Case Study: Agile SE Process for Centralized SoS Sustainment at Northrop Grumman

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Six years of effective employment and evolution, winning praise from GAO and users alike.
CURVE Environment
(That requires an agile SE process)

Caprice
- External data sources change their services at will
- COTS (Common Off The Shelf) software upgrades deprecate existing interfaces

Uncertainty
- Software and/or hardware may go end-of-life at any point

Risk
- May not be able to meet 15-day schedule for delivery of security fixes

Variation
- Number of security vulnerabilities to address varies greatly week-to-week
- Development man-hours available for capability evolution in competition with higher priority patches and security updates

Evolution
- As technology changes, the program must port existing capability to new technology
Scrum-Based Software Development Process in Decoupled Wave-Like Waterfall

6 Months

5-day planning (P), four 20-day development sprints (abcd), two 10-day Z sprints

Development
- Development
- Development
- Development
- Development

Accreditation
- Accreditation
- Accreditation
- Accreditation
- Accreditation

Operation
- Operation
- Operation
- Operation

Retirement
- Retirement
- Retirement
- Retirement
Sprint Process Overview

These are the agile team activities from a high level sprint perspective.

CDR: Critical Design Review
CIT: Component Integration Testing
CT&E: Certification Test & Evaluation
PDR: Preliminary Design Review
PMO: Program Management Officer
SCR: Software Change Request
SAT: Systems Acceptance Test
SQT: Systems Qualification Test

Scrum (Each Agile team holds a daily scrum)

Sprint Planning (Normally 5 days) → Sprint Allocation → PDR/CDR

Authorization to proceed from PMO - Begin Sprint

Agile Team Development Activities (Normally 20 days)

End Sprint → Retrospective (Normally 1 day)

Sprint Z (Normally 20 days and overlaps with CIT)

Next Development Sprint

Agile Team Members Update Rally Daily

Record Minutes & Action Items → Daily Scrum of Scrums

System Change Request (SCR) Process → To CT&E & SAT/SQT

Lessons Learned → Process Improvement

Prioritized Backlog & Themes

Start

Warfighter Needs

Modified/Refined User Stories

Backlog Management
SoS Web-Portal Evolution Process

Resources
- Tech Mgmnt
- Warfighters
- PMO Personnel

Integrity Management
- Resource mix evolution
- Resource readiness
- Situational awareness
- Activity assembly
- Infrastructure evolution

Sockets: Meeting formats, Sys-1 modular architecture, Automated build environment. User story acceptance criteria, Roles, Culture
Security: Governance, Leadership, Cultural oversight, QA, Metrics, CMMI level 5 oversight, Configuration management
Safety: Open-process visibility, Open no-penalty communication, On-boarding, Team user-story estimation, 40-hour work load
Service: Documented accessible ConOps, Embedded environment awareness, Continuous DevOps integration, AAP for Systems 1&2
Asynchronous/Simultaneous Agile Life-Cycle Framework

Awareness
Situation awareness and evaluation of external and internal environments and evolution, for threat and opportunity.

Concept
Identify needs. Explore concepts. Propose viable solutions.

Development

Production
Produce and improve systems. Evolve infrastructure. Inspect and test.

Retirement
Store, archive or dispose of sub-systems and/or system.

Support
Provide sustained system capability.

Utilization
Operate system to satisfy users’ needs.

Engage
Awareness Stage is Critical Driver of Agility

Awareness Stage is Critical Driver of Agility
3. System of Innovation (SOI)

- System-1 is the target system under development.
- System-2 is the SE process life cycle that produces System-1.
- System-3 is the process improvement system, that learns, configures, and matures System-2.

(Substantially all the ISO15288 processes are included in all four Manager roles)
Some Notable Process Concepts

- Intimate stakeholder involvement in the SE process.

- Asynchronous and simultaneous life cycle stage activity, in never-ending system growth and evolution.

- Hybrid Scrum/Waterfall/Wave process-model integration, in contract conformance.

- CMMI level 5 procedure discipline, providing seamless new-release operational stability.

- Awareness and mitigation of external environment evolution.

- Real-time optimal process-control model, for re-prioritizing development-increment activity and acting on feedback.
Four Key Findings
Emerging from ASELCM Project:

1. Life Cycle Model Framework
2. ASELCM 3-System Pattern
3. CURVE problem-space characterization
4. MME behavior principles

www.parshift.com/s/ASELCM170415-AgilityInSE-Findings.pdf
Characterizing the Problem-Space

**CURVE**

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

**Capriciousness:** Unknowable situations.  
Unanticipated system-environment change.

**Uncertainty:** Randomness with unknowable probabilities.  
Kinetic and potential forces present in the system.

**Risk:** Randomness with knowable probabilities.  
Relevance of current system-dynamics understanding.

**Variation:** Knowable variables and associated variance ranges.  
Temporal excursions on existing behavior attractor.

**Evolution:** Gradual successive developments.  
Experimentation and natural selection at work.
Emerging Fundamental Principles

All case studies enable and facilitate (in core, but different methods):

- Project situational sensing and response.
- Team-members’ engagement sensing and response.
- Development-issue sensing and response.
- Integration-issue sensing and response.
- Assimilated shared-culture and evolution.
- Process and procedure evolution.
- Product evolution.

Three Categories of Fundamental Principles Emerge:

- Sense/Monitor – awareness is the driver of agility
- Respond/Mitigate – action is the expression of agility
- Evolve – applied learning is the sustainer of agility
Agility-Facilitating Operational Principles

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

**Mitigating** (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 process ConOps)
Relevant References

Agile Systems Engineering Life Cycle Fundamentals Project, Documents at: https://connect.incose.org/ProgramsProjects/ASELCM/Pages/Home.aspx, alternatively at www.parshift.com/ASELCM/Home.html


