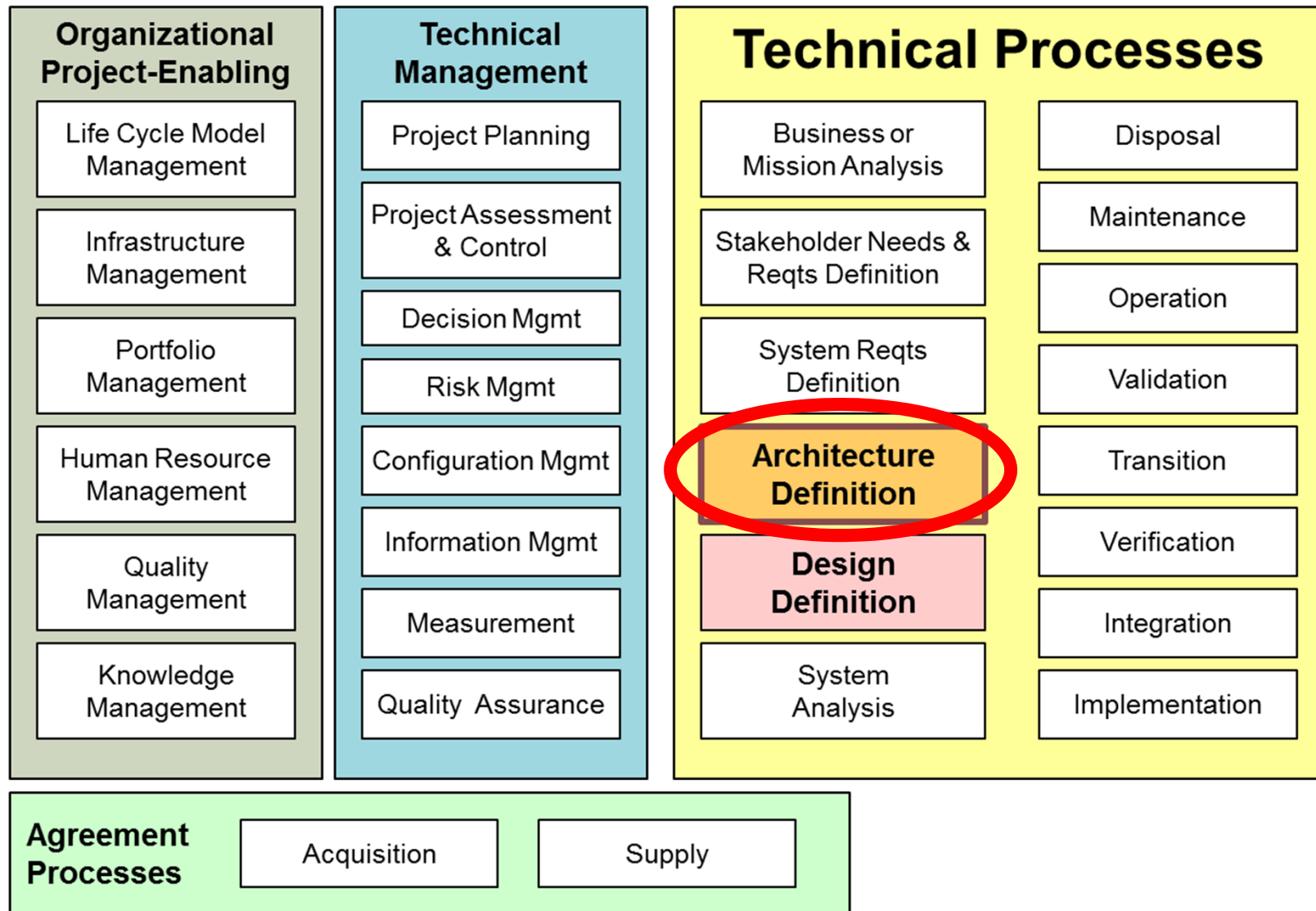


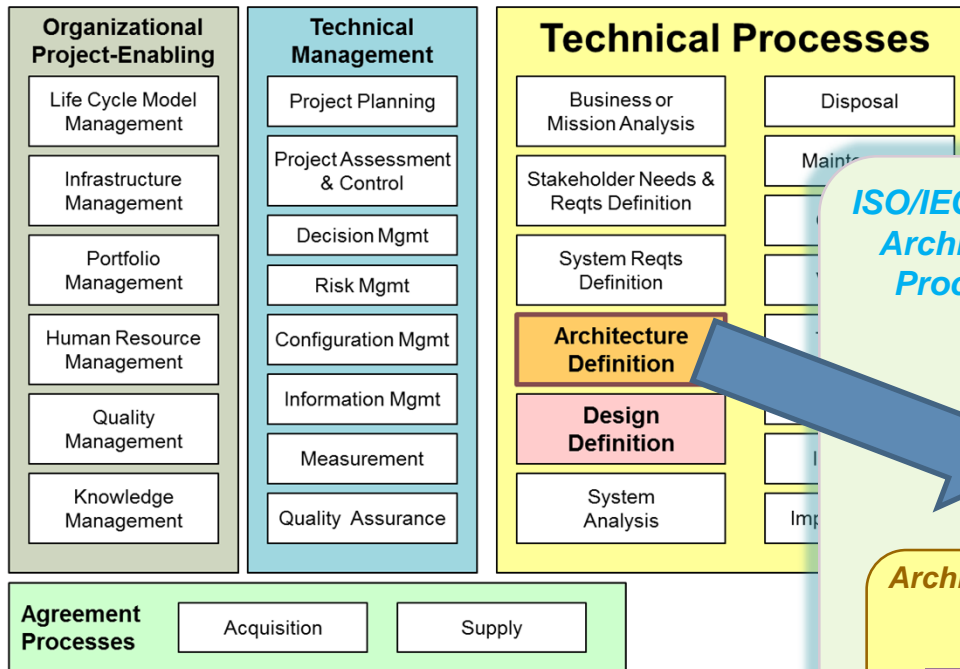
Overview of Emerging ISO Standards on Architecture

***James N Martin, PhD
Enterprise Systems Engineering***

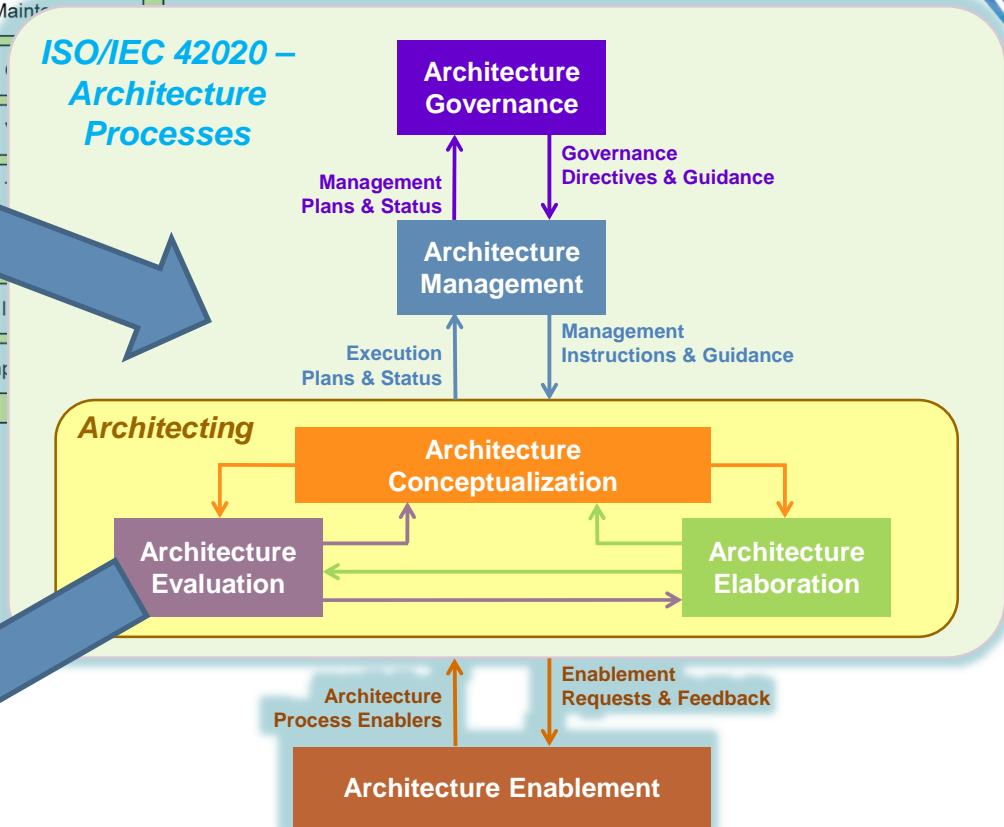
***Ground System Architectures Workshop
27 February 2018***

ISO 15288 – System Lifecycle Processes

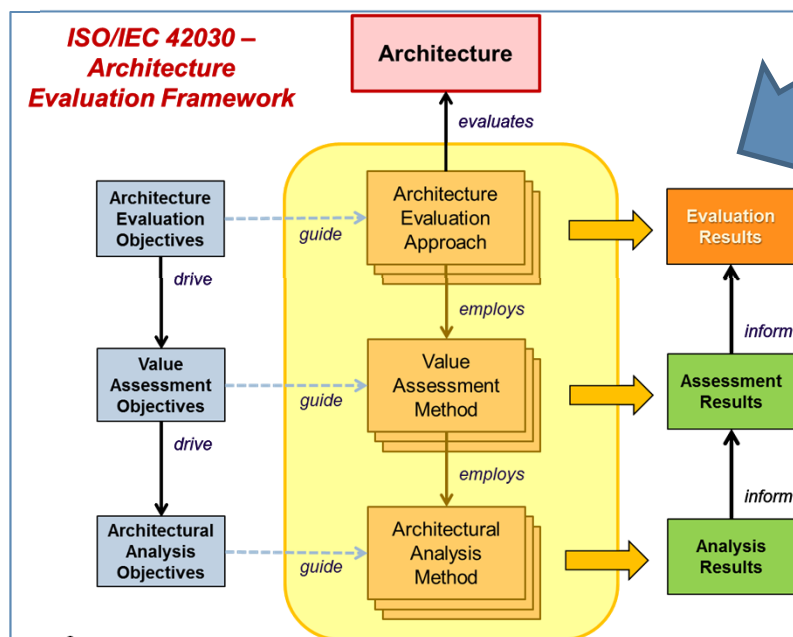




ISO/IEC 42020 – Architecture Processes



ISO/IEC 42030 – Architecture Evaluation Framework





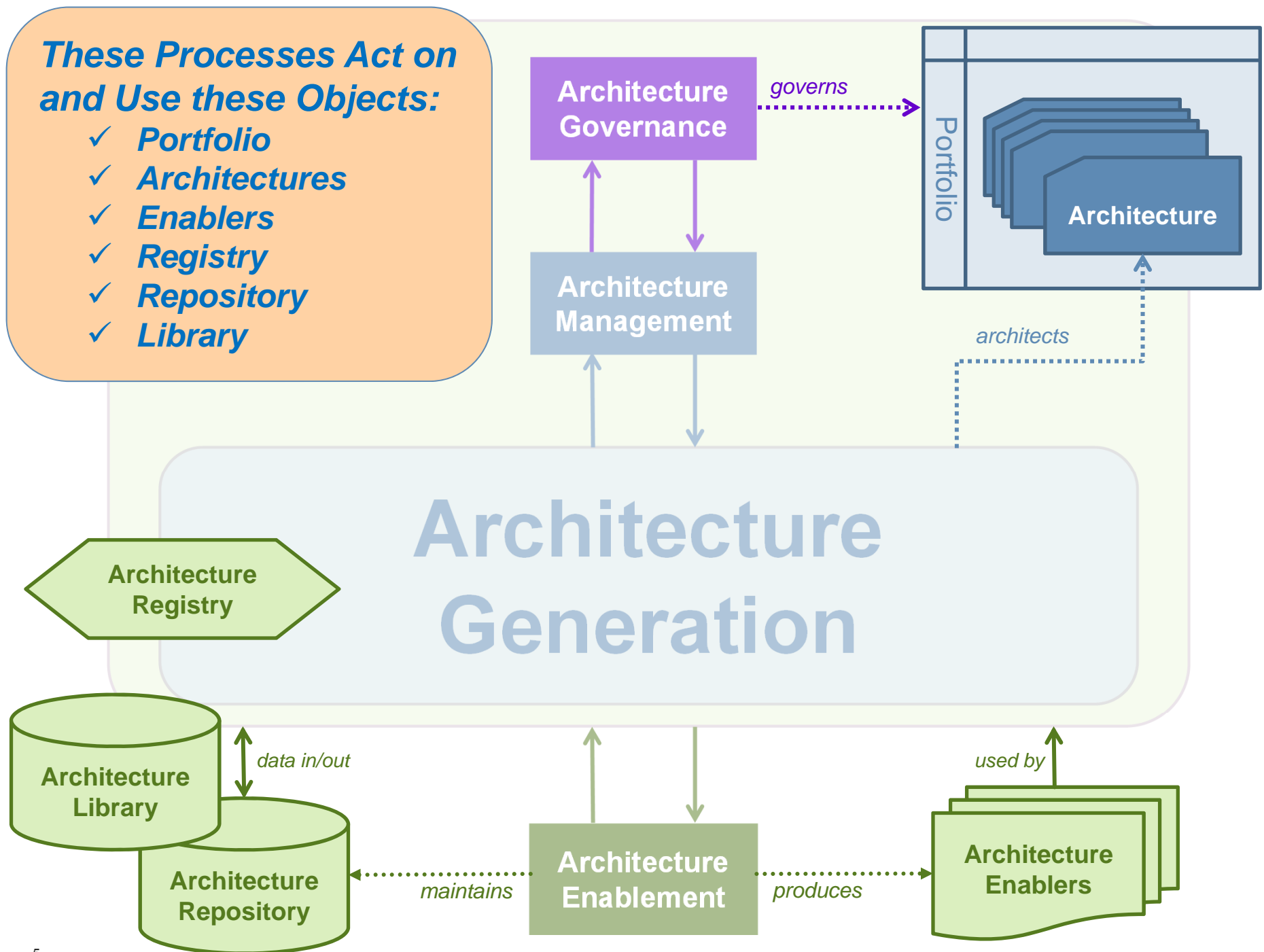
Architecture Standards from ISO

Current & Future

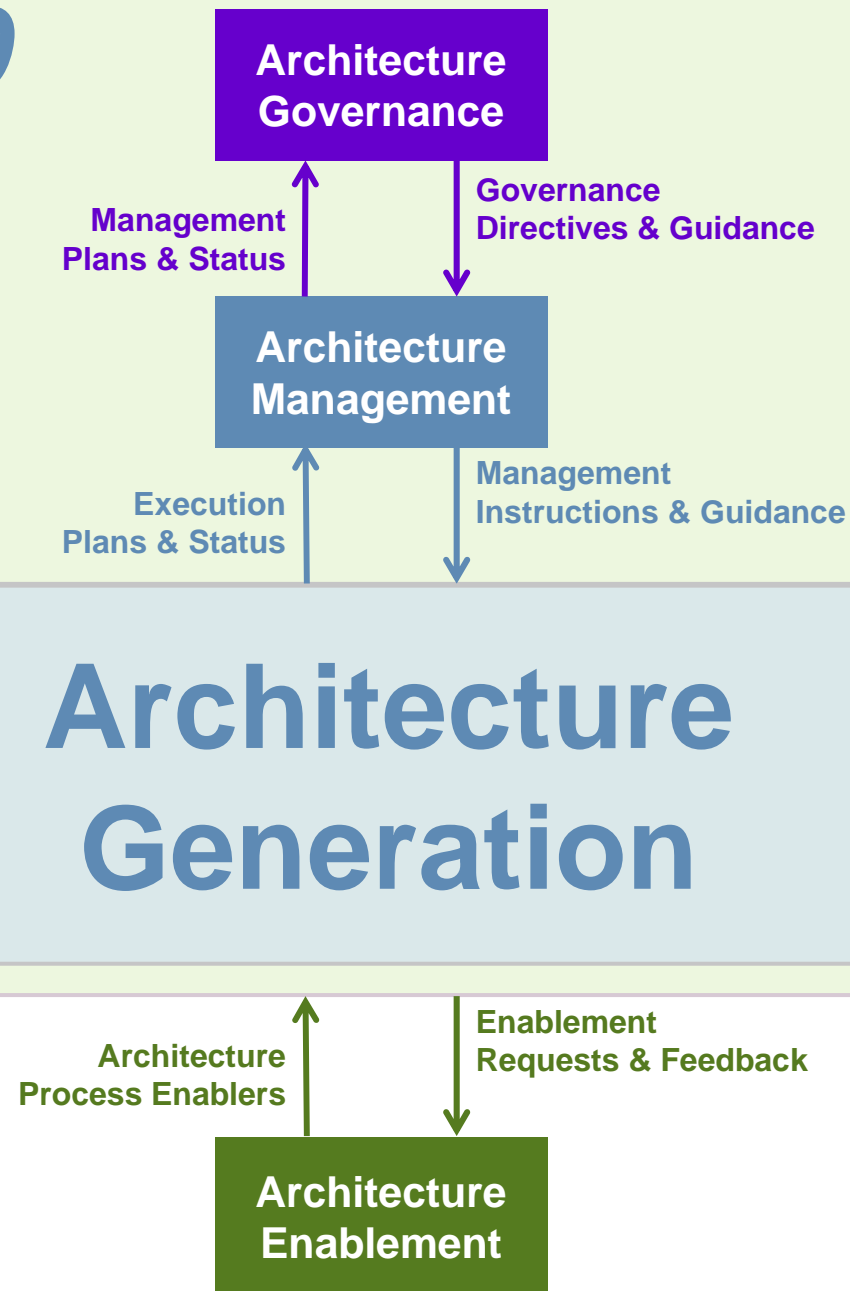
- 42010 – Architecture Description
 - *Concepts used in architecture frameworks and modeling tools*
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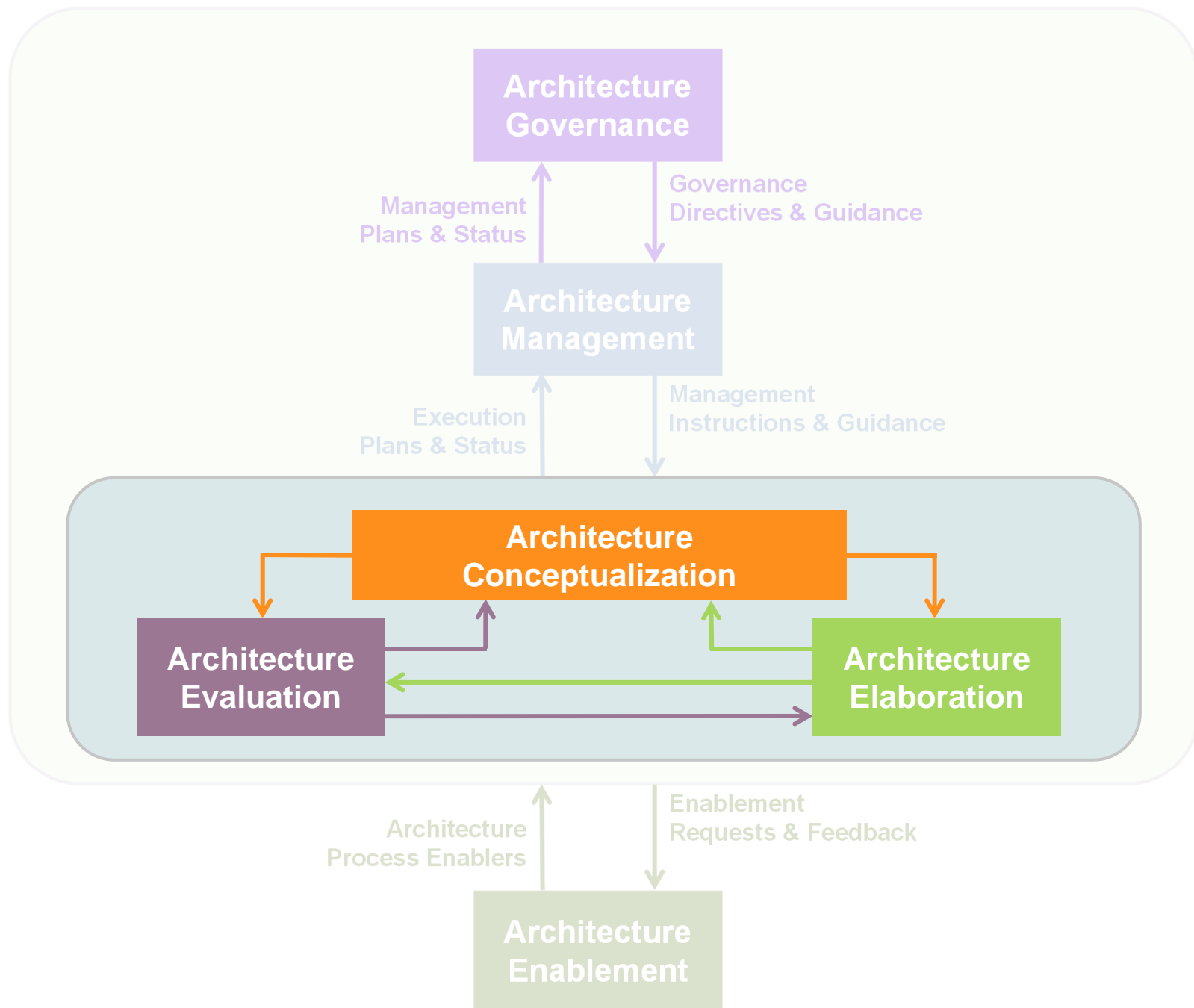
- **42020 – Architecture Processes**
 - *Started 2015 (expected release in 2018)*
- **42030 – Architecture Evaluation Framework**
 - *New Draft now in review cycle*
 - *To be published in 2019*

- 42040 – Architecture Methods
 - *Future*
- 42050 – Architecture Tools
 - *Future*



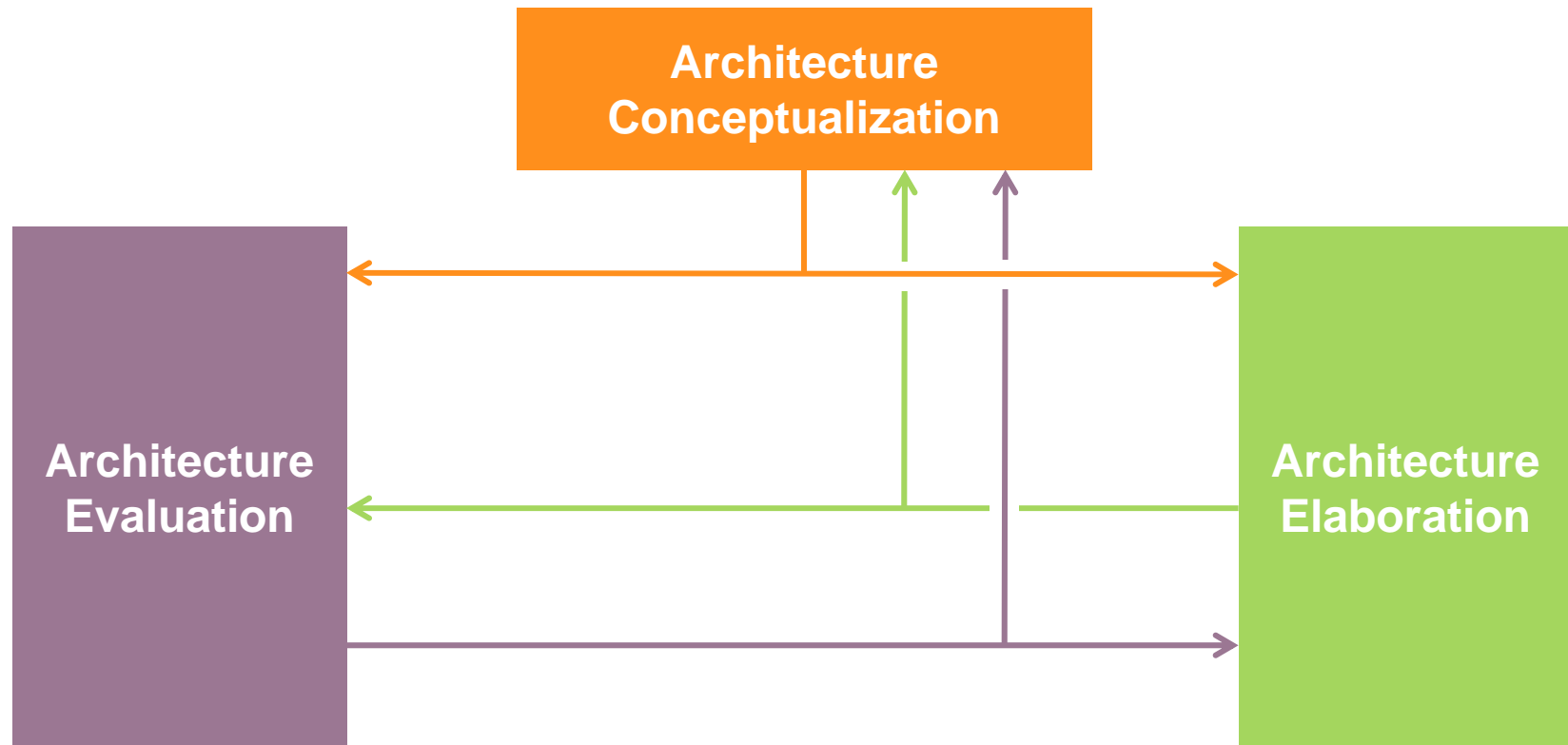
42020





The Core Processes for Architecture Generation

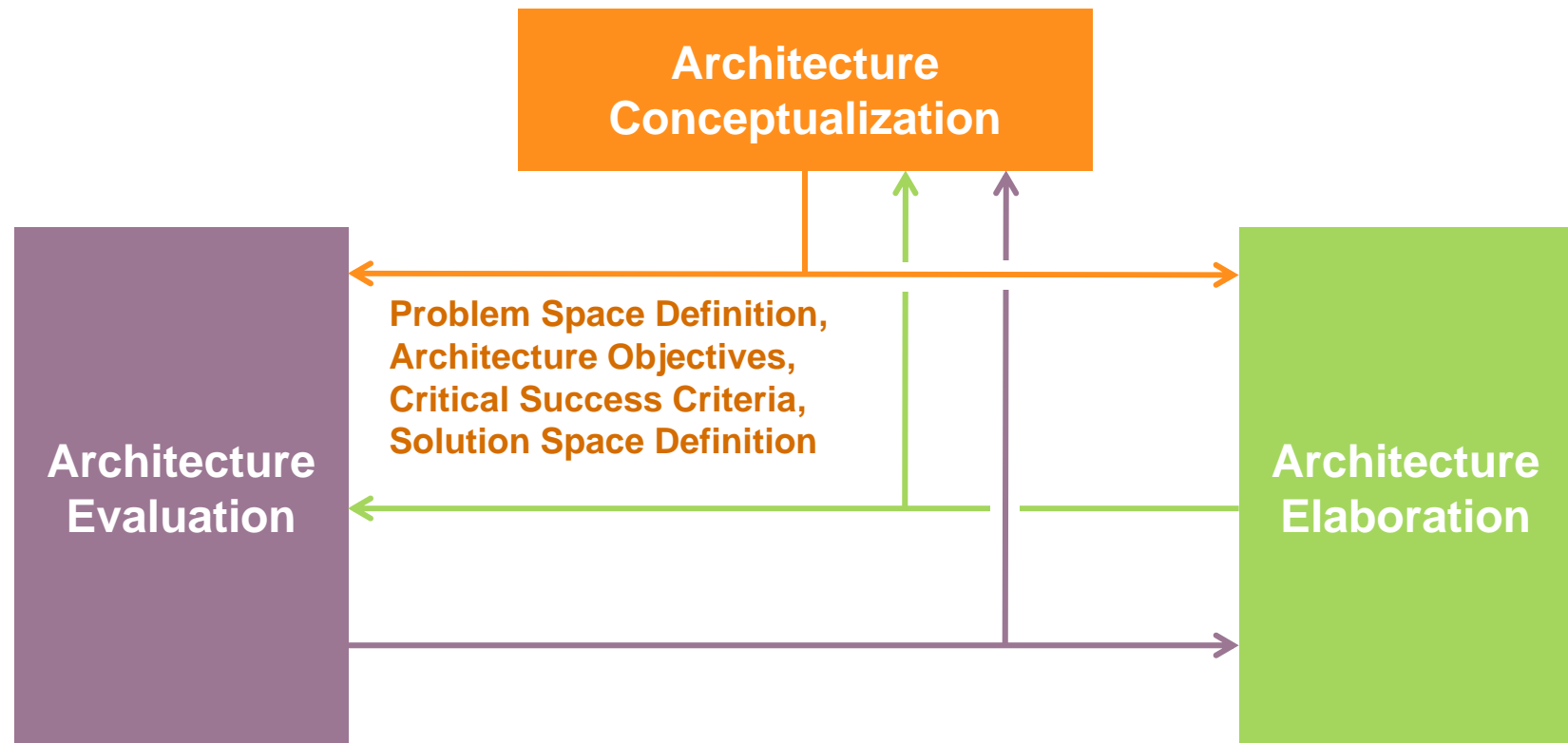
Sometimes known as “Architecting”...



At the Heart of what architecture is all about...

Architecture Conceptualization Process

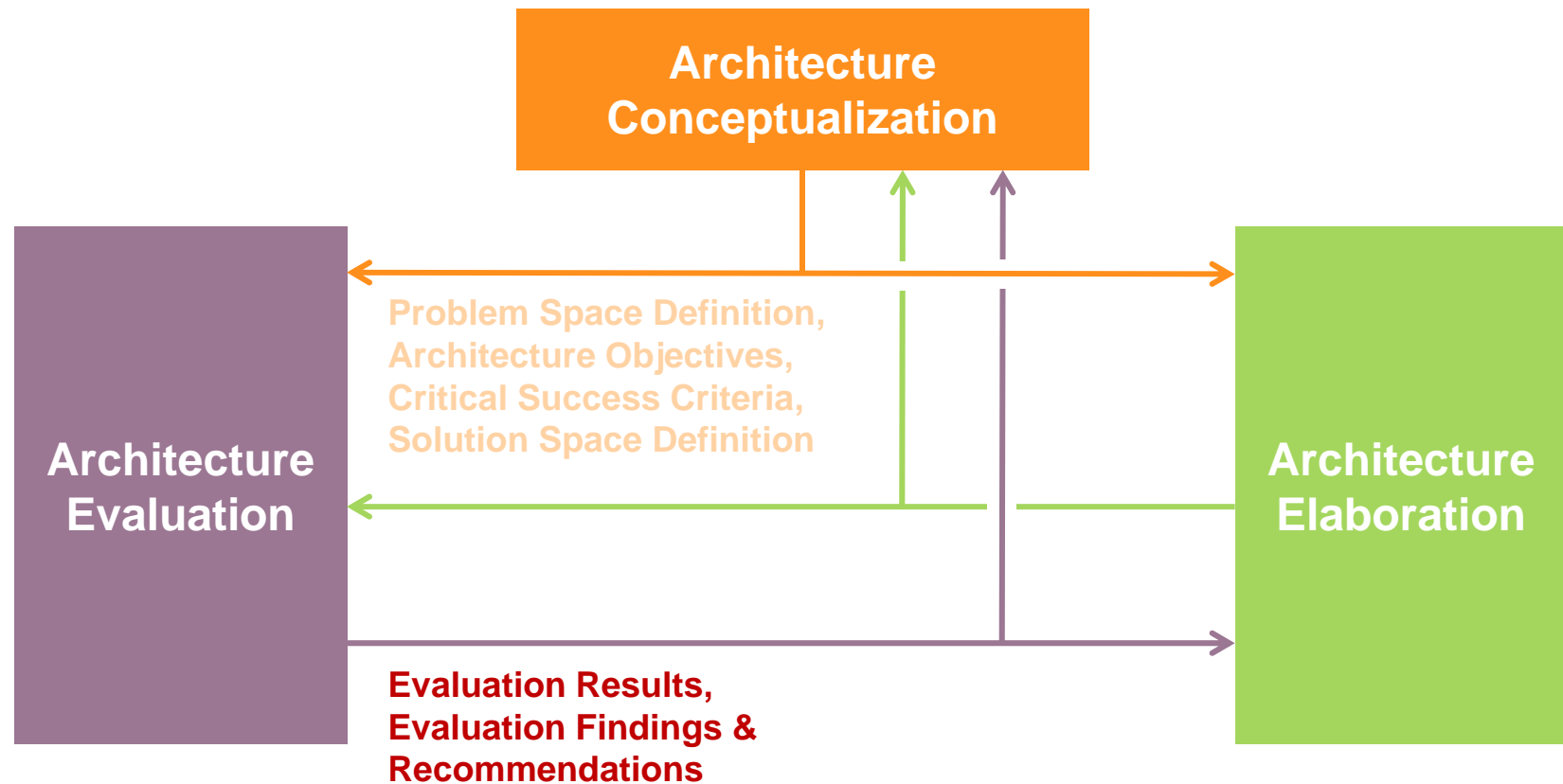
Question: What are alternative ways of solving the Problem?



Good “problem framing” followed by exploration of alternative solutions...

Architecture Evaluation Process

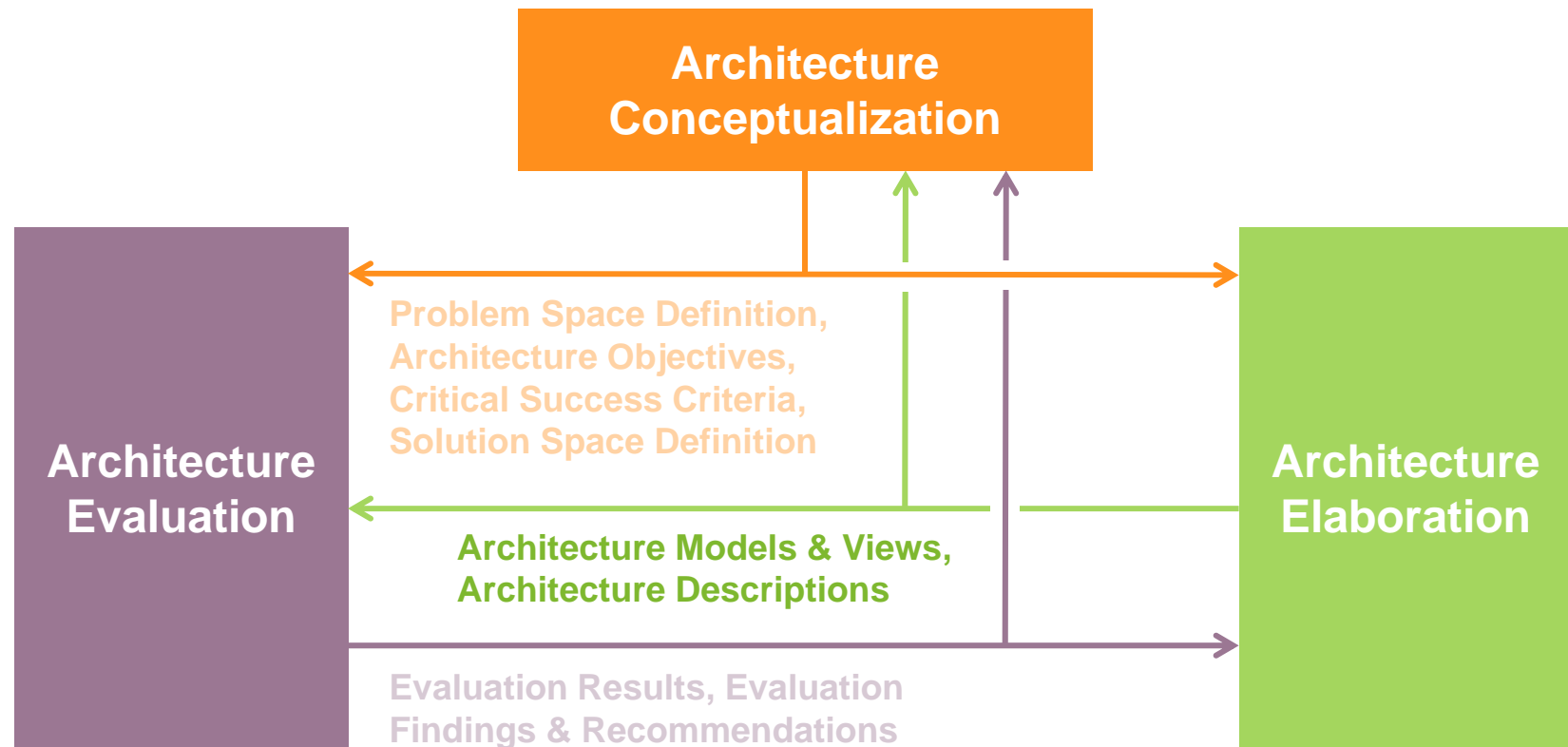
Questions: How good is it? Does it meet the needs?



What does it do? How well does it do this? What difference will it make?

Architecture Elaboration Process

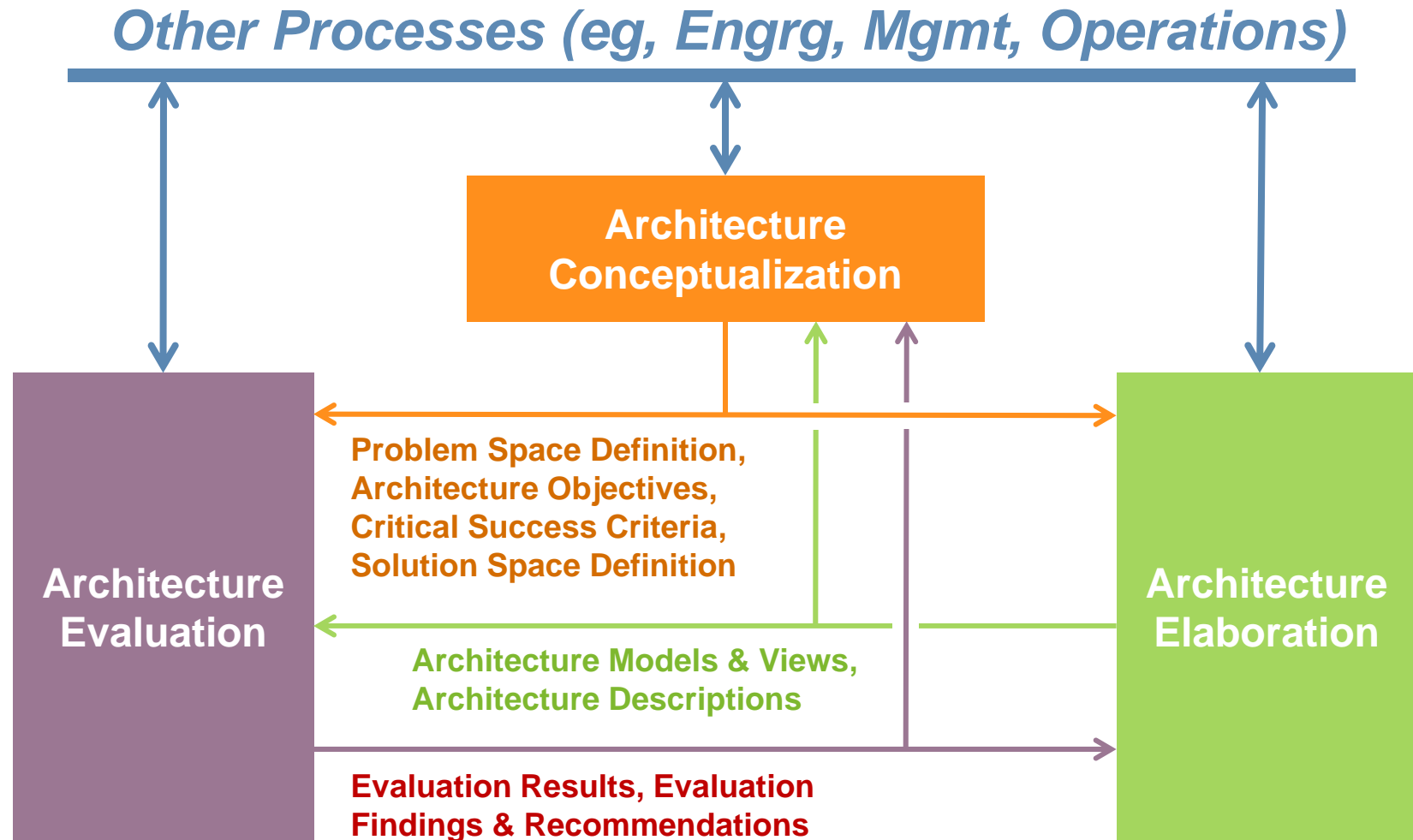
Question: Is there enough “detail” enough for the use of and for the understanding by downstream users?



Application of architecture frameworks, modeling patterns & profiles, and hard core model development techniques & procedures

Interactions with Other Processes

Requirements, Risk, Planning, Budgeting, Management, etc...



Architecting can be very influential across the project and organization, as well as throughout the system life cycle

Two Types of Architecture

Enterprise Architectures

*utilize
these*

Solution Architectures

- Vision & Goals
- Policies & Practices
- Mission & Business Elements
 - Capabilities
 - Segments
 - Execution Threads
 - Organizations
 - Resources

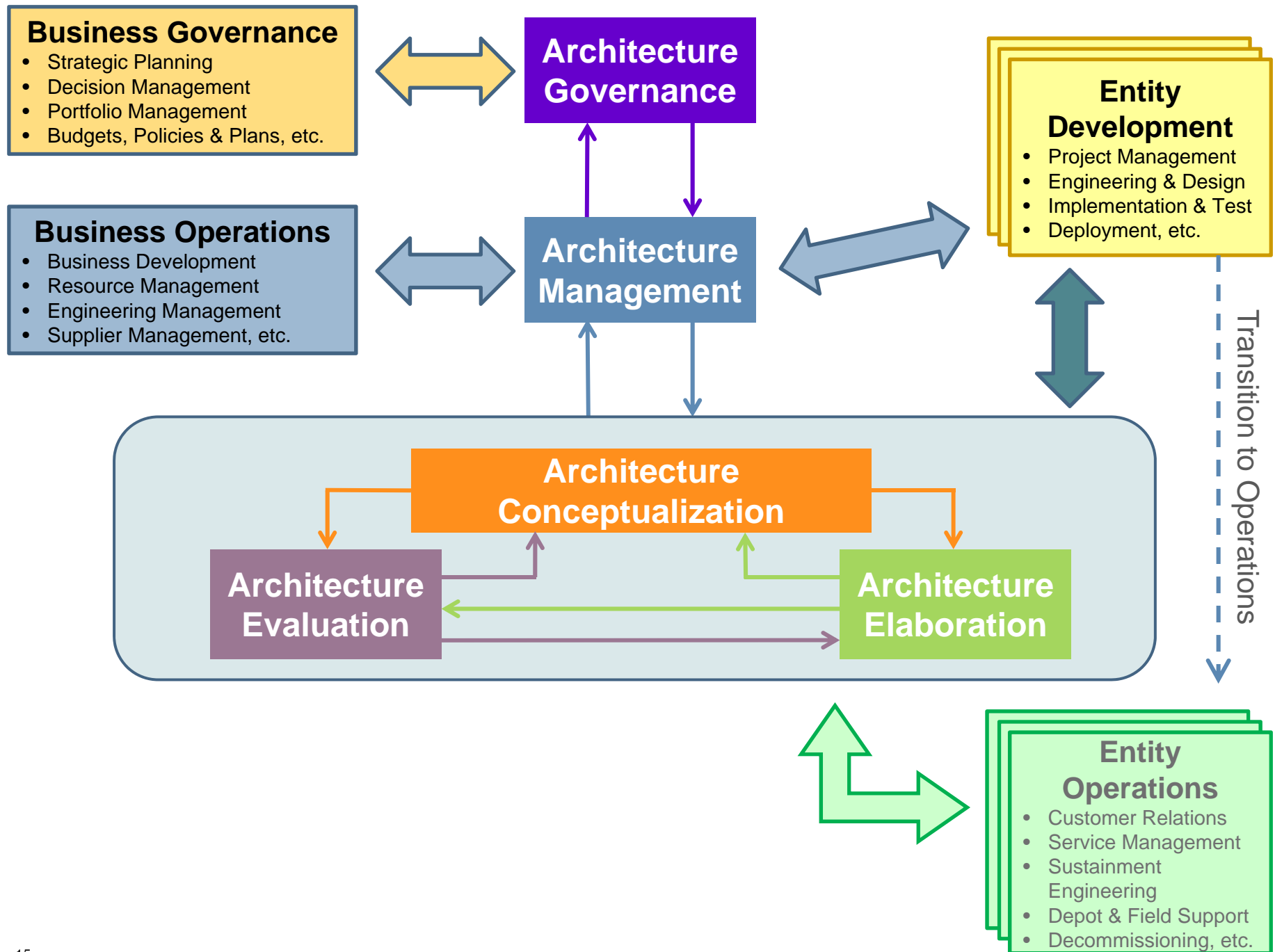
- **System Solutions**
 - Hardware
 - Software
 - People (Roles)
- **Non-System Solutions**
 - People & Organizations
 - Processes & Services
 - Rules & Regulations
 - Education & Training
 - Facilities & Infrastructure

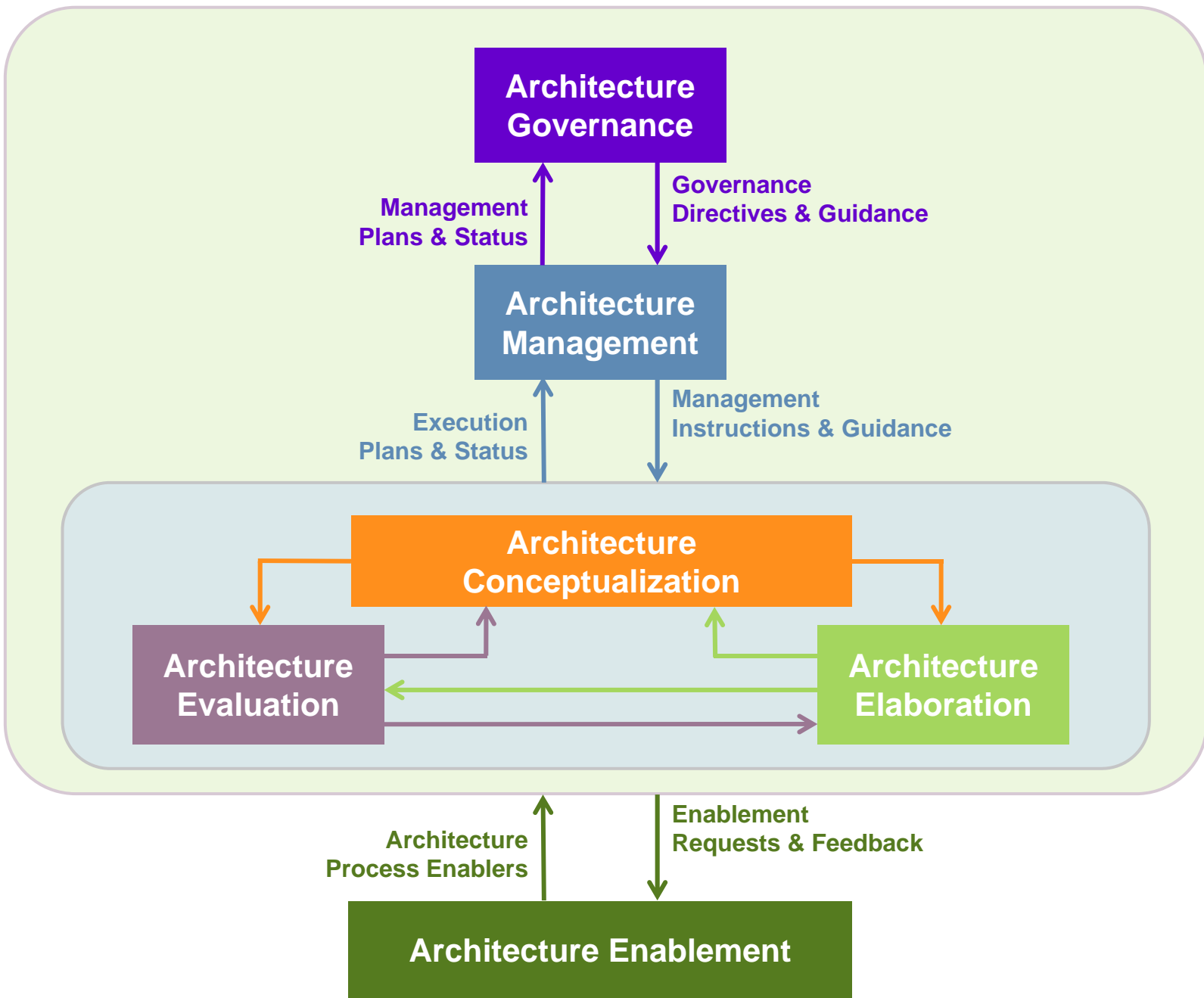
Kinds of “Solutions” to be Architected...

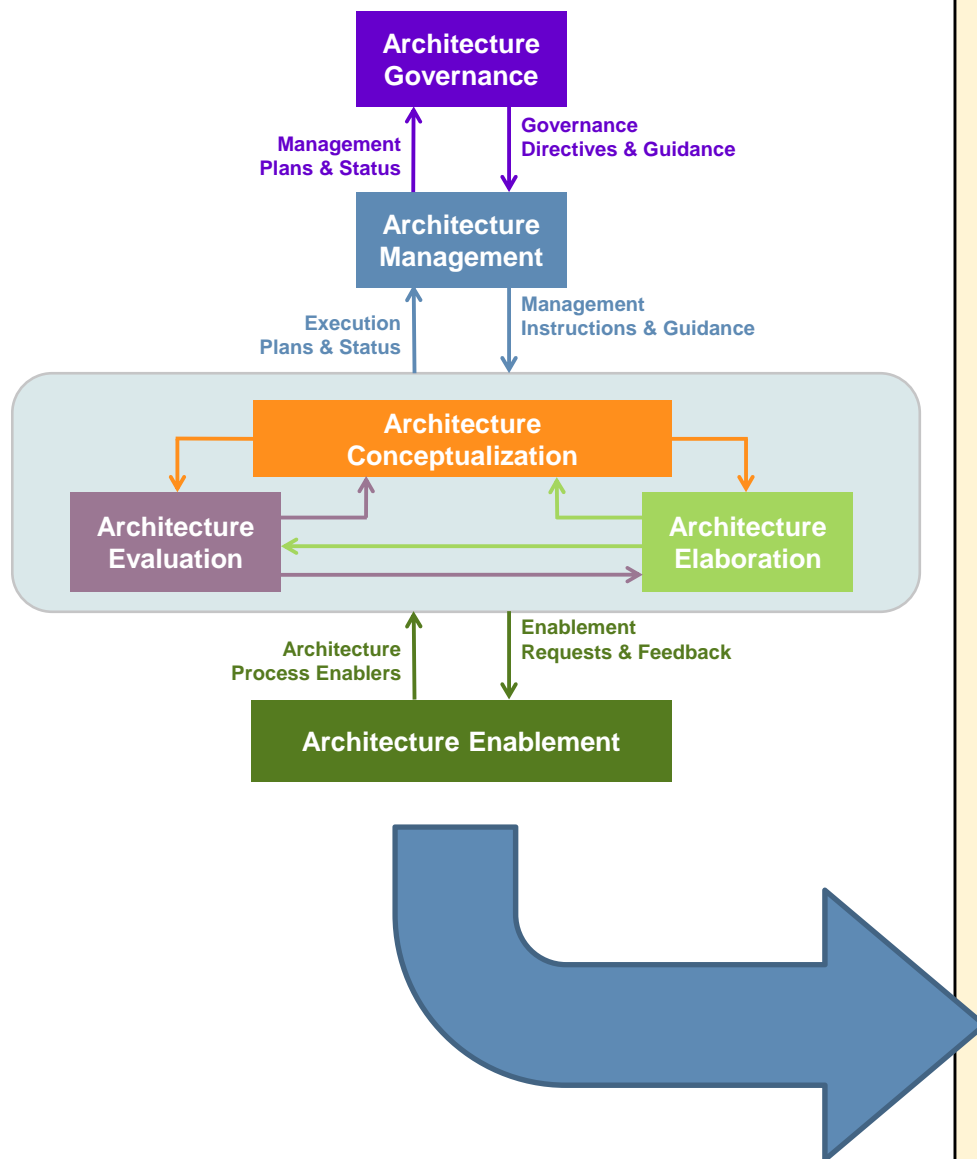


1. Enterprise
2. System of systems
3. Collection of systems
4. Class of systems
5. Family of systems
6. Product line
7. Individual system
8. Portion of a system
9. Product
10. Service
11. Individual hardware or software item
12. Any other entity that is amenable to architectural definition (*eg, data, doctrine, organization, process, method, technique, policy, facilities, etc*)

***Solution = System Elements +
Non-System Elements***







6 Processes → 45 Activities

6 Architecture governance process

- 6.1 Prepare for and plan the architecture governance effort
- 6.2 Monitor, assess and control the architecture governance activities
- 6.3 Establish architecture collection objectives
- 6.4 Make architecture governance decisions
- 6.5 Monitor and assess compliance with governance directives and guidance
- 6.6 Review implementation of governance directives and guidance

7 Architecture management process

- 7.1 Prepare for and plan the architecture management effort
- 7.2 Monitor, assess and control the architecture management activities
- 7.3 Develop architecture management approach
- 7.4 Perform management of the architecture collection
- 7.5 Monitor architecting effectiveness
- 7.6 Prepare for completion of the architecture management plan

8 Architecture conceptualization process

- 8.1 Prepare for and plan the architecture conceptualization effort
- 8.2 Monitor, assess and control the architecture conceptualization activities
- 8.3 Characterize problem space
- 8.4 Establish architecture objectives and critical success criteria
- 8.5 Synthesize potential solution(s) in the solution space
- 8.6 Characterize solutions and the tradespace
- 8.7 Formulate candidate architecture(s)
- 8.8 Capture architecture concepts and properties
- 8.9 Relate the architecture to other architectures and to relevant affected entities
- 8.10 Coordinate use of conceptualized architecture by intended users

9 Architecture evaluation process

- 9.1 Prepare for and plan the architecture evaluation effort
- 9.2 Monitor, assess and control the architecture evaluation activities
- 9.3 Determine evaluation objectives and criteria
- 9.4 Determine evaluation methods and integrate with evaluation objectives and criteria
- 9.5 Establish measurement techniques, methods and tools
- 9.6 Collect and review evaluation-related information
- 9.7 Analyze architecture concepts and properties and assess stakeholder value
- 9.8 Characterize architecture(s) based on assessment results
- 9.9 Formulate findings and recommendations
- 9.10 Capture and communicate evaluation results

10 Architecture elaboration process

- 10.1 Prepare for and plan the architecture elaboration effort
- 10.2 Monitor, assess and control the architecture elaboration activities
- 10.3 Identify or develop architecture viewpoints
- 10.4 Develop models and views of the architecture(s)
- 10.5 Relate the architecture to other architectures and to relevant affected entities
- 10.6 Assess the architecture elaboration
- 10.7 Coordinate use of elaborated architecture by intended users

11 Architecture enablement process

- 11.1 Prepare for and plan the architecture enablement effort
- 11.2 Monitor, assess and control the architecture enablement activities
- 11.3 Manage the architecture process enablers
- 11.4 Acquire, develop and establish enabling capabilities, services and resources
- 11.5 Deploy enabling capabilities, services and resources
- 11.6 Improve architecture enablement capabilities, services and resources

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Sample Activities & Tasks

1. Prepare for and plan the architecture

conceptualization effort

- a) *Identify the potential problem area(s) that can be addressed by an architecture.*
- b) *Define the expected purpose, scope, objectives, and level of detail of the architecture conceptualization effort.*
- c) *Define one or more architecture conceptualization approaches that are consistent with the architecture governance and management directions and are consistent with the purpose, scope and objectives of this effort.*
- d) *Select or develop the requisite architecture conceptualization techniques, methods and tools.*
- e) *Plan the architecture conceptualization effort.*
- f) *Establish metrics for the architecture conceptualization effort.*
- g) *Collect the data and information needed for the architecture conceptualization effort.*
- h) *Obtain access to enablers needed for the architecture conceptualization effort.*
- i) *Ensure personnel are trained in the use of identified techniques, methods and tools.*

2. Monitor, assess and control the architecture

conceptualization activities

- a) *Report architecture conceptualization activity plans and status.*
- b) *Monitor and assess whether architecture governance directives and guidance are being followed.*
- c) *Monitor and assess whether architecture management instructions and guidance are being followed.*
- d) *Monitor and assess metrics for the architecture conceptualization effort.*
- e) *Identify and assess risks and opportunities associated with the architecture conceptualization effort.*
- f) *Maintain traceability of architecture conceptualization results to the source material used during the process.*
- g) *Ensure that relevant technical, project and organizational processes are properly using architecture conceptualization products.*
- h) *Ensure that relevant enterprise processes are properly using architecture conceptualization products.*

3. Analyze problem space

- a) *Identify current and projected situation(s) in the problem space.*
- b) *Identify relevant aspects of the identified situation(s).*
- c) *Identify problems or difficulties in the current and projected situation(s).*
- d) *Identify stakeholders and their concerns corresponding to each of these problems or difficulties.*
- e) *Identify quality attributes associated with these stakeholder concerns.*
- f) *Understand how the problems or difficulties affect different stakeholders and their priorities in addressing them.*
- g) *Understand complexities of each problem or difficulty, its cause and effect, and how it is being addressed currently in each of the identified situations.*
- h) *Determine bounding conditions, root causes, and relevant scenarios for each identified problem or difficulty.*

- i) *Determine gaps or shortfalls of current or planned solutions in addressing the problem.*
- j) *Identify relevant assumptions, degrees of freedom, constraints, conditions and challenges.*
- k) *Develop an inference network showing the cause and effect relationships for the identified problem(s) or difficulties.*
- l) *Formulate a clear statement of the problem(s).*
- m) *Identify and define architecture objectives that address the problem(s).*
- n) *Define evaluation criteria that can be used to assess the degree to which the problems(s) are resolved and to inform exploration and selection of alternatives.*

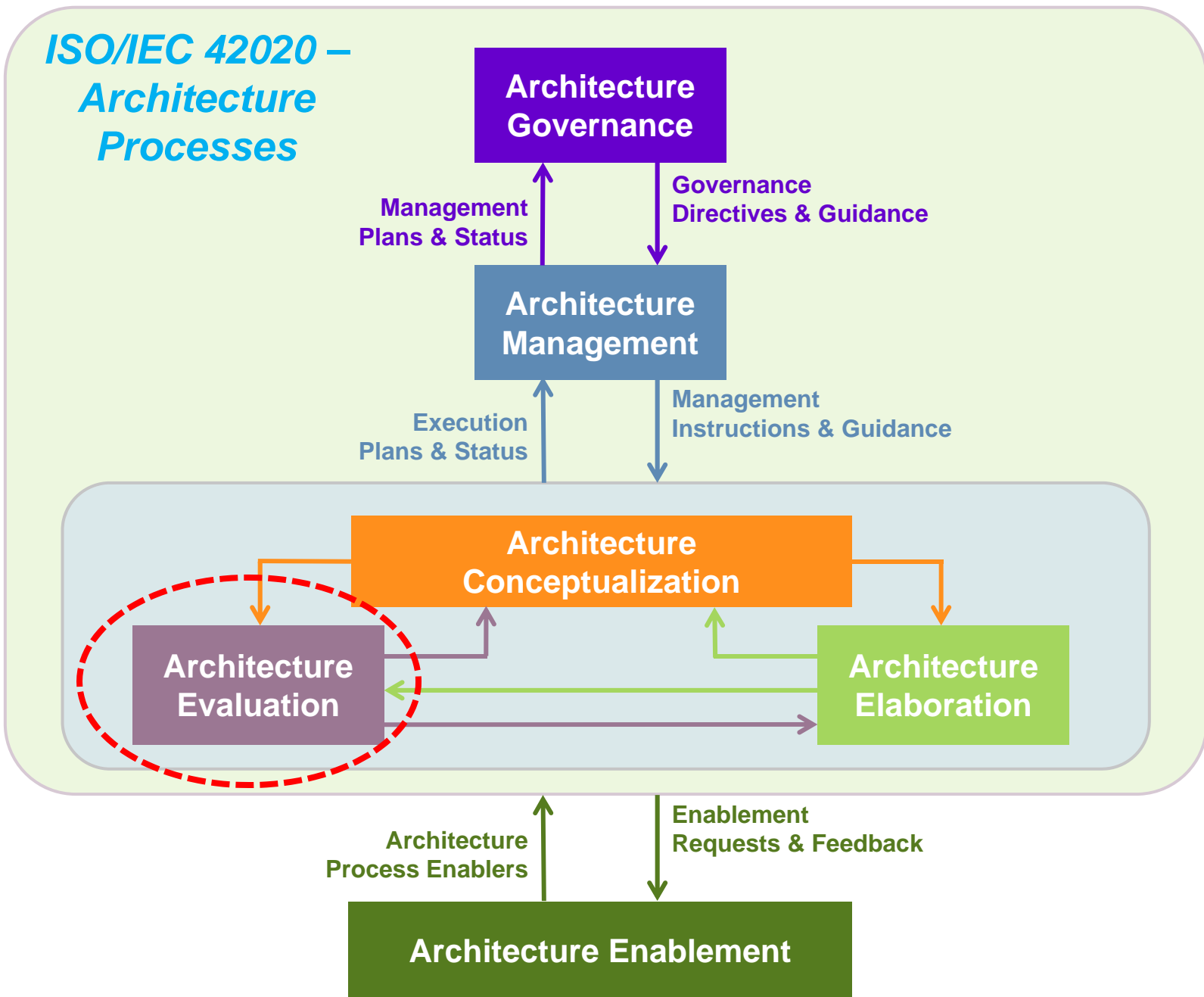
4. Synthesize potential solution(s)

- a) *Develop an objectives view by reformulating the elements in the inference network as conditions and levels to be achieved in addressing the problems revealed by the inference network.*
- b) *Identify problem mitigation strategies that can achieve these conditions and levels and serve as potential solution(s).*
 - 1) *Perform technology scan for relevant technologies.*
 - 2) *Perform problem/solution pattern scan for relevant solutions to similar problems.*
 - 3) *Perform natural system metaphor scan for possible naturally occurring solutions to similar problems.*
- c) *Review the resulting relationships between problem mitigation strategies and problem causes to assure the completeness of the potential solution(s).*
- d) *Formulate purpose statement(s) for each potential solution.*
- e) *Identify needs, wants and expectations for each potential solution.*
- f) *Identify relevant critical success factors and key performance indicators.*
- g) *Understand stakeholders' value creation context and formulate value propositions for each potential solution.*
- h) *Identify strengths, weaknesses, opportunities and threats for each potential solution.*
- i) *Identify other important aspects related to each potential solution, including but not limited to the following.*
 - 1) *Identify and characterize risks for each potential solution.*
 - 2) *Identify assumptions with respect to each potential solution.*
 - 3) *Identify additional problems that might be caused by each potential solution.*
 - 4) *Determine remaining gaps or shortfalls after implementing the proposed solutions.*
- j) *Harmonize elements of each potential solution to ensure that it can be realized in a coherent and cohesive manner.*
- k) *Formulate a roadmap for implementing the proposed solution(s).*
- l) *Define evaluation criteria that can be used to assess the degree to which the proposed solution(s) address the specified problem(s) and to inform exploration and selection of alternatives.*

5. Formulate potential architecture(s)

- a) *Establish and capture the desired functional and non-functional characteristics based on the potential solution(s) with respect to the purpose of each solution that correspond to the quality attributes identified during problem space analysis.*
- b) *Etc...*

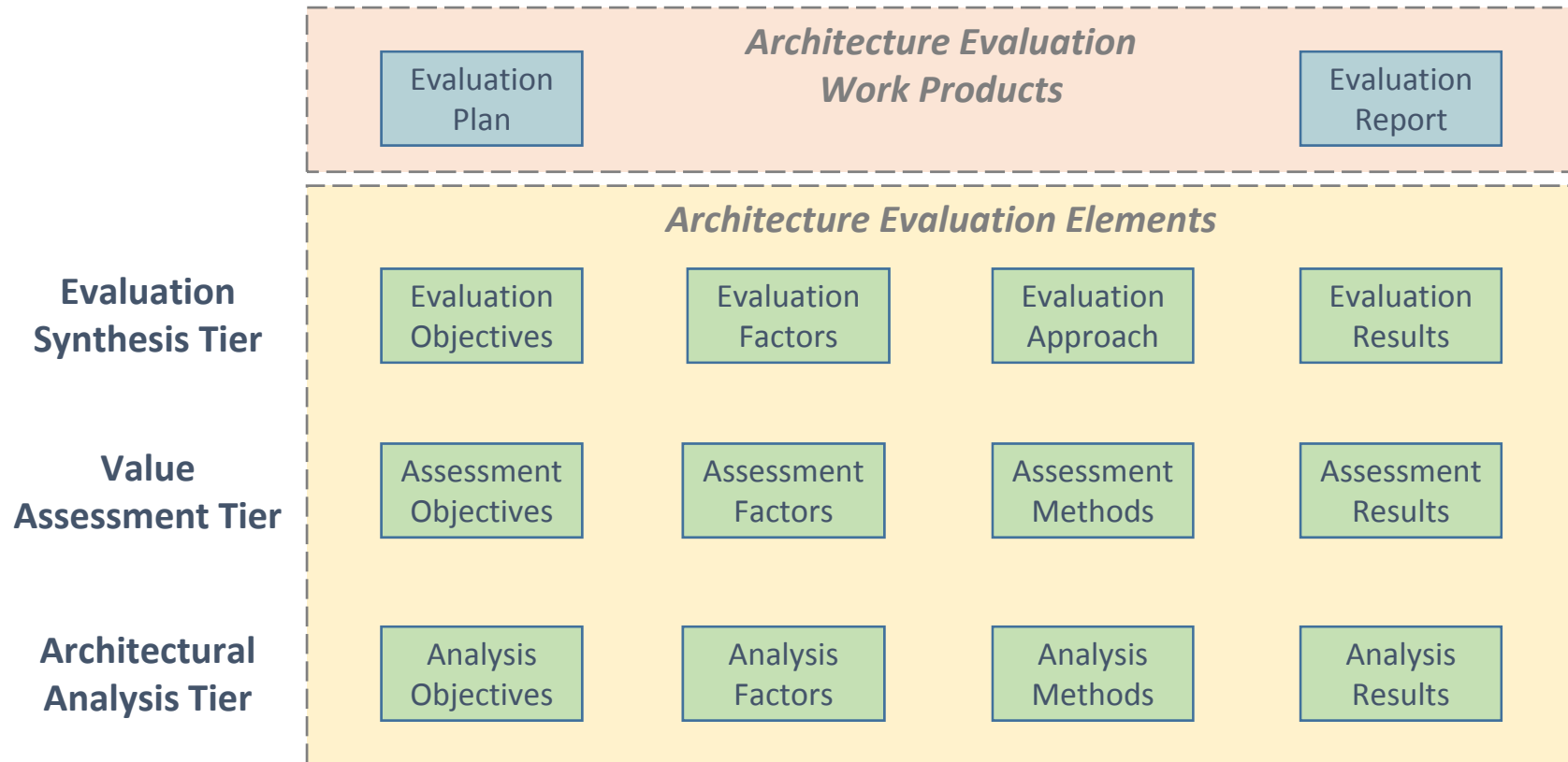
ISO/IEC 42020 – Architecture Processes





42030 – Architecture Evaluation Framework

A 3-Tier Framework for organizing the evaluation effort



Objectives, Factors, Methods & Results organized in a well-structured manner to facilitate more effective evaluations



Architecture Standards from ISO

Current & Future

- 42010 – Architecture Description
 - *Concepts used in architecture frameworks and modeling tools*
 - *Published in 2011 – Based on the IEEE 1471 standard*

- **42020 – Architecture Processes**
 - ***Started 2015 (expected release in 2018)***
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Conclusions

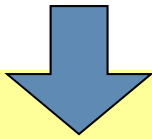


- Emerging standards on architecture
 - *Could be adopted by your organization*
 - *Useful for personal mastery of architecting*
 - *Can provide a useful “framework” for developing Ground System Architectures*
- Architecture is about more than...
 - *Architecture products, models, views...*
 - *Engineering the right stuff*
 - *“System” solutions*

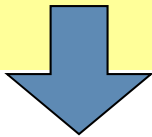
From Needs to Architecture



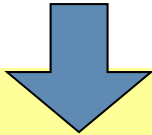
Needs



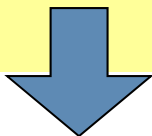
Operations Concept



Functional Capabilities



Architecture



- What needs are we trying to fill?
- What is wrong with the current situation?
- Is the need clearly articulated?

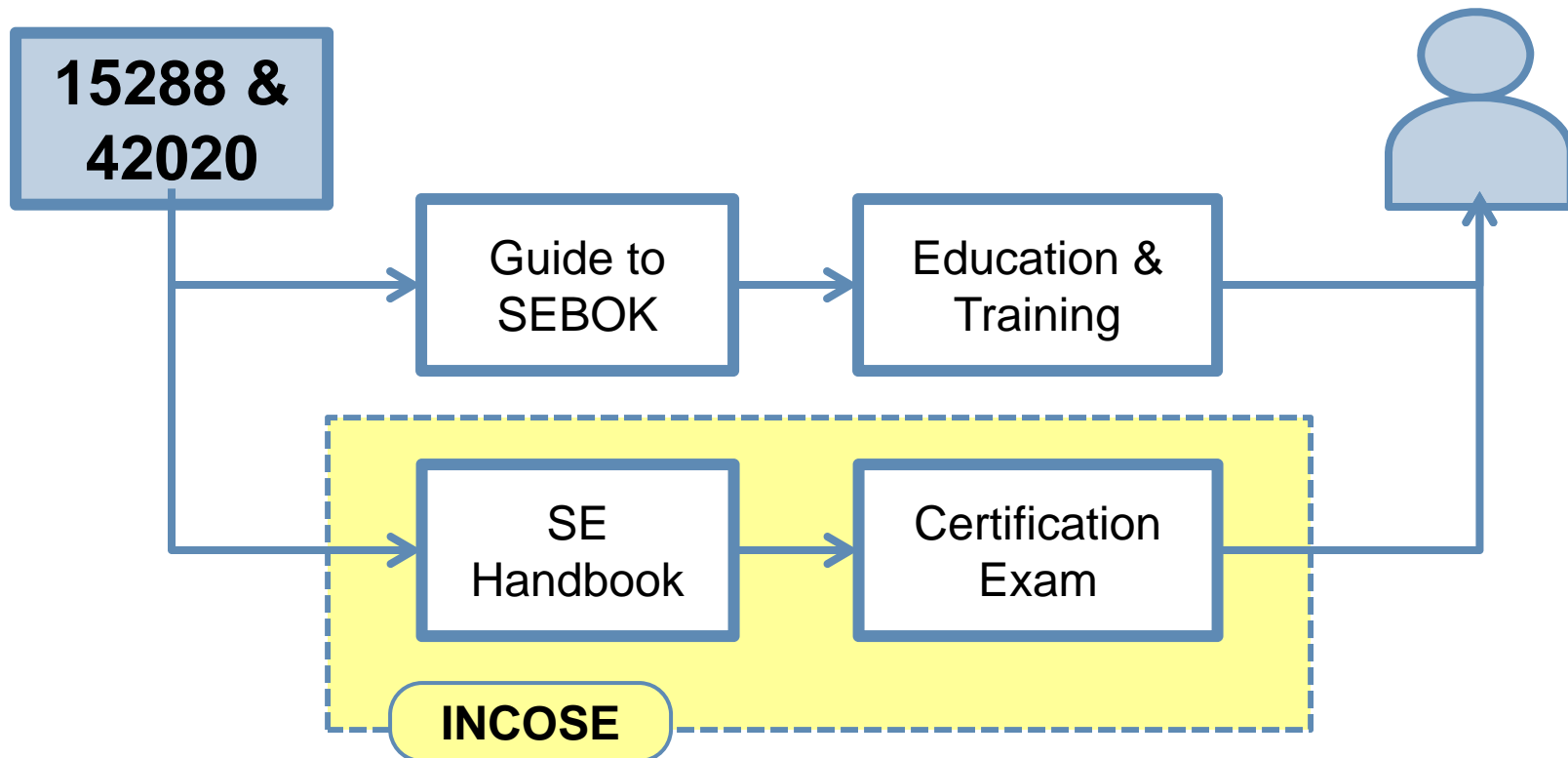
- Who are the intended users?
- How will they use our products?
- How is this different from the present?

- What specific capability will we provide?
- To what level of detail?
- Are element interfaces well defined?

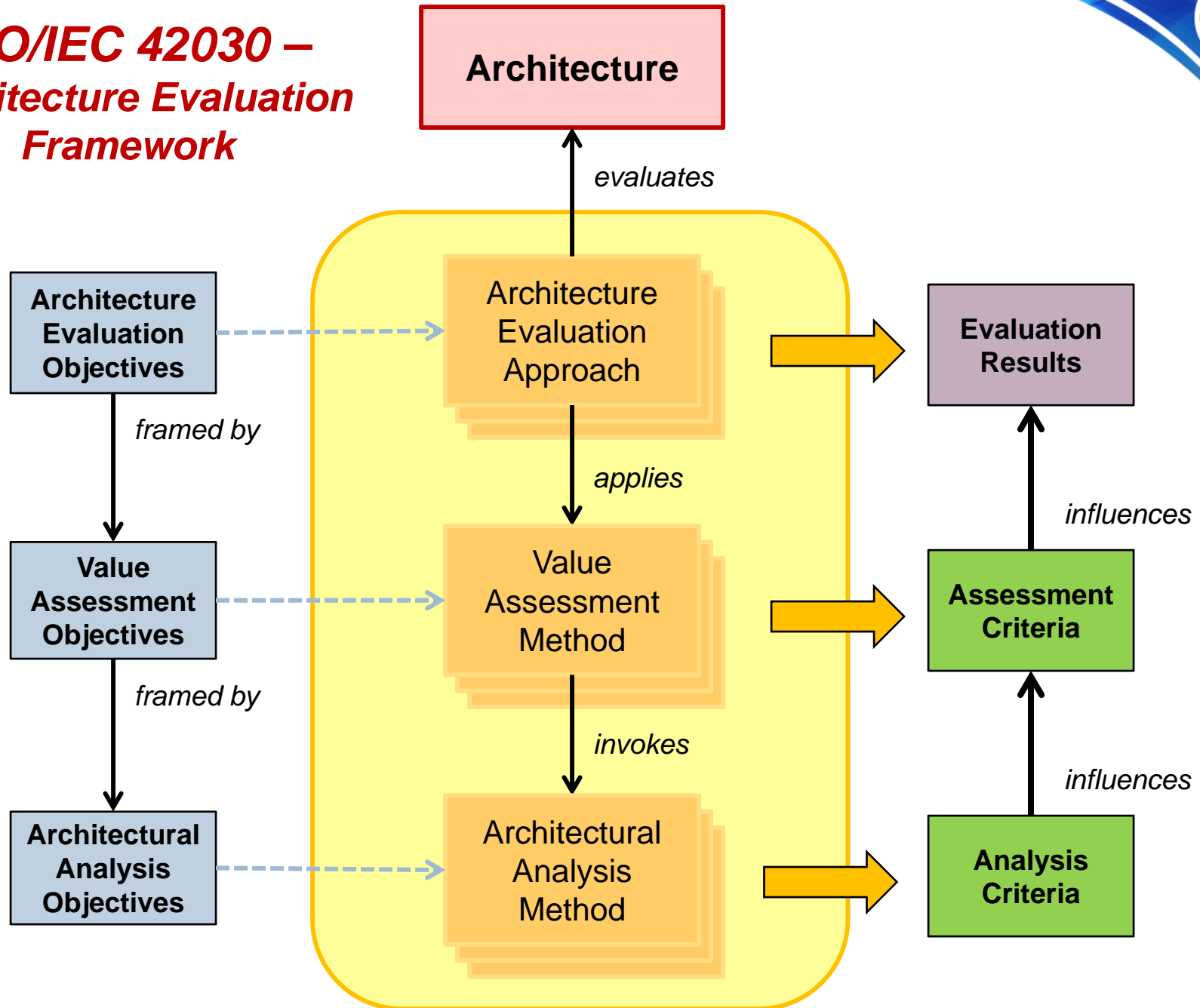
- What is the overall plan of attack?
- What elements make up the overall approach?
- Are these complete, logical, and consistent?

Why use ISO standards?

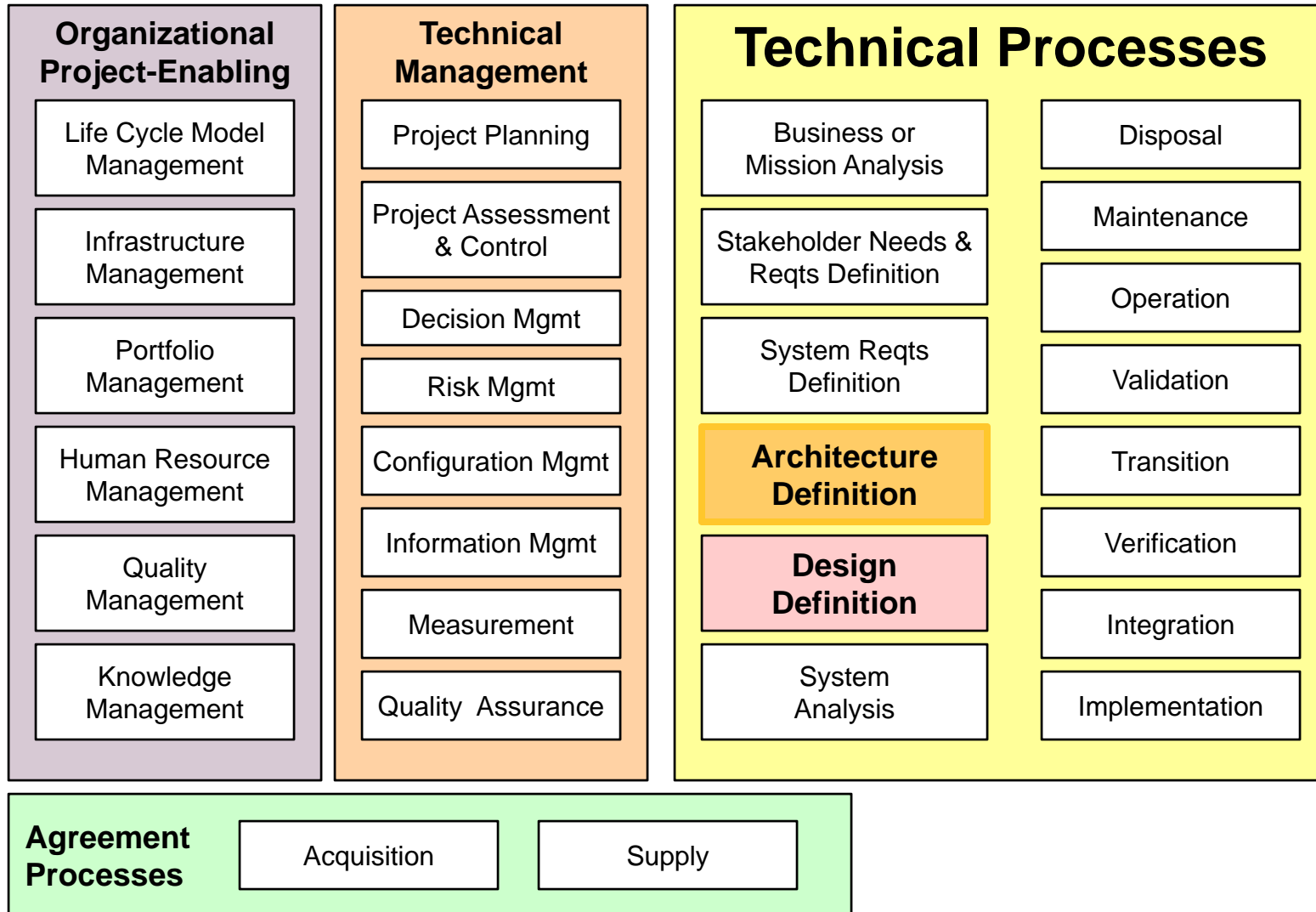
- ISO/IEC 15288 – System Life Cycle Processes (March 2015)
- ISO/IEC 42020 – Architecture Processes (~2017)



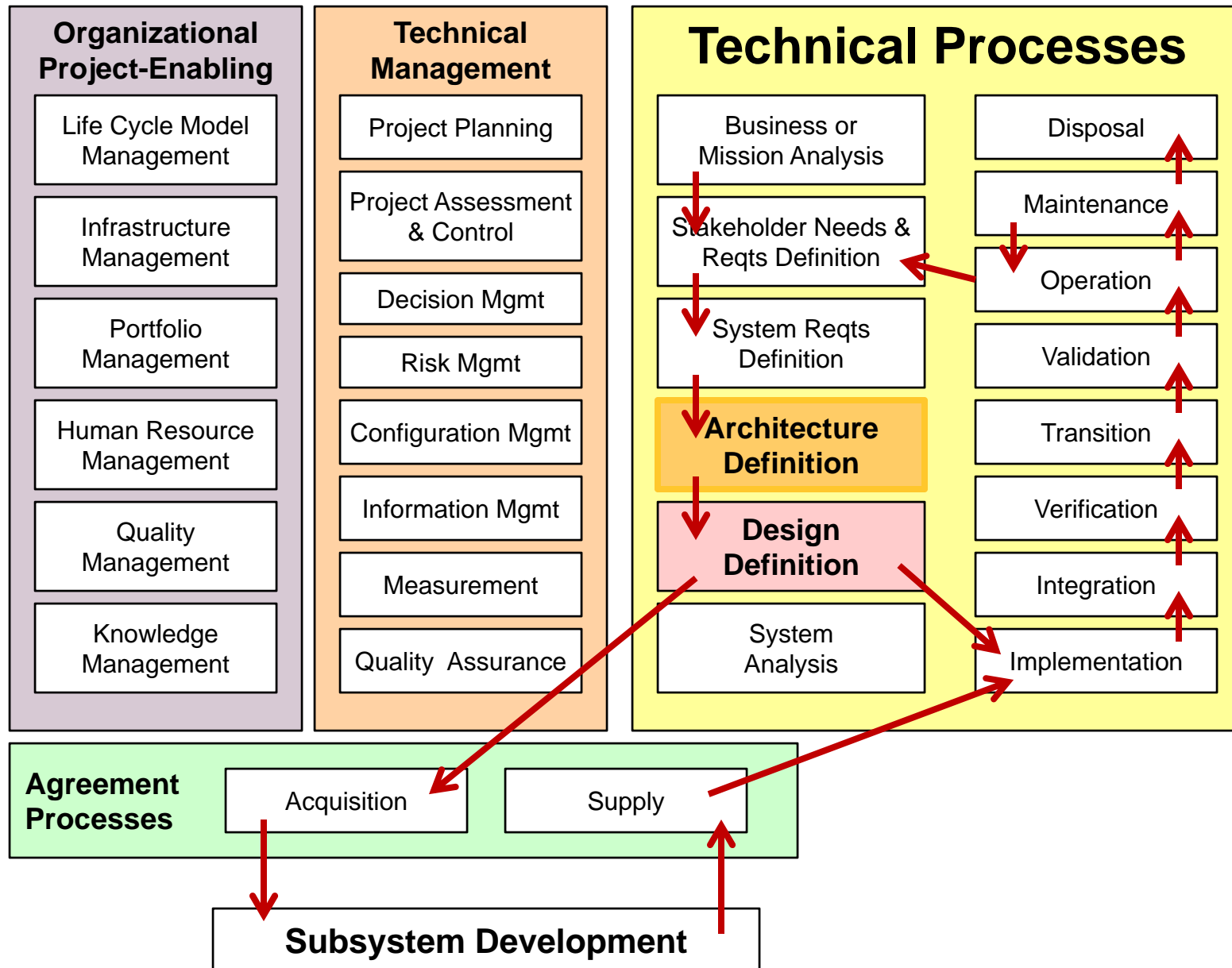
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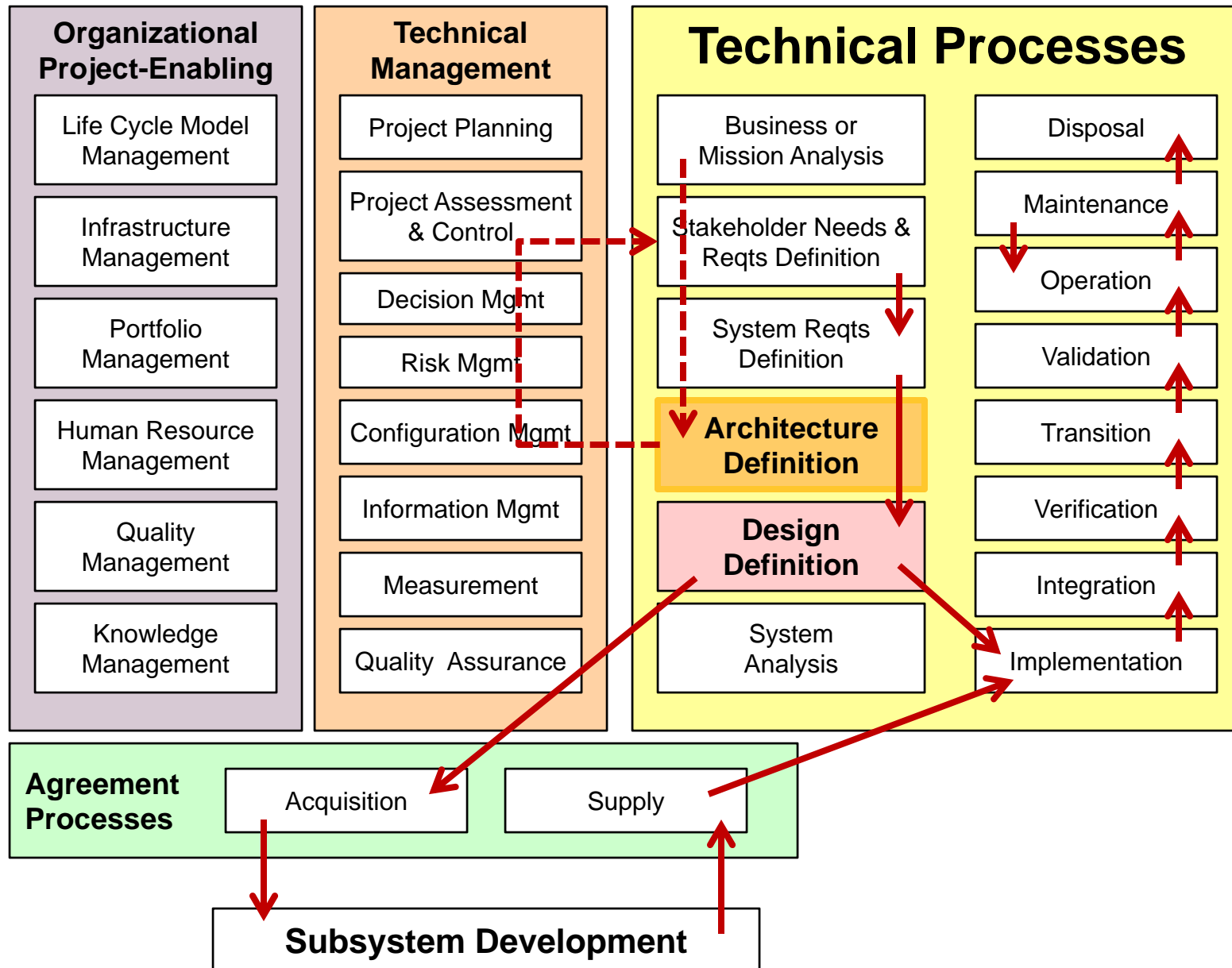
System Life Cycle Processes in 15288 (2015)



Traditional Top-Down System Development



Architecture-Driven System Development



Architecture Drives More than Just Design

