

# Essence for Systems Engineering (Systems Engineering Essence)

INCOSE  
Russian  
Chapter



Berlin  
20 June 2013

# Context

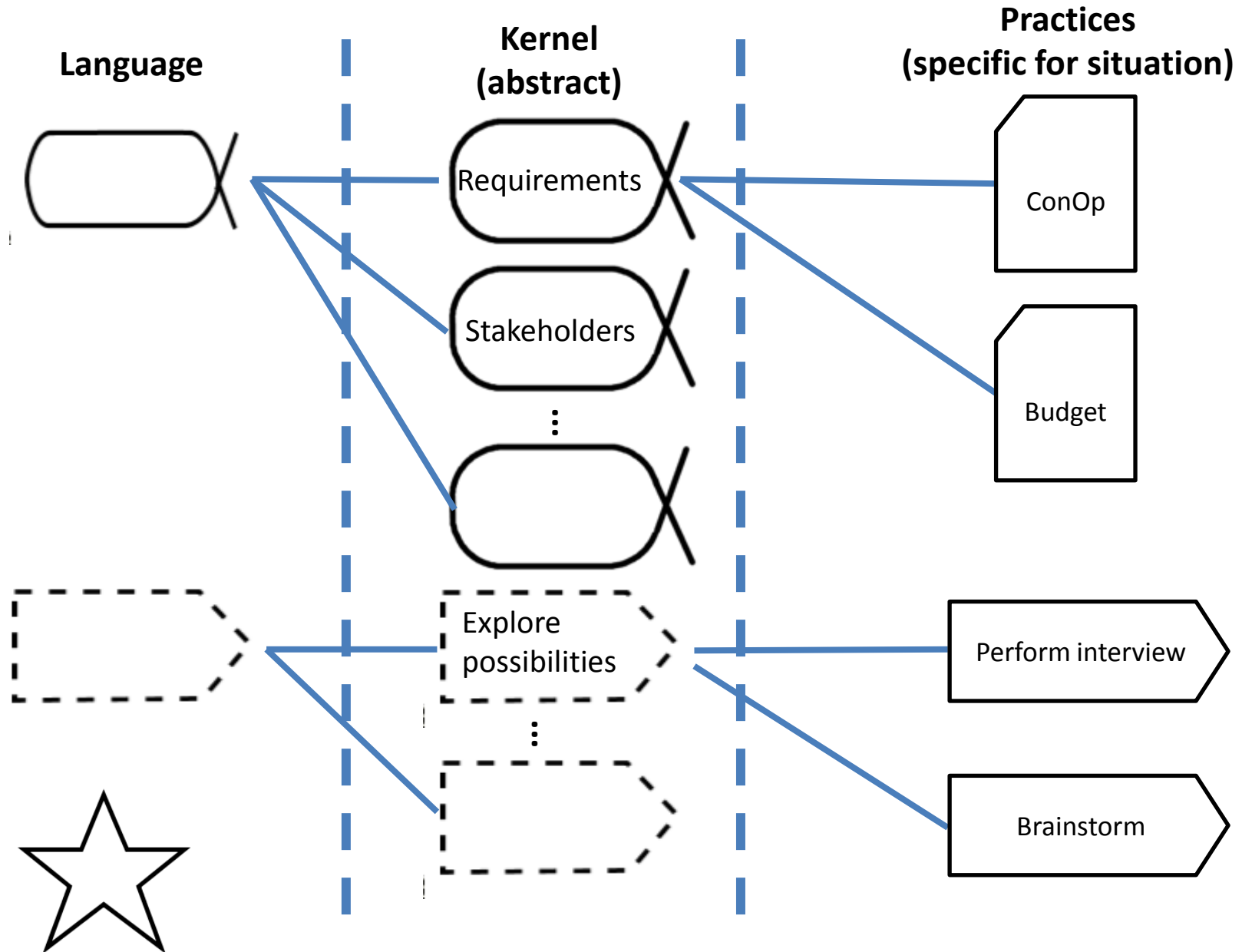
Roadmap (<http://semat.org/?p=863>):

- 1st of August 2013 – define model and architecture ontological status in the Essence
- 1st of September 2013 – publish first draft of the Essence kernel extension for Systems Engineering
- 1st of December 2013 – map Essence Systems Engineering kernel elements to ISO 15926
- End of December 2013 – publish first version of the “Essence systems engineering kernel elements (mapped to the ISO 15926)”

Achievements:

- Proposal discussed at the INCOSE Russian Chapter on 22<sup>nd</sup> of May 2013 (<http://incose-ru.livejournal.com/42524.html>).
- Proposal discussed at MESI conference on 6-7<sup>th</sup> of June 2013 (<http://www.mesi.ru/our/events/detail/121699/>) with Ivar Jacobson and wider audience.

# Language, kernel, practice



# Alpha: states = checklists : checkpoints

ALPHA -- Abstract-Level Progress Health Attribute.

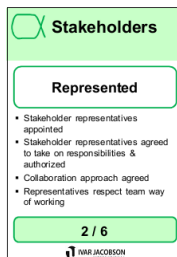
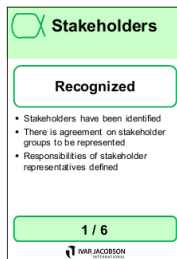
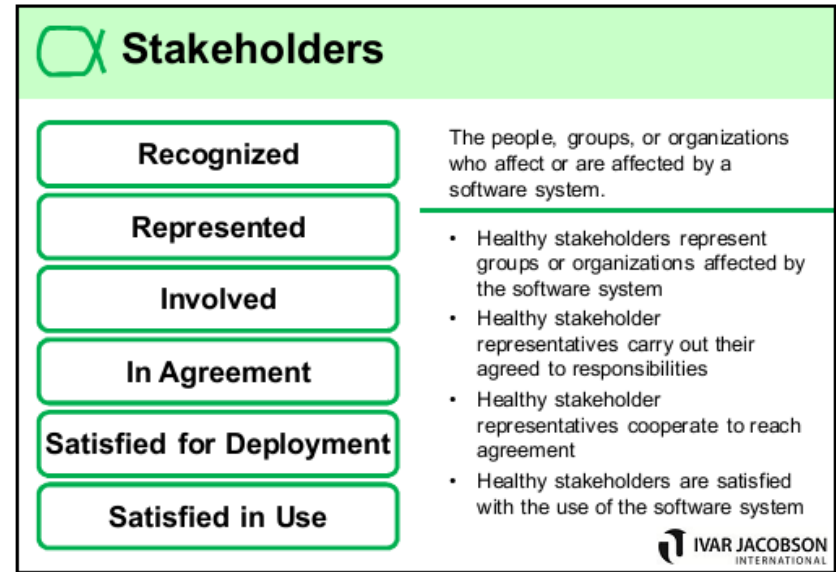
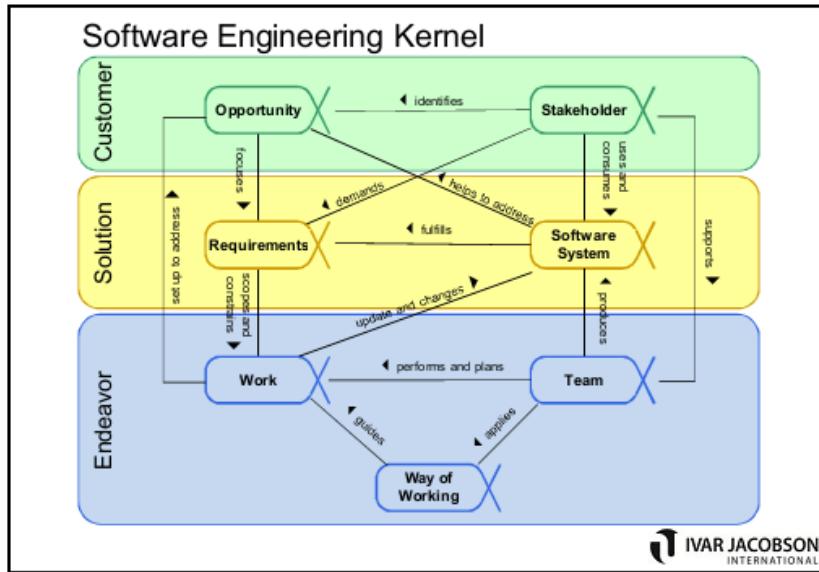
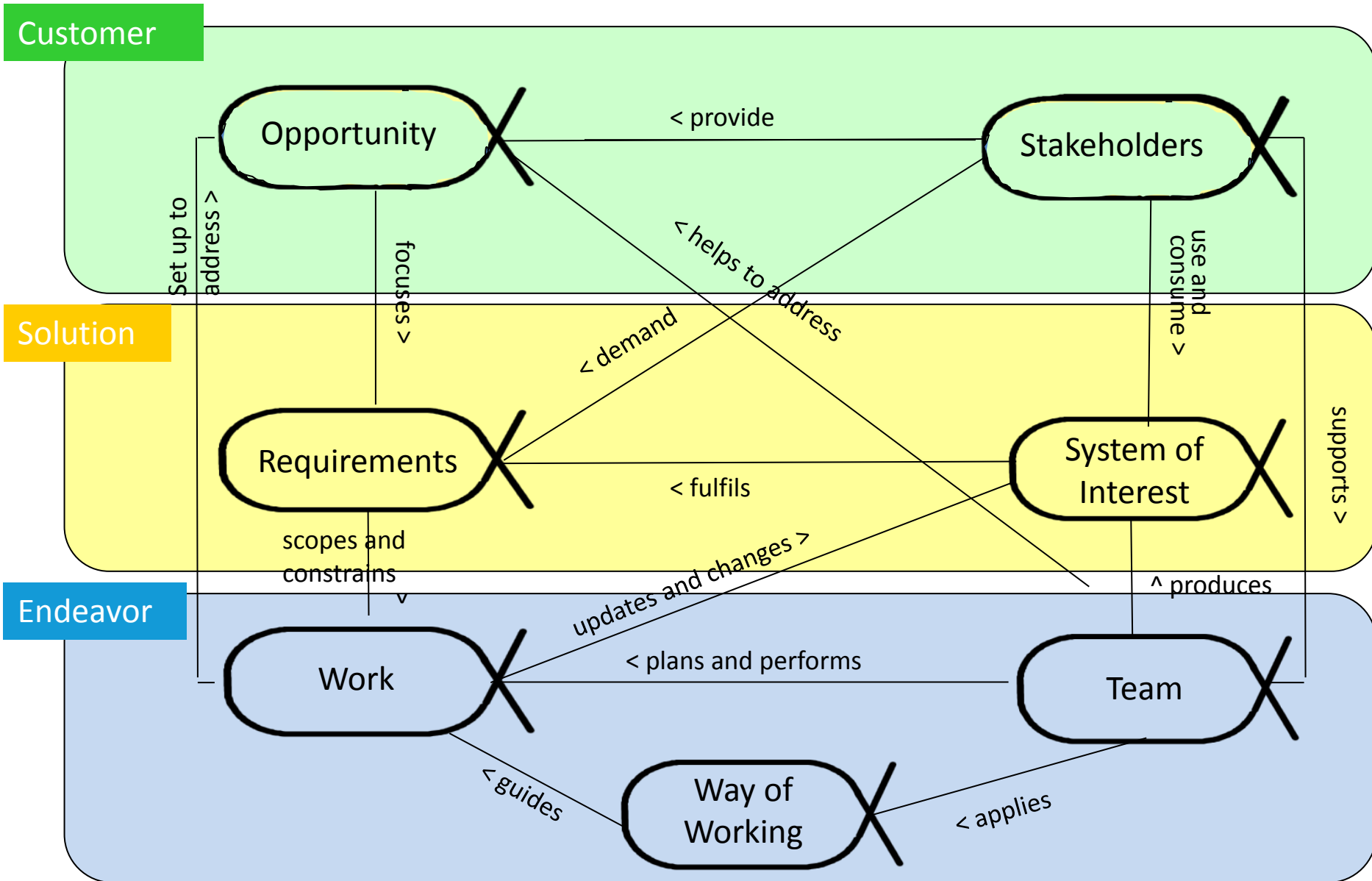


Table 8 – Checklist for Stakeholders

State	Checklist
Recognized	<p>All the different groups of stakeholders that are, or will be, affected by the development and operation of the software system are identified.</p> <p>There is agreement on the stakeholder groups to be represented. At a minimum, the stakeholder groups that fund, use, support, and maintain the system have been considered.</p> <p>The responsibilities of the stakeholder representatives have been defined.</p>
Represented	<p>The stakeholder representatives have agreed to take on their responsibilities.</p> <p>The stakeholder representatives are authorized to carry out their responsibilities.</p> <p>The collaboration approach among the stakeholder representatives has been agreed.</p> <p>The stakeholder representatives support and respect the team's way of working.</p>

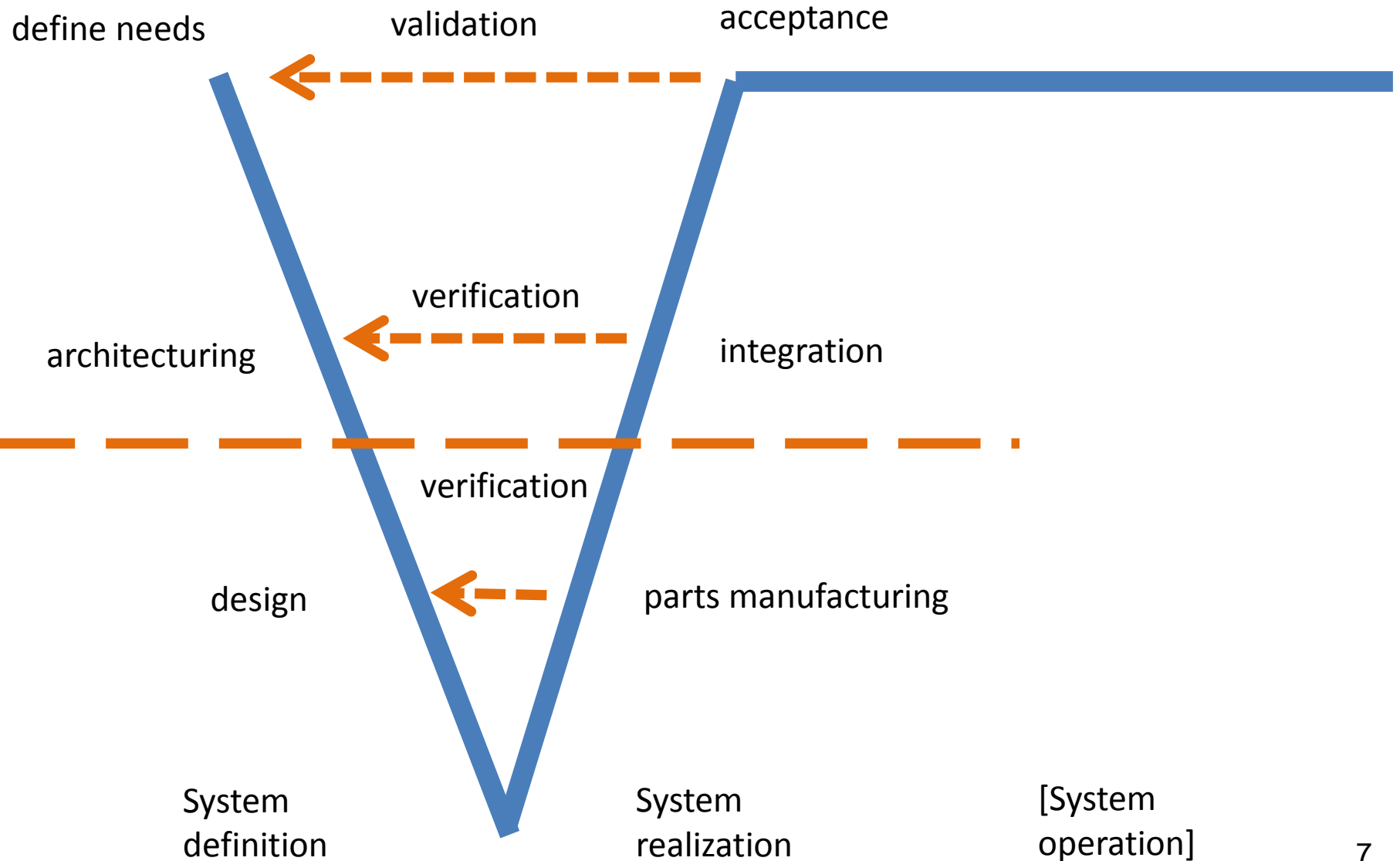
# Engineering project alphas: as is



# Systems engineering

- Intuition: V-model
- Focus on system definition (more resources to define the system, i.e. more work with bits rather than atoms)
- Agile in the work with bits, cascade in the work with atoms.
- Architecture and design are of the same importance as requirements (constraints to design solutions, focusing in Essence terms).

# 2D representation of Life Cycle: practices executed in time



# Requirements, Architecture, Design and System: state redistribution is needed

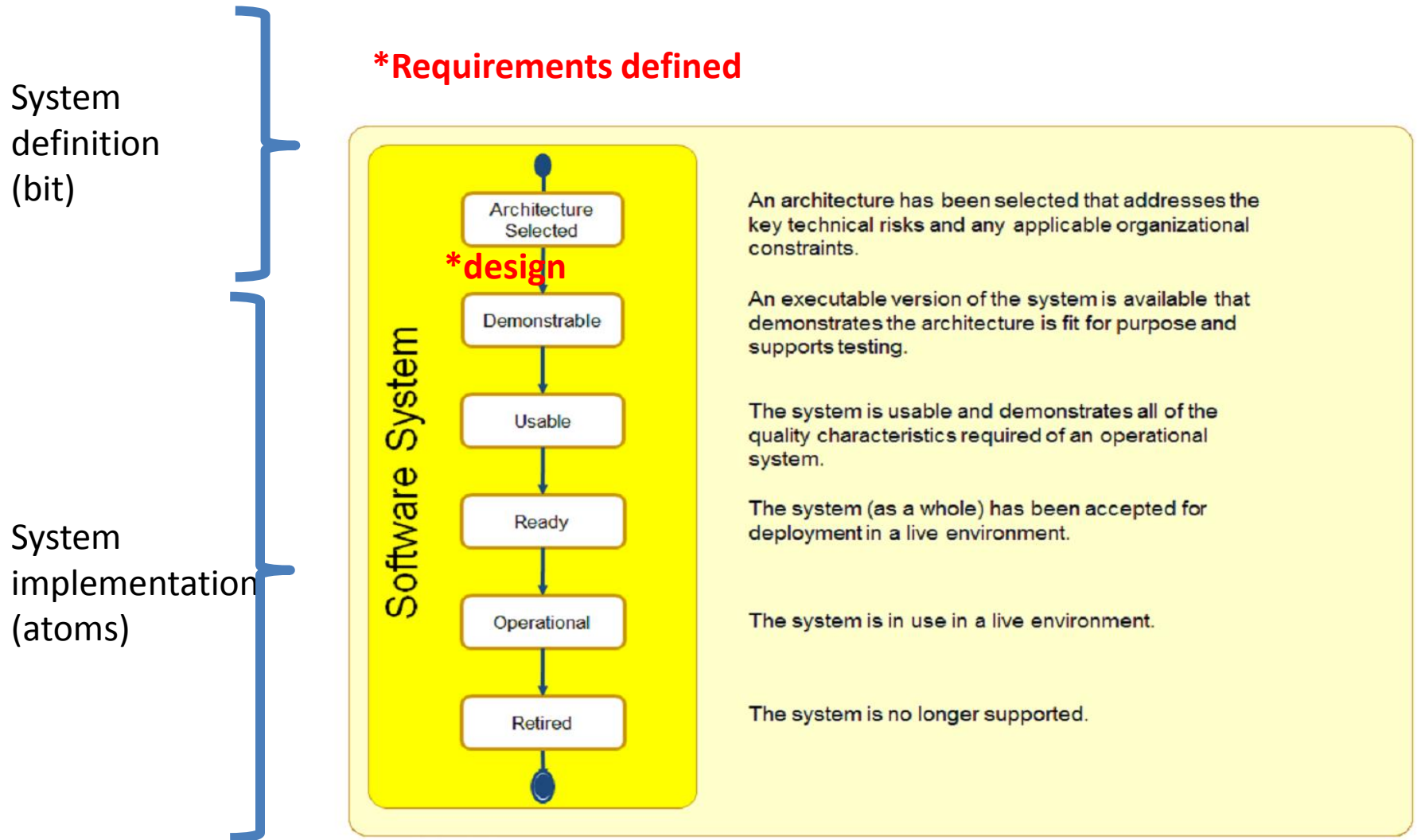


Figure 12 – The states of the Software System



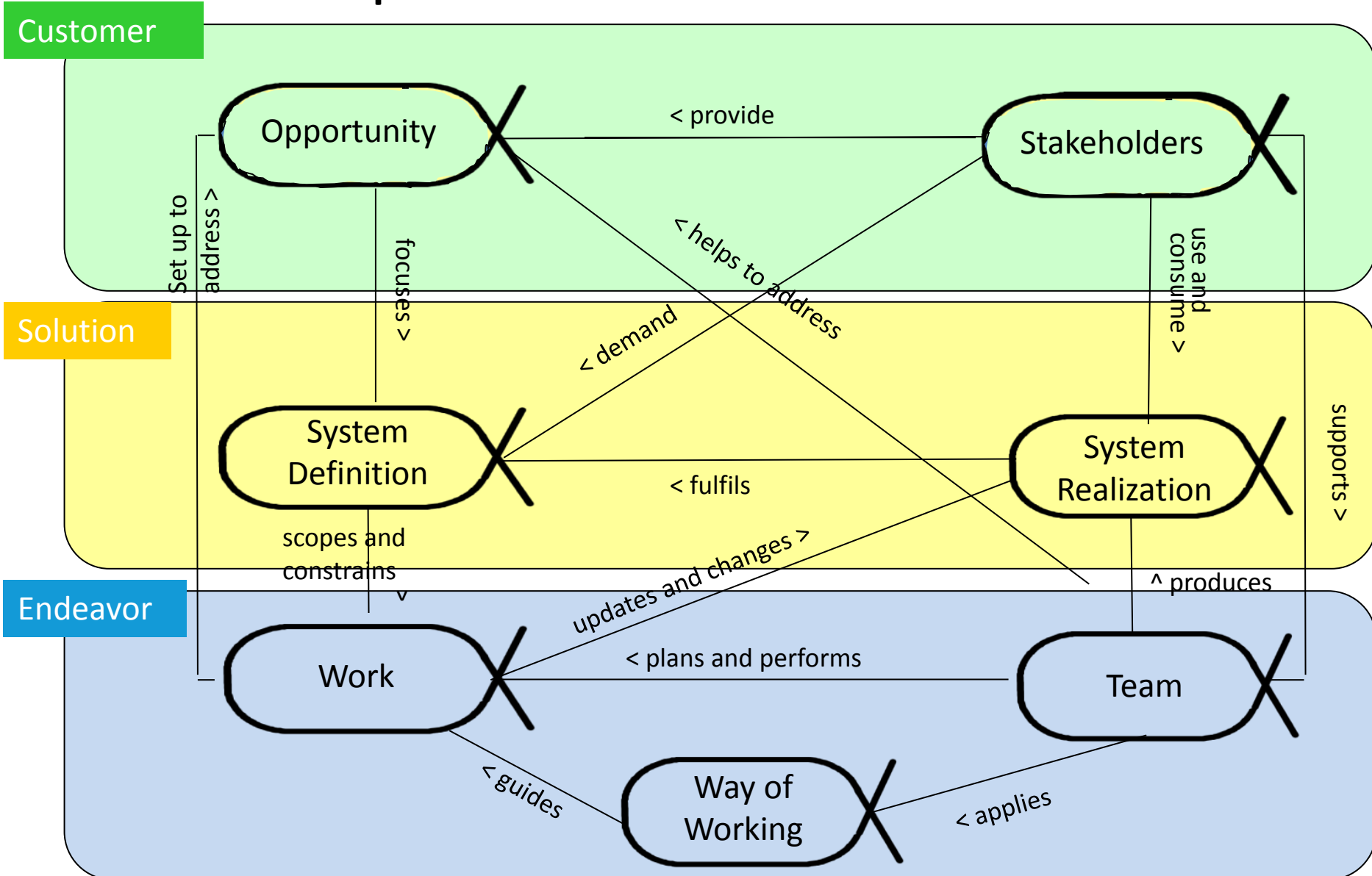
# Essence and Architecture

- Not present in current standard as alpha:  
«architecture wasn't addressed explicitly in many software projects»
- Required by systems engineering methodology (design should be architectural)
- Current Essence kernel choices for architecture modeling:
  - Architecture is an independent alpha
  - Architecture is a sub-alpha of alpha “System”
  - Architecture is a pattern

# Trade-off options

- System **definition** (result of system definition activities in V-diagram) alpha with requirements, architecture and design as sub-alphas (with system **descriptions** as work products): with redistribution of states from System **realization** alpha
- Architecture and design as first class kernel alphas
- Architecture and design as sub-alpha of system
- Architecture as Patterns (according to Ian Dietz – link between requirements and system like GORE patterns is link between Opportunities/Goals and Requirements)

# Proposal: kernel modification

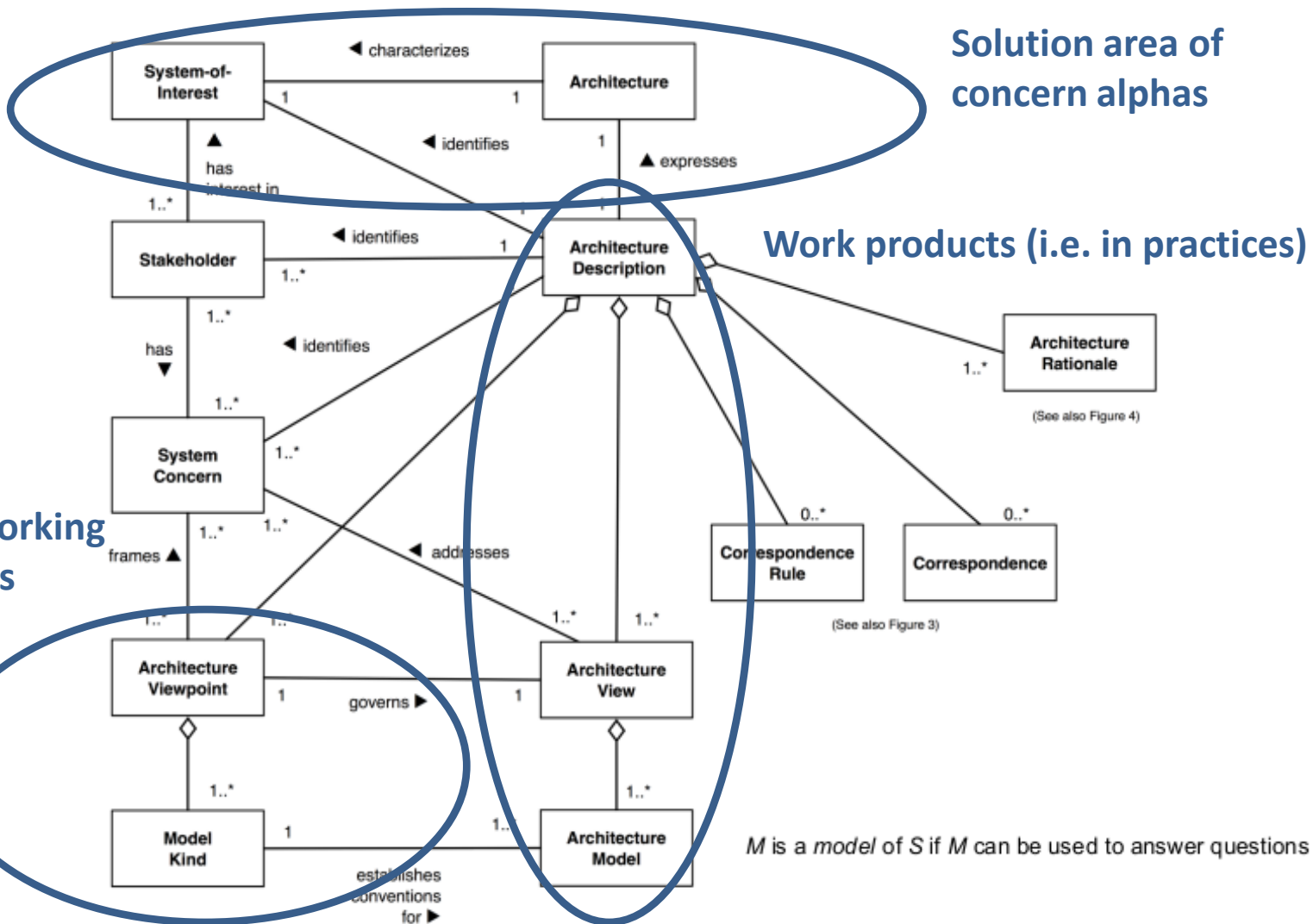


# System Definition vs System Realization

- System Definition = Requirements, Architecture, Design
- Composed from models that grouped by views – generalized from ISO 42010
- System definition frameworks are sub-alphas of way-of-working (generalized from ISO 42010 architectural framework)
- System definition languages are sub-alphas of way-of-working too («language» is a practice in a method aka «resource» - «language» in ISO 24744)

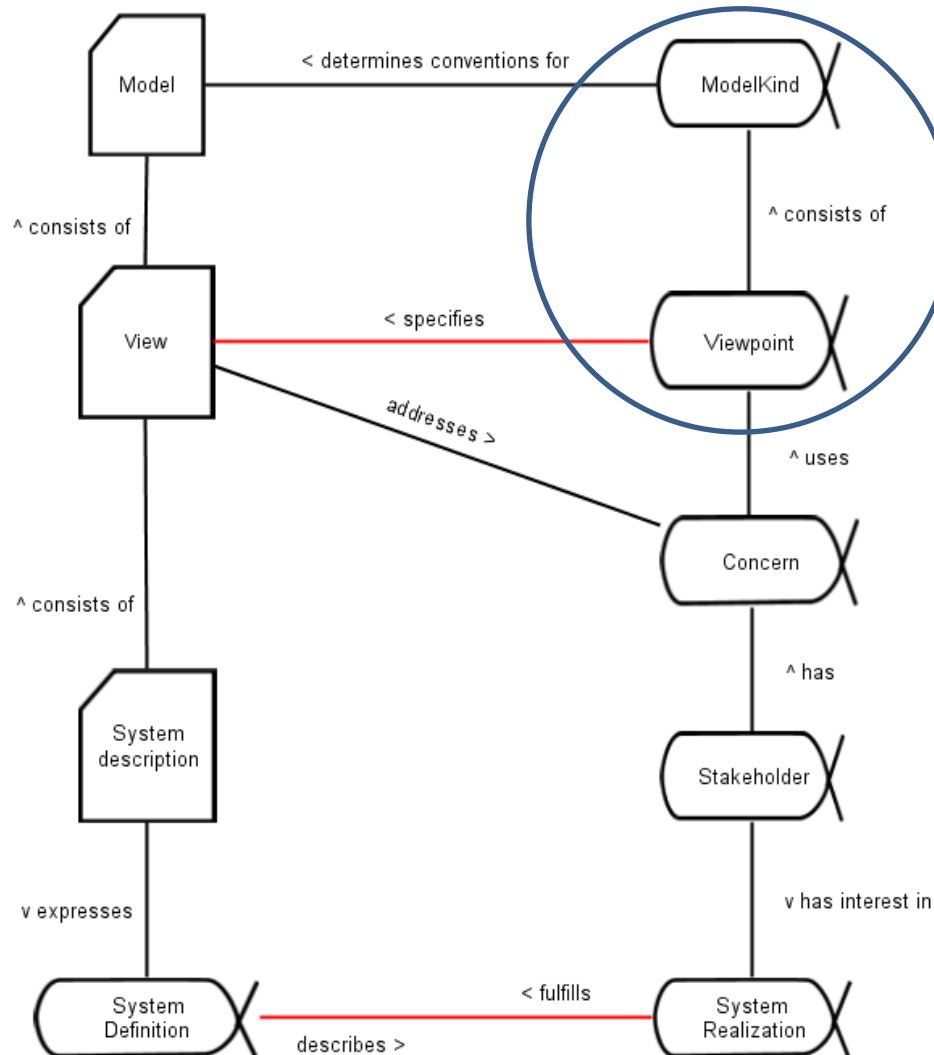
# ISO 42010

Map to Essence



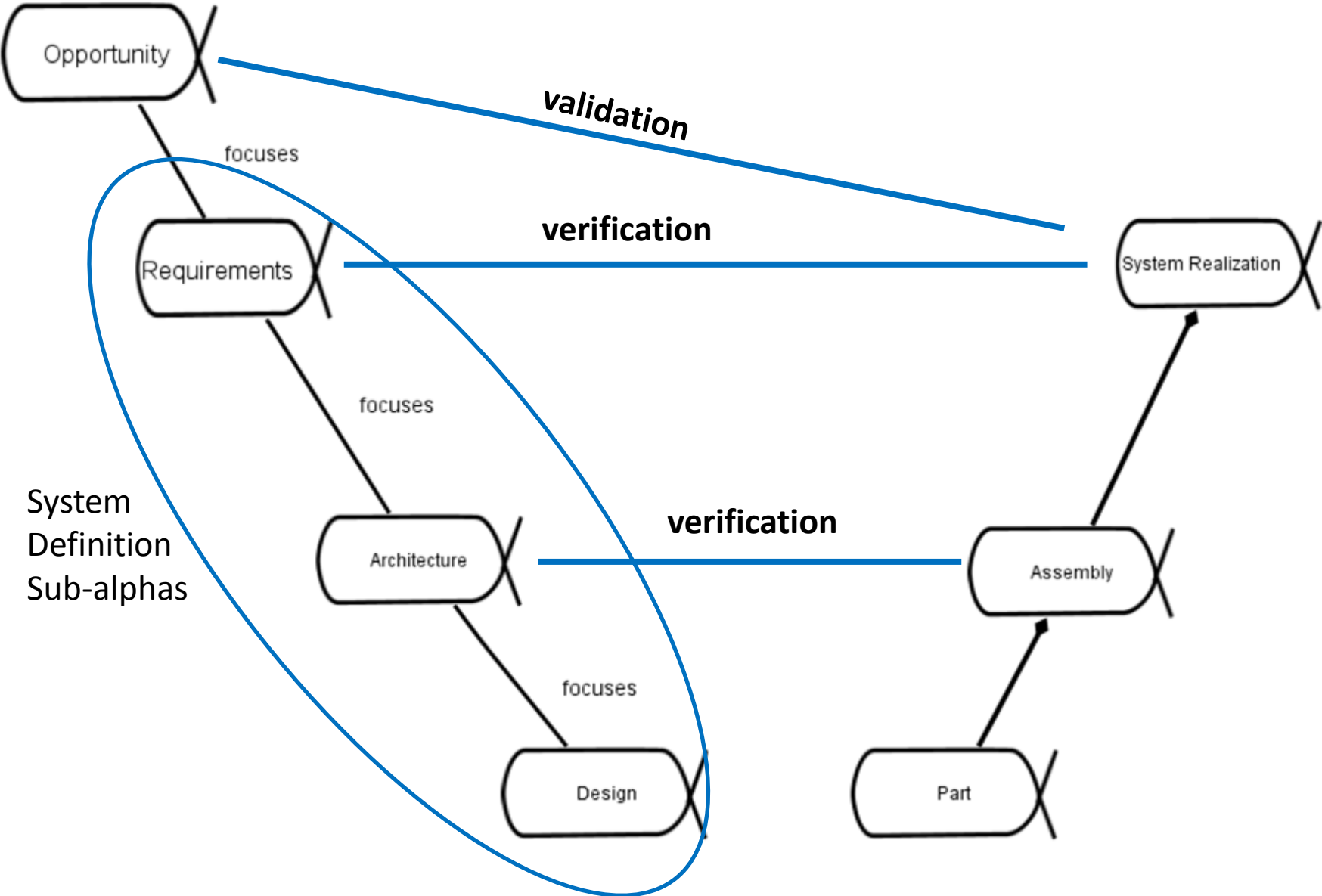
There are two common approaches to the construction of views: the synthetic approach and the projective approach. In the synthetic approach, the Architect constructs views of the system-of-interest and integrates these views within an architecture description using model correspondences. In the projective approach, the Architect derives each view through some routine, possibly mechanical, procedure of extraction from an underlying repository. This International Standard is usable with either of these approaches to views.

# System definition and realization (ISO 42010 generalization)



Way-of-working  
sub-alphas  
(specified by  
standards)

# Solution area of concern alphas & V-model



# Solution Area of Concern Alpha States

<p> <b>System Definition</b></p> <p><b>Conceived</b></p> <p>It is clear how the system will be defined.</p> <ul style="list-style-type: none"> <li>It is clear what success is for the new system.</li> <li>Viewpoints are agreed upon.</li> <li>The approach to concord descriptions among the stakeholders has been agreed.</li> <li>The description change management mechanisms have been agreed.</li> </ul> <p> 1/6</p>	<p> <b>System Definition</b></p> <p><b>Consistent</b></p> <p>Consistent System definition has been created.</p> <ul style="list-style-type: none"> <li>Descriptions are documented and available for the team and stakeholders.</li> <li>The origin of the description is clear.</li> <li>Descriptions are examined.</li> <li>Contradictory descriptions have been identified and are dealt with.</li> <li>The team understands descriptions and agrees to implement them.</li> <li>The system implementing the descriptions is accepted by the stakeholders as worth realizing.</li> </ul> <p> 2/6</p>	<p> <b>System Definition</b></p> <p><b>Used for Production</b></p> <p>System definition is used for system production.</p> <ul style="list-style-type: none"> <li>Enough of the descriptions are ready for starting system realization.</li> <li>Realization technologies have been defined.</li> <li>Part of the team responsible for system realization acknowledges available descriptions sufficient to realize the system.</li> <li>Issues occurring during system realization lead to the re-work and actualization of the system definition.</li> </ul> <p> 3/6</p>	<p> <b>System Definition</b></p> <p><b>Used for Verification</b></p> <p>System definition is used for testing.</p> <ul style="list-style-type: none"> <li>There are no missed parts of the system definition that make testing impossible.</li> <li>Tests, success criteria and test methods have been defined.</li> <li>Stakeholders agree with test scope.</li> </ul> <p> 4/6</p>	<p> <b>System Definition</b></p> <p><b>Used for Operation</b></p> <p>System definitions is used by stakeholders for operation.</p> <ul style="list-style-type: none"> <li>System definition is used for gathering information about state of the operational system realization.</li> <li>System definition within information about the state of the operational system is used for making decisions about maintenance, repair, and modernization.</li> </ul> <p> 5/6</p>	<p> <b>System Definition</b></p> <p><b>Used for Disposal</b></p> <p>System definition is used for system disposal.</p> <ul style="list-style-type: none"> <li>System definition is used for making decision about system disposal or operation extension.</li> <li>System definition shows absence of undesirable consequences (e.g. environment pollution) through system disposal.</li> <li>System definition is used for planning and performing disposal or recycling of the system realization.</li> </ul> <p> 6/6</p>
<p> <b>System Realization</b></p> <p><b>Raw materials</b></p> <p>Raw materials for system realization are available and ready parts manufacturing.</p> <ul style="list-style-type: none"> <li>Raw materials for system realization are available and allow manufacturing of the parts with required properties.</li> <li>Facilities for manufacturing parts from the raw materials are available.</li> <li>Parts production and logistic schedule has been agreed.</li> <li>Parts manufacturing works are ready to start.</li> </ul> <p> 1/6</p>	<p> <b>System Realization</b></p> <p><b>Parts</b></p> <p>Parts have been produced and are ready for integration.</p> <ul style="list-style-type: none"> <li>Parts of the system have been produced and/or purchased and checked.</li> <li>Integration schedule has been agreed.</li> <li>Integration works are ready to start.</li> </ul> <p> 2/6</p>	<p> <b>System Realization</b></p> <p><b>Demonstrable</b></p> <p>The system has been assembled from the parts and is ready for testing.</p> <ul style="list-style-type: none"> <li>Some functions of the system can be exercised and key characteristics can be measured.</li> <li>Key system characteristics have been demonstrated.</li> <li>Critical interfaces have been demonstrated.</li> <li>The integration with other existing systems has been demonstrated.</li> <li>The relevant stakeholders agree that system has to be tested.</li> </ul> <p> 3/6</p>	<p> <b>System Realization</b></p> <p><b>Ready</b></p> <p>The system (as a whole) has been accepted for deployment in a live environment.</p> <ul style="list-style-type: none"> <li>The functionality of the system has been tested.</li> <li>Level of defects is acceptable for the stakeholders.</li> <li>Setup and other user documentation is available.</li> <li>The stakeholder representatives accept the system as fit-for-purpose.</li> <li>Configuration of the system to be handed over to the stakeholders is known.</li> <li>The stakeholder representatives want to make the system operational.</li> <li>The system is fully supported to the agreed service levels.</li> </ul> <p> 4/6</p>	<p> <b>System Realization</b></p> <p><b>Operational</b></p> <p>The system is in use in a live environment.</p> <ul style="list-style-type: none"> <li>The system has been made available to the stakeholders intended to use it.</li> <li>At least one example of the system is fully operational.</li> <li>The system is fully supported to the agreed service levels.</li> </ul> <p> 5/6</p>	<p> <b>System Realization</b></p> <p><b>Retired</b></p> <p>The realized system is no longer supported and disposed and/or recycled.</p> <ul style="list-style-type: none"> <li>The system realization has been replaced or discontinued.</li> <li>The system is no longer supported.</li> <li>There are no "official" stakeholders who still use the system.</li> <li>Updates/ modifications to the system will no longer be produced.</li> <li>All material components of the system are re-used or have been properly disposed.</li> </ul> <p> 6/6</p>



# Thank you!

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