Overview
Agile Systems and SE Working Group

Ted Mulder, Past-President of San Diego INCOSE Chapter (Presenter)
Rick Dove, Chair of Agile Systems and SE Working Group (Presentation)

General Info

Chair: Rick Dove, Paradigm Shift International, dove@parshift.com

Co-Chair: Ron Lyells, retired Honeywell, rlyells@aol.com

Co-Chair: Larri Roser, Raytheon, Larri_Rosser@raytheon.com

Co-Chair: Kevin Gunn, MITRE, kgunn@mitre.org

Members on Mailing List: 198 (16-Jul-2019)

IW19 Participants: 41 (37 on-site, 4 remote)

IS19 Participants: 23 (18 on-site, 5 remote)

INCOSE Connect: https://connect.incose.org/WorkingGroups/ASASE/Pages/Home.aspx

Public Page: www.incose.org/incose-member-resources/working-groups/transformational/agile-systems-se

General Operations

Two open workshops a year are held, one at IW and one at IS. Both can be attended remotely on the web.

The IW workshop is a full day, sometimes two. The IS workshop is limited to 1.5 hours by INCOSE decree.

These workshops generally review projects in process, consider new projects, discuss working group strategy, and collaborate on issues of interest.

Every workshop results in an after-action synopsis that is posted in the shared documents area of the working group's Share Point site:
https://connect.incose.org/WorkingGroups/ASASE/Pages/Home.aspx

Getting involved means attending the workshops, and/or contacting project leaders directly and saying you'd like to work with them on whatever the project is, and/or proposing a project you'd like to lead.

Usual projects are coauthoring symposium papers and white papers, participating in IS panel sessions and INCOSE INSIGHT special theme issues, SEBoK and Handbook contributions, and producing formal INCOSE products such as special white papers and reports.

Charter

Charter (briefly, full charter in docs at INCOSE Connect site)

Purpose: Develop a body of knowledge that will inform systems engineering on how to deal with unpredictable, uncertain, and evolving environments.

Goals:

- **Agile systems-engineering and agile-systems engineering fundamentals.**
- **Agile acquisition processes.**
- **Supplier Quick Reaction Capability (QRC).**
- **Design that can respond effectively to the pace of technology and changing user expectations.**
- **International engagement.**

Scope: Fundamentally necessary and sufficient INCOSE-relevant architectural concepts and concept-employment principles that enable any system or process to be agile.

INTERNATIONAL COUNCIL ON SYSTEMS ENGINEERING
7670 Opportunity Road, Suite 220, San Diego, CA 92111 USA
PHONE: 1-858-541-1725 or 800-366-1164 *[US & CANADA]* · FAX: 1-858-541-1728
EMAIL: info@incose.org · WEB: www.incose.org

INCOSE 2018 Working Group Award

11 December 2018

Rick Dove
dove@parshift.com

Dear Mr. Dove,

We are delighted to confirm that the **Agile Systems & Systems Engineering Working Group** has been selected to receive an award for **Sustained Performance in 2018**. This award is intended to recognize the Agile Systems Working Group for their continuous efforts, contributions and publications including webinars, INSIGHT articles, papers, panels and tutorials in the field of Agile Systems and Systems Engineering, their engagement with other organizations including NDIA and other INCOSE WGs over a multi-year period.

The award will be presented during the IW 2019 Opening Plenary at 8 am on Saturday 26 January in Torrance, California. Please sit up front. If you are unable to attend, please let us know the name of the individual who will be accepting the award on behalf of the Working Group.

Your role as a leader of the Agile Systems & Systems Engineering Working Group team has been critical in achieving this success. As a volunteer organization, INCOSE depends on the time and effort graciously contributed by individuals like yourself to deliver its programs and continue to take the organization forward. Thank you for taking on this role within INCOSE.

Our congratulations to you and to all members of the Agile Systems & Systems Engineering Working Group for achieving this success.

Sincerely,

Garry Roedler
President

Mike Celentano
Technical Director

2018 Sustained Performance Award

"We are delighted to confirm that the Agile Systems and Systems Engineering Working Group has been selected to receive an award for sustained performance in 2018. This award is intended to recognize the Agile Systems Working Group for their continuous efforts, contributions and publications including webinars, INSIGHT articles, papers, panels and tutorials in the field of Agile Systems and Systems Engineering, their engagement with other organizations including NDIA and other INCOSE WGs over a multi-year period."

WG Operating Principles

Objectives:

– Leverageable fundamentals rather than niche practices & recommendations.
– Applied rather than theoretical research.
– In-demand knowledge products for the practitioner.
– Embraceable knowledge products (a joy to use).
– Testing and refinement to verify efficacy.
– Socialization and facilitated-assimilation of results.

Project execution:

Clear project objectives, customers, and plans.
Core members with passionate interest driven by personal value.
Effective project leadership.
Firm deliverable dates.
Frequency & Momentum – project-progress meetings weekly.
Knowledge-development and remote collaboration tools.
Incrementally releasable deliverables – papers towards INCOSE products.
Reflective process learning.
Oversight progress facilitation.

Reality:

People work on what they want to work on, but we attempt to guide.

Agile Systems & Systems Engineering Engineering WG

Completed Projects

Mail list: request inclusion from dove@parshift.com

INCOSE INSIGHT Theme Issues

- July 2014: *Agile-Systems Engineering*
- July 2016: *Agile System Security: Sustainable Systems Evolve*
- July 2018: *Enabling and Practicing Agile Systems Engineering*

Projects and Products

- 8 INCOSE Webinars every September since 2012
- SE Handbook Content for V4 (Section 9.9)
- 4 case studies of Agile SE
- Continuous Iterative Development (DSB recommendation)

Ongoing Projects

Projects and Products

- INCOSE Webinars
- Agile SE Life Cycle Model
- Decision Guidance for Applying Agile SE

Papers/Panels/Tutorials

- INCOSE Symposium (summer)
- **Non-INCOSE conferences**

Collaborations (Ongoing)

- NDIA Agile SE WG
- NDIA Continuous Integration & Acquisition WG
- INCOSE
  - Systems Security Engineering WG
  - Critical Infrastructure Protection and Recovery WG
  - Complex Systems WG
  - Systems Science WG

Current Projects

- Agile Systems Engineering Life Cycle Model – INCOSE Product
- Mixed Discipline Continuous Integration Platform (CIP)
- Panel and paper for IS20 on CIP
- Agile SE in the Future of Systems Engineering (FuSE)
- Handbook Update
- Agile LCM recommendations to 15288 et al. standards

Status of Past and Current Projects

Webinars	**Persistent**
– 2012/13/14/15/16/17/18 Sept. INCOSE Webinars – Agile 101-102-103-104-105-106-201: Agility Fundamentals	**Done**
– 2015 Jan Town Hall – Agile SE Life Cycle Model Fundamentals Project	**Done**
– 2015 Apr Webinar – Natural-System Patterns for SEing of Agile Self Organizing Security	**Done**
– 2015 Jun Webinar – System Engineering for Software Intensive Projects Using Agile Methods	**Persistent**
Projects	**Dormant**
– Agile Collaborative Knowledge Development for Working Groups, POC: Rick Dove	**WIP**
– Decision Guidance for Applying Agile SE, POC: Ron Lyells	**WIP**
– CAB Agile SE Priority Team IW/IS workshop facilitation, POC: Rick Dove	**Done**
– Systems Summit Collaborative Exchange ConOps, POC: Rick Dove	**Persistent**
– WSRC 2019 Agility Track Paper Reviews (6 WG members)	**Done**
INCOSE Products	**Done**
– SE Handbook Section 9.9: Agile Systems Engineering – Published in July 2015	**WIP**
– Agile Systems Engineering Life Cycle Model Fundamentals, POC: Rick Dove	**Persistent**
Papers, Panels, Tutorials, Workshops	**Done**
– Papers Past: IS14 (3), IS15 (4), IS16 (3), SysCon17 (1), IS17 (1), IS18 (2) , IS19 (4)	**Done**
– Tutorials Past: IW15 (1), IS15 (1)	**Done**
– Panels Led: IS15 (1)	**Done**
– Panel Participation: IS13 (1), IS16 (1)	**Persistent**
Collaborations	**Done**
– CAB, Agile SE Priority Team, POC: Rick Dove	**Persistent**
– Healthcare WG, POC: Bill Schindel	**Persistent**
– NDIA Agile SE WG, POC: Larri Rosser	**WIP**
– NDIA Continuous Iterative Development and Acquisition WG, POC: Larri Rosser	**Persistent**
– Systems Security Engineering WG, POC: Rick Dove	**WIP**
– Complex Systems WG, POC: Larri Rosser	**WIP**
– Systems Science WG, POC: Rick Dove	**Persistent**
INSIGHT Publications:	**Done**
– 2014-Q2, Theme Issue: Agile-Systems Engineering & Agile Systems-Engineering	**Done**
– 2015-Q2, Article: Practitioner Attention to Systems Engineering Delivery of Sustainable Value	**Done**
– 2016-Q2, Theme Issue: Agile Security – Joint project with Agile SE working group	**Done**
– 2017-Q3, Article: On Defining Agile Systems Engineering	**Done**
– 2018-Q2, Theme Issue: Enabling and Practicing Agile Systems Engineering	**Persistent**
Tracks and Papers at Non-INCOSE Conferences	**Done**
– 2014 Oct, NDIA SE Conference: Domain Independent Agile SE Life Cycle Model Project	**Done**
– 2015 Jan, ITEA El Paso Conference: INCOSE Project – Agile SE Life Cycle Model Fundamentals	**Done**
– 2015 Jun 16-19, ICCRTS Symposium Proceedings, Agile C2 Security Track (3 papers)	**Done**
– 2016 Jul 28, ISSS Plenary presentation: Enabling and Facilitating Engineered Sustainability	**Done**
– 2017 Apr 24, IEEE SysCon, Montreal, Quebec, ASELCM Case Study Rockwell Collins	**Persistent**
Awards: 2018 Sustained Performance	

Questions?

How do I get on the distribution list?

- **Request by email to dove@parshift.com**

How do I get involved with a project?

1) **Contact the project POC**
2) **Propose one of your own and recruit participants**

New Project Starting in October 2019
Agile Hardware Systems Engineering

The goals of agile hardware SE are to produce an innovative result, produce a sustainable result, produce a "success-assured" result, rapidly.

Rework is the bane of Rapid.

<u>Need:</u> Minimize rework (common value across all disciplines).

<u>Intent:</u> An agile Continuous Integration Platform (CIP), that enables and facilitates…

- **An asynchronous continuous test capability (less rework).**
- **Early detection of integration issues (less rework).**
- **WIP feedback demos to users/customers/management (less rework).**
- **DevOps/DevSecOps collaborative development interaction (less rework).**
- **Alternative/prototype experimentation (less rework).**
- **A set-based knowledge-development test stand (less rework).**

Agile Hardware SE Project – Preliminary Proposal Concept

Project Objective: Minimization of actual and potential rework cost.

Project Deliverable: A white paper (initially).

Project Focus: Fundamental concepts and principles for continuous integration, with examples.

Some Concepts of interest:

- **Continuous Integration Platform (CIP) that enables & facilitates continuous integration.**
- **Application for multi-discipline, multi-supplier engineering projects.**
- **DevOps and DevSecOps support.**
- **Integration testing support.**
- **Experimental and set-based knowledge-development support.**
- **Stakeholder collaboration and wip demonstration capability.**
- **Performance instrumentation**
- **Affordable incremental-development road map for a CIP (most bang for least buck)**

Some Examples to Learn From and Display:

- **LVC-like mixture of real components, simulated components, and constructed operational management.**
- **Virtual SIL (connected remotely distributed sub-system wip components).**
- **ECB/FPGA/SW CIPs.**
- **Model Centric Engineering mixed discipline platforms**
- **Eclipse (perhaps to draw general services/benefits/principles from)**

Next Steps:

- **Collaboration on refactoring and further fleshing of the above.**
- **An operational-vision "story" of a CIP in action, including goals, need and intent, and general requirements (Dove volunteers to do a strawman by end September).**

Major INCOSE Product Project – In Final Writeup
Agile Systems Engineering Life Cycle Model (ASELCM)

An INCOSE Project to…

- ❑ **Discover generic principles/patterns that are necessary for effective agile systems engineering of SW/FW/HW projects**
- ❑ **Publish informative case studies**
- ❑ **Build evidence-based generic agile-SE life cycle model to inform effective implementation**

And …

- ❑ **Provide material for next INCOSE Handbook revision**
- ❑ **Influence published standards**

Value Proposition for Agile Systems Engineering

Faster, lower cost system development?

An appealing argument, at the business level.

But to achieve this,
a different value proposition is needed at the engineering level:

Minimization of project risk and rework.

Defining Agile Systems Engineering

Need:

Effective system engineering in the face of uncontrolled change.

Intent:

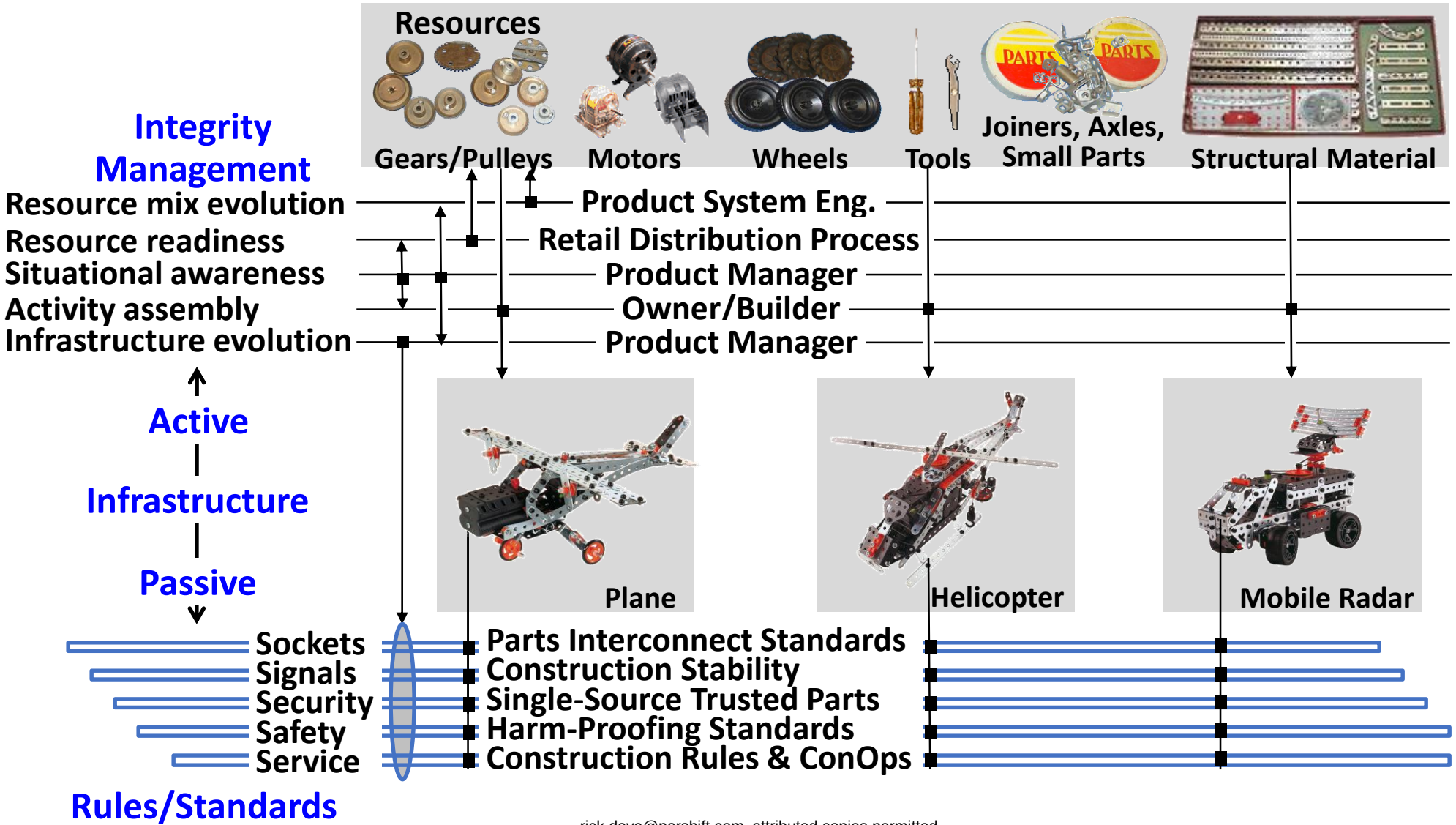
Effective response to a systems engineering operational environment that is capricious, uncertain, risky, variable, and evolving. This intent defines agile systems engineering.

The definition of agile systems engineering is rooted in what it does, not how it does it.

There are many ways to accomplish the how at the project and engineering discipline level.

Iconic Agile Architecture Pattern (AAP)
Notional Concept: System Response-Construction Kit

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



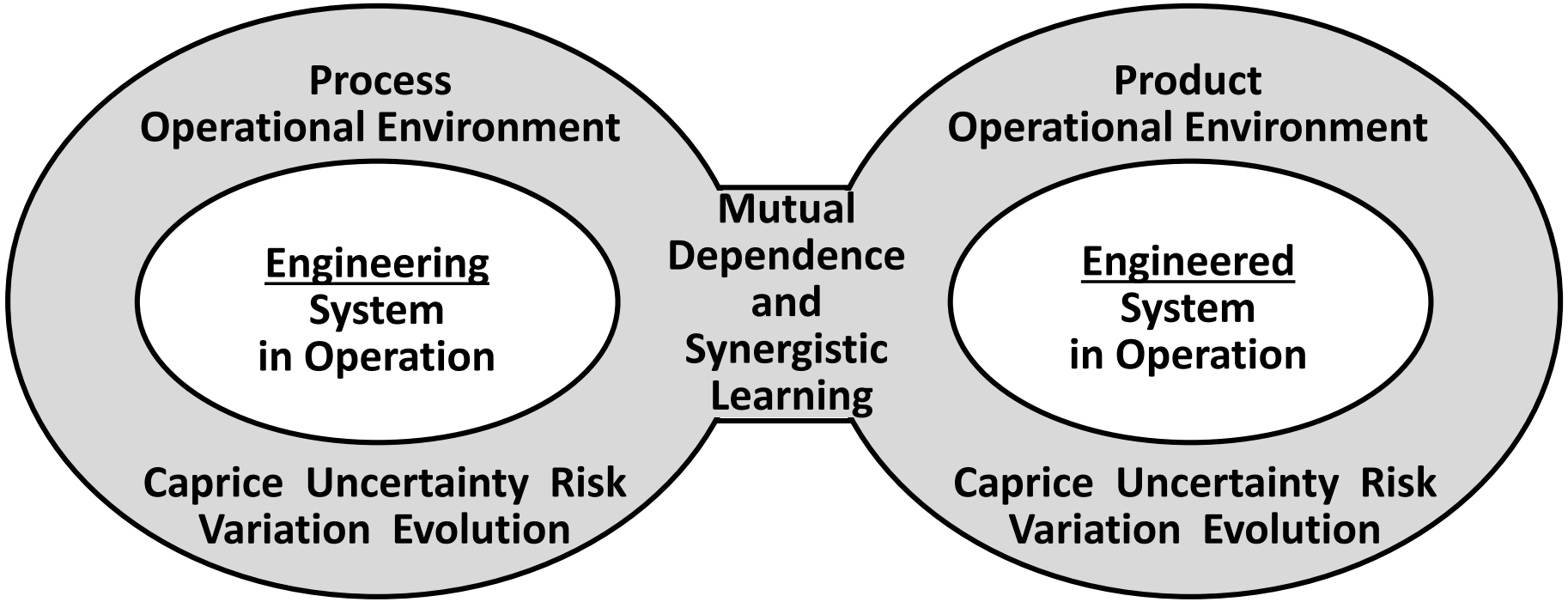
Sustaining Agility Requires …

- **Proactive awareness of situations needing responses**
- **Effective options appropriate for responses**
- **Assembly of timely responses**

Five Agility-Sustaining Responsibilities:

1. **Resource Mix Evolution**
2. **Resource Readiness**
3. **Situational Awareness**
4. **Response Assembly**
5. **Infrastructure Evolution**

Two different systems with synergistic dependencies
(a first principle)



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

ASELCM Project Findings

An IS19 paper discusses:

1. **Agile SE Life Cycle Model Framework**
2. **ASELCM Pattern of Three Concurrent Systems**
3. **CURVE Framework Characterizing the Problem Space**
4. **Operational Principles**
5. **Concept of Information Debt**
6. **General Agile SE Response Requirements**

Above covered in the IS19 paper:

www.parshift.com/s/ASELCM-05Findings.pdf

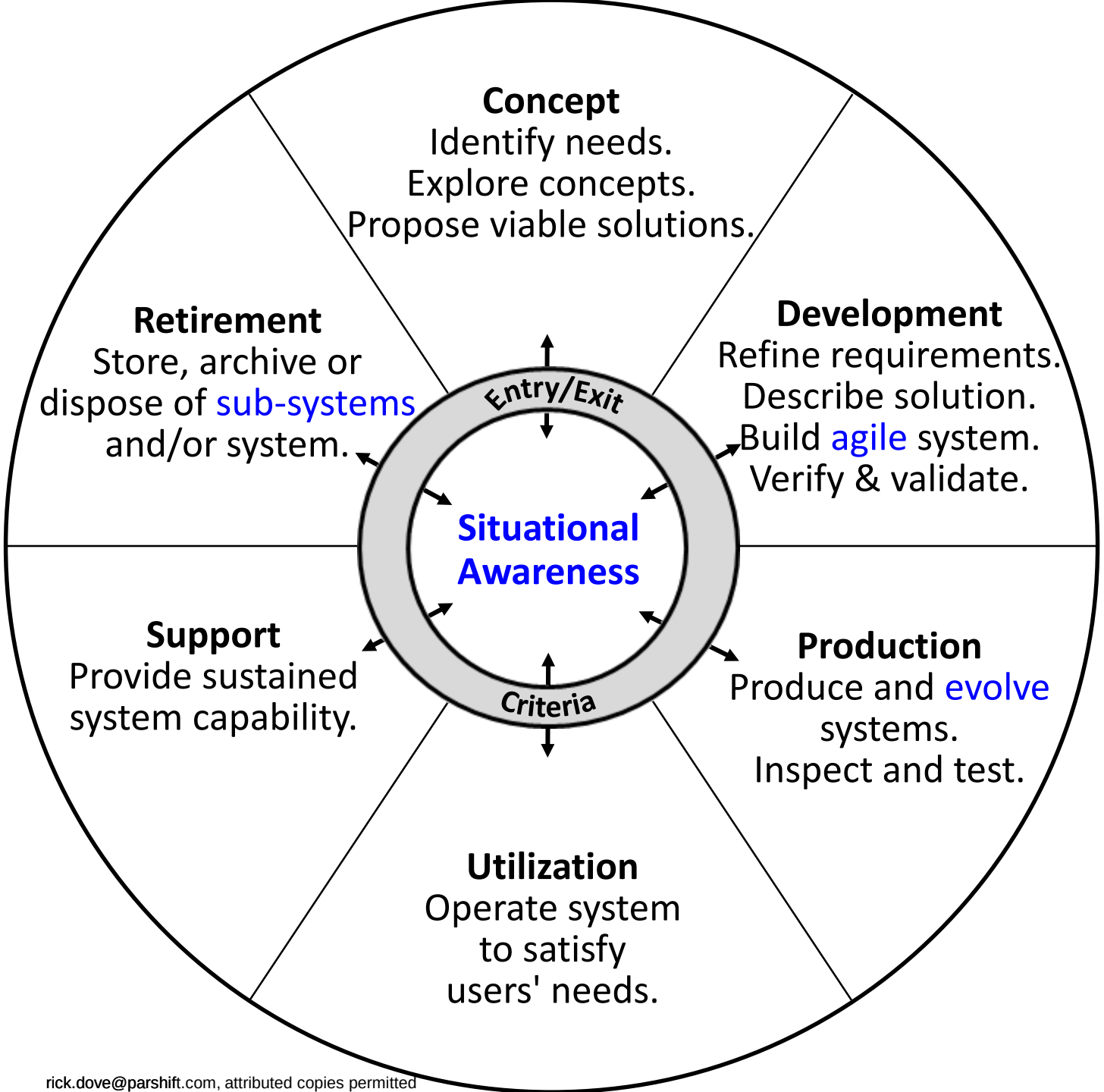
Two additional findings (more to come):

7. **Stakeholder Engagement**
8. **Continuous Integration Platform**

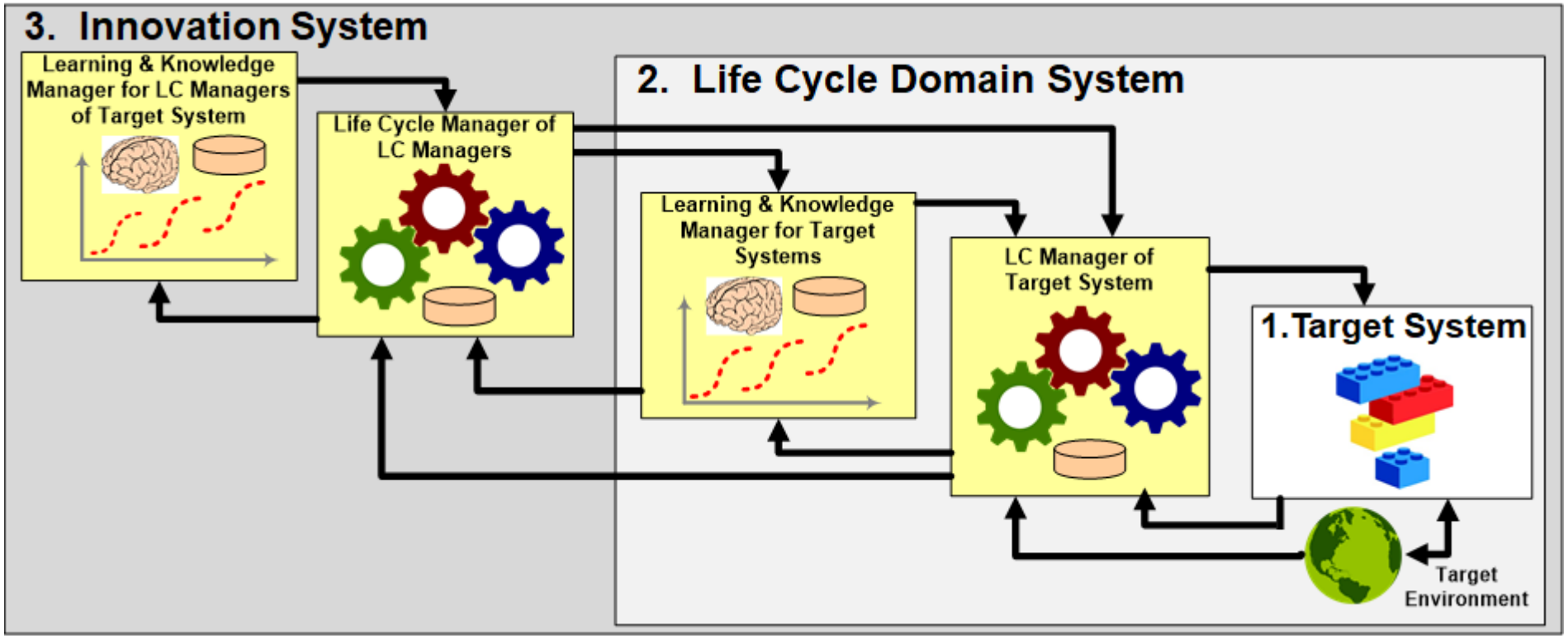
1. Agile SE Life Cycle Model Framework

Asynchronous/Concurrent Stages.
Consistent with
ISO/IEC/IEEE 24748-1:2018

Situational Awareness Engages System Evolution Stages/Tasks



2. ASELCM Pattern of 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 domain that produces System-1.
- System-3 is the process improvement system, called the system of innovation that learns, configures, and matures System-2.

The Innovation System is responsible for situational awareness and evolution, the provider of operational agility. Intent is continuous, not episodic, info flow.

3. CURVE Framework for Characterizing the Problem Space

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)

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

The general CURVE shown here is applicable to both S2 and S1.

S2 and S1 have cyber-physical-social dimensions.

General SE CURVE
Caprice
• Survivability (i.e., current order compatibility) • Occurrence and nature of emergent behavior • Game-changing technologies • Availability of symbiotic social relationships
Uncertainty
• Relevance (i.e, appropriate to current desires) • Cohesion in the greater SoSs (multiple) • Integrity and symbiosis of social relationships.
Risk
• Viability (i.e., capable of working successfully) • Cohesion among constituent parts
Variation
• Operational environments • Social compatibility
Evolution
• Toward more operating environment complexity • Toward more SoI complexity • Toward shorter SoI static viability • Toward new technology options • Toward new malevolent threats to viability • Toward greater social involvement.

4. Operational Principles

Sensing (observe, orient)

- External awareness (proactive alertness)
- Internal awareness (proactive alertness)
- Sense making (risk & opportunity analysis, trade space analysis)

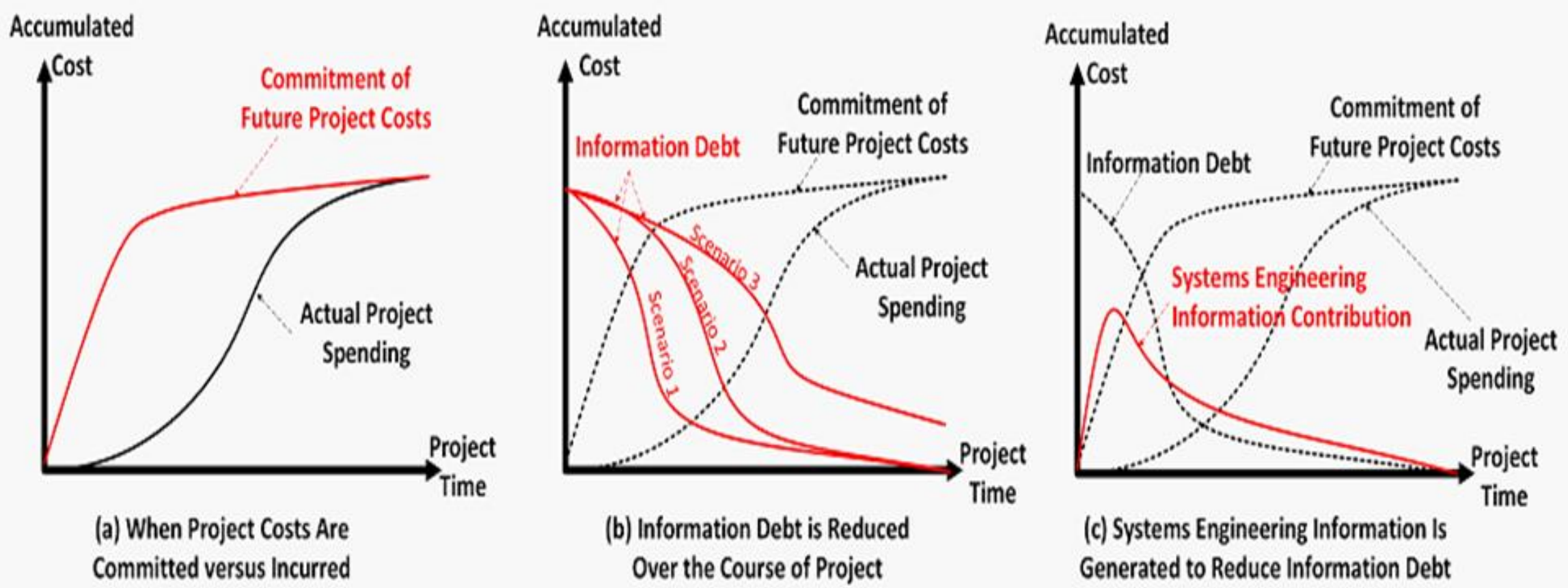
Responding (decide, act)

- Decision making (timely, informed)
- Action making (invoke/configure process activity for the situation)
- Action evaluation (validation & verification)

Evolving (improve above with more knowledge and better capability)

- Experimentation (variations on process ConOps)
- Evaluation (internal and external judgement)
- Memory (evolving culture, response capabilities, and process ConOps)

5. Concept of Information Debt



Future costs of a project become committed early by SE decisions. One of the traditional arguments for early stage SE investment.

Will project end with outstanding information debt: a "working system" but an interest penalty caused by shortage of needed information?

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

6. General Agile SE Response Requirements

Domain		Response Requirements
Proactive	Creation	•Opportunity & risk awareness •Response actions/options • Acculturated memory • Decisions to act
	Improvement	•Awareness/Sensing •Memory in culture, options, ConOps • Action/option effectiveness
	Migration	•New fundamentally-different types of opportunities and risks
	Modification (Capability)	•Actions appropriate for needs •Personnel appropriate for actions
Reactive	Correction	•Insufficient awareness •Ineffective actions/options • Wrong decisions
	Variation	•Effectiveness of actions/options •Effectiveness of evaluation
	Expansion (Capacity)	•Capacity to handle 1-? actions simultaneously
	Reconfigu-ration	•Elements of an action •Response managers/engineers

7. Stake Holder Engagement

Developers
Subcontractors
Security Engineers
Operators
Producers
Maintainers
Customers
End Users
Management

Engagement can’t be forced.

Engagement can’t be perceived as a time-eating task.

Engagement must provide experiential and take-away value to all involved.

DevOps concept offers a discussion path.

Narrowly named, but it can work, and is likely here to stay.

8. Continuous Integration Platforms

Agile SE processes deal with changing knowledge and environment

- **They learn and employ that learning during SE process operation**
- **They modify/augment product-development work-in-process, enabled by an SoI Agile Architecture Pattern (AAP)**

Agile SW development relies on AAP for SoI structure – commercially available

- **Program code development employs an object-oriented development platform (e.g., C++, Java, Eclipse)**
- **Web code development employs a loosely-coupled modularity inherent with hyperlinked web-pages**

Agile HW development doesn't have off-the-shelf integration platforms

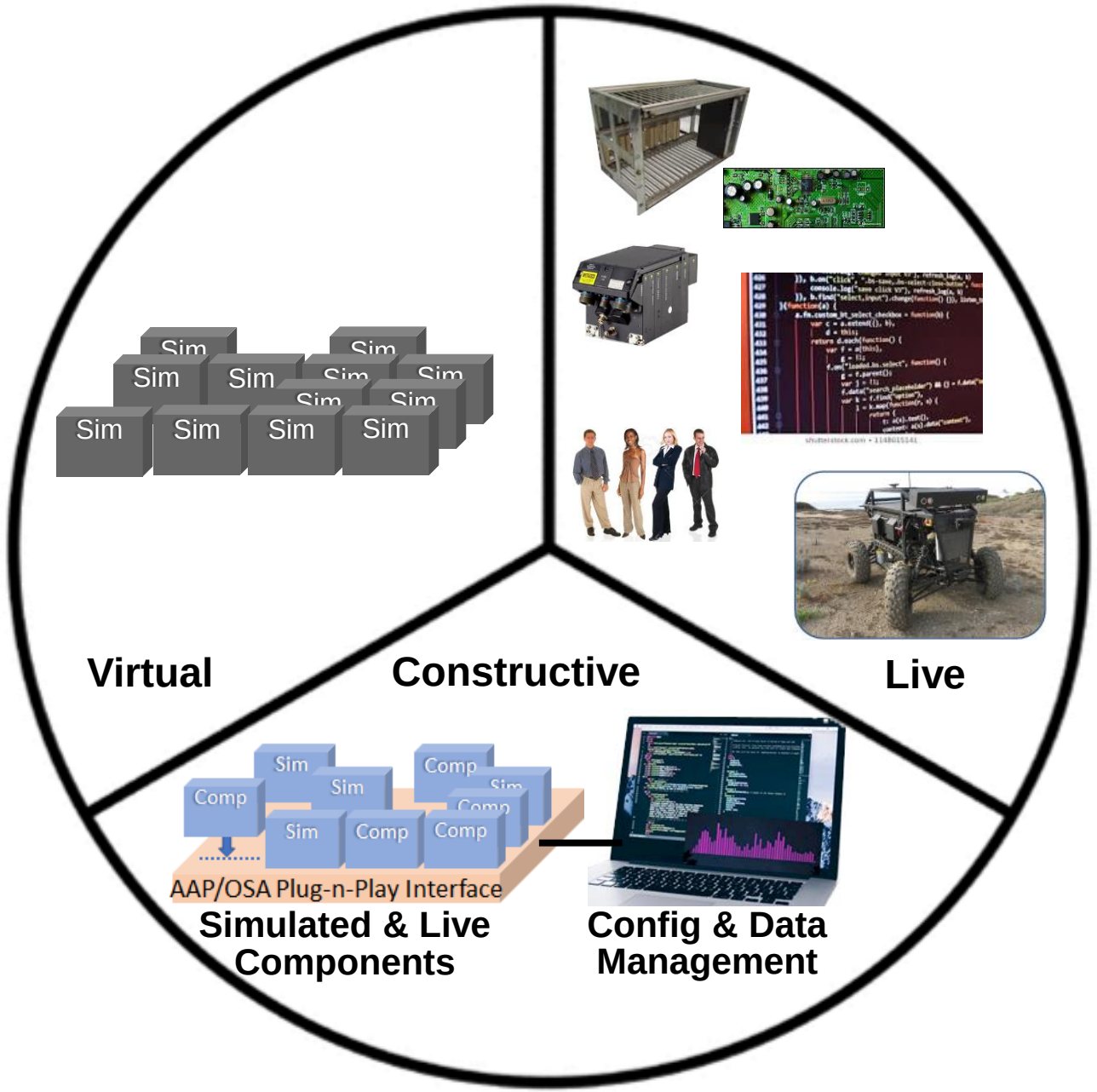
- **Proprietary Product-Line-Engineering employs AAP**
- **Proprietary Open System Architecture (OSA) employs AAP**
- **Proprietary Live-Virtual-Constructive employs AAP**

Live Virtual Constructive CIP

Live components
(people, things)
Virtual components
(simulations)
Constructive capabilities
(configuration and data management)

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

An LVC/CIP demonstration/test/experimental events
can occur at any time with the latest instantiation of simulations & components.



AAP: Agile Architecture Pattern
OSA: Open Systems Architecture

Studies Supporting the Findings

Fundamentals of Agile Systems Engineering – Part 1. Dove, R., R. LaBarge. International Council on Systems Engineering. International Symposium, Las Vegas, NV, USA, June 30-July 3, 2014. www.parshift.com/s/140630IS14-AgileSystemsEngineering-Part1.pdf

Introduction to the Agile Systems Engineering Life Cycle MBSE Pattern. Schindel, W., R. Dove. International Council on Systems Engineering. International Symposium, Edinburgh, Scotland, July 18-21, 2016. www.parshift.com/s/160718IS16-IntroToTheAgileSystemsEngineeringLifeCycleMBSEPattern.pdf

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Case Study: Agile Hardware/Firmware/Software Product Line Engineering at Rockwell Collins. Dove, R., W. Schindel, R. Hartney. 11th Annual IEEE International Systems Conference. Montreal, Quebec, Canada, April 24-27, 2017. www.parshift.com/s/ASELCM-02RC.pdf

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