Systems and Software Life Cycle Process Standards: Foundation for Integrated Systems and Software Engineering

For: ***NDIA Systems Engineering Conference***

Date: **23 October 2008**

Presented By: **Teresa Doran**

SEI Partner
TECHSOFT
Technical Software Services, Inc.

Overview

- Purpose
- TECHSOFT
- Standards-based Process Improvement Success
- Why Harmonize?
  - Issues
  - Impacts to you
- SE/SW LCP Alignment and Integration
  - Path
  - Concepts
  - Where we are today
  - How we got here – Key changes in 15288 & 12207
- Large Scale Harmonization
- Benefits Summary

Purpose

Show how the key changes in the alignment of a foundational systems/software standards set (ISO/IEC/IEEE 15288 and ISO/IEC/IEEE 12207) facilitates integrated systems and software engineering, project management, and acquisition

Who We Are

- Founded in 1990
- Based in Pensacola, Florida
  - Presence in Charleston, SC
- Primarily, a DoD Contractor
- Experienced Staff
  - High % Masters level personnel
  - Majority with Security Clearances
  - SEI-Authorized CMMI® Lead Appraisers
  - SEI-Authorized CMMI® Instructors
  - International SE/SW Standards Expertise

What We Do

- Systems & Software Development
- Database Applications
- Security / IA
- Web Development
- Network Engineering/Hosting
- Training
- Process Engineering/Process Improvement
  - CMMI®
  - SEI Partner

Standards-based Process Improvement

Example of a Successful Approach

Source: N65236-ENGOPS-BRIEF-0068-1.1, Standardization of Systems Engineering & Project Management Using CMMI, M.T. Kutch, Jr., 17JUL08

Full OPD, But Today's Focus:15288/12207

This SSC has 15288 and 12207-based SE/SWE Technical Processes

SSC-C SE Revitalization Plan Aligned with DoD SE Revitalization

SPAWAR Systems Center Charleston

Elements of SSC-C SE Revitalization

Policy / Guidance
- SSC-C SE Instruction
- SSC-C SE Process Manual
- SSC-C SW-Dev Process Manual
- SSC-C SW-Maint Process Manual
- EPO Website
- ePlan Builder

Training / Education
- Intro to PI WBT
- SE 101 WBT
- SE Fundamentals
- SE for Managers
- Project & Process Workshop
- Intro to Software Engr.
- Architecture Dev. WBT
- Certification/Degrees

Assessment & Support
- CMMI® Level 2
- CMMI® Level 3
- CMMI® Level 4/5
- Project Reviews
- Balanced Scorecard
- Lean Six Sigma
- Integrated Product Teams
- IT Tools

Underway
Completed/Ongoing

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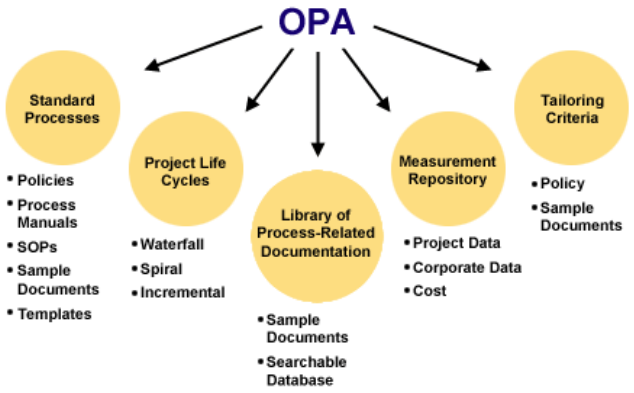
7

Process Asset Library

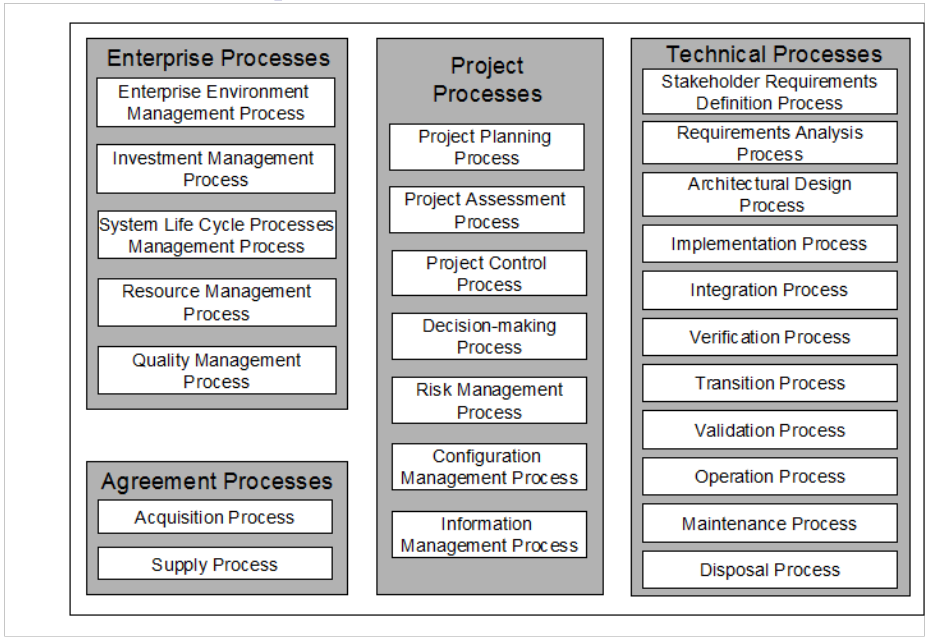
With Extensive OPA Support



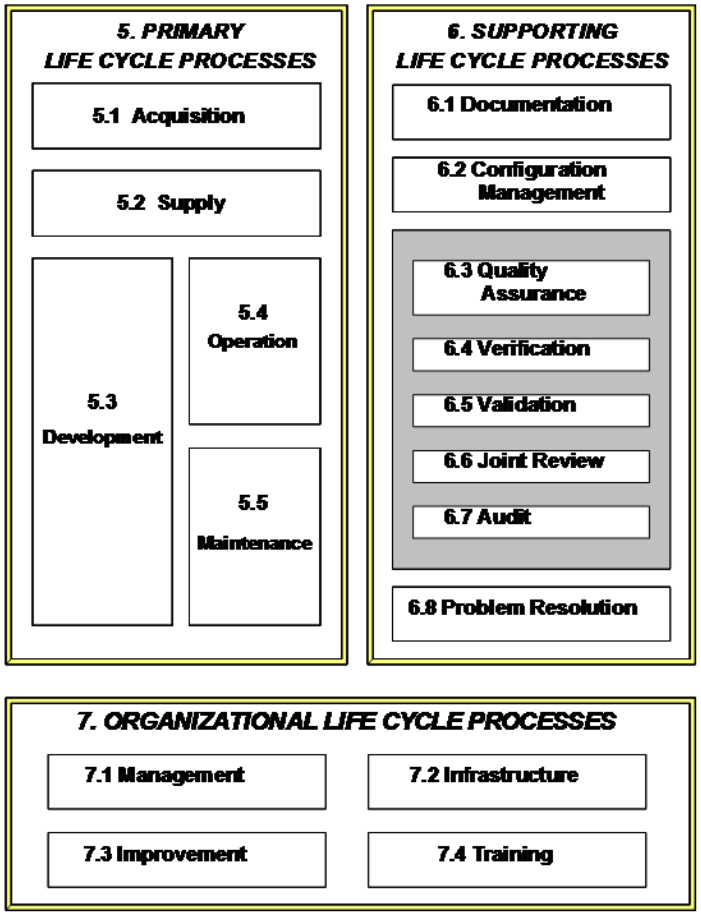
Source: N65236-ENGOPS-BRIEF-0048-1.2, Tools and Resources to Enable Systems Engineering Improvement, M.T. Kutch, Jr. & M. Knox, NOV07

So what's the problem with 15288 and 12207

ISO/IEC 15288:2002



ISO/IEC 12207:1995



Using Them Together!

- Conflicting terms and definitions
- Overlapping, yet distinct processes
- Different process architectures
- Different levels of prescription

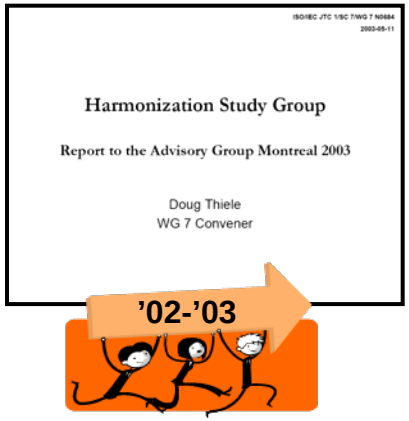
Unintegrated 12207 amendments from 2002 and 2004 are difficult to use and also not adopted by IEEE

Why You Should Care

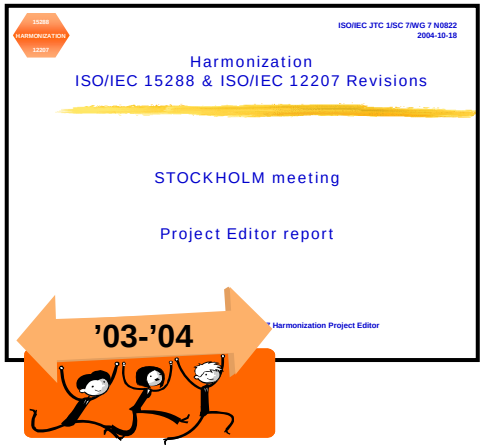
- Leverage the Commonalties
  - Identify and explain the differences
  - Use the interfaces
- Promote Communication and Team Integration
  - Identify strengths, views, and appropriate focused implementations
  - Reduce us/them, finger-pointing, stove-piping
- Improve Resource Performance
  - Personnel, Processes, Tools, Services
- Lower Costs
  - Reduce redundancy and inefficiency

Benefits of Standards Harmonization
Supports Integration, Facilitates Management, Simplifies Acquisition

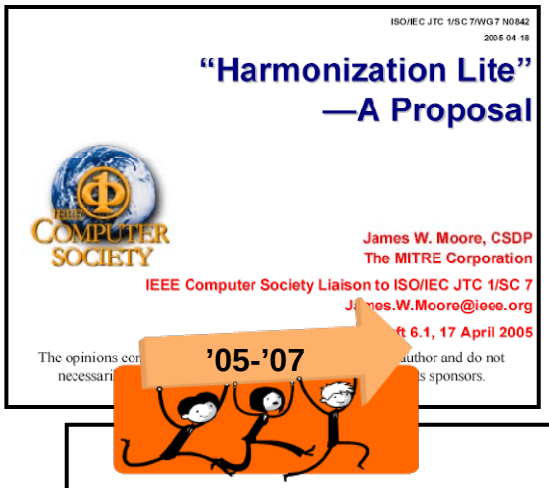
15288-12207 Harmonization Path



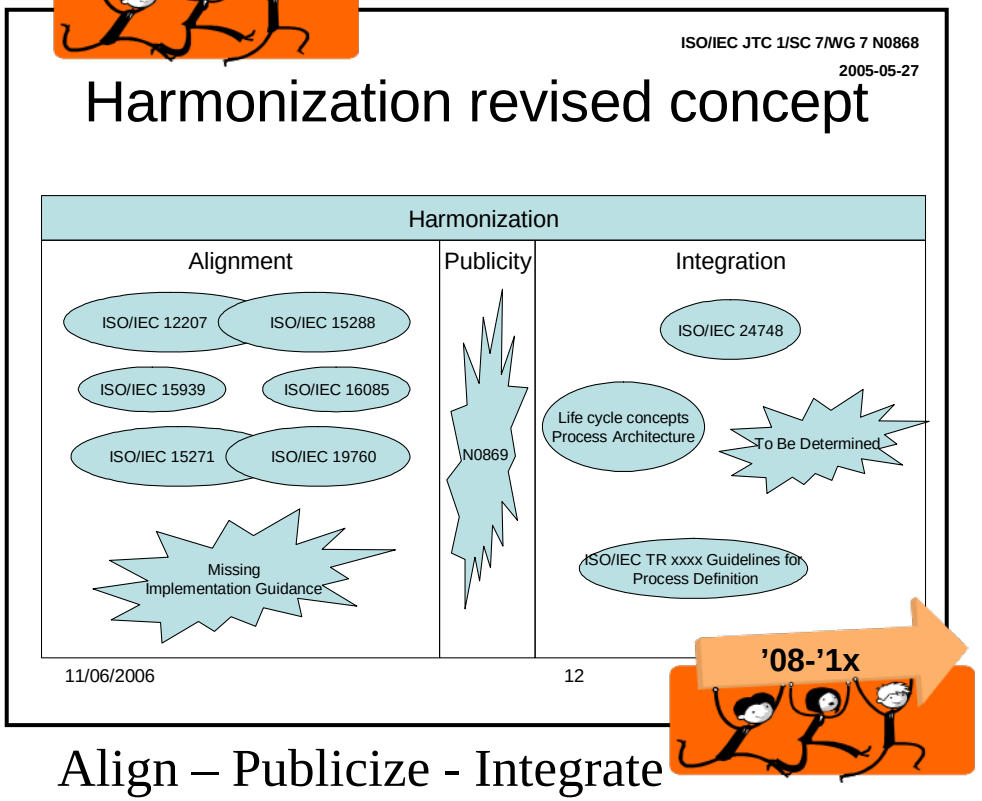
Studies



Implementation hits a snag

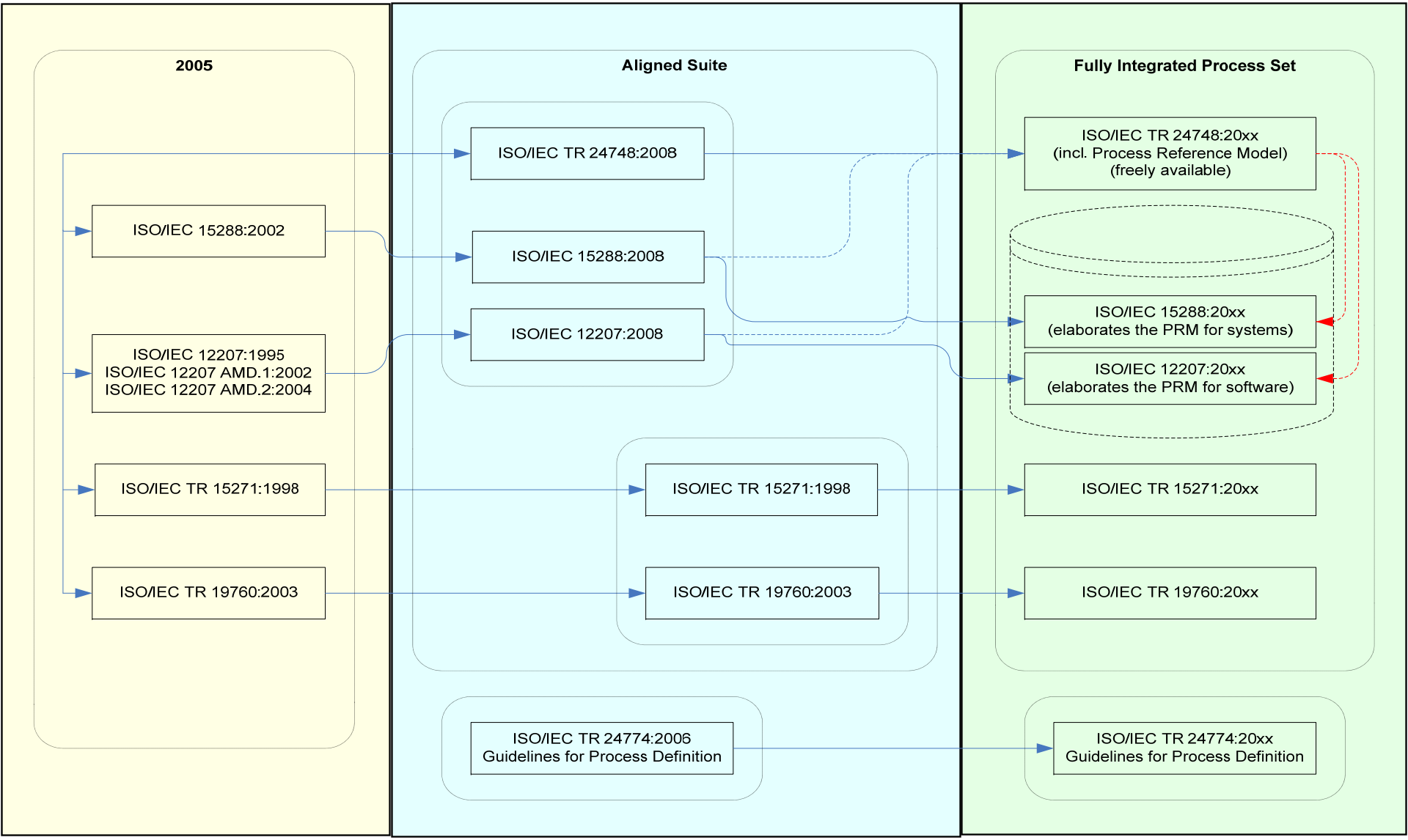


Eat that elephant one bite at a time!



Align – Publicize - Integrate

Concept for the Harmonized Set

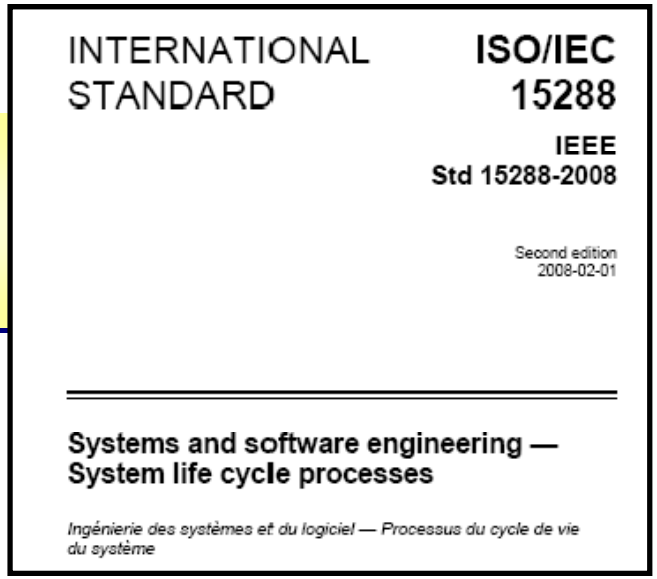


Source: ISO/IEC JTC1/SC7 WG7 N01025 Briefing Material, 24MAY07

Where We Are Today

Nearly identical process models

System Level Processes


INTERNATIONAL STANDARD

ISO/IEC 15288

IEEE Std 15288-2008

Second edition 2008-02-01

Systems and software engineering — System life cycle processes

Ingénierie des systèmes et du logiciel — Processus du cycle de vie du système


INTERNATIONAL STANDARD

ISO/IEC 12207

IEEE Std 12207-2008

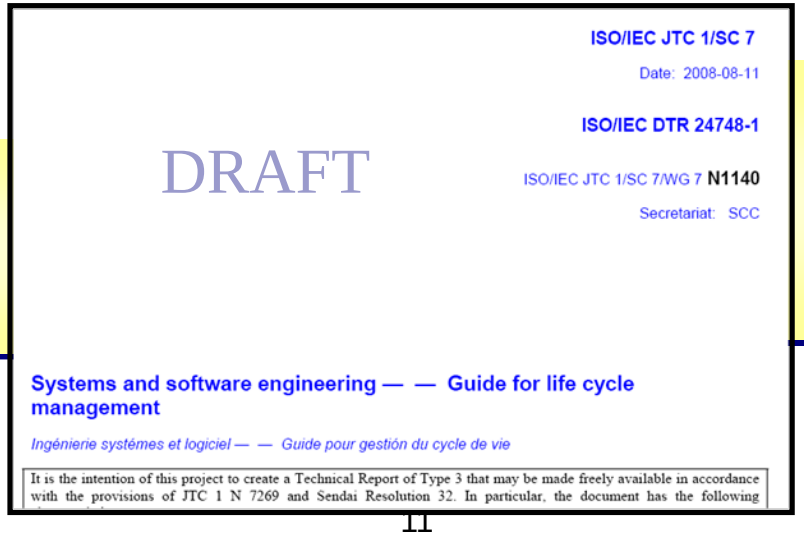
Second edition 2008-02-01

Systems and software engineering — Software life cycle processes

Ingénierie des systèmes et du logiciel — Processus du cycle de vie du logiciel

System Processes Specialized To Software and Software-Specific Processes

Life Cycle Concepts
Process Concepts
LC Models, Stages


ISO/IEC JTC 1/SC 7

Date: 2008-08-11

ISO/IEC DTR 24748-1

DRAFT

ISO/IEC JTC 1/SC 7/WG 7 N1140

Secretariat: SCC

Systems and software engineering — — Guide for life cycle management

Ingénierie systèmes et logiciel — — Guide pour gestión du cycle de vie

It is the intention of this project to create a Technical Report of Type 3 that may be made freely available in accordance with the provisions of JTC 1 N 7269 and Sendai Resolution 32. In particular, the document has the following

LC Adaptation
Domains, Disciplines, & Specialties
Prior Version Transition

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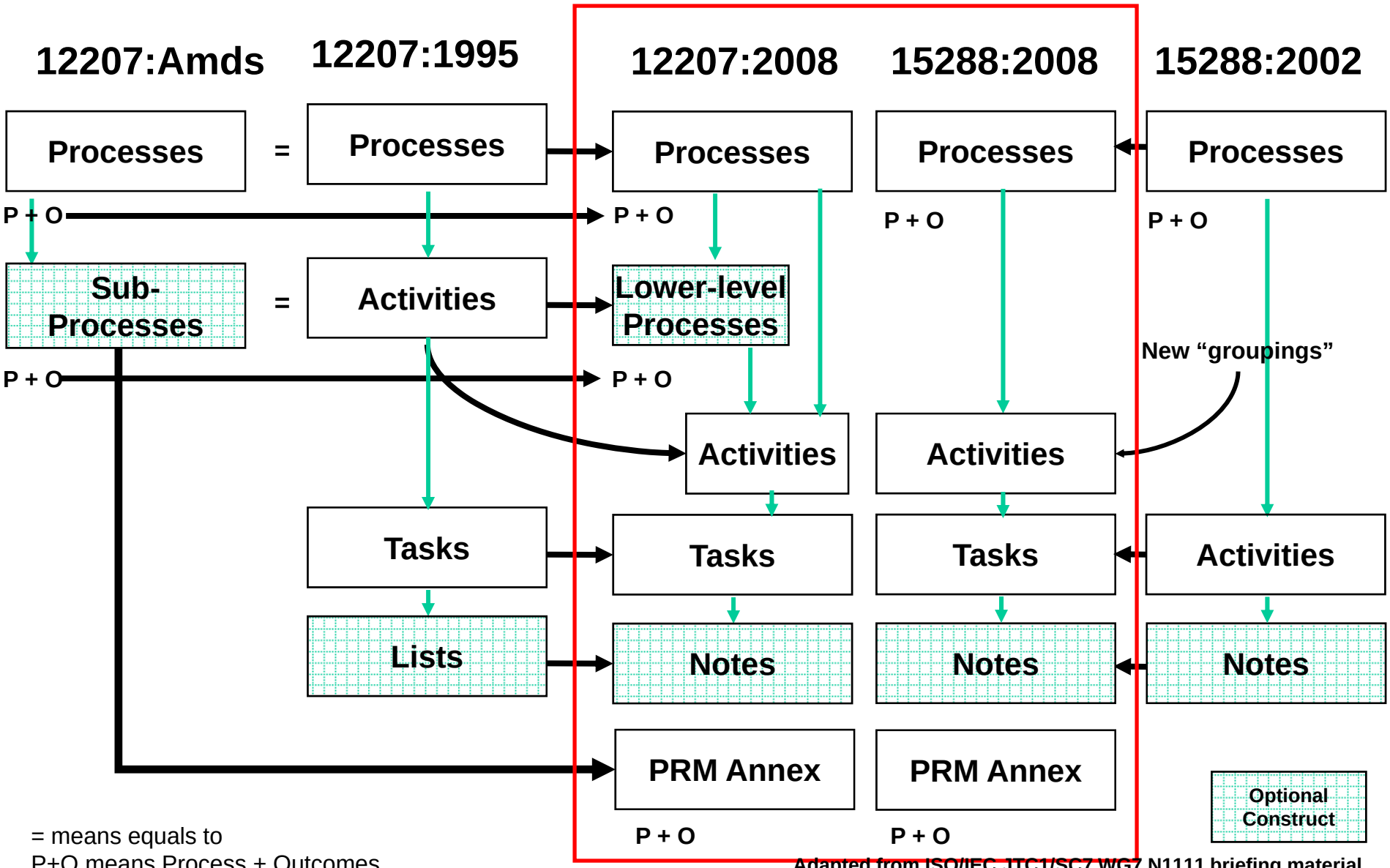
Relations of Process Constructs among ISO/IEC 12207:1995 and its Amendments, 15288:2002, 15288:2008 & 12207:2008



= means equals to
P+O means Process + Outcomes

Adapted from ISO/IEC JTC1/SC7 WG7 N1111 briefing material
Source: Anatol Kark, National Research Council, Canada

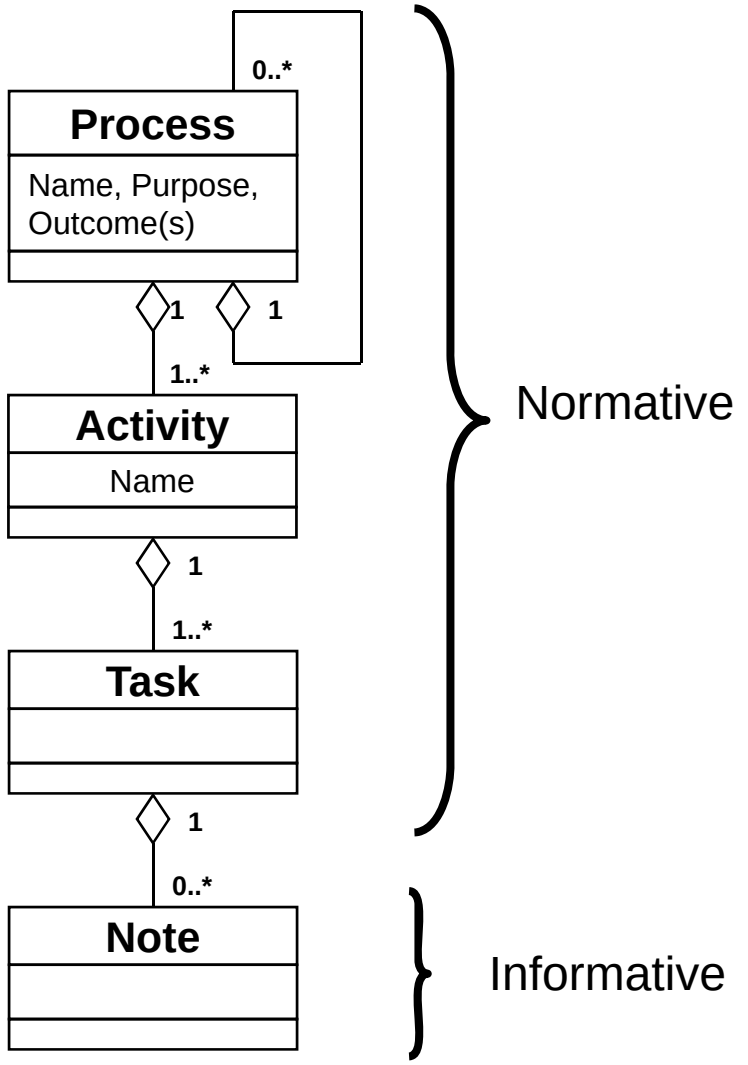
12207/15288:2008 Process Constructs

Processes require a purpose and outcome. All processes have at least one activity. The processes, with their statements of purpose and outcomes, constitute a Process Reference Model (PRM).

Activities are constructs for grouping together related tasks. The activities provide a means to look at related tasks within the process to improve understanding and communication of the process. If an activity is cohesive enough, it can be converted to a (lower level) process by defining a purpose and a set of outcomes.

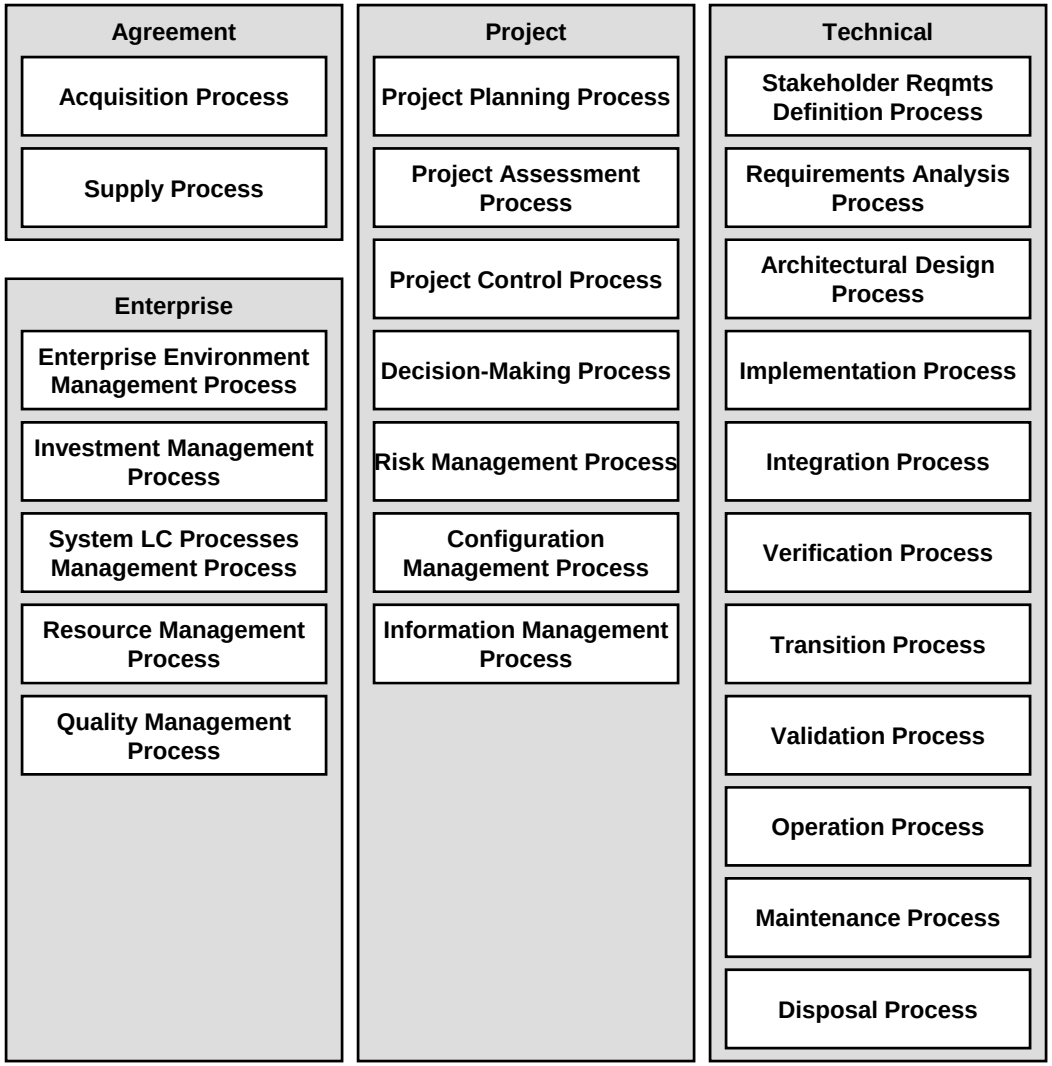
A task is a detailed provision for implementation of a process. It may be a requirement (“shall”), a recommendation (“should”), or a permission (“may”).

Notes are used when there is a need for explanatory information to better describe the intent or mechanics of a process. Notes provide insight regarding potential implementation or areas of applicability such as lists, examples and other considerations.



Adapted from ISO/IEC JTC1/SC7 WG7 N1025 briefing material

The Life Cycle Processes of 15288:2002



Source: WG7 N1111; Adapted by Jim Moore, MITRE Corporation from chart by Anatol Kark, National Research Council, Canada

Building 15288:2008 – Activities and Tasks

Activity-Task allocation is new to 15288:2008

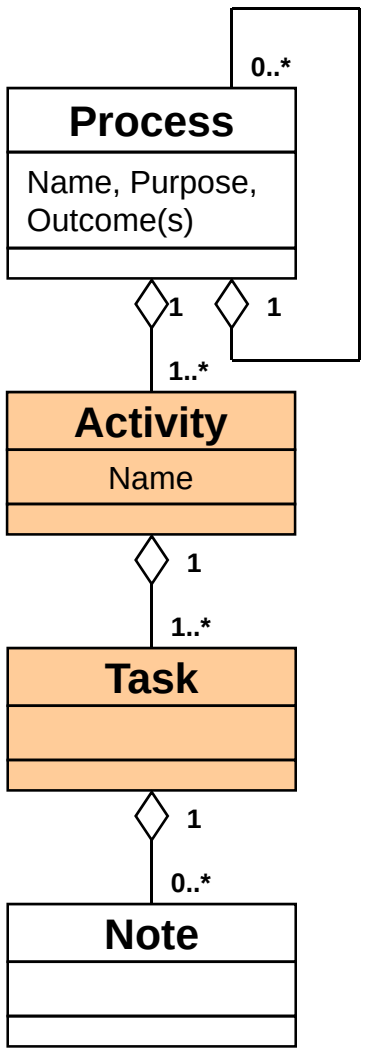
Provides structural alignment with 12207

Agreement
- Acquisition Process
- Supply Process

Enterprise
- Enterprise Environment Management Process
- Investment Management Process
- System LC Processes Management Process
- Resource Management Process
- Quality Management Process

Project
- Project Planning Process
- Project Assessment Process
- Project Control Process
- Decision-Making Process
- Risk Management Process
- Configuration Management Process
- Information Management Process

Technical
- Stakeholder Reqmts Definition Process
- Requirements Analysis Process
- Architectural Design Process
- Implementation Process
- Integration Process
- Verification Process
- Transition Process
- Validation Process
- Operation Process
- Maintenance Process
- Disposal Process



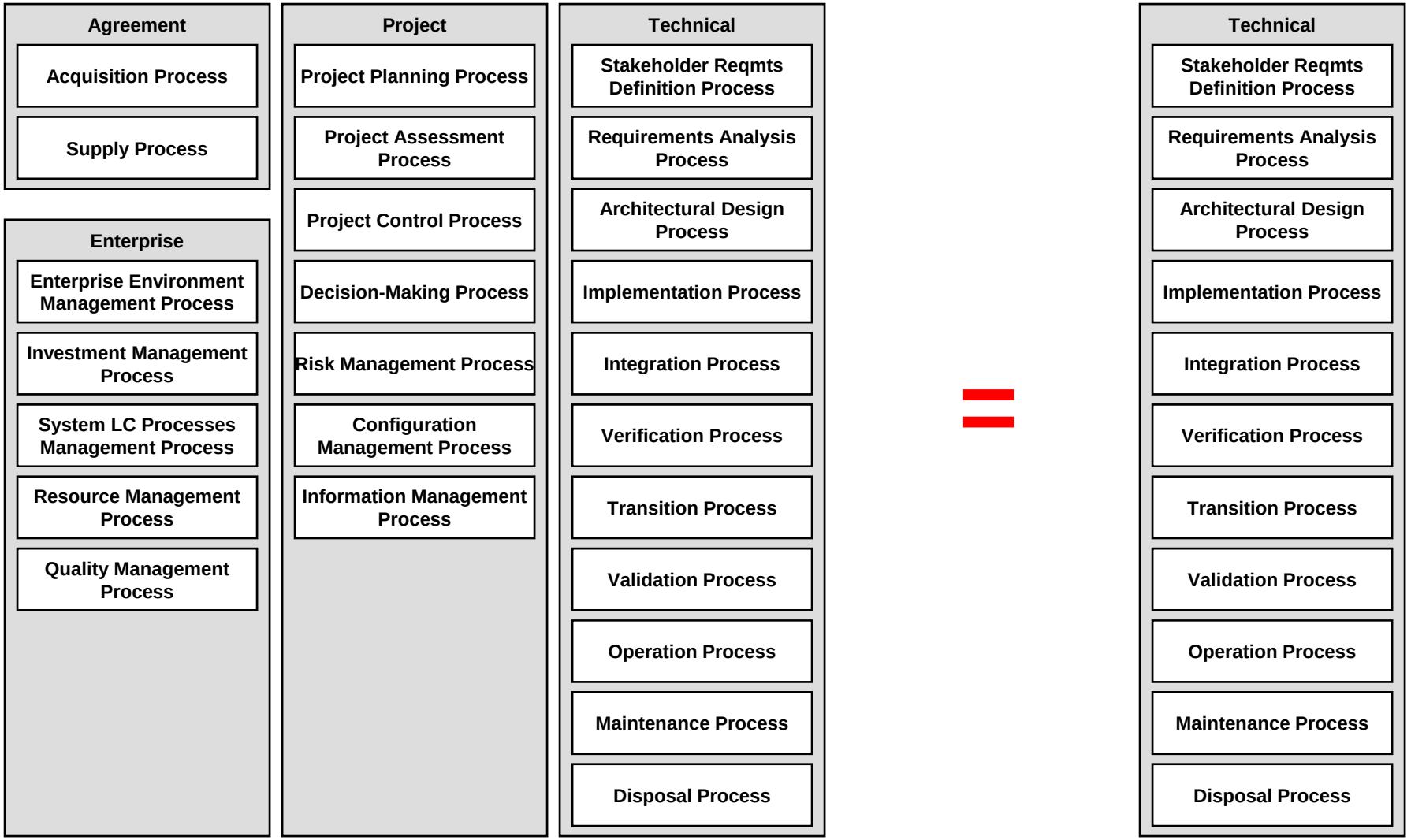
Normative

Informative

Adapted from WG7 N1111; Source: Jim Moore, MITRE Corporation and Anatol Kark, National Research Council, Canada

Building 15288:2008 – Technical Processes

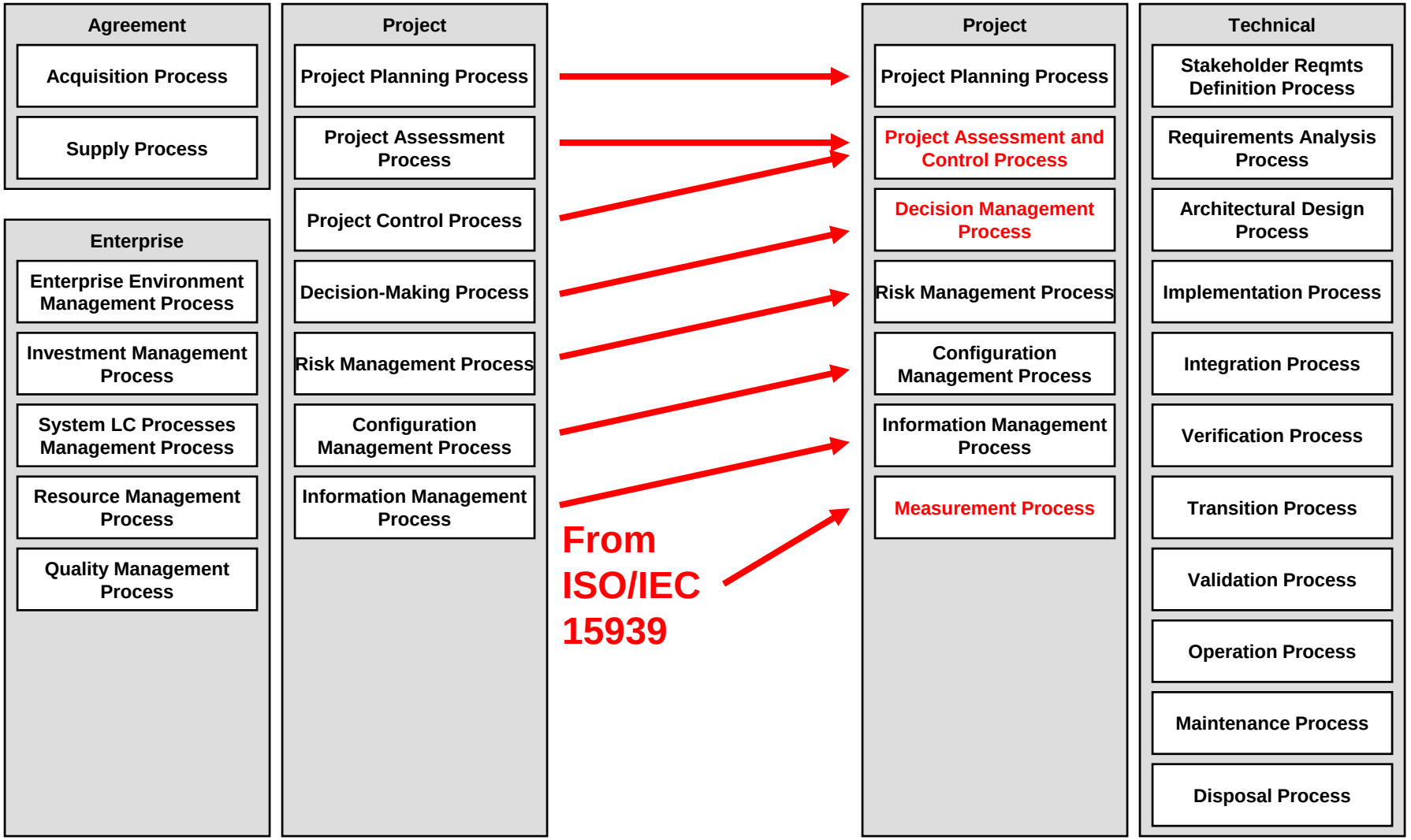
15288:2008 has the same set of technical processes as 15288:2002



Source: WG7 N1111; Adapted by Jim Moore, MITRE Corporation from chart by Anatol Kark, National Research Council, Canada

Building 15288:2008 – Project Processes

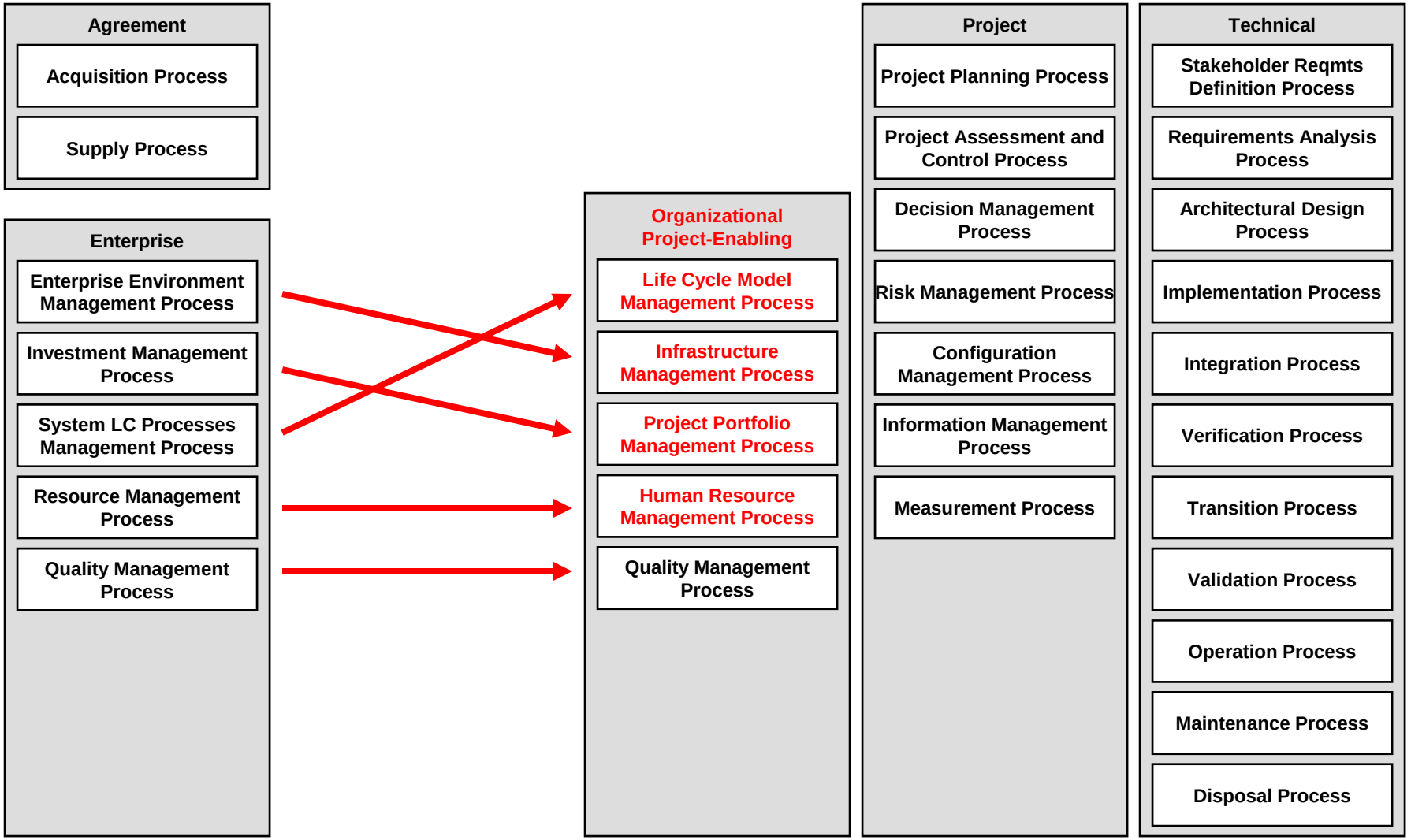
15288:2008 has a similar set of project processes as 15288:2002



Source: WG7 N1111; Adapted by Jim Moore, MITRE Corporation from chart by Anatol Kark, National Research Council, Canada

Building 15288:2008 – Project-Enabling Processes

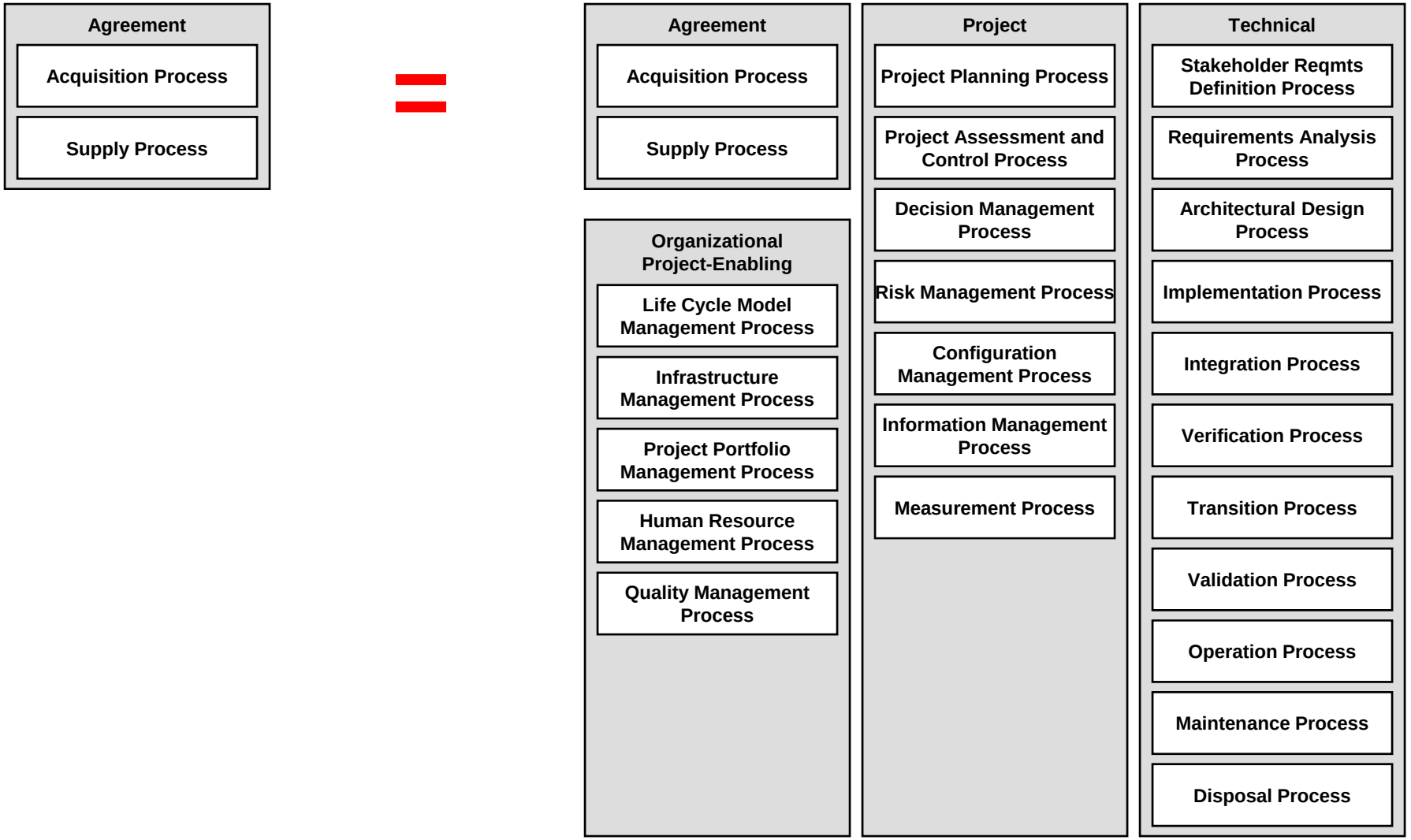
15288:2008 has a similar set of project-enabling processes as 15288:2002



Source: WG7 N1111; Adapted by Jim Moore, MITRE Corporation from chart by Anatol Kark, National Research Council, Canada

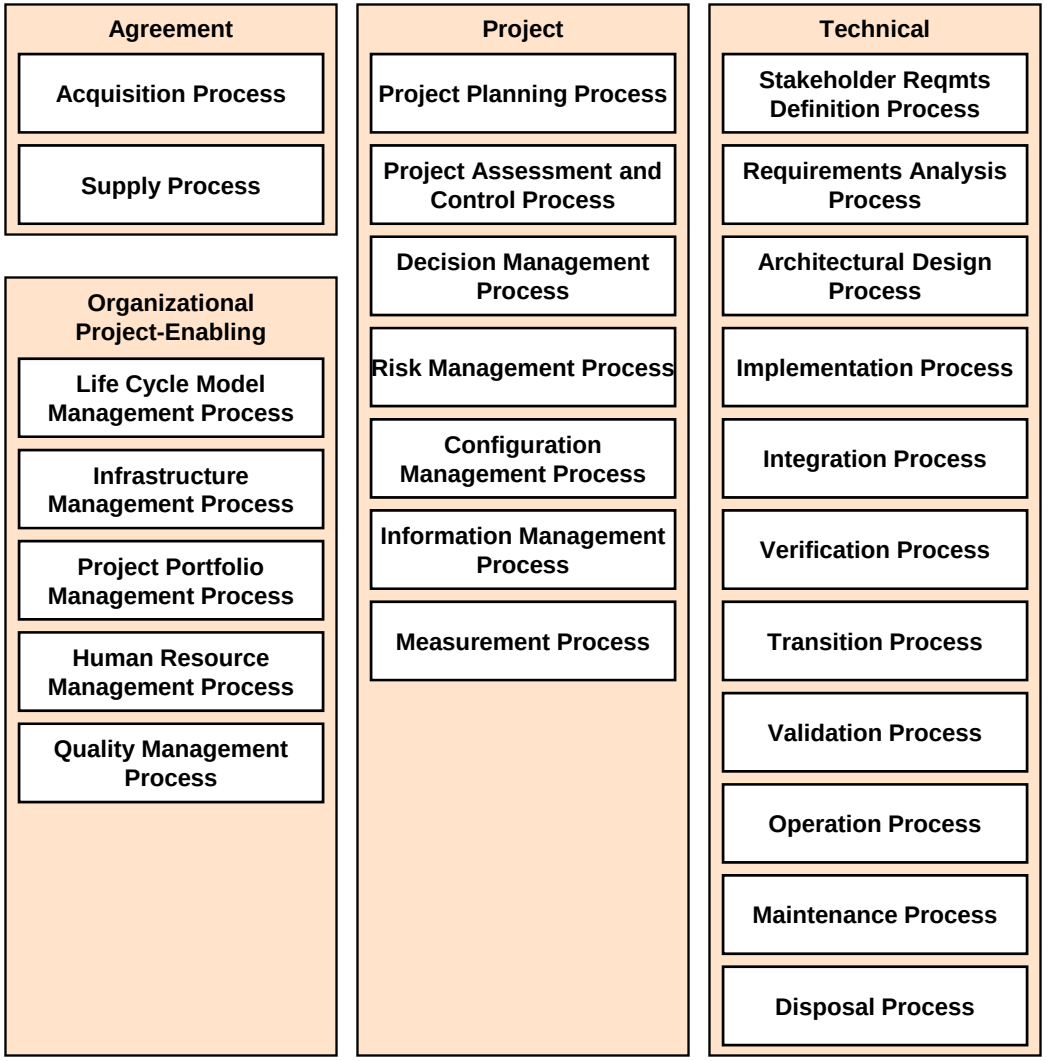
Building 15288:2008 – Agreement Processes

15288:2008 has the same set of agreement processes as 15288:2002



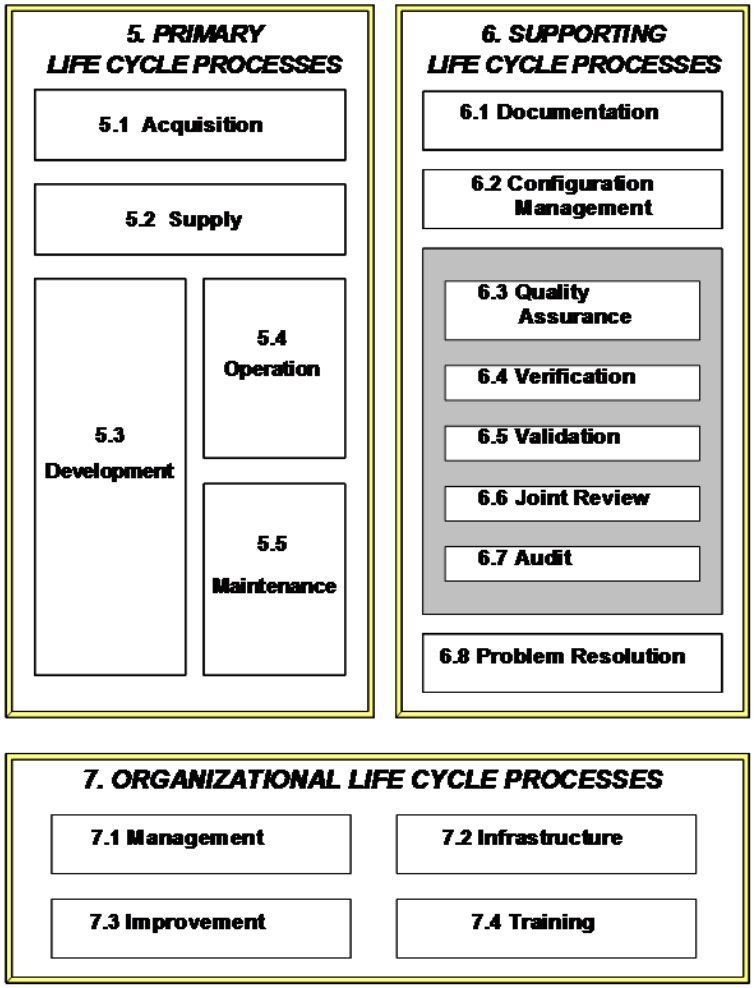
Source: WG7 N1111; Adapted by Jim Moore, MITRE Corporation from chart by Anatol Kark, National Research Council, Canada

The Life Cycle Processes of 15288:2008



Source: WG7 N1111; Adapted by Jim Moore, MITRE Corporation from chart by Anatol Kark, National Research Council, Canada

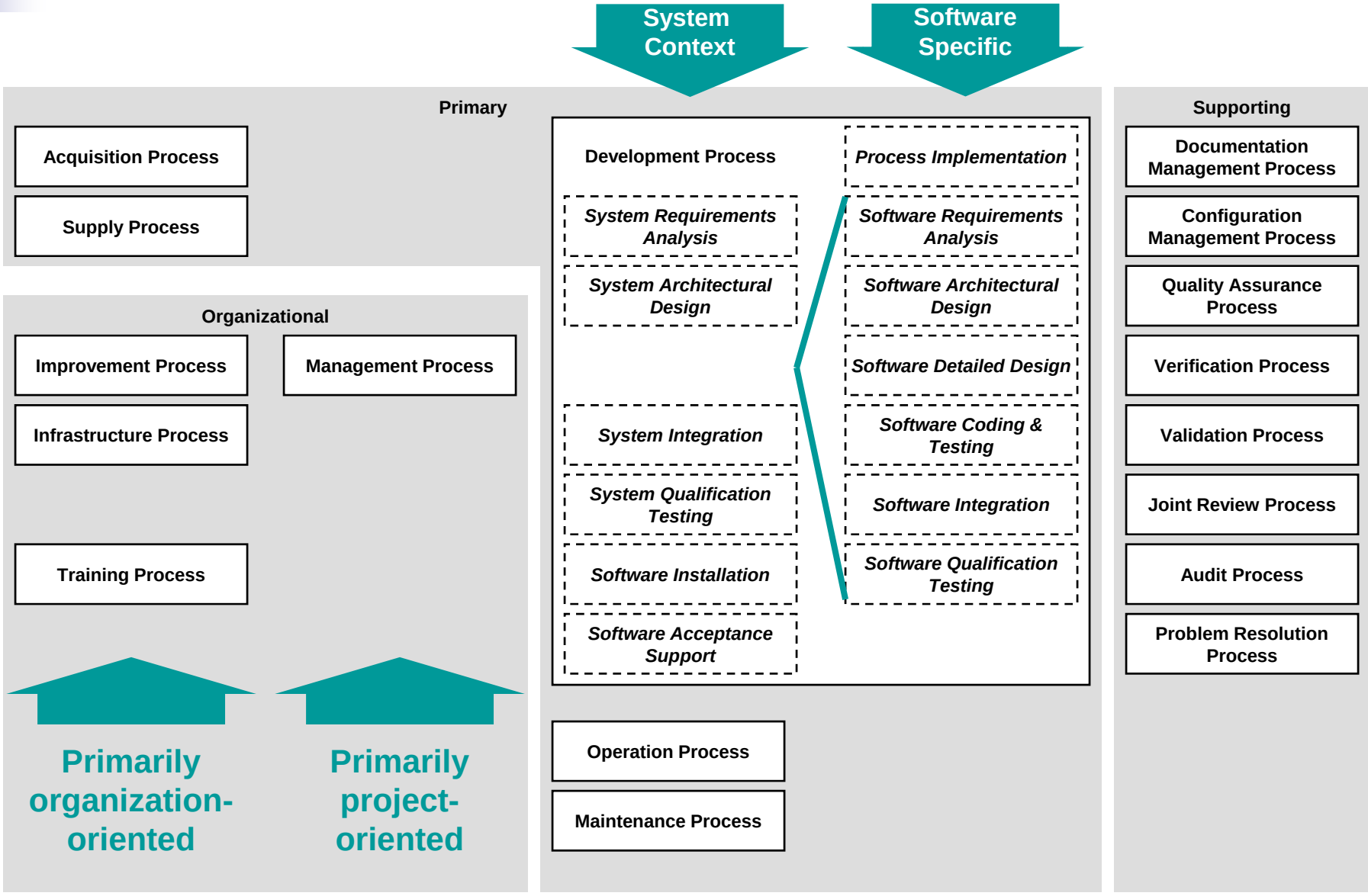
The Life Cycle Processes of 12207:1995



The Familiar 1995 LCP Categories Process Structure and Titles

Adapted from WG7 N1111 briefing material

The Life Cycle Processes of 12207:1995



Adapted from WG7 N1111; Source: Jim Moore, MITRE Corporation

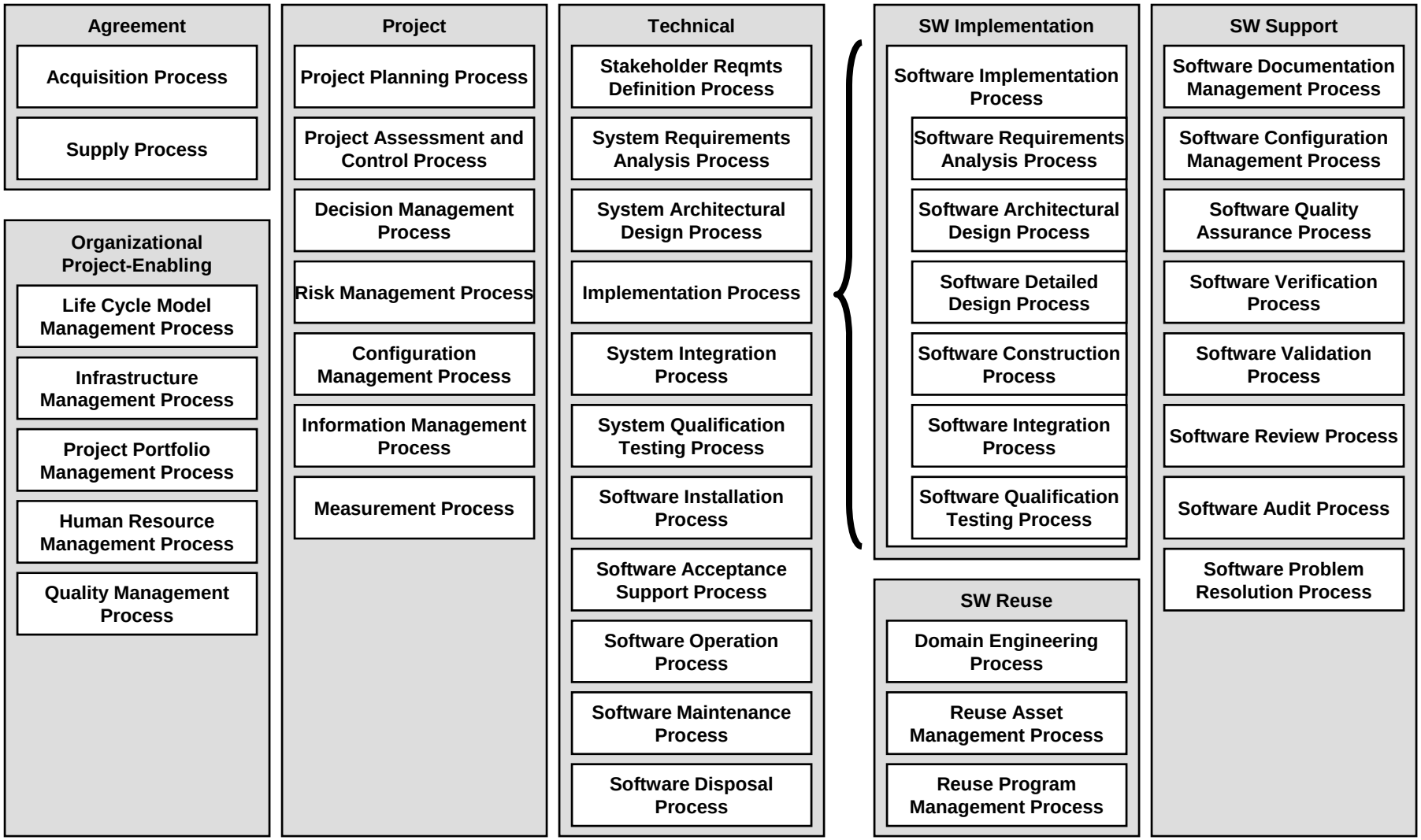
Box with dashed border was an Activity in 1995

12207 Amd.1:2002 and Amd.2:2004

- Defined a Process Reference Model (PRM) for 12207
  - Process Name, Purpose, and Outcomes
- Restructured processes to provide higher granularity
  - Introduced sub-processes (e.g based on Development activities)
  - Improvement, Human Resource, Acquisition, Supply, Development, Operation, Management
- Introduced extensions, elaborations and new processes
  - e.g. to better support process assessment (15504-2), usability(13407), measurement (15939), product evaluation(14598), and reuse/asset management (IEEE 1517)
- Added activities and tasks for 8 new processes
- Made some corrections

Generally aligned and incorporated in body of revised 12207
Several sub-processes allocated as lower-level PRM only processes

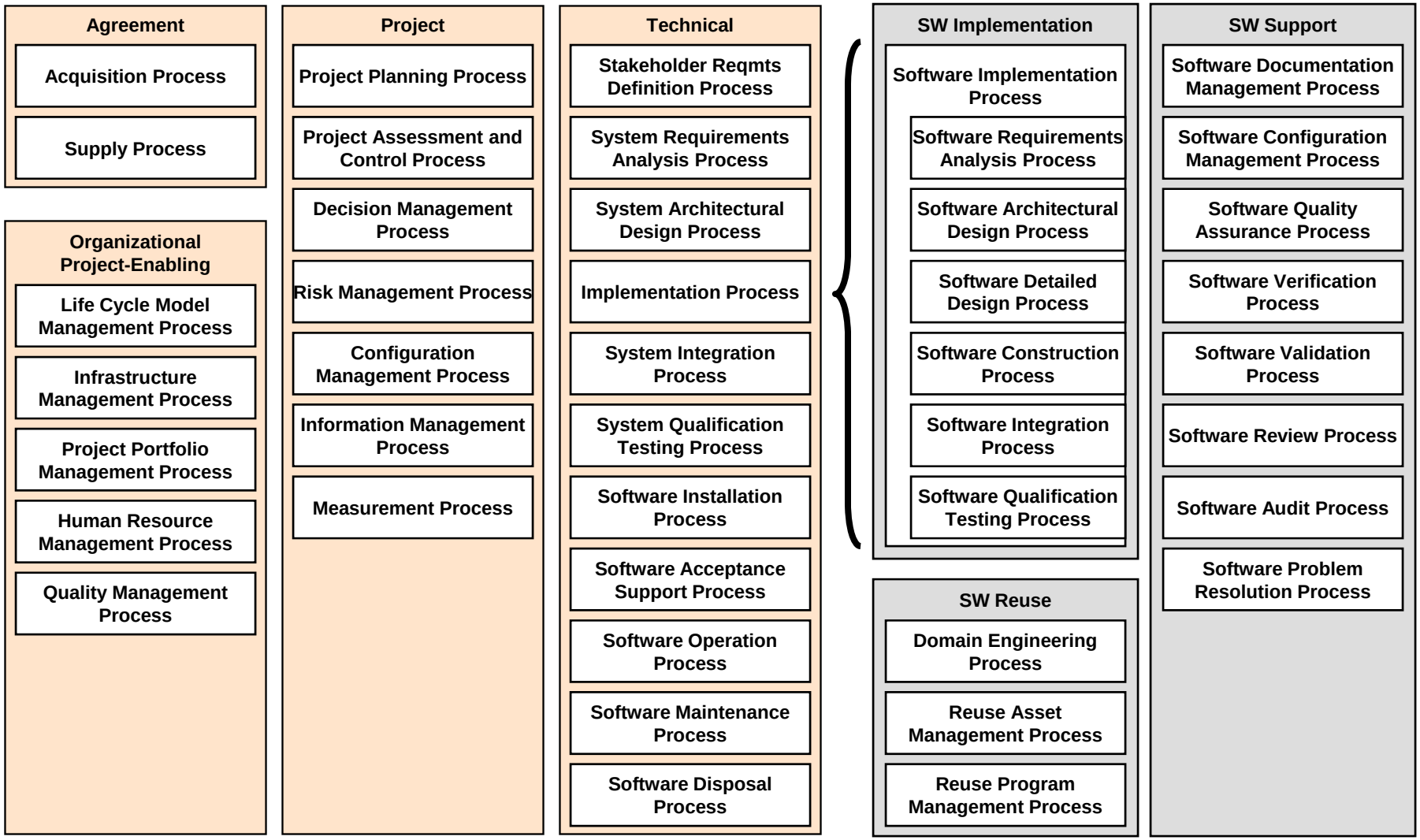
The Life Cycle Processes of 12207:2008



Adapted from WG7 N1111; Source: Jim Moore, MITRE Corporation

Building 12207:2008 – System Context

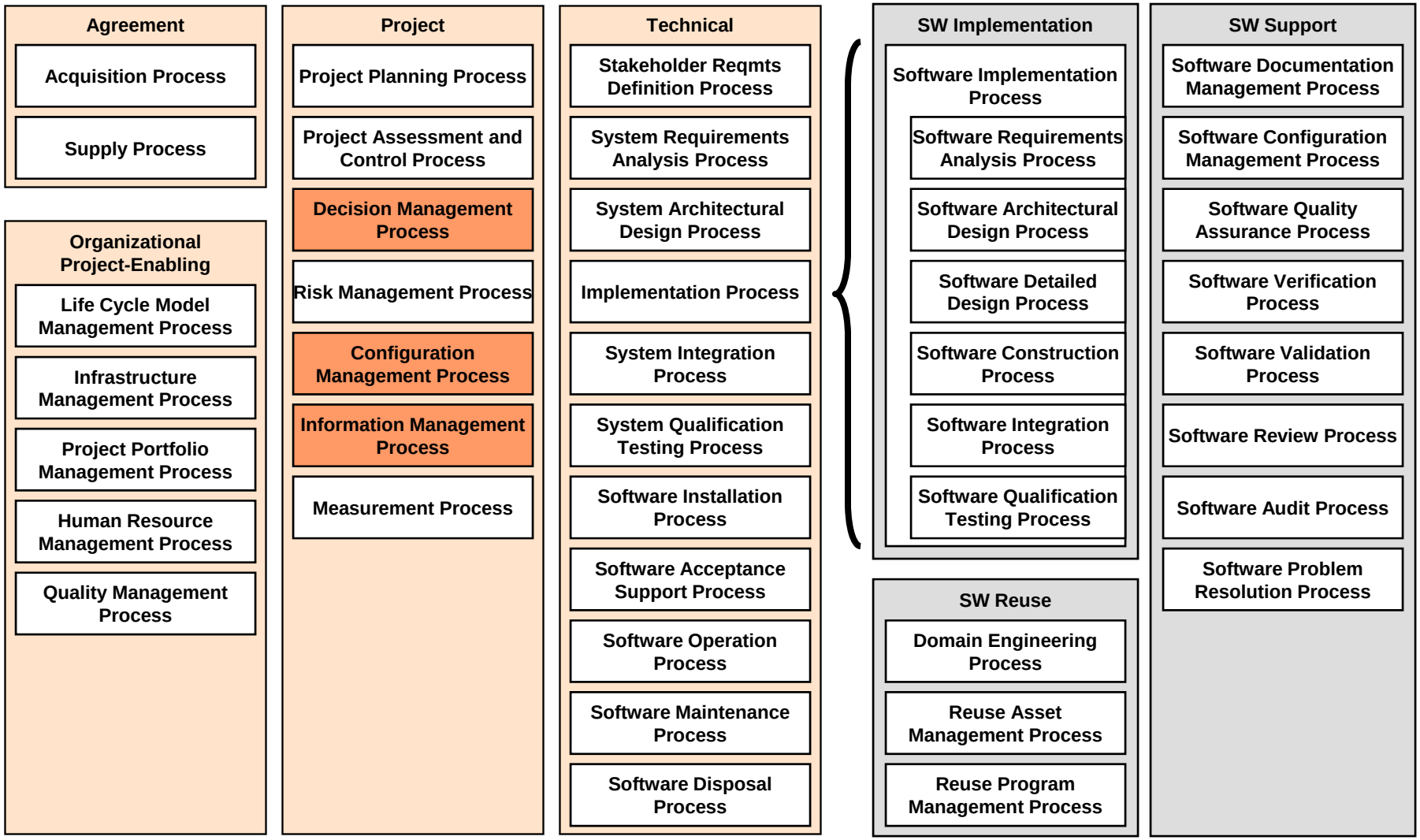
Structural alignment with 15288 system level categories



Adapted from WG7 N1111;

Building 12207:2008 – System Context

System Context Processes based on 15288 Processes

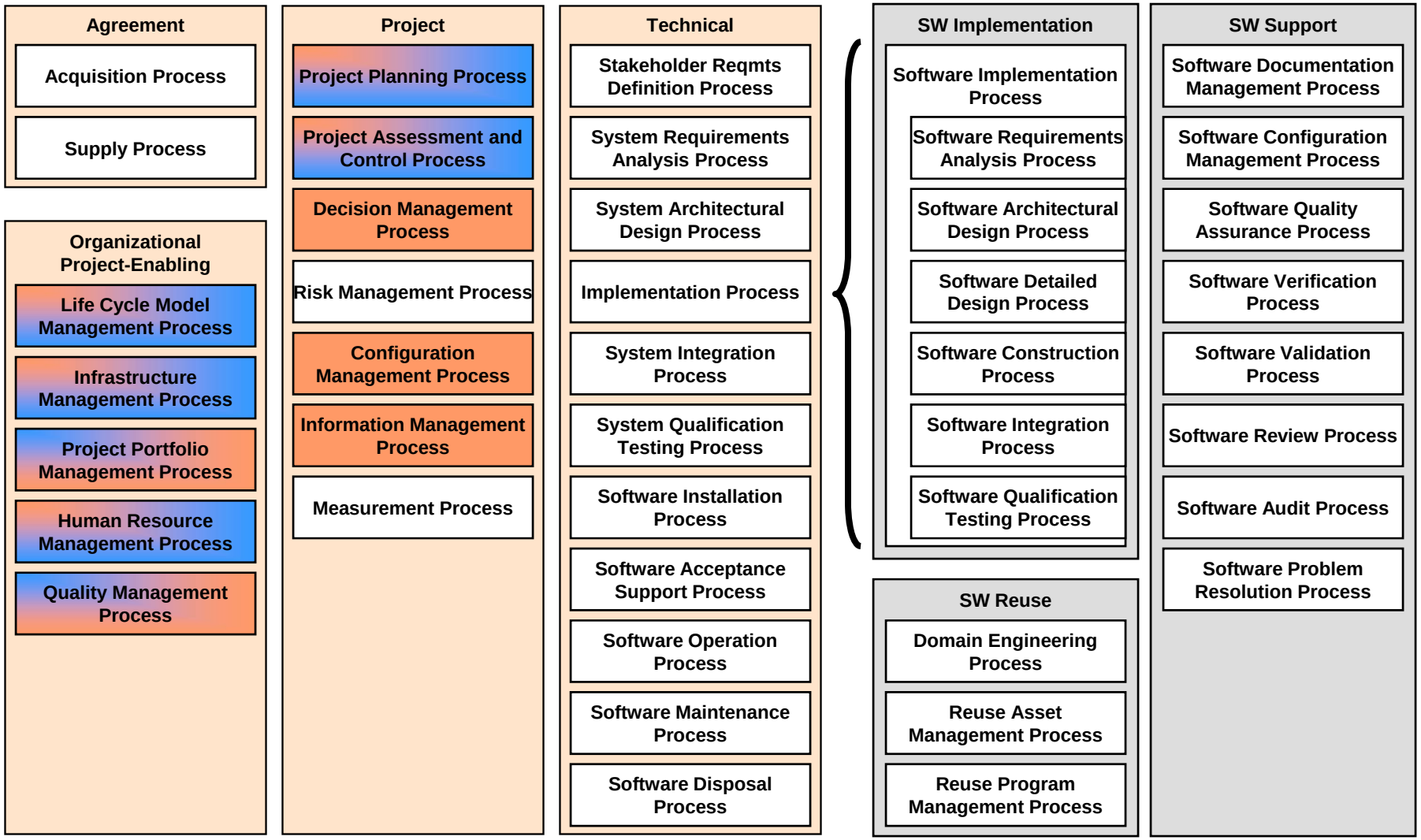


Adapted from WG7 N1111;

Adapted 15288 Outcome/s Activities, Tasks

Building 12207:2008 – System Context

Include 12207 Organizational Processes: Improvement, Infrastructure, Human Resource/Training, Management

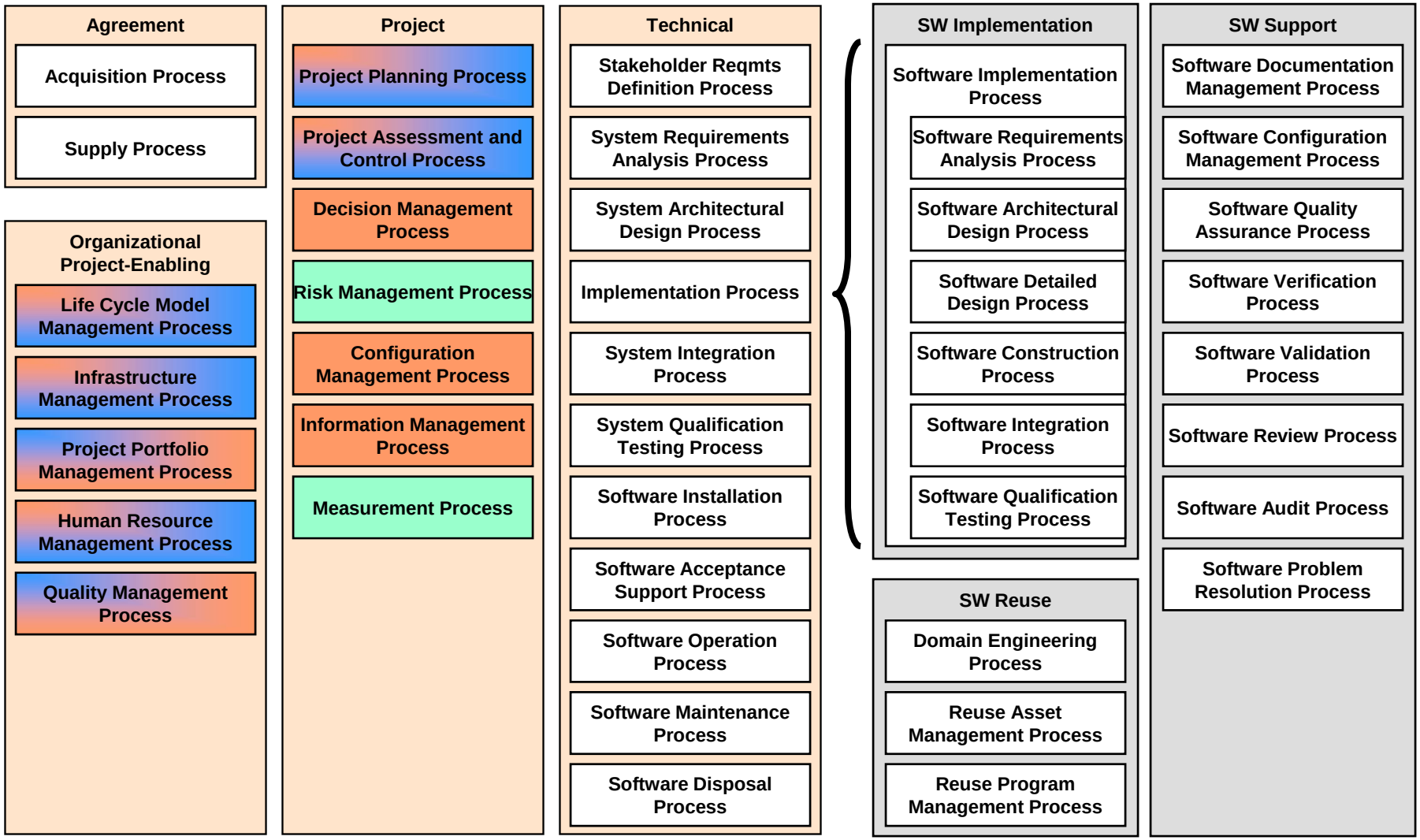


Adapted from WG7 N1111;

Adapted 15288 Outcome/s Activities, Tasks	One or more 12207 Outcomes	Blended 12207 & 15288 Activities and Tasks	One or more 15288 Outcomes	12207-based Outcome/s Activities, Tasks

Building 12207:2008 – System Context

Risk Management from 16085 and Measurement from 15939 are added



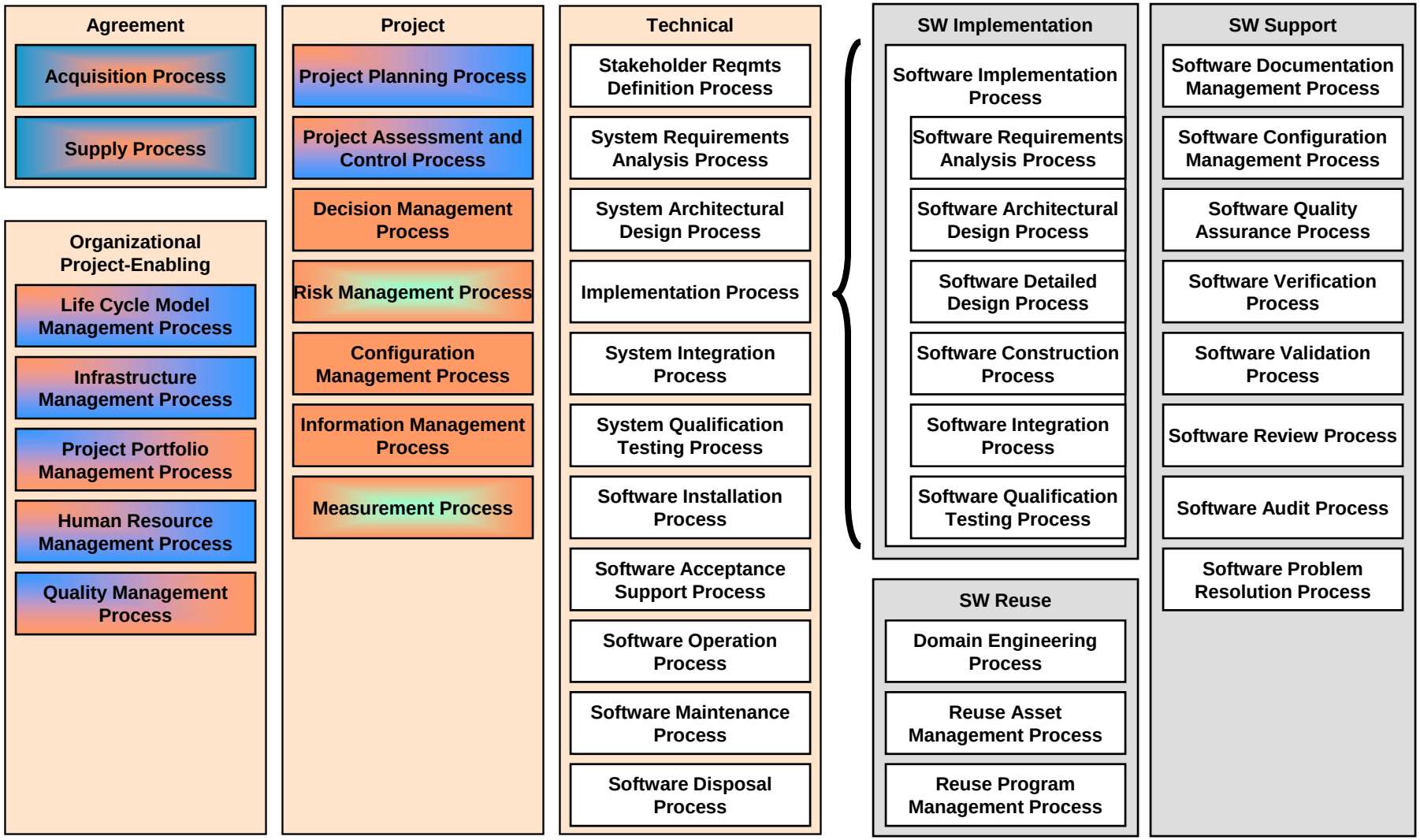
Adapted from WG7 N1111;

Adapted 15288 Outcome/s Activities, Tasks	One or more 12207 Outcomes	Blended 12207 & 15288 Activities and Tasks	One or more 15288 Outcomes	12207-based Outcome/s Activities, Tasks

Building 12207:2008 – System Context

Risk Management and Measurement are now almost identical to 15288

12207 Acquisition and Supply are blended with 15288 Agreement Processes

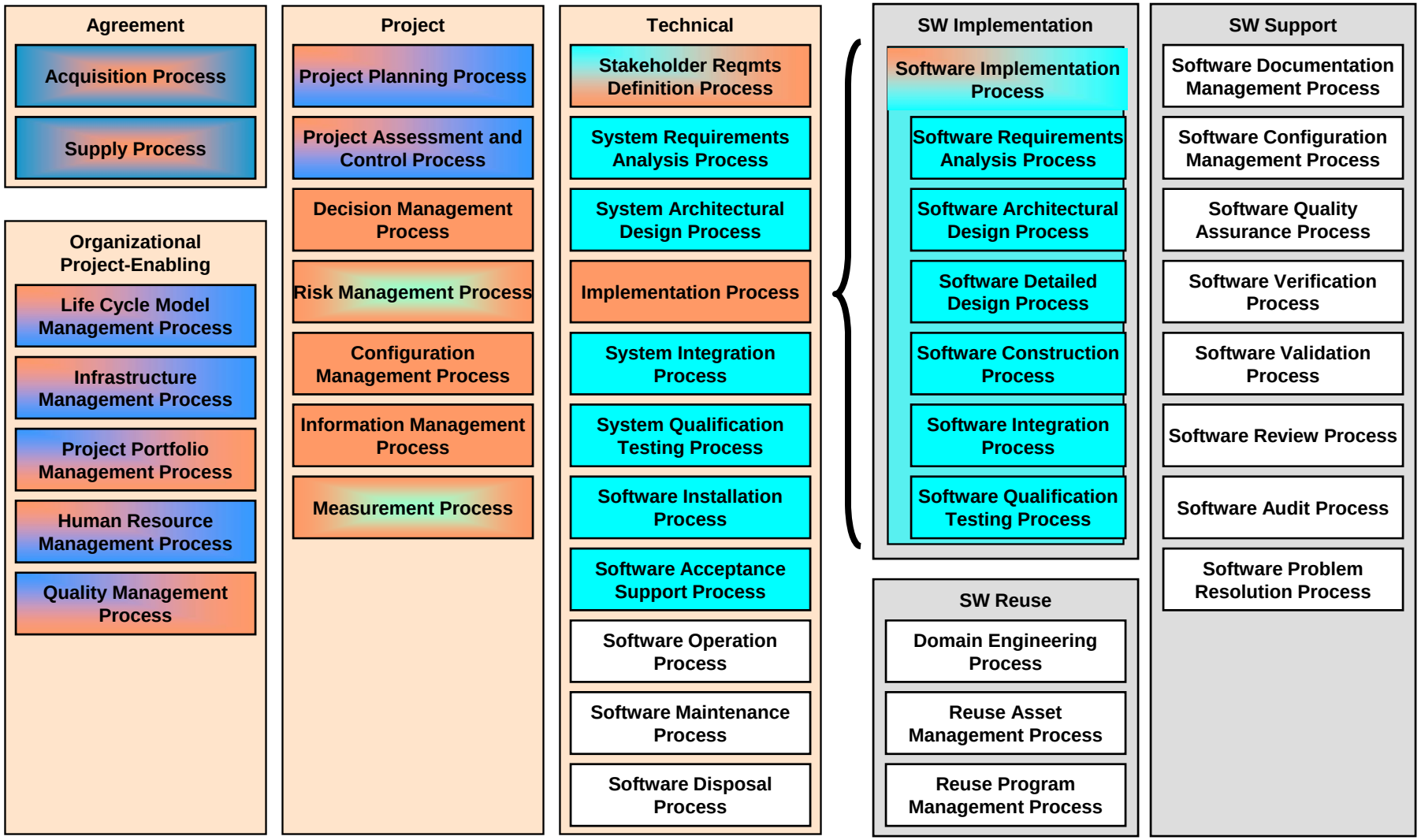


Adapted from WG7 N1111;

Adapted 15288 Outcome/s Activities, Tasks	One or more 12207 Outcomes	Blended 12207 & 15288 Activities and Tasks	One or more 15288 Outcomes	12207-based Outcome/s Activities, Tasks

Building 12207:2008 – System and Software

Development Activities form System Context and Software Specific Processes

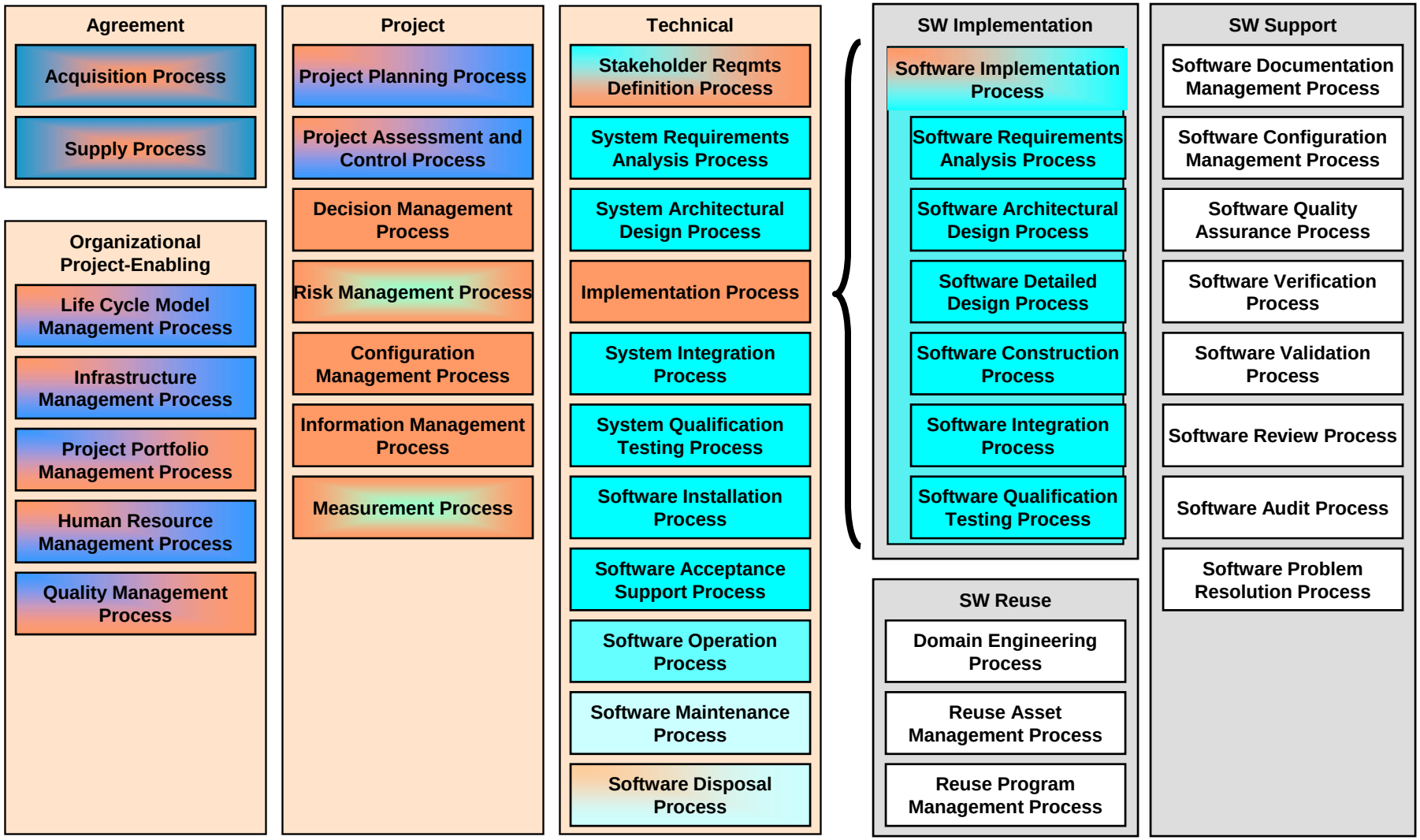


Adapted from WG7 N1111;

Adapted 15288 Outcome/s Activities, Tasks	One or more 12207 Outcomes	Blended 12207 & 15288 Activities and Tasks	One or more 15288 Outcomes	12207-based Outcome/s Activities, Tasks

Building 12207:2008 – System Context

12207 Operation and Maintenance Processes complete the System Context

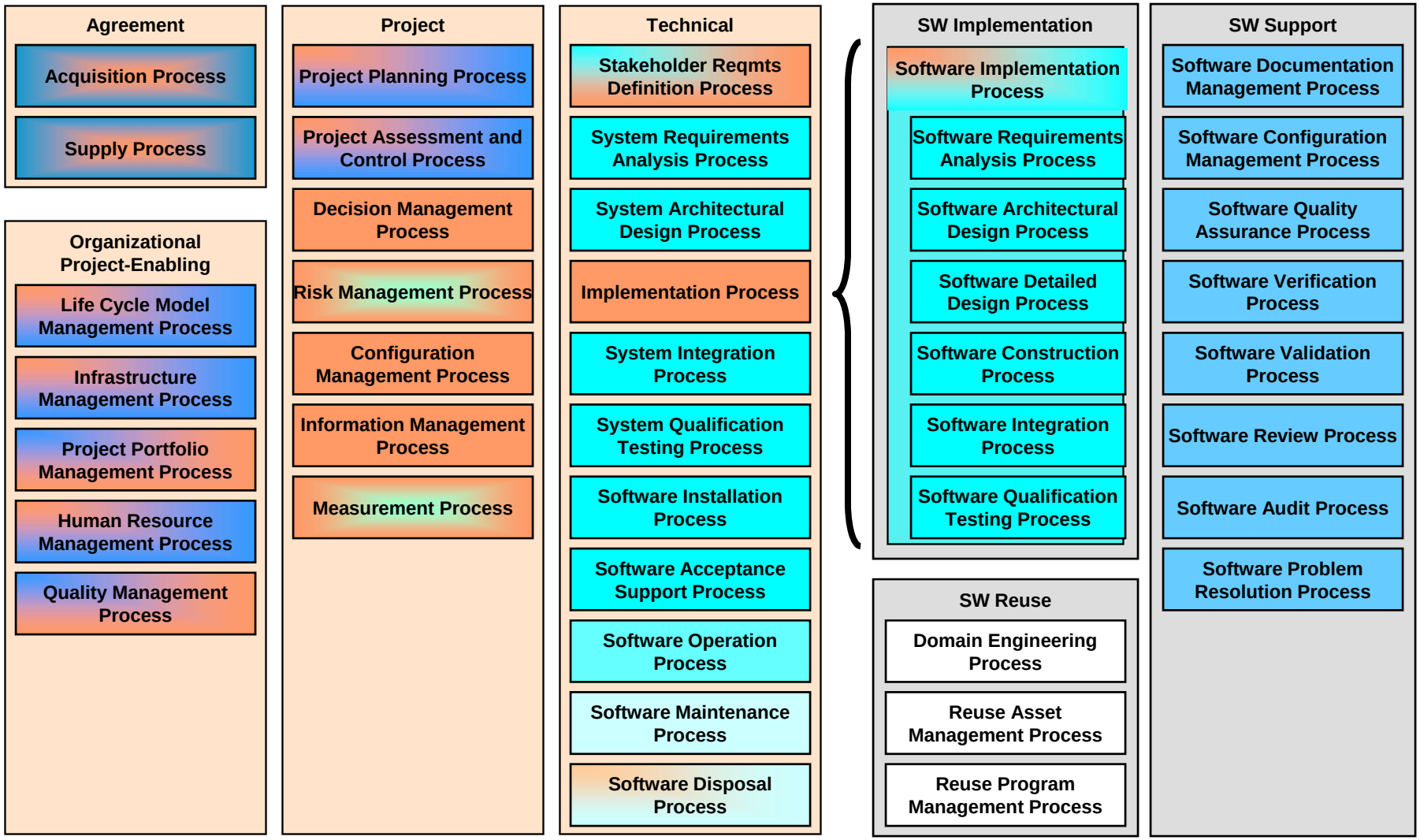


Adapted from WG7 N1111;

Adapted 15288 Outcome/s Activities, Tasks	One or more 12207 Outcomes	Blended 12207 & 15288 Activities and Tasks	One or more 15288 Outcomes	12207-based Outcome/s Activities, Tasks

Building 12207:2008 – Software Specific

Software Specific Support almost the same as 12207 Supporting Processes

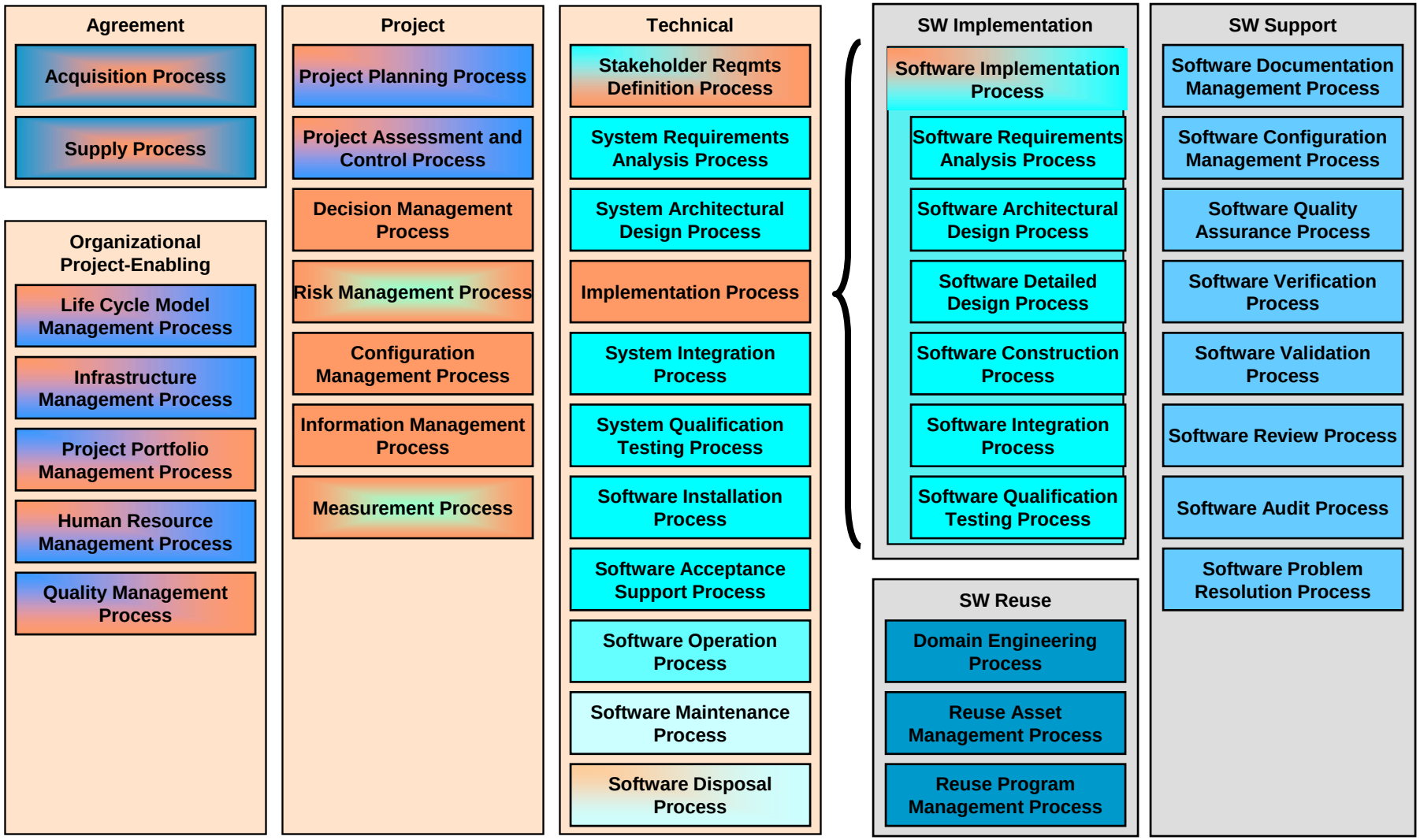


Adapted from WG7 N1111;

Adapted 15288 Outcome/s Activities, Tasks	One or more 12207 Outcomes	Blended 12207 & 15288 Activities and Tasks	One or more 15288 Outcomes	12207-based Outcome/s Activities, Tasks

Building 12207:2008 – Software Specific

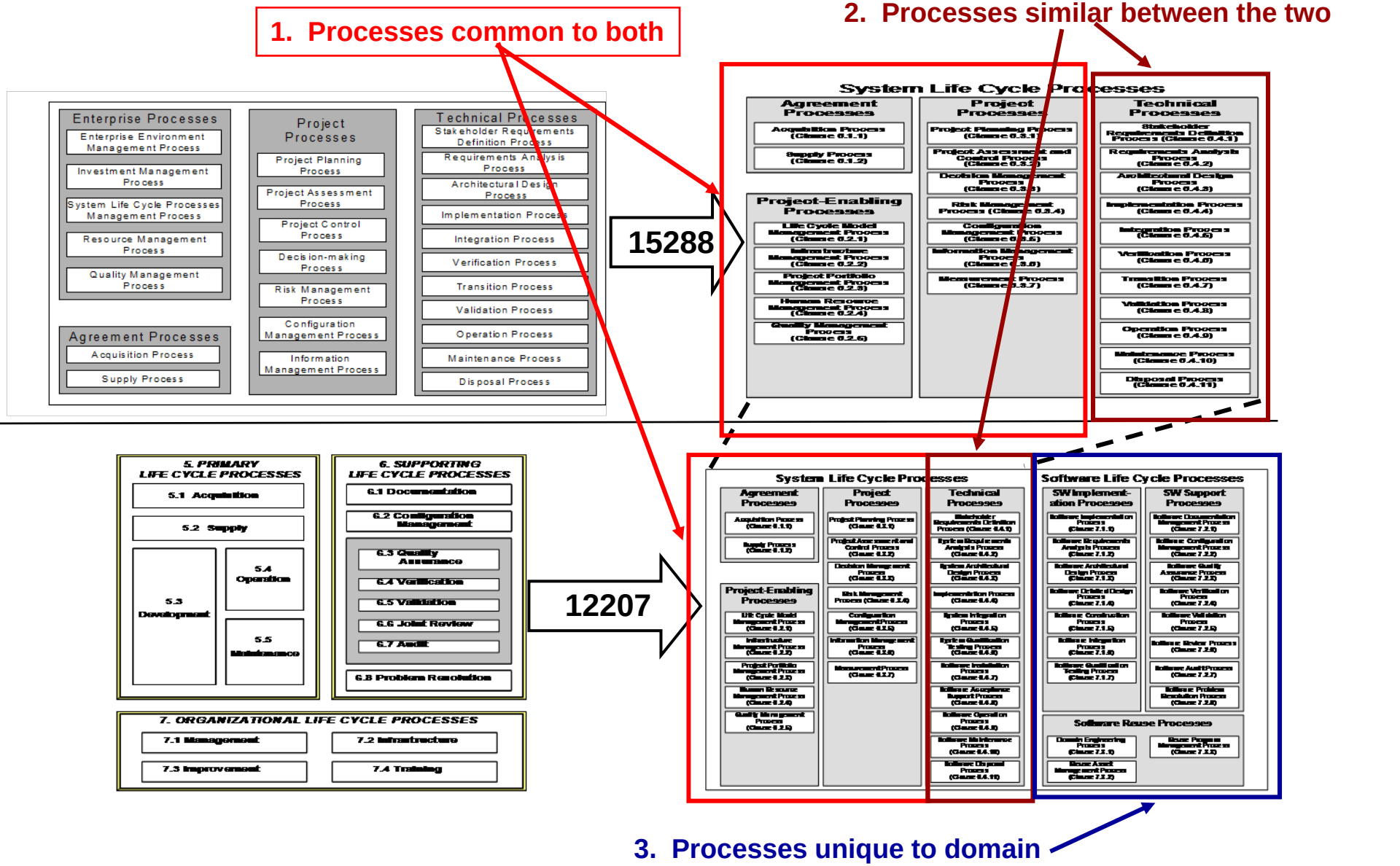
12207 Organizational Processes for Reuse conclude the Software Specific set



Adapted from WG7 N1111;

Adapted 15288 Outcome/s Activities, Tasks	One or more 12207 Outcomes	Blended 12207 & 15288 Activities and Tasks	One or more 15288 Outcomes	12207-based Outcome/s Activities, Tasks

Another Way of Looking at It



Source: WG7 N1103 Strategy for Integration Study Group Final Report, 22APR08, slide by Richard Kitterman, Northrop Grumman

Revised Content (Viewed from 12207)

Revised Standards

- Front Matter
1. Scope
2. Conformance
3. Normative References
4. Terms and Definitions
5. Application of this International Standard
6. System Life Cycle Processes
7. *Software Life Cycle Processes {Italicized indicates 12207 Only}*

The 12207 Annexes (12207 and 15288 differ somewhat in format and content here)

A. Tailoring (Normative)

B. Process Reference Model (Normative)
   - 15504-2 Conformance, *PRM Lower Level Processes for Acquisition, Supply, Life Cycle Model Management, Human Resource Management, and Software Operation*

C. History and Rationale (Informative)
   - *History*, Process Integration/Constructs and Usage, *Relationships, Process Definition Sources*

D. Process Alignment of 12207-15288 {Clause 6} (Informative)

E. Process Views (Informative)
   - Concepts, and *Process View for Usability Example*

F. Some Example Process Descriptions (Informative)

G. Relationship to other IEEE standards (Informative)

H. Bibliography (Informative)

I. List of {IEEE} participants (Informative)

Aligned 15288 and 12207 Set Provides

- Coordinated Terms and Definitions
- Integrated Process Structure
- Coordinated Process Sets
  - Backward compatible
  - Usable stand alone or jointly by systems and software teams
  - System Context processes are nearly identical or the 12207 processes provide software-appropriate specializations of, or contribute to the outcomes of, the corresponding15288 processes
  - Especially on Agreement and Project Processes
- Common Conformance/Tailoring
- Common Life Cycle Model and Stage Concepts
- Free Guidance (Annexes and Plan for TR 24748-1)

Easier Joint Use – Improved Efficiency – Reduced Costs
Common Acquisition, Supply and Management Views

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Towards Full LCP Integration

- WG7 Study Group on Harmonization Integration Strategy Report
  - SC7 Life Cycle Process Harmonization Advisory Group (LCPHAG)
    - Work with SWG5 across SC7 and externally for analyses and recommendations
    - Model SC7's current LCPs and supporting standards
    - Study Process Repository and Electronic Publishing Concepts
  - Rigorous review of SC7 Vocabulary (WG22)
  - Start revision to 15289 (Documentation) to reflect aligned set.

- Some 15288-12207 Integration Considerations:
  - Common purpose and outcomes
  - Architecture of the standards
  - Level of prescription of activities and tasks
  - Life cycle treatments
  - Application to services and operations
  - Common verification and validation concepts
  - Common configuration management concepts
  - Alignment with other applicable standards
  - Rationalization of application guides

Source: WG 7 N1103 – Strategy for Integration Study Group Final Report, 22APR08

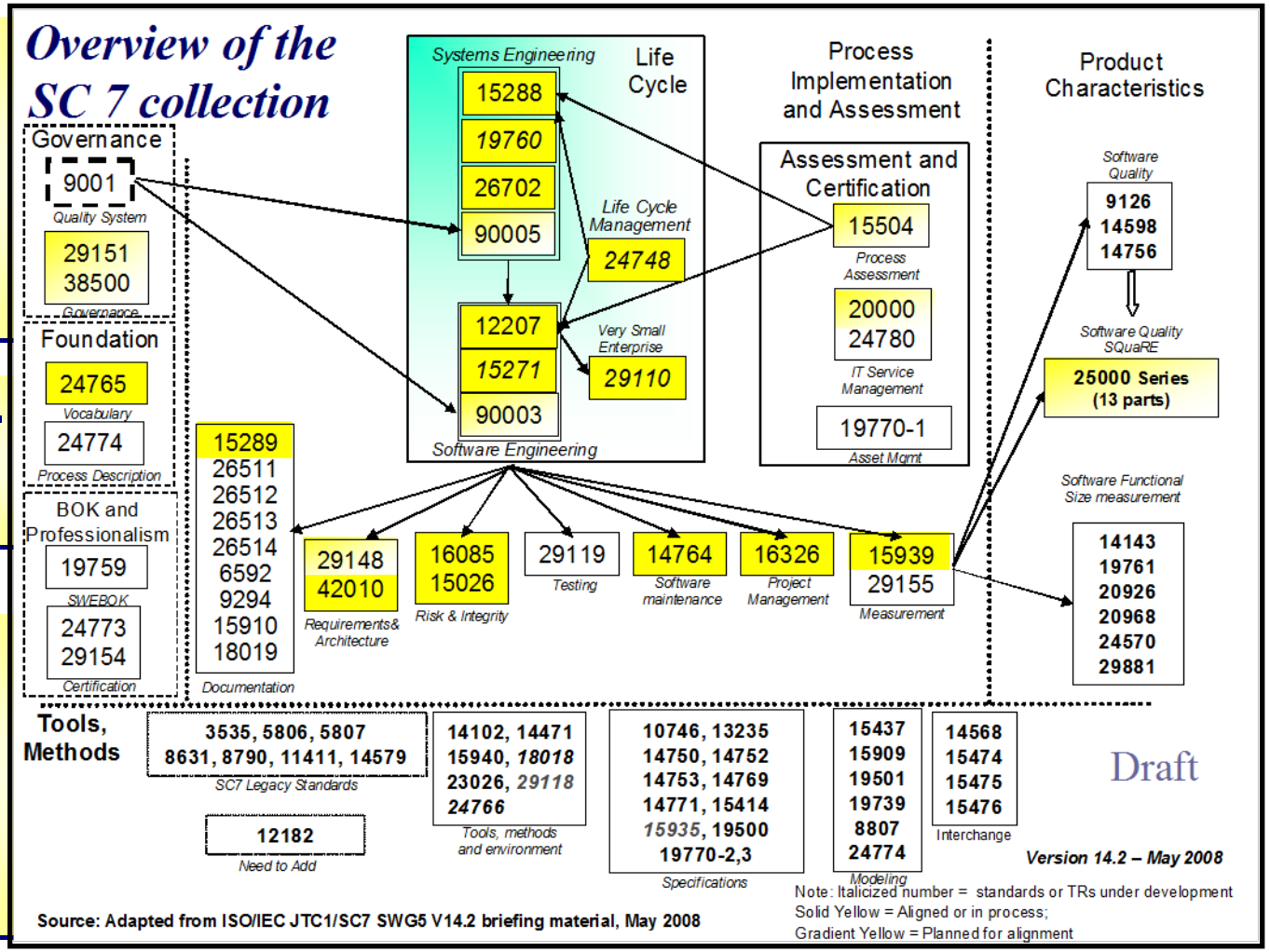
SC7's Large Scale Harmonization Efforts

SWG1
- **Business Planning**

SWG5
- **Standards Management**

Study Groups, e.g.
- **Relationships**
- **Integration**

LCPHAG
- **Modeling**
- **Architectural Analysis**
- **Process Repository**



Harmonization Across Collections

The State of Harmonization … Today

Topic	Status	Remarks
Terminology & Concepts	Yellow ↑	Shared BOK, joint vocabulary project, potential certification framework
Quality management	Yellow	IEEE is adopting ISO/IEC 90003 approach.
Testing	Orange ↑	Both IEEE and BSI will harmonize with SC7 processes
Architecture description	Green	SC7 adopted IEEE standard and will harmonize with processes.
Product quality	Yellow ↑	ISO/IEC 12119 was revised as 25051. IEEE will withdraw its standard.
Life cycle processes	Green	
Systems engineering	Green	Shared SE process standard; harmonization with other LC processes underway
SW maintenance	Green	Project to merge IEEE and ISO standards is completed
Measurement	Yellow ↑	IEEE will adopt 15939 after its current revision. Some details remain.
Risk management	Green	SC7 adopted IEEE standard and is now extending it to the systems level.
Project management	Yellow ↑	Project is merging the incompatible standards.
Verification and validation	Red	Fundamentally different approaches. Good intentions, but no action yet.
Configuration management	Yellow	SC7 withdrew its standard; systems issues remain. IEEE is about to revise.
SW process assessment	Yellow ↑	Harmonization with LC process standards is underway
Requirements engineering	Orange ↑	Joint project has been approved; mashup of relevant standards is being prepared.
SW life cycle data	Yellow ↑	IEEE is adopting 15289 to replace 12207.1
User documentation	Yellow ↑	IEEE 1063 has been incorporated into 26514. IEEE will adopt it.
CASE tools	Yellow	Minor incompatibilities
Notations	Harmless	Distinct standards for distinct notations
Internet	Green	Shared standard
IT Services, Management, Governance	Yellow	IEEE will adopt 20000 standards
Specialty Engineering (Safety, Security)	Orange ↑	Unrelated approaches will be addressed in part by coordination revision of 15026
Others	Yellow	Many unrelated standards

The State of Harmonization in 1995

Topic	Status	Remarks
Terminology & Concepts	Red	Different vocabulary standards
Quality management	Orange	ISO: Driven down from ISO 9001. IEEE: traditional QA approach.
Testing	Orange	IEEE standards unrelated to SC7 processes.
Architecture description	Harmless	SC7 didn't have architecture standards.
Product quality	Yellow	Unrelated standards
Life cycle processes	Red	Incompatible standards
Systems engineering process	Yellow	Unrelated standards
SW maintenance	Red	Incompatible standards
Measurement	Yellow	Unrelated standards
Risk management	Harmless	No standards at all
Project management	Red	Incompatible standards
Verification and validation	Red	Fundamentally different approaches; minor incompatibilities in details
Configuration management	Red	Incompatible standards
SW process assessment	Yellow	Nothing in IEEE. ISO process assessment incompatible with ISO LC.
Requirements engineering	Orange	IEEE standards unrelated to SC7 processes
SW life cycle data	Red	Incompatible standards
User documentation	Red	Incompatible standards
CASE tools	Yellow	Minor incompatibilities
Notations	Harmless	Distinct standards for distinct notations
Internet	Harmless	No standards
IT Services, Management, Governance	Harmless	No standards
Specialty Engineering (Safety, Security)	Orange	Unrelated approaches
Others	Yellow	Many unrelated standards

IEEE CS May 2008 Status Report to SC7

Stoplight charts show marked improvement between the IEEE and SC7 Standards Collections

Source: 07N3997 2008-05 IEEE-CS Liaison Report to SC7– J. Moore, MITRE

Harmonization Benefits Summary

Alignment

- Achieves short term objectives
- Maintains backward compatibility
- Starts disparate users towards goal

Integration

- Tackles the 'religious' issues
  - Technical and Political
- Achieves long term goals in a set

Large Scale Harmonization

- Solves big picture issues within and across SDOs

Each Level Brings You

- Easier process definition and implementation
- Better team communication and integration
- Improved performance at lower cost
- Increased benefit and usefulness of implementing these standards in your organization

Eases Your Integration, Management, and Acquisition Burden

SEIPartner
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Technical Software Services, Inc.

Questions?

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- **ISO/IEC/IEEE 12207 Project Editor**
- **15288-12207-24748 Editorial Team Member**
- **IEEE Std 1220™-2005 Project Editor (aka ISO/IEC 26702:2007)**
- **ISO/IEC JTC1/SC7 Life Cycle Process Advisory Group Chair**

Abbreviations - 1

ANSI – American National Standards Institute
CMMI – Capability Maturity Model Integration
CMU – Carnegie Mellon University
IEC – International Electrotechnical Commission
IEEE – Institute of Electrical and Electronics Engineers
IEEE CS – IEEE Computer Society
INCOSE – International Council on Systems Engineering
ISO – International Organization for Standardization
IT – Information Technology
JTC1 – ISO/IEC Joint Technical Committee 1: Information Technology
LCP – life cycle process
NWIP – new work item proposal
OPA – organizational process assets
OPD – organizational process definition
SC – subcommittee
SG – study group

Abbreviations - 2

SC7 – ISO/IEC JTC1 SC 7: Software and Systems Engineering
SE – systems engineering
SEI – Software Engineering Institute (at CMU)
S2ESC – Software and Systems Engineering Standards Committee (IEEE CS)
SEP – SE process
SWE – software engineering
SWG – special WG
WG – working group
WG7 – ISO/IEC JTC1 SC7 WG 7: Life Cycle Management
VSE – very small enterprise

References - 1

For ISO and ISO/IEC Standards (Current and Withdrawn):

http://www.iso.org/iso/iso_catalogue.htm

1) **ISO 9001:2005, *Quality management systems — Requirements***
2) **ISO/IEC 12207:2008, *Systems and software engineering — Software life cycle processes***
3) **ISO/IEC 15288:2008, *Systems and software engineering — System life cycle processes***

For ISO/IEC documents and in-process standards and technical reports (TRs): *http://www.jtc1-sc7.org/*

4) **SC7 N4143: ISO/IEC DTR 24748.2:2009, *Systems and software engineering — Guide for life cycle management***

References - 2

For IEEE Standards:

http://www.ieee.org/web/standards/home/index.html

IEEE Std 1220™-2005, *IEEE Standard for Application and Management of the Systems Engineering Process*

Or related information:

http://standards.computer.org/s2esc/

IEEE CS Software and Systems Engineering Standards Committee – for on-going SE/SW standards activities

http://pascal.computer.org/sev_display/index.action

SEVOCAB: An IEEE CS and ISO/IEC JTC 1/SC7 project, SEVOCAB includes definitions from international standards; This database is issued periodically as a formal, published International Standard (ISO/IEC 24765) reflecting a "snapshot" of the database.