Architecture Definition –

A New Process in the Systems Engineering Standard (ISO/IEC 15288)

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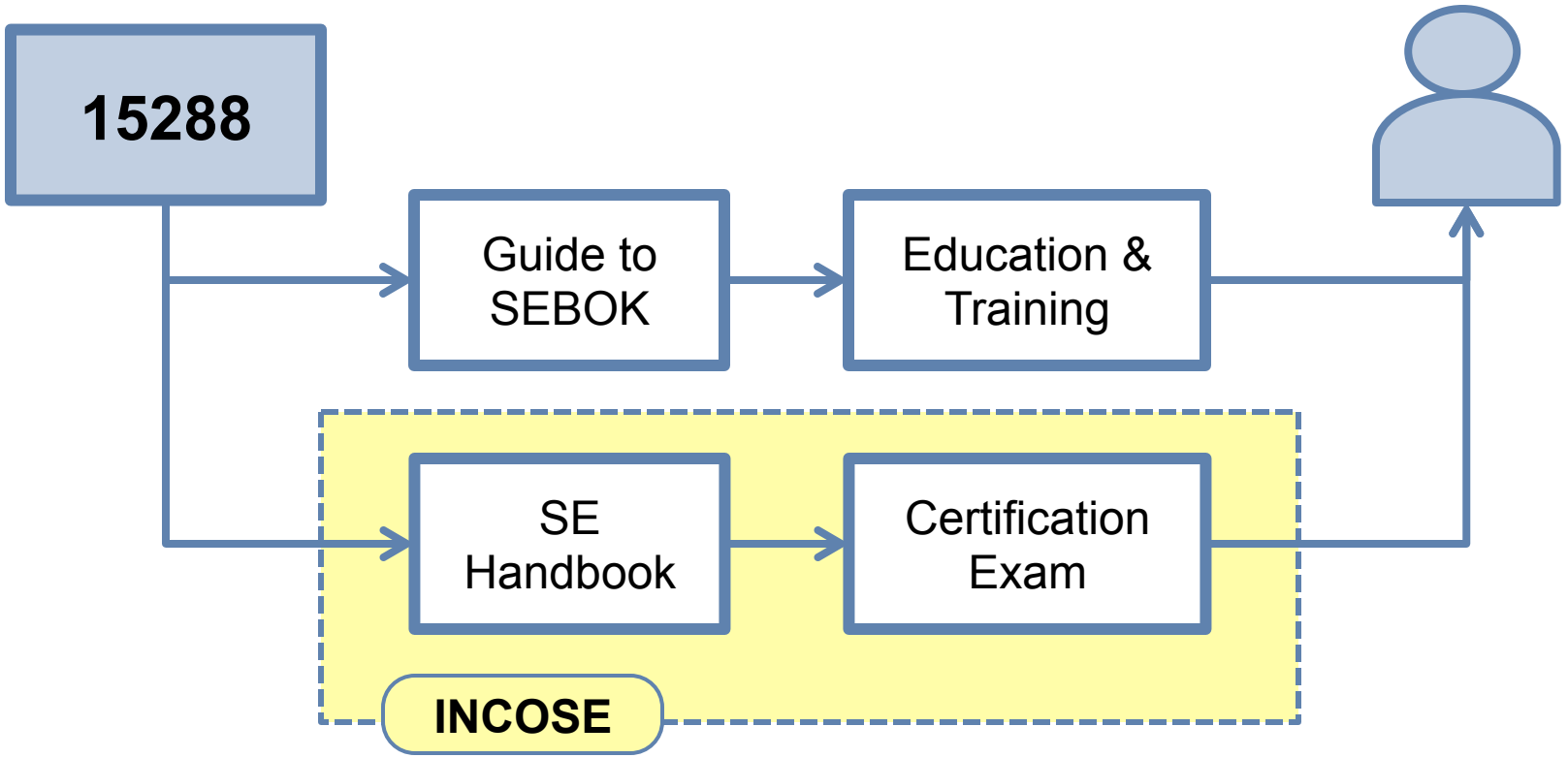
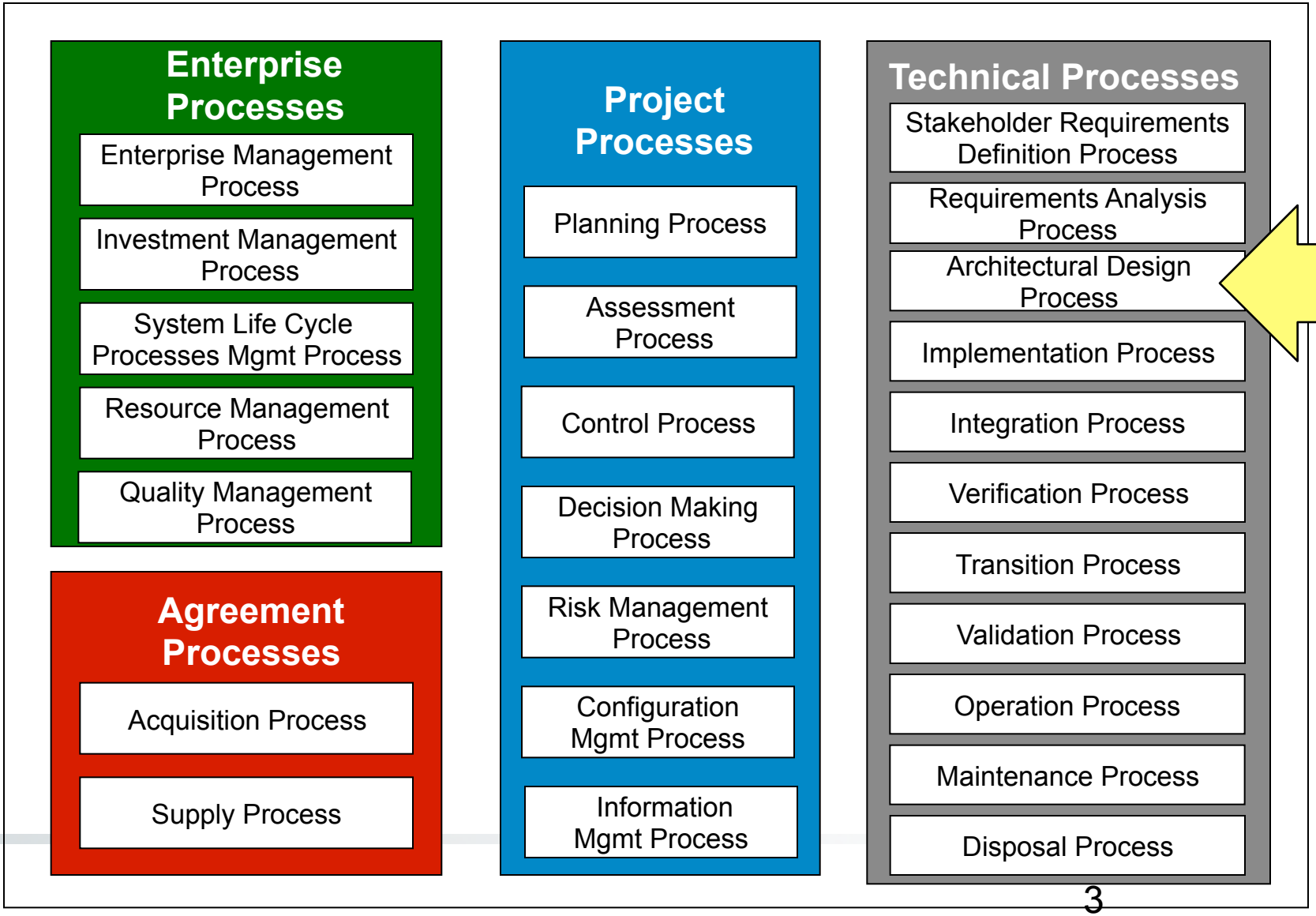
INCOSE Standards Liaison to SC7
Architecture Working Group WG42

Why use ISO standards?

- ISO/IEC 15288 – System Life Cycle Processes (March 2015)
  - *Supplements (to be developed for later publication)*
    - IEEE 15288-1 – Application of SE on Defense Programs
    - IEEE 15288-2 – Technical Reviews and Audits on Defense Programs



Processes in 15288 Standard (2008)



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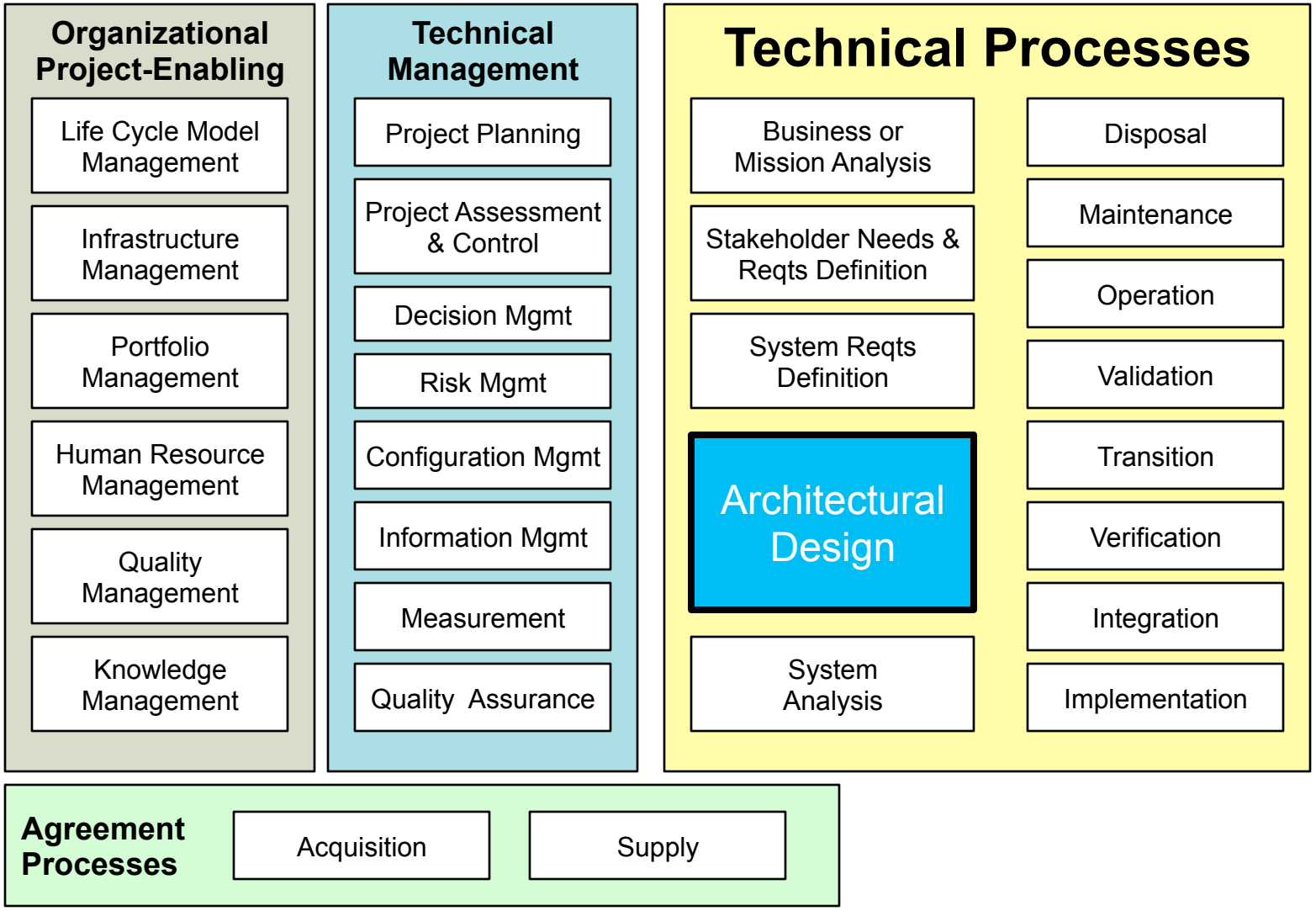
System Life Cycle Processes in 15288 (~2012 draft)

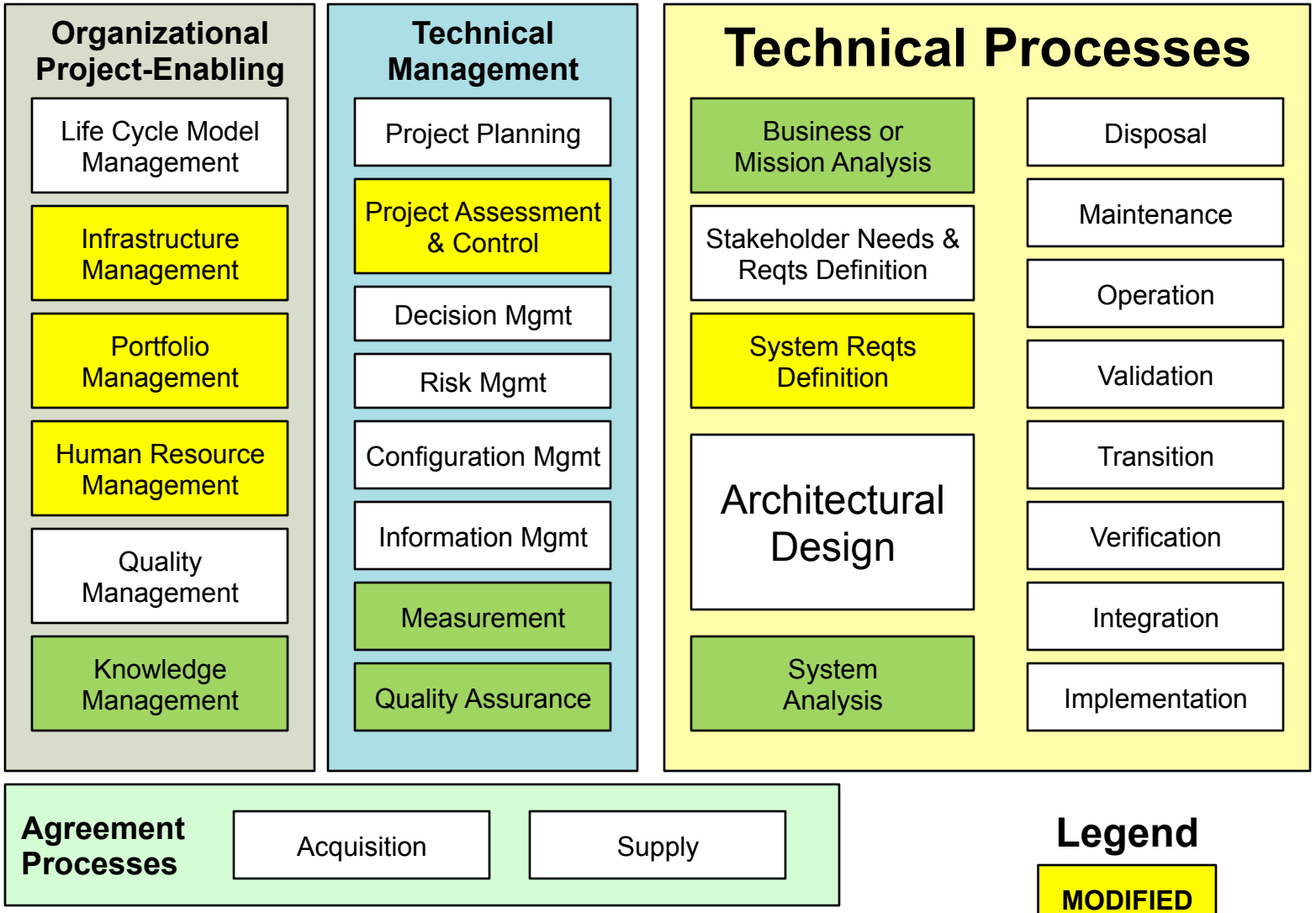


Architectural Design Activities (15288:2008)

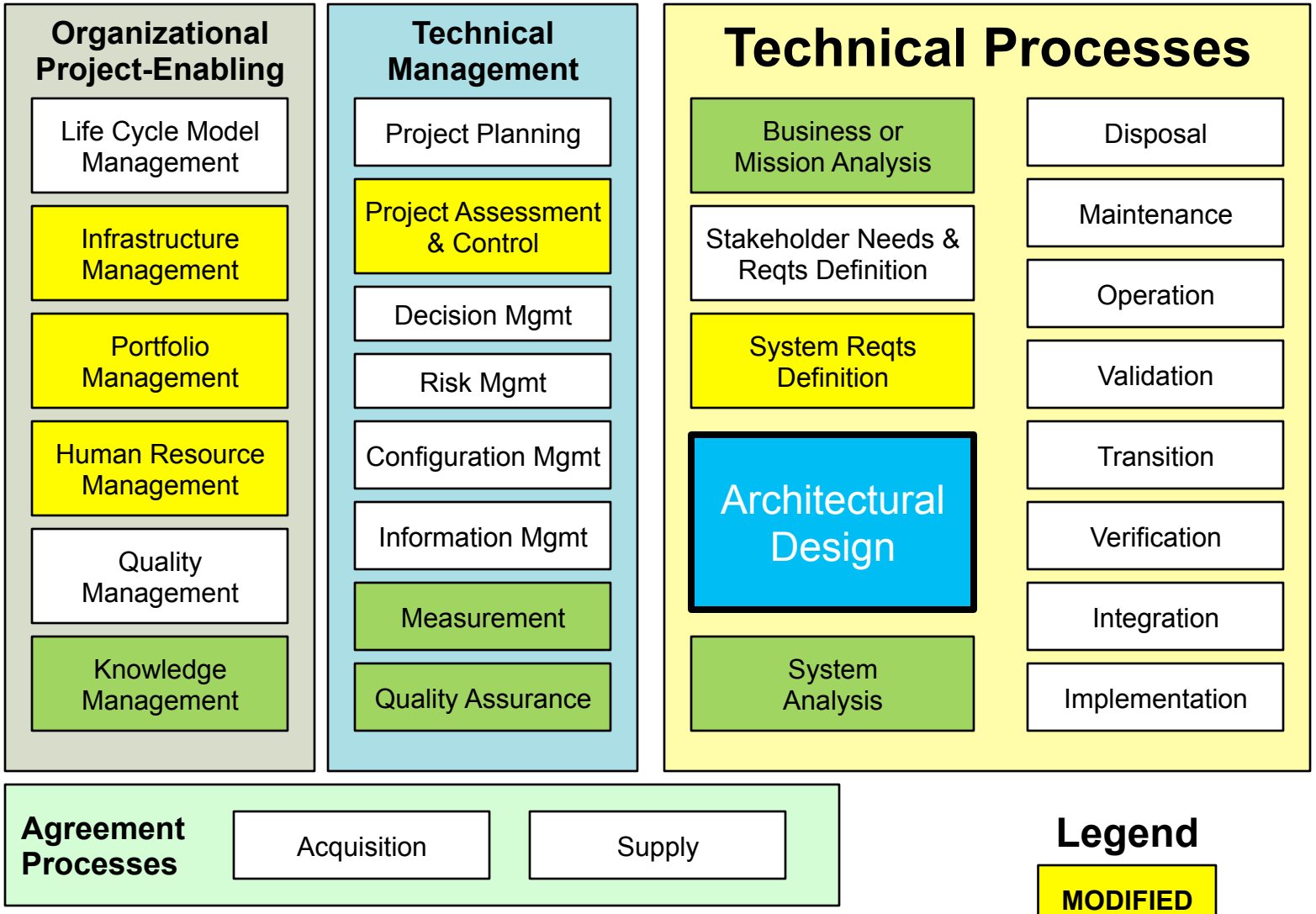
Architectural Design

- **Define the architecture**
  - *Define appropriate logical architectural designs*
  - *Partition the system functions… and allocate them to elements of system architecture. Generate derived requirements… for the allocations.*
  - *Define and document the interfaces between system elements and at the system boundary with external systems*
- **Analyze and evaluate the architecture**
  - *Analyze resulting architectural design to establish design criteria for each element*
  - *Determine which system requirements are allocated to operators*
  - *Determine whether hardware and software elements… are available off-the-shelf*
  - *Evaluate alternative design solutions…*
- **Document and maintain the architecture**
  - *Specify the selected physical design solution…*
  - *Record the architectural design information*
  - *Maintain mutual traceability… requirements*

Key Changes and Additions



Why not change Architectural Design?



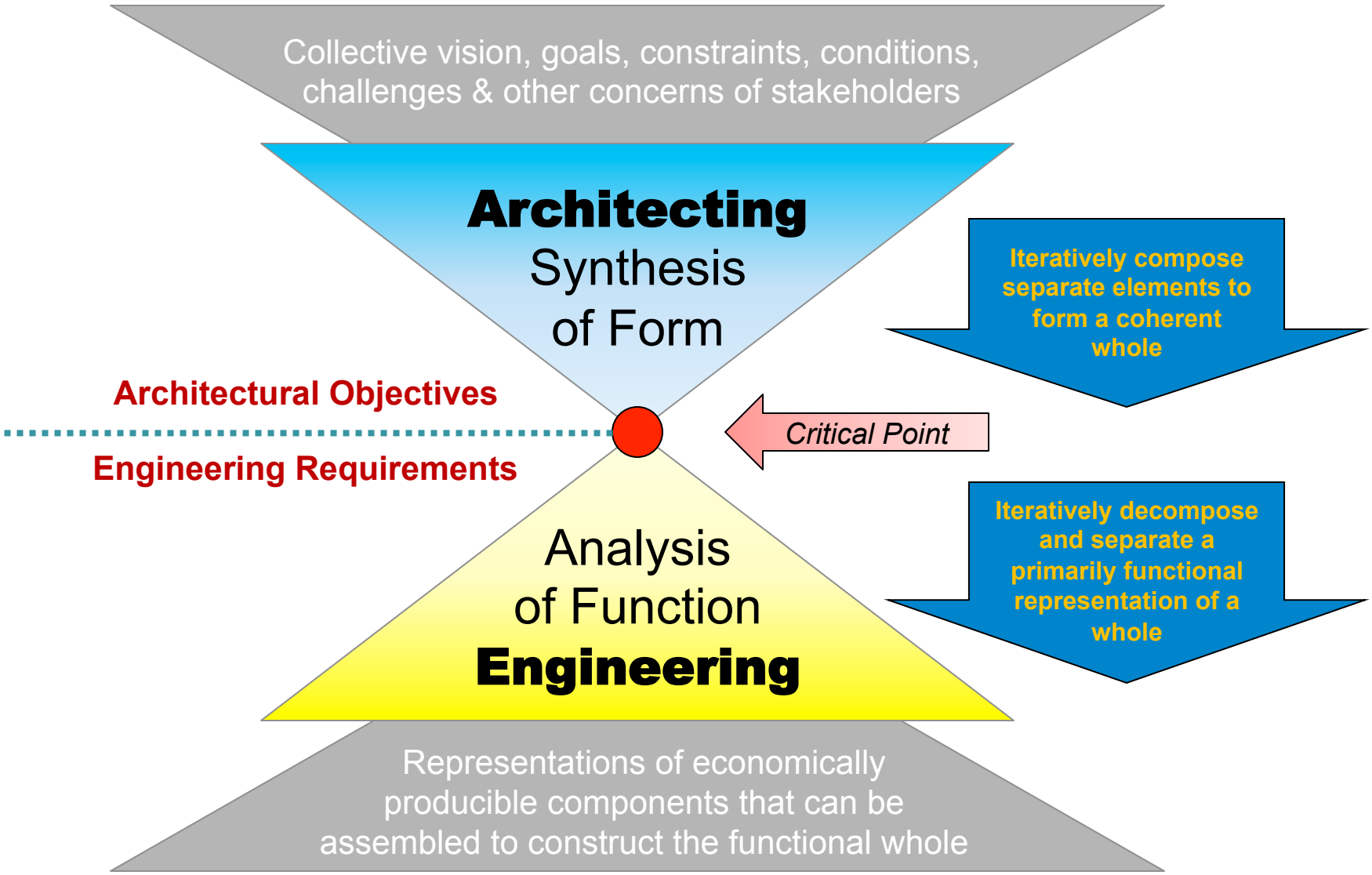
Why the Need to Separate Architecture from Design?

- Be more consistent with other ISO architecture concepts and terms
- Allow for Architecture to drive more than one System Design
  - *Multiple design across a product line*
  - *Multiple versions of a design, all consistent with a single architecture*

Why the Need to Separate Architecture from Design?

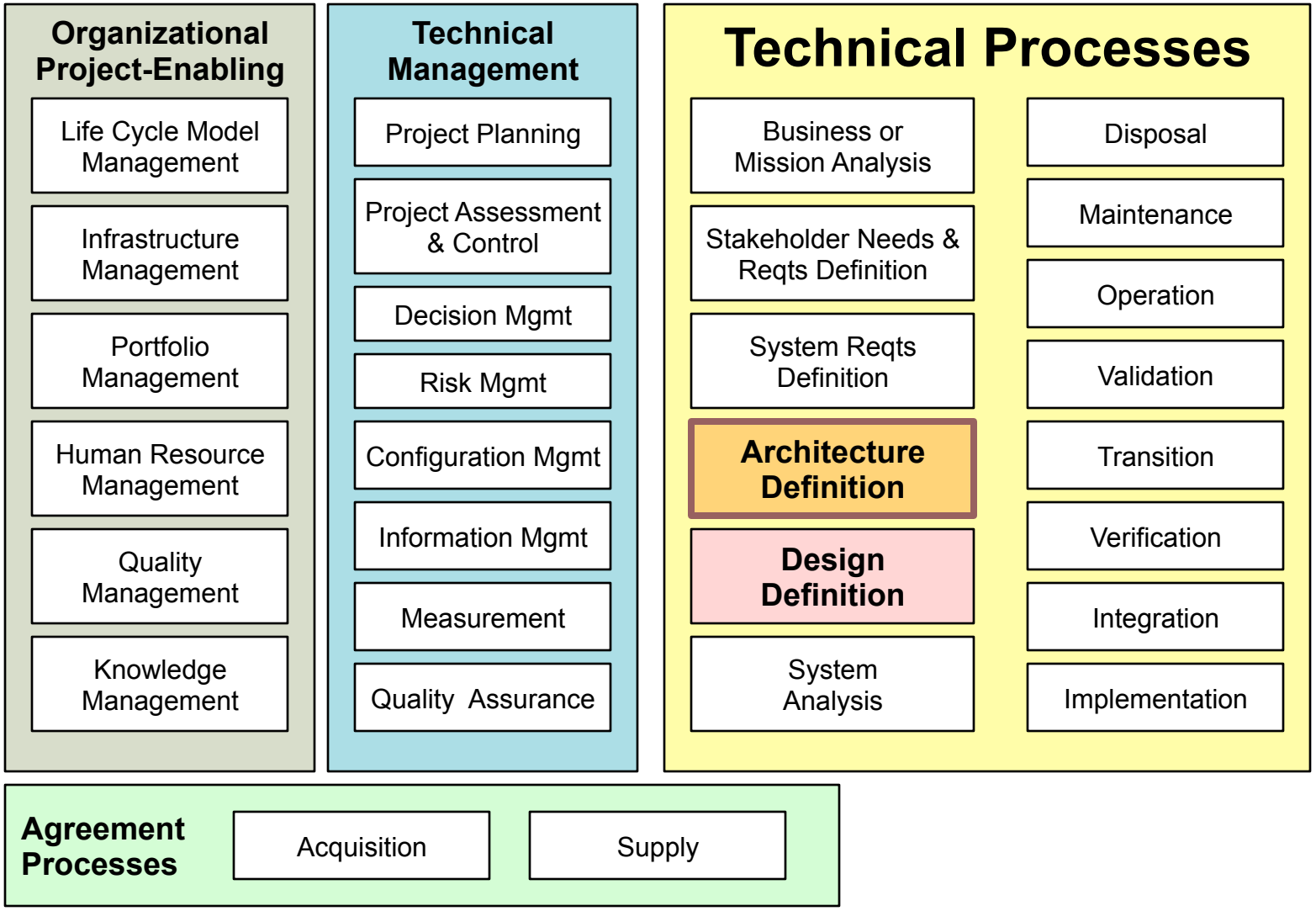
- Be more consistent with other ISO architecture concepts and terms
- Allow for Architecture to drive more than one System Design
  - *Multiple design across a product line*
  - *Multiple versions of a design, all consistent with a single architecture*
- Allow for Architecture to be used by Project Technical Management and Enterprise activities (eg, project planning, measurement, decision management, portfolio management, etc)
- Respect traditional separation of architecture and design activities in the age-old Civil Architecture & Engineering domain
- Architecture (ie, Architecture) and Engineering (ie, Design) are often done by different people with different skillsets and expertise

Architecting & Engineering – Two Sides of the Same Problem



Adapted from: Walt Okon, DOD Architecture Training, 12 Dec 2007

System Life Cycle Processes in 15288 (2014 draft)



Separation of Architecture & Design Processes (2014)

Architecture Definition

- Prepare for architecture definition
- Develop architecture viewpoints
- Develop models and views of candidate architectures
- Relate the architecture to design
- Assess architecture candidates
- Manage the selected architecture

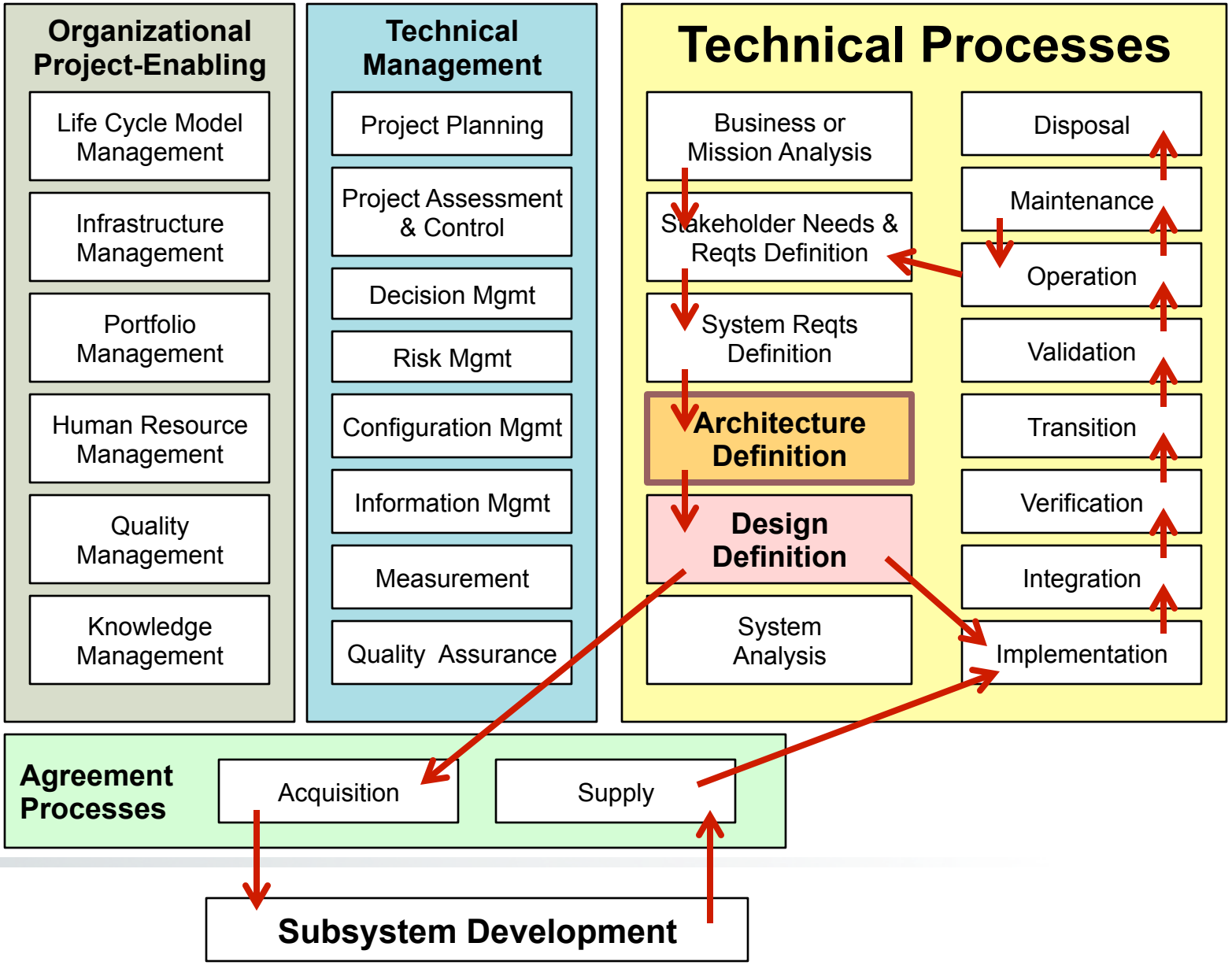
Design Definition

- Prepare for design definition
- Establish design characteristics and design enablers related to each system element
- Assess alternatives for obtaining system elements
- Manage the design

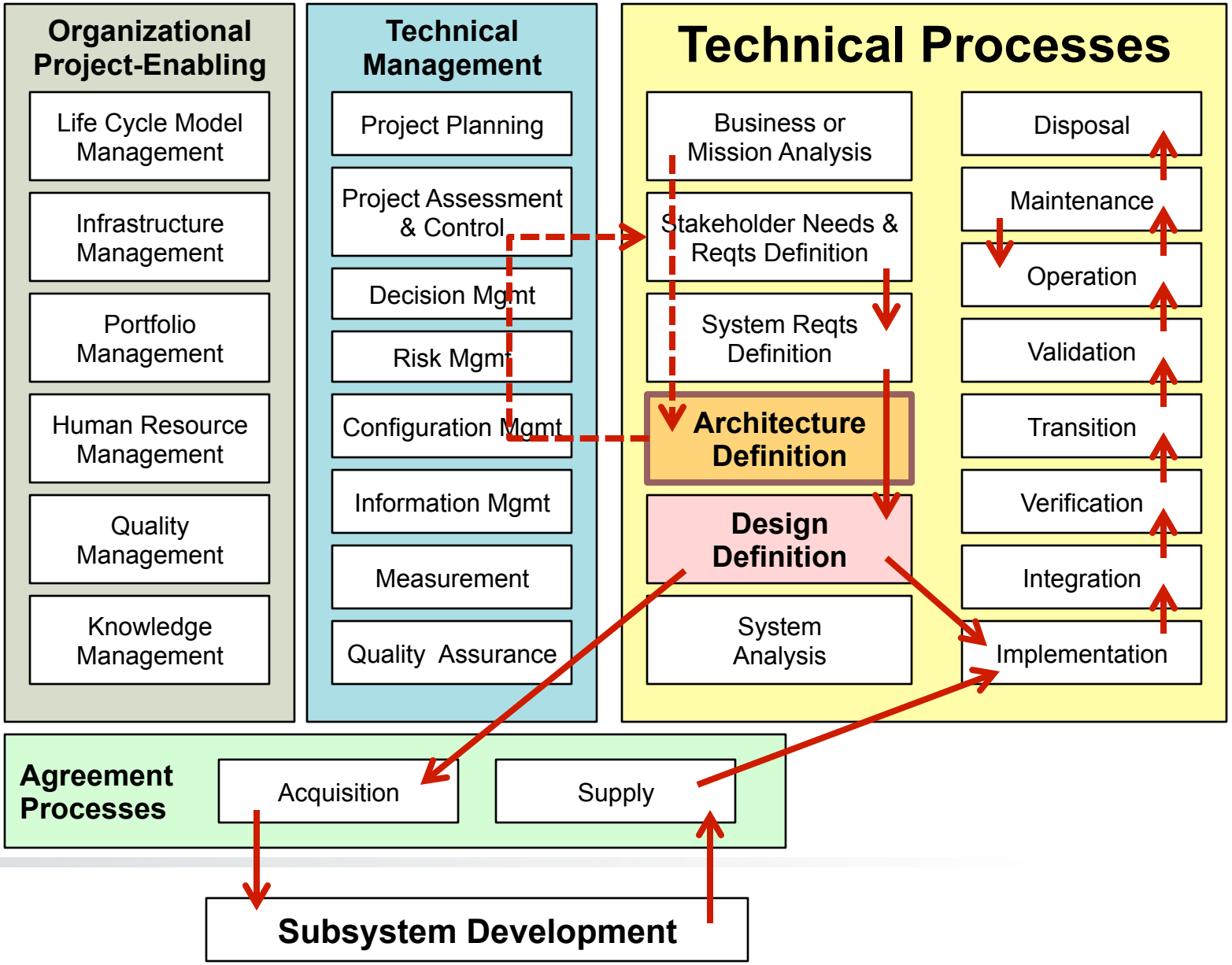
For each "system of interest" in the complete solution

For the complete solution and concerns of all stakeholders

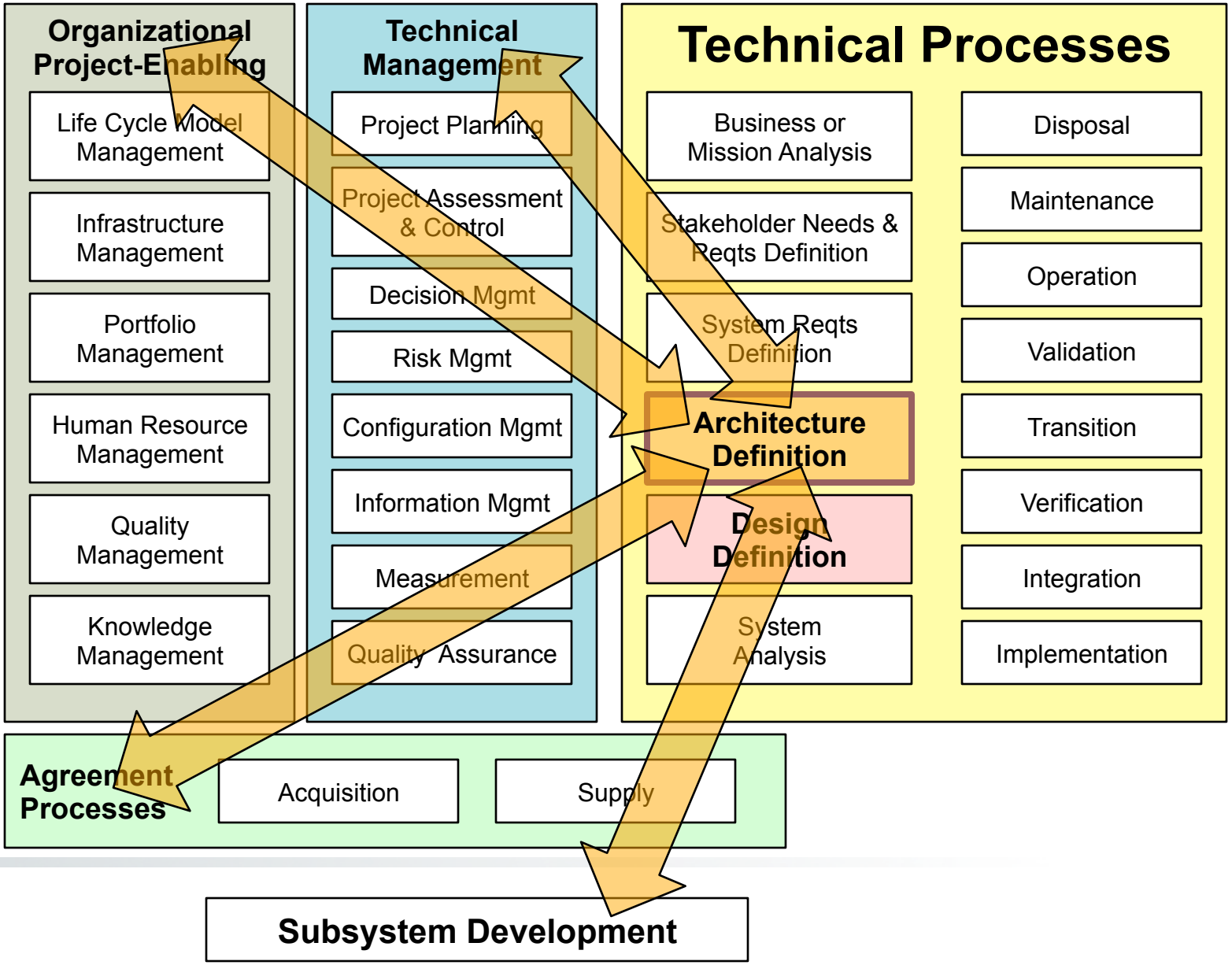
Traditional Top-Down System Development



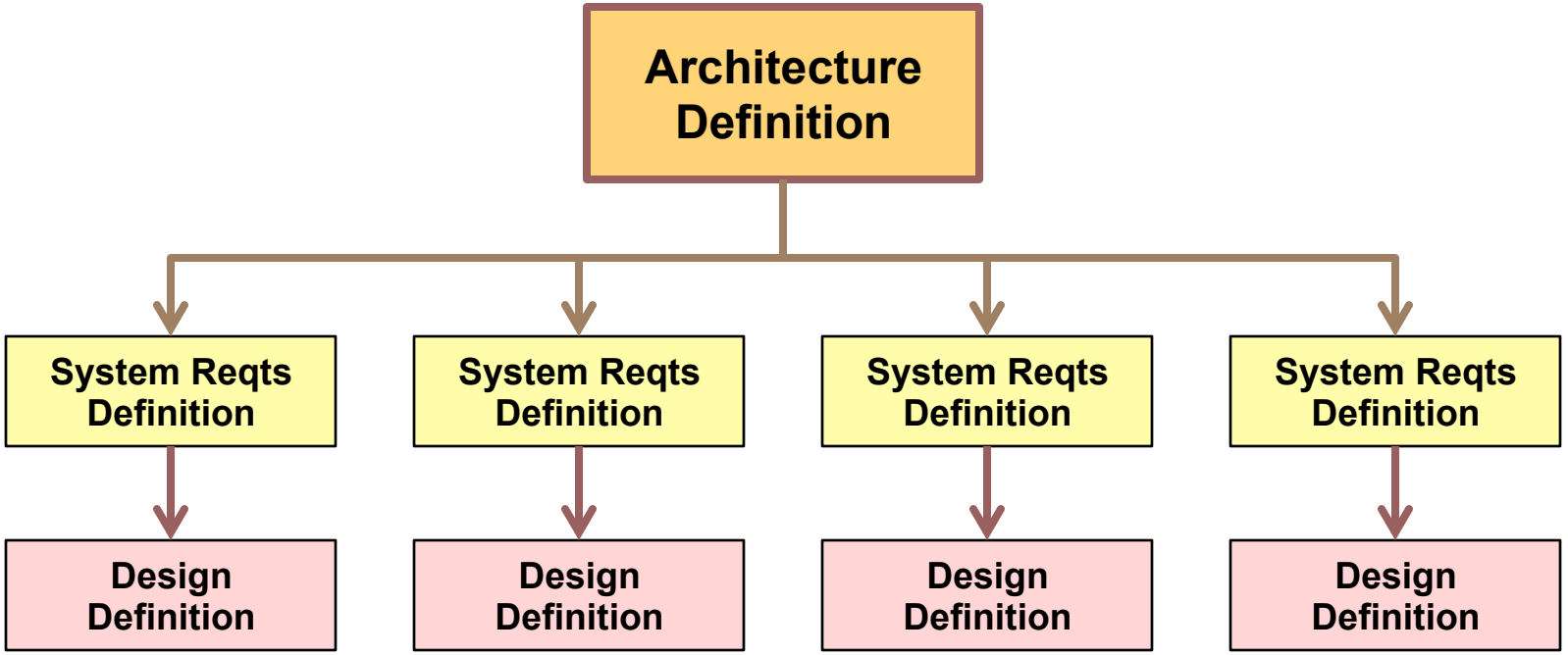
Architecture-Driven System Development



Architecture Drives More than Just Design



Architecture Can Drive Several Different Systems



Can address several different cases:

- Architecture of total solution with multiple systems
- Product line of systems for different markets, users, etc
- System of Systems with separately managed and operated systems

Purpose of the Architecture Definition Process

- Purpose
  - *Generate system architecture alternatives*
  - *Select one or more alternatives that frame stakeholder concerns and meet system requirements*
  - *Express this in a set of consistent views*

- Effective Architecture
  - *… is design-agnostic to maximum extent possible to allow for maximum flexibility in the design trade space*
  - *… highlights and supports trade-offs for the Design Definition process*
    - … as well as for other processes, such as Portfolio Management, Life Cycle Management, Project Planning, System Requirements Definition, Verification, Operations, etc

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Architecture Definition Activities (2014 draft)

Architecture Definition

1. Prepare for architecture definition

a) *Review pertinent information and identify key drivers…*
b) *Identify stakeholder concerns*
c) *Define the architecture definition roadmap, approach, and strategy*
d) *Identify and plan for… enabling systems and services [for AD]*
e) *Obtain or acquire access to the enabling systems or services…*

2. Develop architecture viewpoints

a) *Select, adapt, or develop viewpoints and model kinds…*
b) *Establish or identify potential architecture framework(s) to be used…*
c) *Capture rationale for selection of framework(s), viewpoints and model [kinds]*
d) *Select or develop supporting modelling techniques and tools*
e) *Define evaluation criteria based on stakeholder concerns and key requirements*

3. Develop models and views of candidate architectures
4. Relate the architecture to design
5. Assess architecture candidates
6. Manage the selected architecture

Architecture Definition Activities (2014 draft)

Architecture Definition

1. Prepare for architecture definition
2. Develop architecture viewpoints
3. **Develop models and views of candidate architectures**
   a) *Define the system context and boundaries…*
   b) *Identify architectural entities and relationships between entities that address key stakeholder concerns and critical system requirements*
   c) *Allocate concepts, properties, characteristics, behaviors, functions, and/or constraints that are significant to architecture decisions of the system to architectural entities*
   d) *Select, adapt, or develop models of the candidate architectures of the system*
   e) *Compose views from the models of the candidate architectures…*
   f) *Harmonize models and views with each other*
4. **Relate the architecture to design**
   a) *Identify system elements that relate to architectural entities and the… relationships*
   b) *Define the interfaces… between the system elements and with external entities*
   c) *Partition, align and allocate requirements to architectural entities and system elements*
   d) *Map system elements and architectural entities to design characteristics*
   e) *Define principles for the system design and evolution*
5. Assess architecture candidates
6. Manage the selected architecture

Architecture Definition Activities (2014 draft)

Architecture Definition

1. Prepare for architecture definition
2. Develop architecture viewpoints
3. Develop models and views of candidate architectures
4. Relate the architecture to design

5. Assess architecture candidates

a) *Assess each candidate architecture against constraints and requirements*
b) *Assess each candidate architecture against stakeholder concerns using evaluation criteria, plus identify and understand trade-offs*
c) *Select the preferred architecture(s) and capture key decisions and rationale*
d) *Establish the architecture baseline of the selected architecture(s)*

6. Manage the selected architecture

a) *Formalize the architecture governance approach…*
b) *Obtain explicit acceptance of the architecture by stakeholders*
c) *Maintain concordance and completeness of the architectural entities and their architectural characteristics*
d) *Organize, assess and control evolution of the architecture models and views*
e) *Maintain the architecture definition and evaluation strategy*
f) *Provide key information items that have been selected for baselines*

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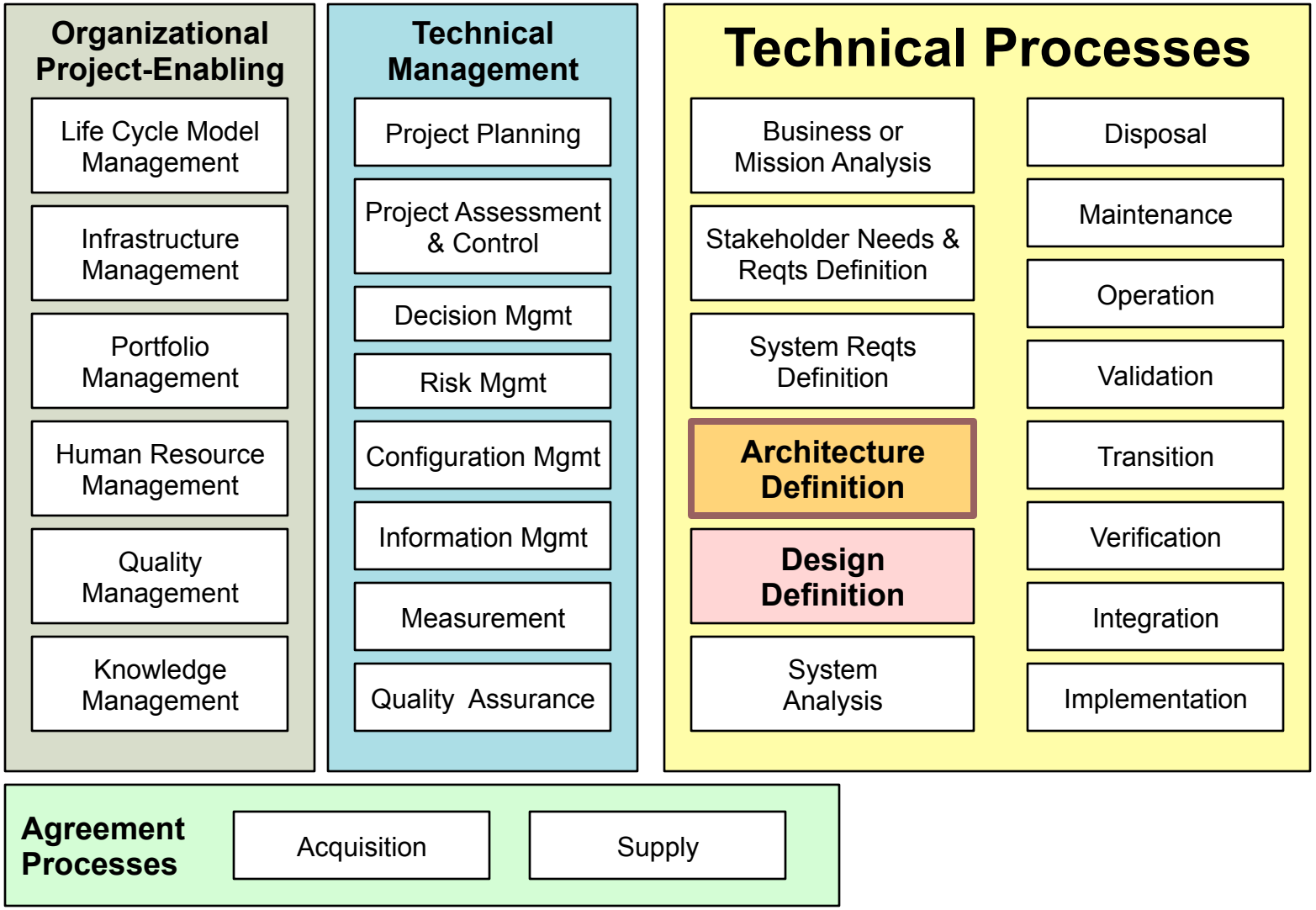
The New Architecture Definition Process



Summary

- New process for Architecture Definition allows for a broader scope of what architecture deals with (not just top-level design)

- Aligns the standard with current practices

- Expands the notion of what of what Architecture can be used for
  - ✓ Portfolio management
  - ✓ Supply chain management
  - ✓ Knowledge management
  - ✓ Program assessment & evaluation
  - ✓ System of systems development
  - ✓ Enterprise transformation
  - ✓ Budget & program planning
  - ✓ Operational planning