

Webinar

Agile SE Processes 203: Agility as a System

16-Sep-2020

Updated 10-Nov-2020

Rick Dove

Anthem, AZ, dove@parshift.com, 575-770-7101

CEO/CTO, Paradigm Shift International

Adjunct Professor, Stevens Institute of Technology

Chair: INCOSE WG for Agile Systems & Systems Engineering



Agile 203 webinar slides: [Agile SE Agility as a System](#)

Agile 202 webinar slides: [Agile SE Continuous Integration](#)

Agile 201 webinar slides: [Agile SE Problem Space Requirements](#)

Agile 106 webinar slides: [Agile System/Process as Risk Management](#)

Agile 105 webinar slides: [Agile System/Process Operational Awareness](#)

Agile 104 webinar slides: [Agile System/Process Engagement Quality](#)

Agile 103 webinar slides: [Agile System/Process Design Principles](#)

Agile 102 webinar slides: [Agile System/Process Design Requirements](#)

Agile 101 webinar slides: [Agile System/Process Architecture Pattern](#)

(updated asynchronously from time-to-time)

Abstract

Systems engineering is codified as a collection of interrelated life cycle processes. Agility in systems engineering is accomplished by explicit capabilities in these processes for situational awareness, learning, and agile life cycle management. Collectively isolated these capabilities could be called the Agility System; but it is known formally as the System of Innovation, as it delivers improved stakeholder value.

In agile systems engineering the System of Innovation is embedded and distributed throughout the life cycle processes at relevant points. It functions as the learning and life cycle manager. Its core is the central Situational Awareness stage that triggers entry into all other stages in the Agile Systems Engineering Life Cycle Model. The Situational Awareness stage is also the stage that initiates a system project and initiates the selection or design of a suitable systems engineering approach.

All systems engineering processes have at least a tacit System of Innovation. Agile software development processes begin to get explicit with periodic retrospectives on both process and product work-in-process outcomes, and with incremental experiment and learning loops. For mixed-discipline SE projects we should identify what needs to be monitored and sensed to avoid undesirable outcomes, what response strategies are needed to address situational changes, and how coherent evolution in process and product will occur. And of course, where are these things done in the life cycle processes and by what agency?

This webinar will explore general concepts and strategies in the System of Innovation for tailored application appropriate to a project context.

Prelude:

Eight Principal Findings from the INCOSE ASELCM Project

(ASELCM: Agile Systems Engineering Life Cycle Model)

- 1. Problem-Space Characterization – Agile 201**
- 2. Response Requirements – Agile 201**
- 3. Stakeholder Engagement – Agile 202**
- 4. Continuous Integration Platform – Agile 202**
- 5. Agile SE Life Cycle Framework**
- 6. Managing Information Debt**
- 7. ASELCM Operational Pattern**
- 8. Operational Principles**

Prelude:

Eight Principal Findings from the INCOSE ASELCM Project

(ASELCM: Agile Systems Engineering Life Cycle Model)

- 1. Problem-Space Characterization – Agile 201**
- 2. Response Requirements – Agile 201**
- 3. Stakeholder Engagement – Agile 202**
- 4. Continuous Integration Platform – Agile 202**
- 5. Agile SE Life Cycle Framework**
- 6. Managing Information Debt**
- 7. ASELCM Operational Pattern – Agile 203**
- 8. Operational Principles – Agile 203**

1. Problem Space Characterization

Internal and external environmental forces
that impact process and product as systems

Caprice: unanticipated system-environment change
(randomness among unknowable possibilities)

Uncertainty: kinetic and potential forces present in the system
(randomness among known possibilities with unknowable probabilities)

Risk: relevance of current system-dynamics understanding
(randomness among known possibilities with knowable probabilities)

Variation: temporal excursions on existing behavior attractor
(randomness among knowable variables and knowable variance ranges)

Evolution: experimentation and natural selection at work
(relatively gradual successive developments)

2. General Response Strategies

Domain		Response Strategies	
Proactive	Creation	<ul style="list-style-type: none"> •Threat and opportunity awareness •Response actions/options 	<ul style="list-style-type: none"> • Acculturated memory • Decisions to act
	Improvement	<ul style="list-style-type: none"> •Awareness/Sensing •Memory in culture, options, ConOps, SEMP 	<ul style="list-style-type: none"> • Action/option effectiveness
	Migration	<ul style="list-style-type: none"> •New fundamentally-different types of threats and opportunities 	
	Modification (Capability)	<ul style="list-style-type: none"> •Actions appropriate for needs •Personnel appropriate for actions 	
Reactive	Correction	<ul style="list-style-type: none"> •Insufficient awareness •Ineffective actions/options 	<ul style="list-style-type: none"> • Wrong decisions
	Variation	<ul style="list-style-type: none"> •Effectiveness of actions/options •Effectiveness of evaluation 	
	Expansion (Capacity)	<ul style="list-style-type: none"> •Capacity to handle 1-? actions simultaneously 	
	Reconfiguration	<ul style="list-style-type: none"> •Elements of an action •Response managers/engineers 	

3. Stake Holder Engagement

Developers
Operators
Customers

Subcontractors
Producers
End Users

Security Engineers
Maintainers
Management

Three typical forms of stakeholder engagement:

Integrated product team (IPT) is a multidisciplinary group of people who are collectively responsible for delivering a defined product or process. The emphasis of the IPT is on involvement of all stakeholders (users, customers, management, developers, contractors) in a collaborative forum. (Wikipedia)

Concurrent engineering (CE) is a work methodology emphasizing the parallelization of tasks (i.e. performing tasks concurrently), which is sometimes called simultaneous engineering or integrated product development (IPD) using an integrated product team approach. It refers to an approach used in product development in which functions of design engineering, manufacturing engineering, and other functions are integrated to reduce the time required to bring a new product to market. (Wikipedia)

DevOps is a set of software development practices that combine software development (*Dev*) and information-technology operations (*Ops*) to shorten the systems-development life cycle while delivering features, fixes, and updates frequently in close alignment with business objectives. (Wikipedia)

4. Continuous Integration Platform Live Virtual Constructive

Live components
(people, things)

Virtual components
(component simulations)

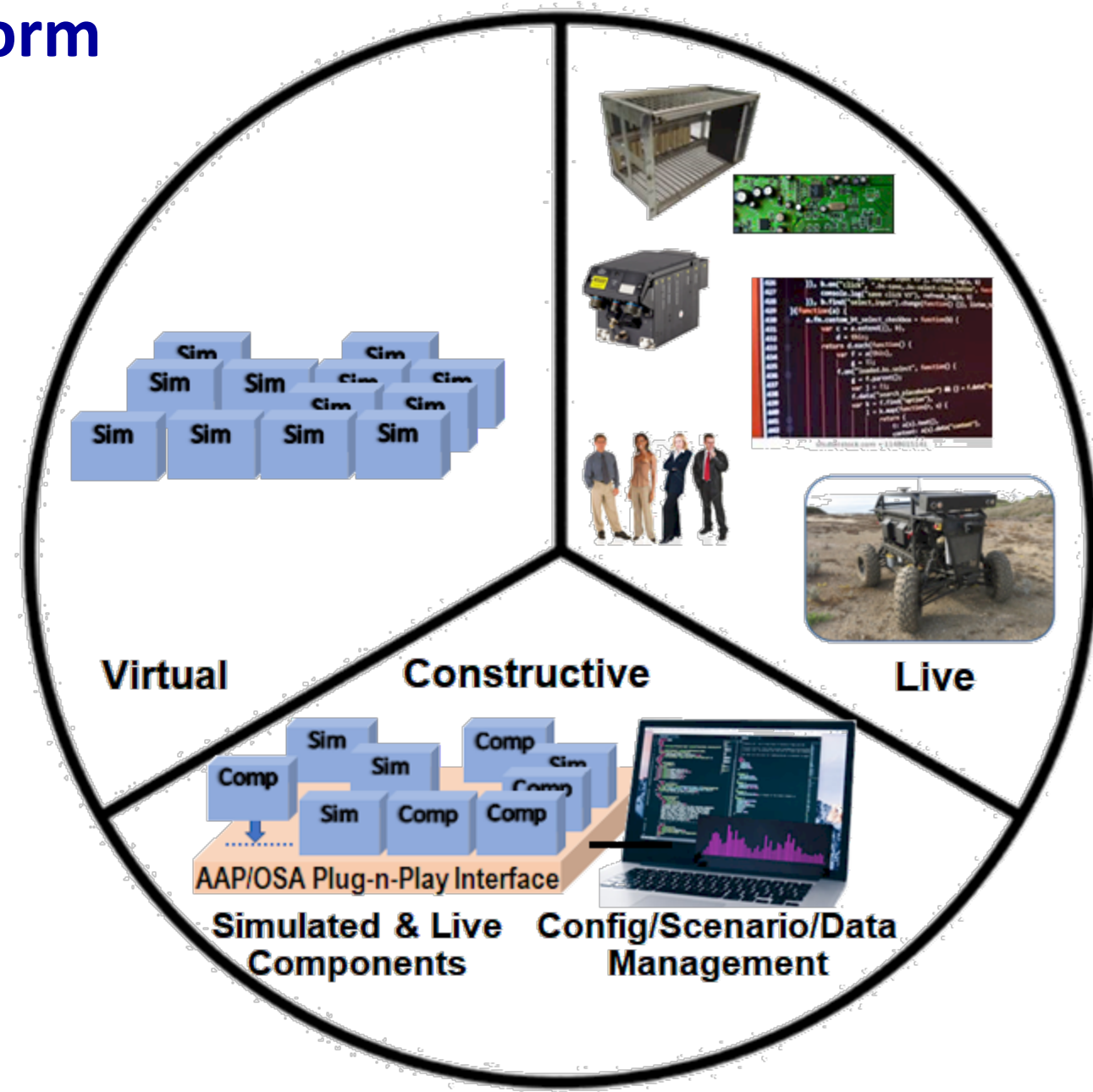
Constructive capabilities
(component mix, scenario simulation, and
performance monitoring/recording)

L&V components are functional system elements;
configured, challenged and monitored
by C elements for performance and anomalies.

Demonstration/test/experimental events
can occur at any time with the latest instantiation of
simulations & components.

Caveat: LVC internet search is dominated by military training applications.

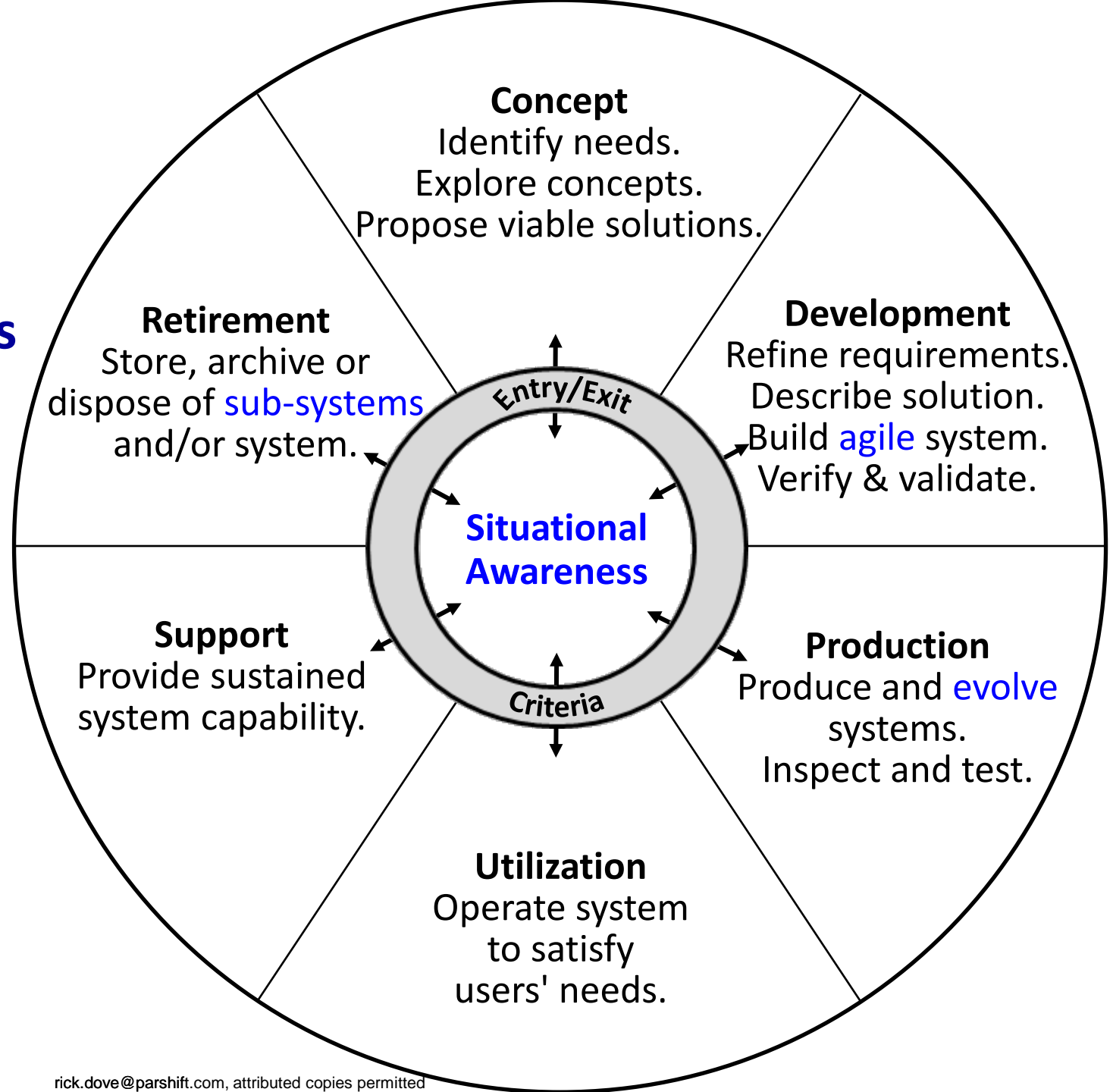
AAP: Agile Architecture Pattern
OSA: Open Systems Architecture



5. Agile SE Life Cycle Framework

**Situational Awareness Engages
Other Stages and Tasks
Asynchronously
Concurrently
Experimentally
Incrementally
Iteratively**

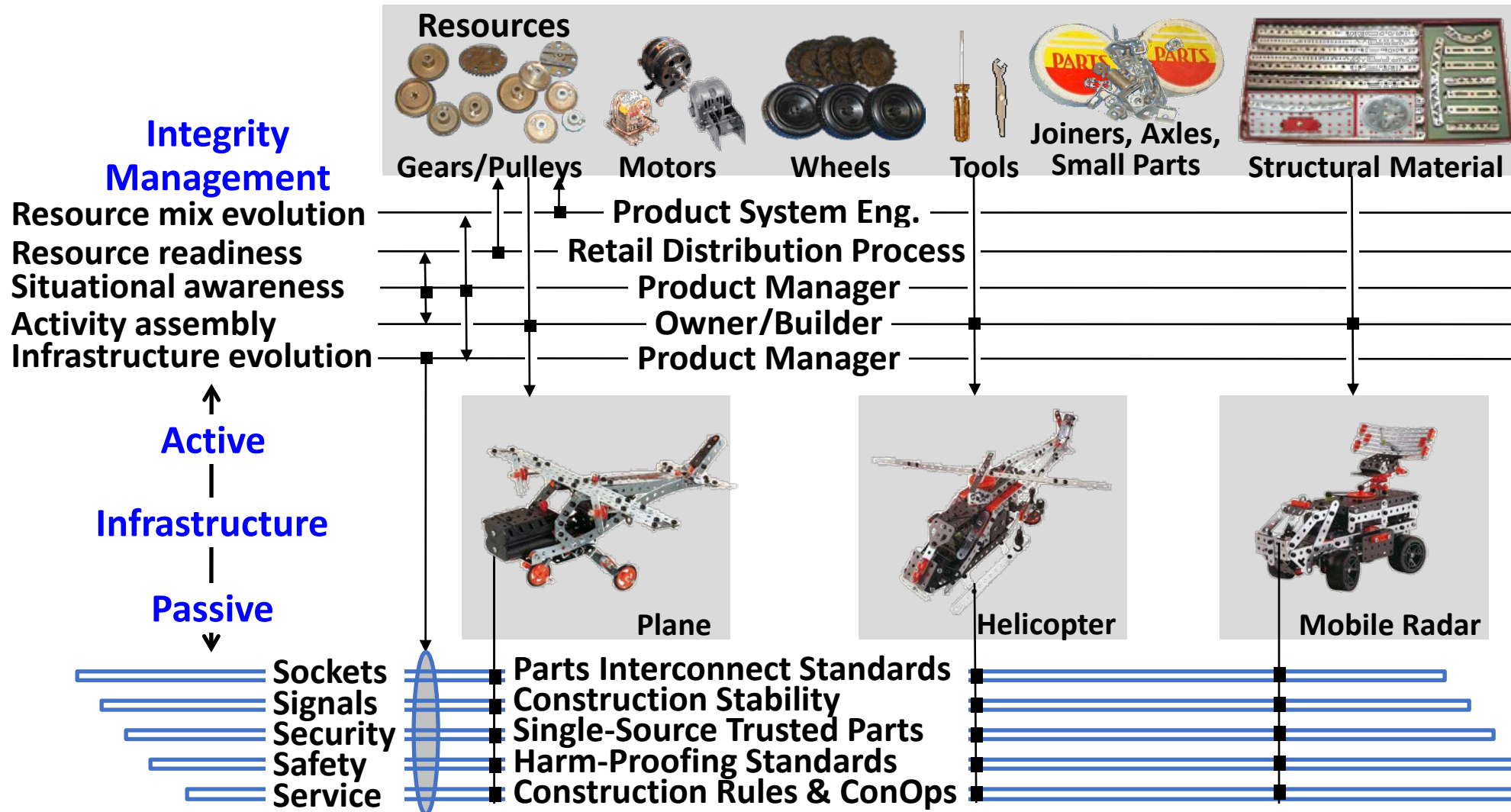
Consistent with
ISO/IEC/IEEE 24748-1:2018



Agile Architecture Pattern (AAP) – Enables Agility

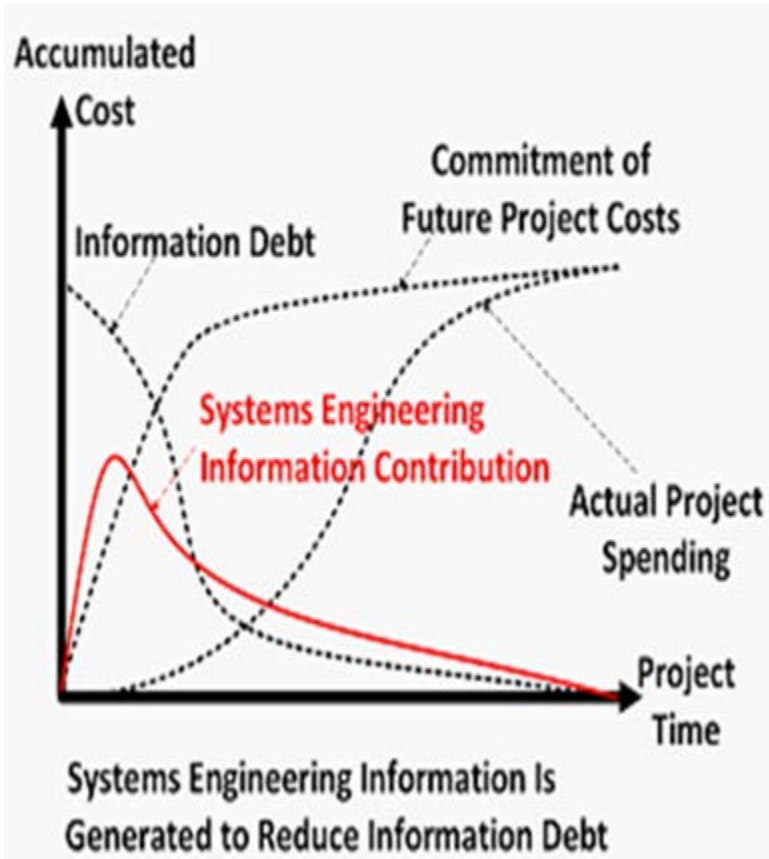
Notional Concept: System Construction/Augmentation Kit

Details in www.parshift.com/s/140630IS14-AgileSystemsEngineering-Part1&2.pdf



Standards – Enable & Constrain

6. Managing Information Debt



Timely SE information must be generated (e.g., reqs, architectures, risk assessments, etc.) early enough in the project.

Knowledge Management for:

- **Team member attrition and replacement**
- **Production and maintenance support**
- **Other-party sustainment and evolution**
- **Upgrades when original developers are gone**
- **Reusable knowledge for other projects**
- **Lessons learned (for product and process)**

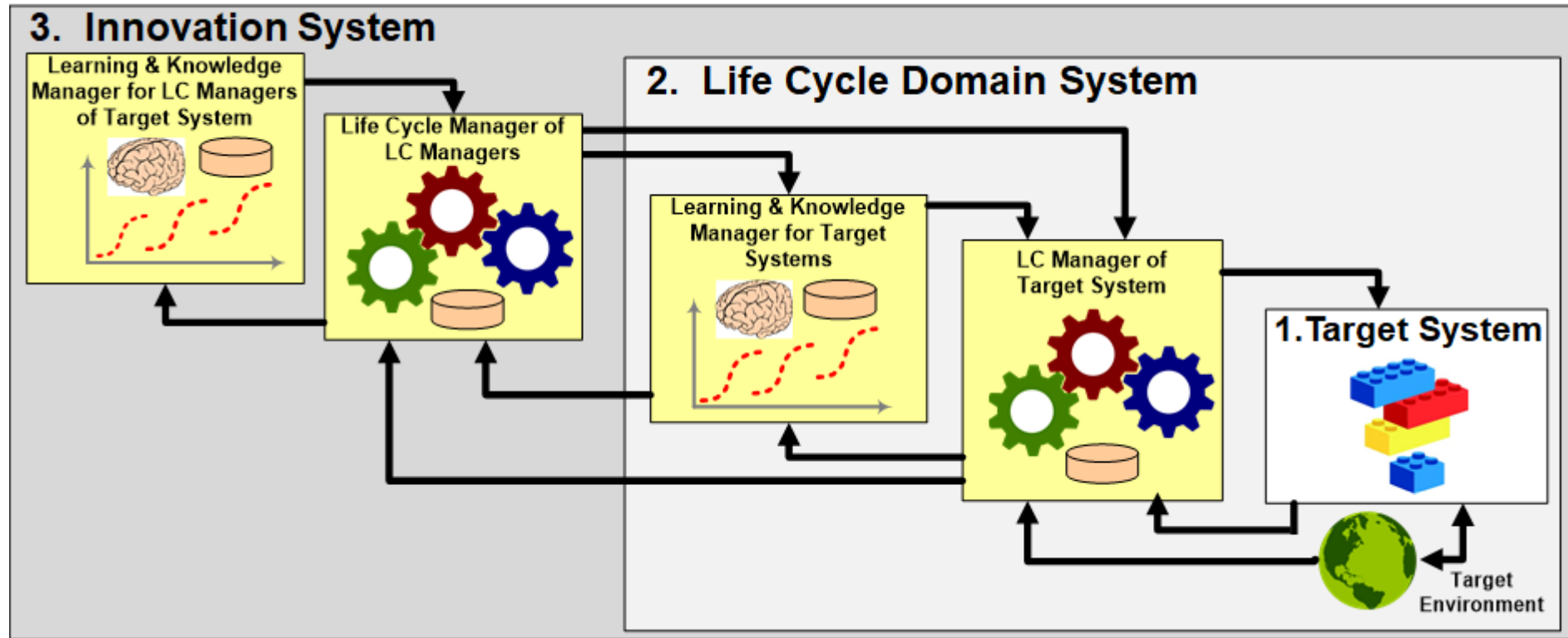
Will development end with outstanding information debt – a “working system” with impaired sustainment and evolution agility?

Here We Focus on Two Findings

7. ASELCM Operational Pattern

8. Operational Principles

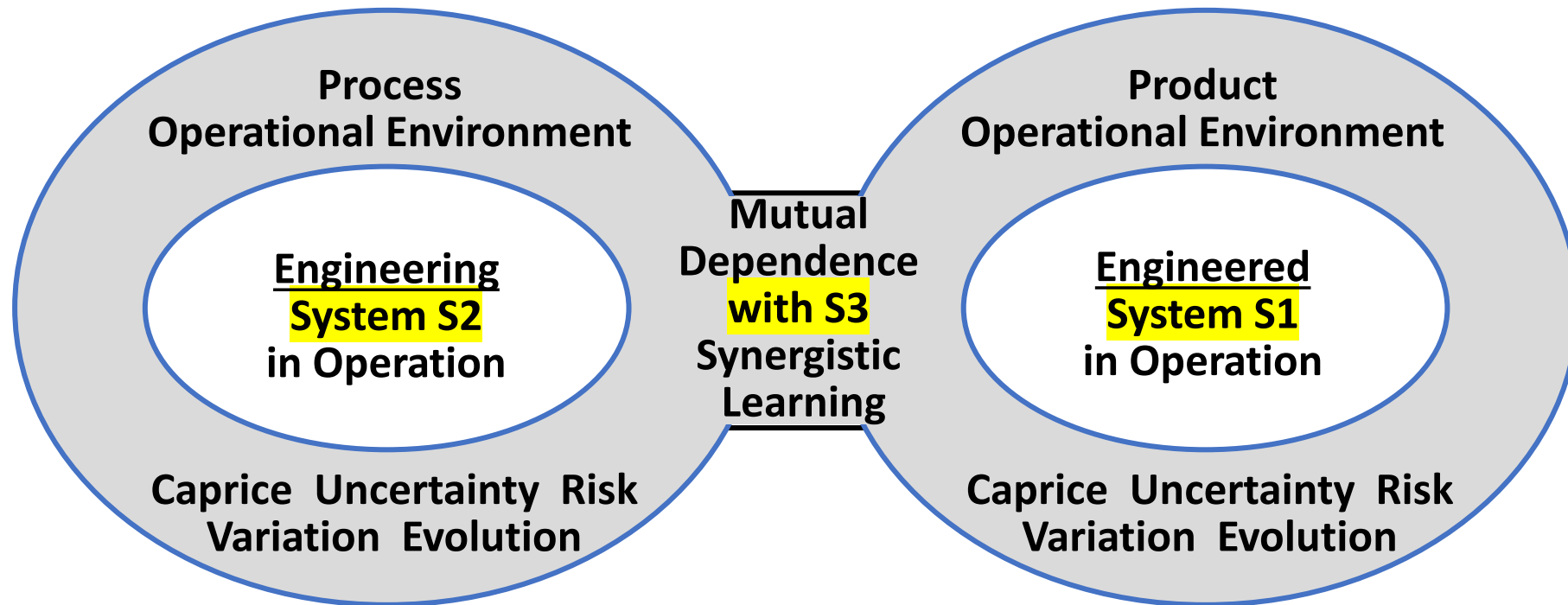
7. ASELCM Operational Pattern – Three Concurrent Systems



- System-1 is the target system under development.
- System-2 includes the basic systems engineering development and maintenance processes, and their operational domains that produces System-1.
- System-3 is the process improvement system, called the system of innovation that learns, configures, and matures System-2.

System 3 is responsible for situational awareness, evolution, and knowledge management, the provider of operational agility. Intent is continuous, not episodic, information flow.

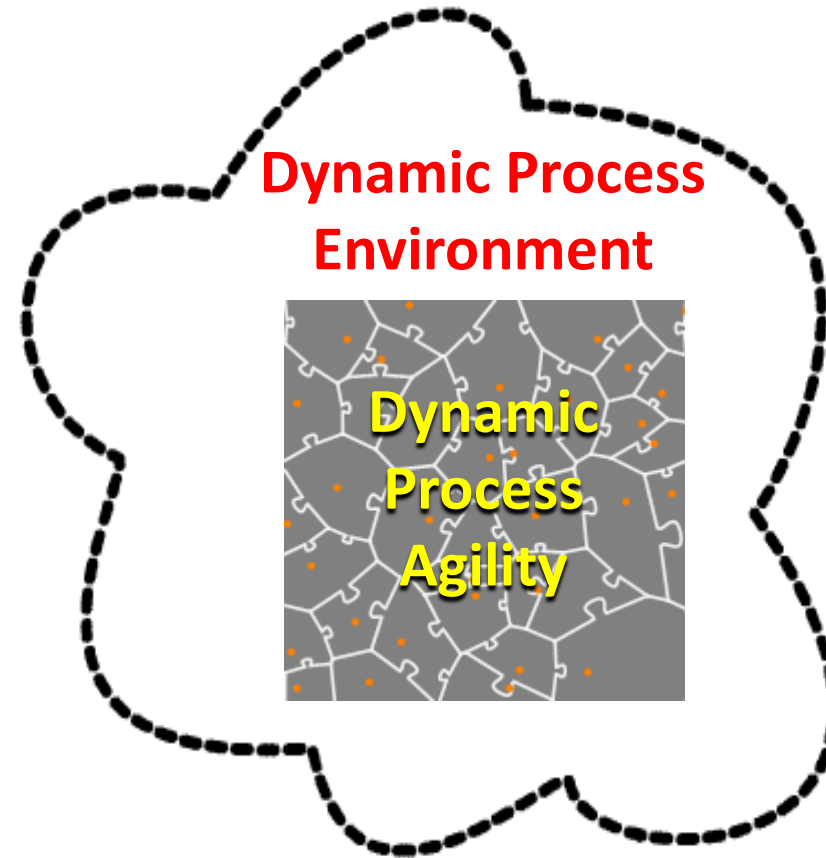
Synergistic Dependencies



**You can't have
an agile engineering process
if it doesn't engineer an agile product
(and vice versa)**

Dynamic Process Must Fit with Dynamic Environment

Agile systems engineering is responsive to the dynamic environments in which it operates.
Attentive awareness of the evolving environments is necessary.



Agility Innovation System

Concept Development Emerging from FuSE Agility Project

Problem	Insufficient breadth and depth of learning activity; barriers to learning application.
Need	Situational awareness and learning embedded in life cycle processes; timely/affordable learning-application enabled; knowledge management.
Barriers	Not clear what to do or where to do it beyond learning ceremonies and contract obligation satisfaction.
Intent	A focus on the why and what that can guide the how appropriate for any operational agility need.
Value	Less rework (cost/time); higher customer/user satisfaction.
Metrics	Relevance of what was learned; impact of applied learning.
Refs	Schindel and Dove 2016; Schindel 2017; Dove and Schindel 2019.

8. Operational Principles

3 principles, 9 strategies

Sensing (observe, orient)

- External awareness (proactive alertness)
- Internal awareness (proactive alertness)
- Evaluation (learning: outcome of sensing, process of sensing)

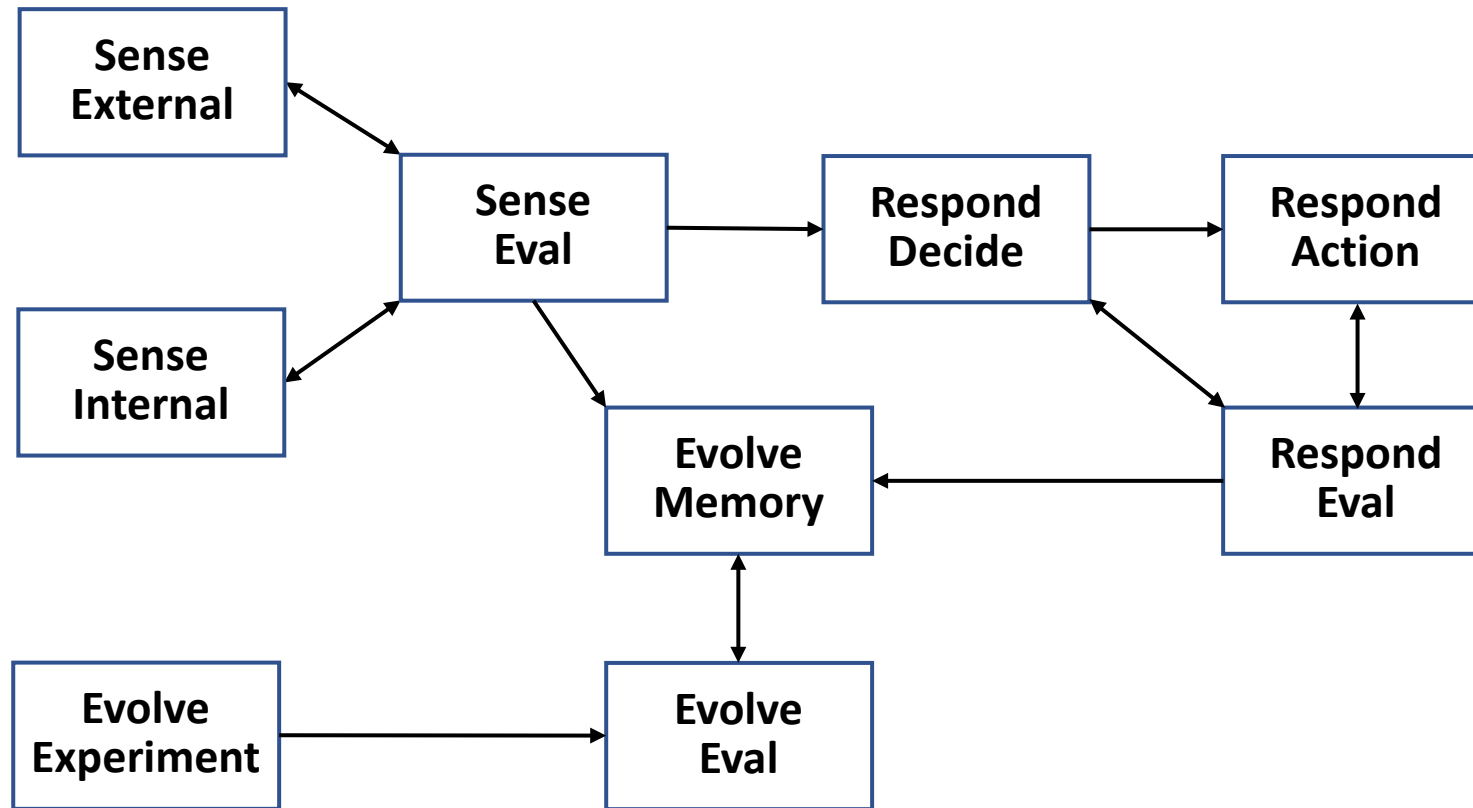
Responding (decide, act)

- Decision making (timely, informed)
- Action making (reconfigure process & product to fit the situation)
- Evaluation (learning: outcome of responding, process of responding)

Evolving (improve above with learned knowledge and capability)

- Experimentation (variations on process and product)
- Evaluation (learning: outcome of evolution, process of evolution)
- Memory (culture, capabilities, ConOps/OpsCon, knowledge management)

Agility Innovation System



This is the WHAT

**Conceptual architecture for tailoring-to-context in a system model.
9 boxes this page correspond to 9 Operational Strategies prior page.**

The goal of agile systems engineering is S2 and S1 compatibility with their CURVED environments.

This goal is the purpose of S3.

The general SE CURVE shown here is applicable to S3, S2, and S1.

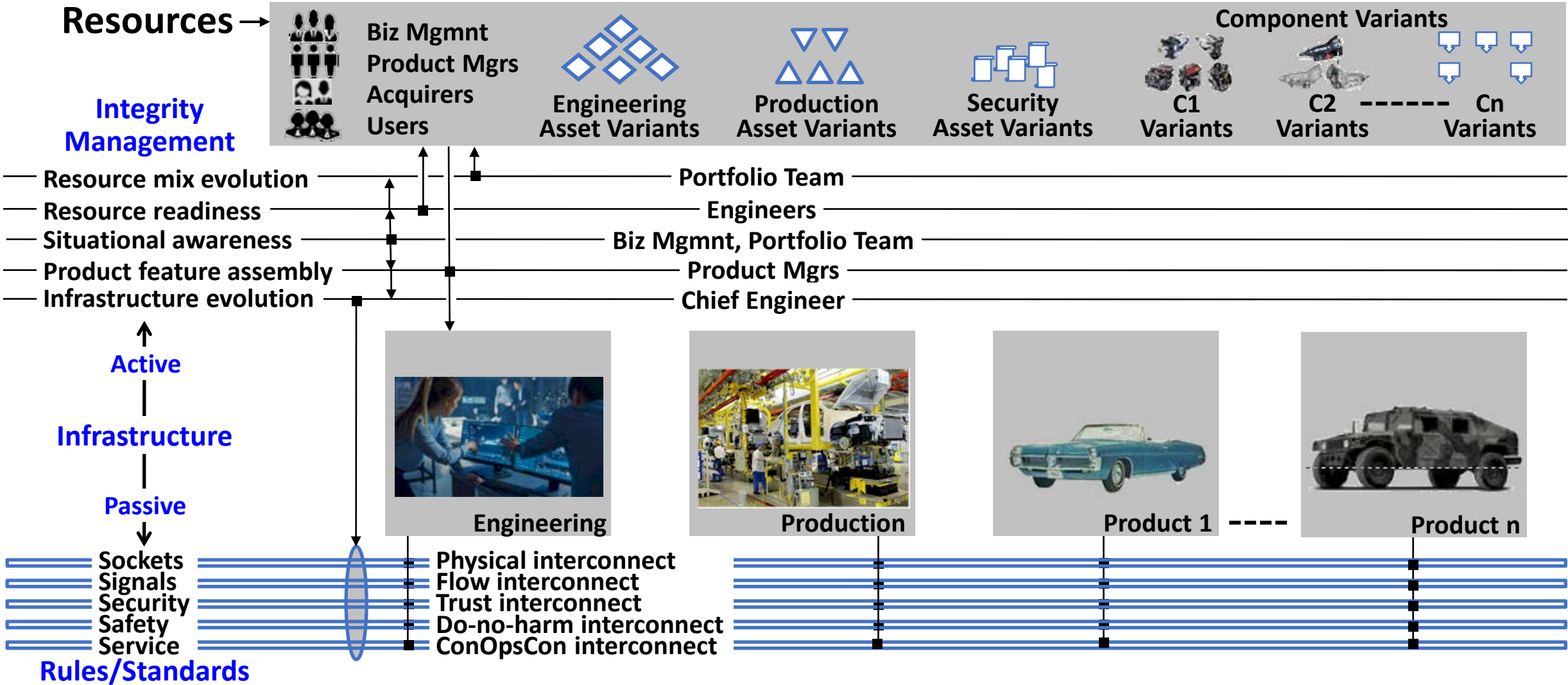
S3, S2, and S1 have cyber-physical-social dimensions.

General SE CURVE
Caprice
<ul style="list-style-type: none"> • Survivability (i.e., current order compatibility) • Occurrence and nature of emergent behavior • Game-changing technologies • Availability of symbiotic social relationships
Uncertainty
<ul style="list-style-type: none"> • Relevance (i.e, appropriate to current desires) • Cohesion in the greater SoSs (multiple) • Integrity and symbiosis of social relationships
Risk
<ul style="list-style-type: none"> • Viability (i.e., capable of working successfully) • Cohesion among constituent parts
Variation
<ul style="list-style-type: none"> • Operational environments • Social compatibility
Evolution
<ul style="list-style-type: none"> • Toward more operating environment complexity • Toward more Sol complexity • Toward shorter Sol static viability • Toward new technology options • Toward new malevolent threats to viability • Toward greater social involvement

This is the WHY

General SE CURVE	General Agility Innovation System CURVE
<p style="text-align: center;">Caprice</p> <ul style="list-style-type: none"> ● Survivability (i.e., current order compatibility) ● Occurrence and nature of emergent behavior ● Game-changing technologies ● Availability of symbiotic social relationships 	<p style="text-align: center;">Caprice</p> <ul style="list-style-type: none"> ● Adequacy of awareness breadth ● Knowledge conflicts ● AI-assisted awareness sensing ● Timeliness and depth of stakeholder engagement
<p style="text-align: center;">Uncertainty</p> <ul style="list-style-type: none"> ● Relevance (i.e, appropriate to current desires) ● Cohesion in systems and SoSs ● Integrity and symbiosis of social relationships. 	<p style="text-align: center;">Uncertainty</p> <ul style="list-style-type: none"> ● Cost vs. value evaluations ● Response decision and action consensus ● SME availability for evaluating what was sensed
<p style="text-align: center;">Risk</p> <ul style="list-style-type: none"> ● Viability (i.e., capable of working successfully) ● Cohesion among constituent parts 	<p style="text-align: center;">Risk</p> <ul style="list-style-type: none"> ● Response decision and action efficacy ● Insufficiently-shared learned knowledge
<p style="text-align: center;">Variation</p> <ul style="list-style-type: none"> ● Operational environments ● Social compatibility ● Human resource loading 	<p style="text-align: center;">Variation</p> <ul style="list-style-type: none"> ● Nature of optimal agility system for project type ● Cooperation ● Sufficiency of awareness attention
<p style="text-align: center;">Evolution</p> <ul style="list-style-type: none"> ● Toward more operating environment complexity ● Toward more Sol complexity ● Toward shorter Sol static viability ● Toward new technology options ● Toward new malevolent threats to viability ● Toward greater social involvement 	<p style="text-align: center;">Evolution</p> <ul style="list-style-type: none"> ● Increasing external sources of potential impact ● Increasing internal sources of potential impact ● Decreasing life of knowledge relevance ● Increasing frequency of innovative technology ● increasing manipulation with fake news ● Increasing assimilation of relevant knowledge

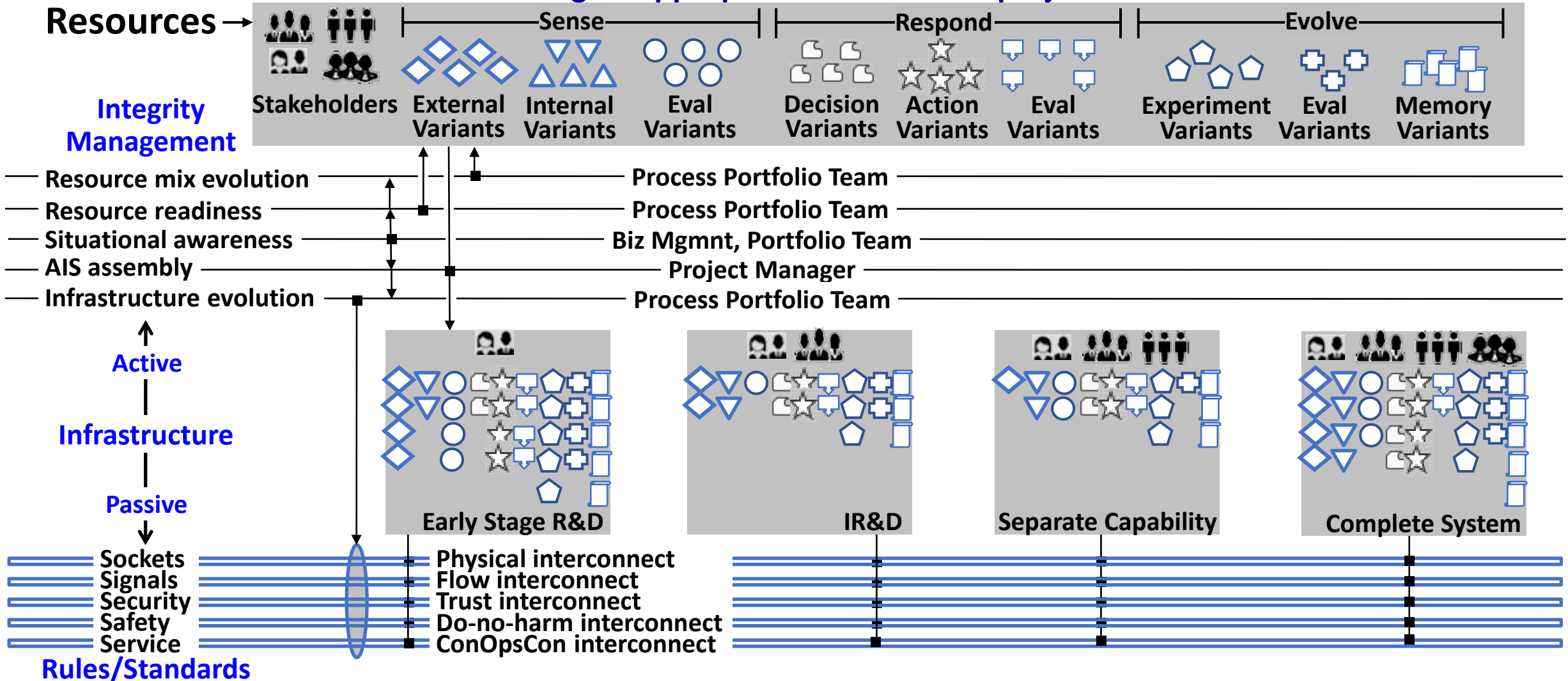
Notional AAP Concept: Product Line Engineering Process



Dove, R. 2020. "Security Issue Detection and Mitigation Patterns for Product Line Resource Variation." INSIGHT, International Council on Systems Engineering. September.

Agility Innovation System AAP – Notional


Concept: Product Line Engineering Architecture and Resource Management for instantiating an appropriate AIS fit to the project context



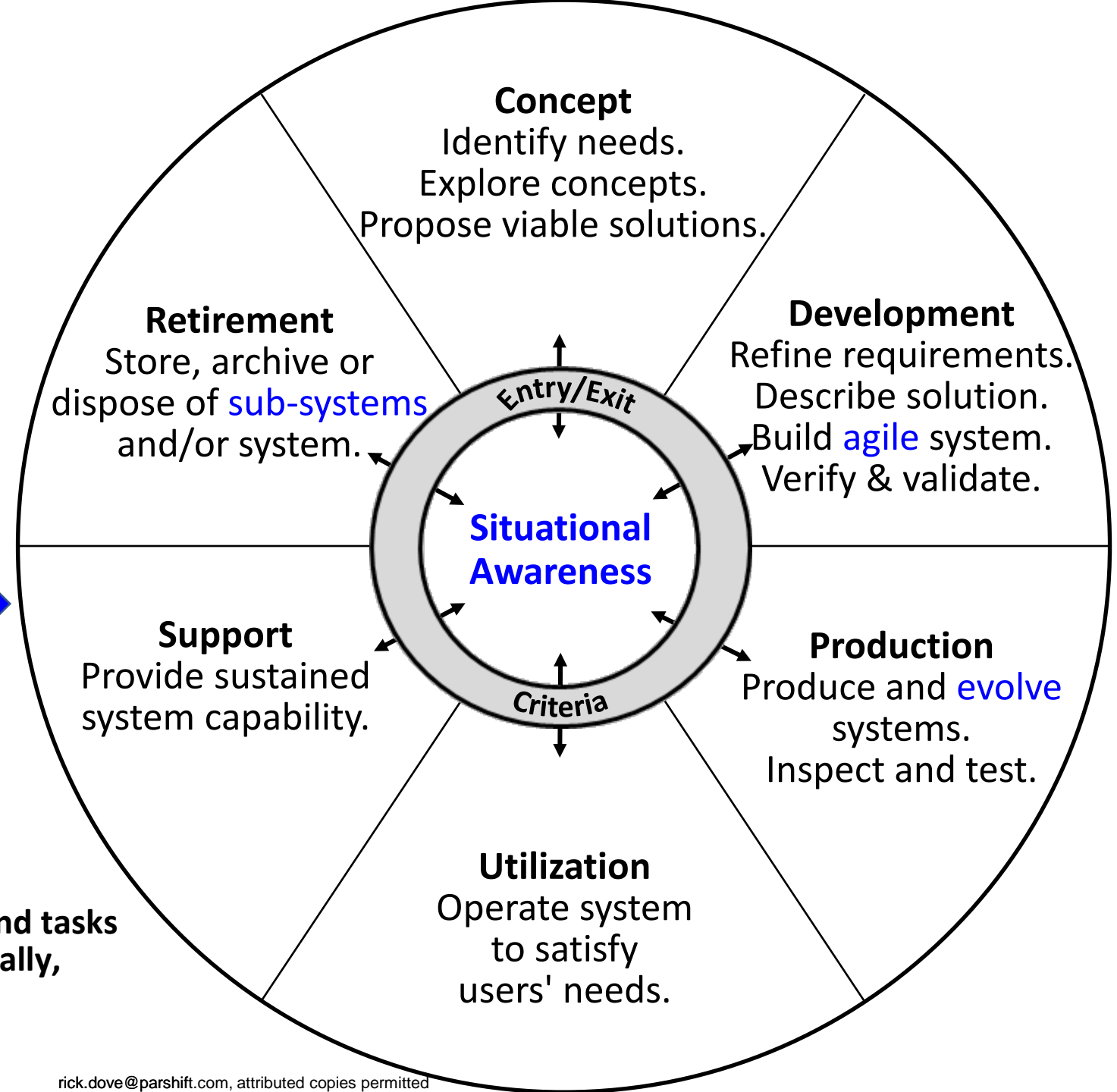
Depicted is a mature system – which starts with a shallow set of variants for the first instantiation, subsequent projects increase the variant population accordingly.

Wrap Up

Life Cycle Model Framework

1. Problem-Space Characterization
2. Response Requirements
3. Stakeholder Engagement
4. Continuous Integration Platform
5. Agile SE Life Cycle Framework 
6. Managing Information Debt
7. **ASELCM Operational Pattern**
8. **Operational Principles**

Situational Awareness engages other stages and tasks asynchronously, concurrently, experimentally, incrementally, and iteratively



References and Additional Info

- Systems of Innovation I: Summary Models of SOI Health and Pathologies. Beihoff, B.C. and W.D Schindel. 2012. Proceedings International Symposium. International Council on Systems Engineering. Rome, Italy, July 9-12.
- Introduction to the Agile Systems Engineering Life Cycle MBSE Pattern. Schindel, W., R. Dove. 2016. Proceedings International Symposium. International Council on Systems Engineering. Edinburgh, Scotland, July 18-21.
www.parshift.com/s/160718IS16-IntroToTheAgileSystemsEngineeringLifeCycleMBSEPattern.pdf
- Innovation, Risk, Agility, and Learning, Viewed as Optimal Control & Estimation. Schindel, W. 2017. Proceedings International Symposium. International Council on Systems Engineering. Adelaide, Australia, July 17-20.
- Agile Systems Engineering Life Cycle Model for Mixed Discipline Engineering. Dove, R., W. Schindel. 2019. Proceedings International Symposium. International Council on Systems Engineering. Orlando, FL, July 20-25. www.parshift.com/s/ASELCM-05Findings.pdf
- The Best of Both Worlds: Agile Development Meets Product Line Engineering at Lockheed Martin. Gregg, S., R. Sharadin, P.C. Clements. 2019. International Council on Systems Engineering. Insight Vol 22, No 2. August.
- Systems Engineering the Conditions of the Possibility (Towards Systems Engineering v2.0). Willett, K.D. 2020. Proceedings International Symposium. International Council on Systems Engineering. July 20-22.
www.researchgate.net/publication/343306942_Systems_Engineering_the_Conditions_of_the_Possibility_Towards_Systems_Engineering_v20
- [Case Study:] Agile systems engineering process features collective culture, consciousness, and conscience at SSC Pacific Unmanned Systems Group. Dove, R, W. Schindel, C. Scrapper. 2016. Proceedings International Symposium. International Council on Systems Engineering. Edinburgh, Scotland, July 18-21.
www.parshift.com/s/ASELCM-01SSCPac.pdf
- Case Study: Agile Hardware/Firmware/Software Product Line Engineering at Rockwell Collins. Dove, R., W. Schindel, R. Hartney. 2017. Proceedings 11th Annual IEEE International Systems Conference. Montreal, Quebec, Canada, April 24-27. www.parshift.com/s/ASELCM-02RC.pdf
- Case study: agile SE process for centralized SoS sustainment at Northrop Grumman. Dove, R, W. Schindel, M. Kenney. 2017. Proceedings International Symposium. International Council on Systems Engineering. Adelaide, Australia, July 17-20. www.parshift.com/s/ASELCM-03NGC.pdf
- Case Study: Agile Systems Engineering at Lockheed Martin Aeronautics Integrated Fighter Group. Dove, R., W. Schindel, K. Garlington. 2018. International Council on Systems Engineering, International Symposium, Washington, DC, July 7-12. www.parshift.com/s/ASELCM-04LMC.pdf

Full Series

Agile 203 webinar slides: [Agile SE Agility as a System](#)
Agile 202 webinar slides: [Agile SE Continuous Integration](#)
Agile 201 webinar slides: [Agile SE Problem Space Requirements](#)
Agile 106 webinar slides: [Agile System/Process Risk Management & Mitigation](#)
Agile 105 webinar slides: [Agile System/Process Operational Awareness](#)
Agile 104 webinar slides: [Agile System/Process Engagement Quality](#)
Agile 103 webinar slides: [Agile System/Process Design Principles](#)
Agile 102 webinar slides: [Agile System/Process Design Requirements](#)
Agile 101 webinar slides: [Agile System/Process Architecture Pattern](#)
(updated asynchronously from time-to-time)

Original webinars with recordings at:

<https://connect.incose.org/Library/Webinars/Pages/INCOSE-Webinars.aspx>

Webinar ID: Webinar 143 Dove 16 September 2020 Agile SE Processes 203
Webinar ID: Webinar 131 Dove 18 September 2019 Agile SE Processes 202
Webinar ID: Webinar 116 Dove 19 September 2018 Agile SE Processes 201
Webinar ID: Webinar 104 Dove 20 September 2017 Agile Systems & Processes 106
Webinar ID: Webinar 092 Dove 28 September 2016 Agile Systems & Processes 105
Webinar ID: Webinar 082 Dove 16 September 2015 Agile Systems & Processes 104
Webinar ID: Webinar 067 Dove 17 September 2014 Agile Systems & Processes 103
Webinar ID: Webinar 056 Dove 18 September 2013 Agile Systems & Processes 102
Webinar ID: Webinar 045 Dove 19 September 2012 Agile Systems & Processes 101