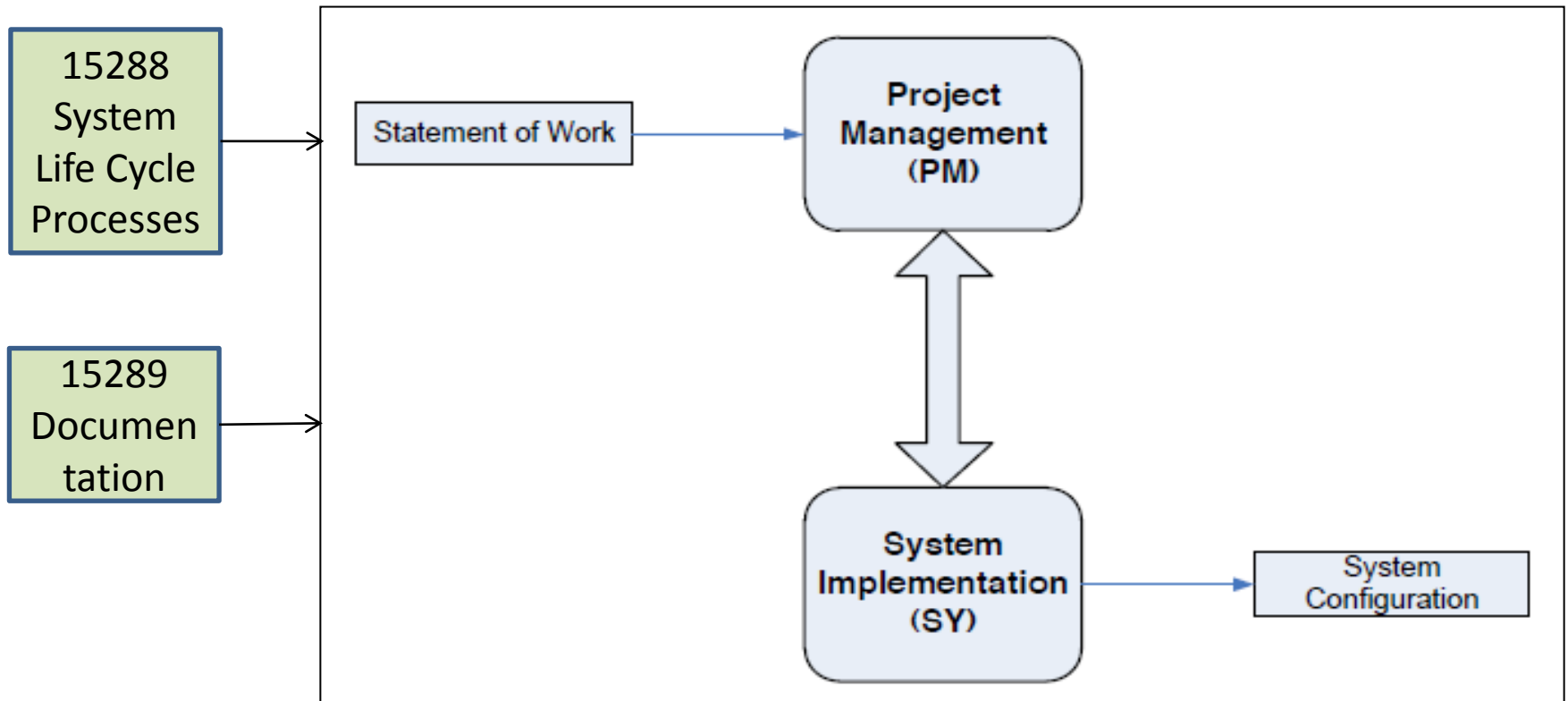
HARMONIZATION WITHIN DoD

- **Revision to the Defense Acquisition Guide, Chapter 4, Systems Engineering**
 - Intend to continue alignment with 15288 and other key resources
 - Draft in review now
- **Currently investigating options for developing defense guidance for the industry standards on SE, CM, and Technical Reviews**

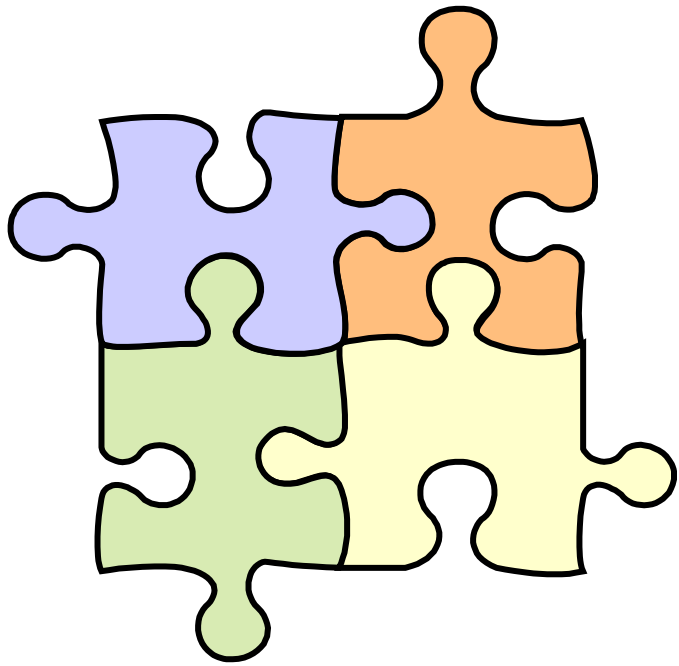


***APPLICATION AND
TAILORING OF
STANDARDS FOR VERY
SMALL ENTITIES***

STANDARDS TAILORING AND APPLICATIONS FOR VSEs



- Includes a subset process activities/outcomes in ISO/IEC/IEEE 15288 and products in ISO/IEC/IEEE 15289
- Considered most essential activities based on VSE profile (<25 people)
- Applies to VSEs who do NOT develop critical system products

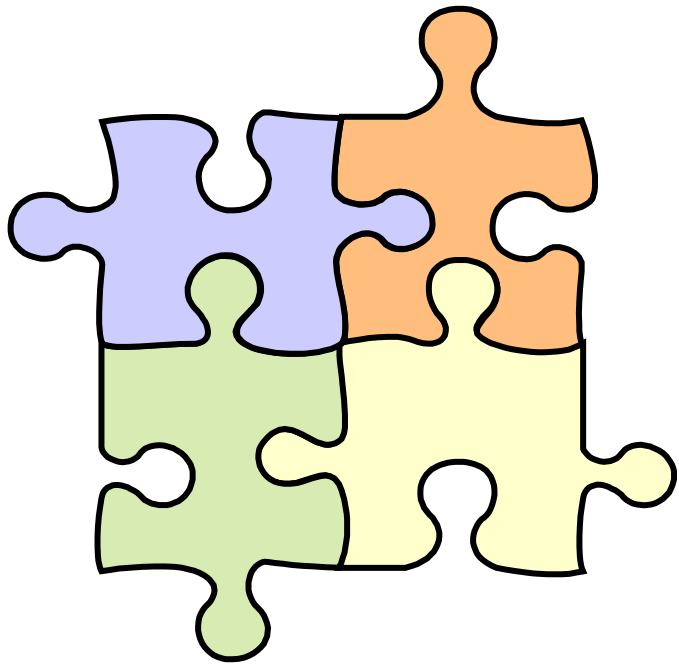


SUMMARY

SUMMARY

- **Great progress has been made in the harmonization of key SE resources**
- **Collaboration among Industry Associations has made this possible**
- **Plans are in place to continue the harmonization through “Technical Co-evolutiuon”**

Questions?



BACK-UP CHARTS

BENEFITS OF USING ISO/IEC 15288

- **Full life cycle approach to systems engineering and systems management**
 - Built on proven experience and lessons learned
 - Life cycle modeling of systems – stage-based
 - A holistic view of engineering the system (software, hardware, humans, and processes)
- **Provides the basis for improving:**
 - Communication and integration among system
 - Quality of the product
 - Productivity
 - Customer satisfaction
- **A process framework that:**
 - Is easy to tailor to meet project/organization needs
 - Reduces risk across the life cycle
- **Part of an aligned set of standards**

Source: Adapted from ISO/IEC JTCl/SC7/WG7 presentation on ISO/IEC 15288.

THE PROBLEM

- **In the past, Systems and Software standards have had different:**
 - **Terminology**
 - **Process sets**
 - **Process structures**
 - **Levels of prescription**
 - **Audiences**
- **These differences have been both between Systems and Software, and to some extent within each**
- **The problem has been exacerbated by competing standards, in whole or part**

Lack of integration both within and across Standards Development Organizations

THE CAUSE

- **Culture**
 - “We’re different”
 - “Not invented here”
- **Organizational**
 - Different teams, committees, etc.
- **Competition**
 - Many Standards Development Organizations
- **Domains**
 - Focused, narrow view often doesn’t look beyond the domain for commonality

**Many obstacles; some real, some perceived, some
self-made**

THE IMPACT

- **Less effective/efficient processes**
 - Not focused on leveraging commonalities – causes redundancy
 - Has resulted in incompatibilities, inconsistencies
- **Less effective solutions**
 - Not focused on a common approach to solve a problem/need
- **Obstacle for:**
 - Communicating (at all levels – disciplines, teams, etc.)
 - Working in integrated teams
 - Leveraging resources
- **Stove-piping due to:**
 - The incompatibilities, inconsistencies
 - Lack of leveraging commonalities

Impacts effectiveness and efficiency of the team

THE OBJECTIVE

- **The objective is to make the standards more usable together by achieving:**
 - **Common vocabulary**
 - **Single, integrated process set**
 - **Single process structure**
 - **Jointly planned level of prescription**
 - **Suitable across the audiences**
 - **Accounts for considerations in wide range of domains and applications**

Work to a common vision, agreements, and general process concepts

BUT IS THIS ENOUGH?

- **Advantages**

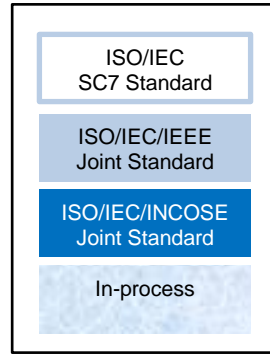
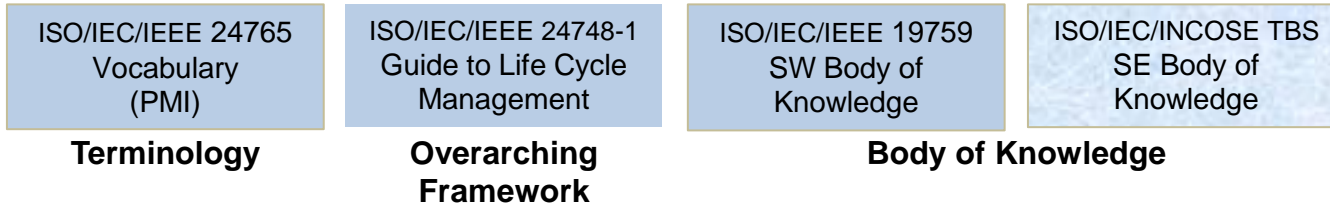
- **Drives to a more consistent set of standards**
- **Provides for “interoperability” of these standards**
- **Creates a better foundation for collaboration between Standards Development Organizations (SDOs)**
 - **Work towards common or complementary/supplementary standards**
 - **Model has worked well with IEEE-CS and INCOSE**

- **But some issues still remain**

- **Still allows for significant redundancy**
- **Still need to account for specialized needs**
- **Alignment does not ensure an integrated set of processes that can be chosen as needed**
 - **Integration phase must be completed to gain this benefit**
 - **Significant coordination/negotiation needed to drive more industry buy-in**

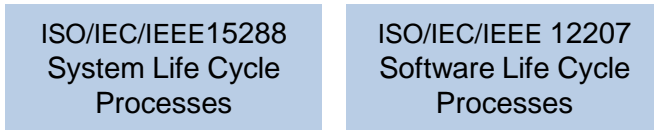
CURRENT ALIGNMENT/INTEGRATION STATUS

Foundation



Legend

Life Cycle Processes

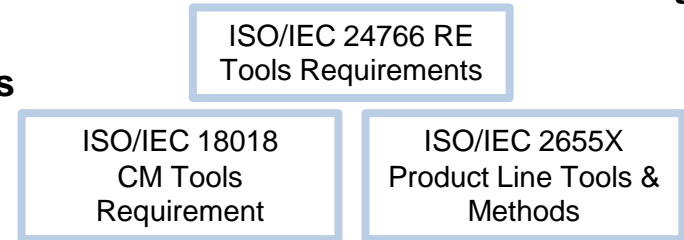


Note: Revision of 15288 and 12207 being planned for harmonization and lessons

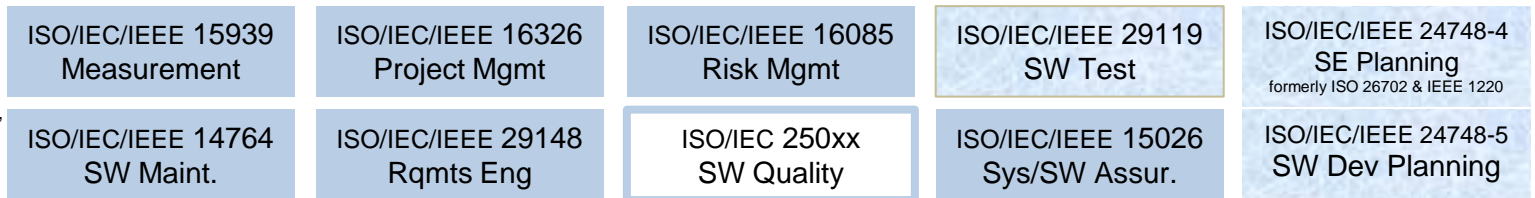
Assessment/Governance



Tools

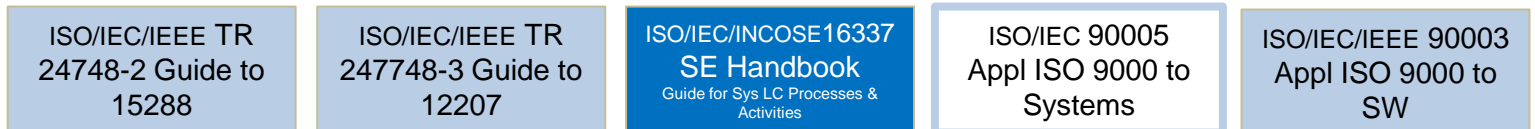


Process Elaborations



Note: Standards for CM, V&V, and System Integration are being studied by ISO, IEC, IEEE and INCOSE

Application Guides



Artifact Descriptions

