# Agility in Defense SE & Acquisition: Some Critical Success Factors

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# Summary

- Agile Defense SE & Acquisition and BBP 3.0
  - Better Buying Power
- Critical success factors vary by life cycle type
  - In-house agile life cycle
  - Outsourced agile development
  - Outsourced agile life cycle
- Other critical success factors
  - Avoiding a herd mentality
  - Process, product, people, project, and risk factors
  - Agility and safety
  - Avoiding one-size-fits-all process models

# Agile SE & Acquisition and BBP 3.0

- **Eliminate Unproductive Processes and Bureaucracy**
  - **Reduce cycle times while ensuring sound investments**
  - **Streamline documentation requirements and staff reviews**
- **Improve Tradecraft in Acquisition of Services**
  - **Strengthen contract management outside the normal acquisition chain**
- **Improve the Professionalization of the Total Acquisition Workforce**
  - **Strengthen organic engineering capabilities**

# Critical Success Factors: In-house agile life cycle

- **Prepare for early success**
  - **Highly agile-qualified sponsors and performers**
  - **Top management buy-in**
  - **Involve all key organizations**
- **Choose project with enterprise-wide benefits**
  - **Based on evidence of critical success factors**
  - **Process, product, people, project, risk**
    - **These will indicate when not to go agile as well**
  - **Emphasize success and commitment to expand usage**
- **Incrementally expand with aid of initial project benefits**

# 4 Potential Critical Success Factors

## From SERC Expedited-SE study


*Final Database*

*Over 30 Interviews with Gov't/ Industry Rapid Development Organizations*

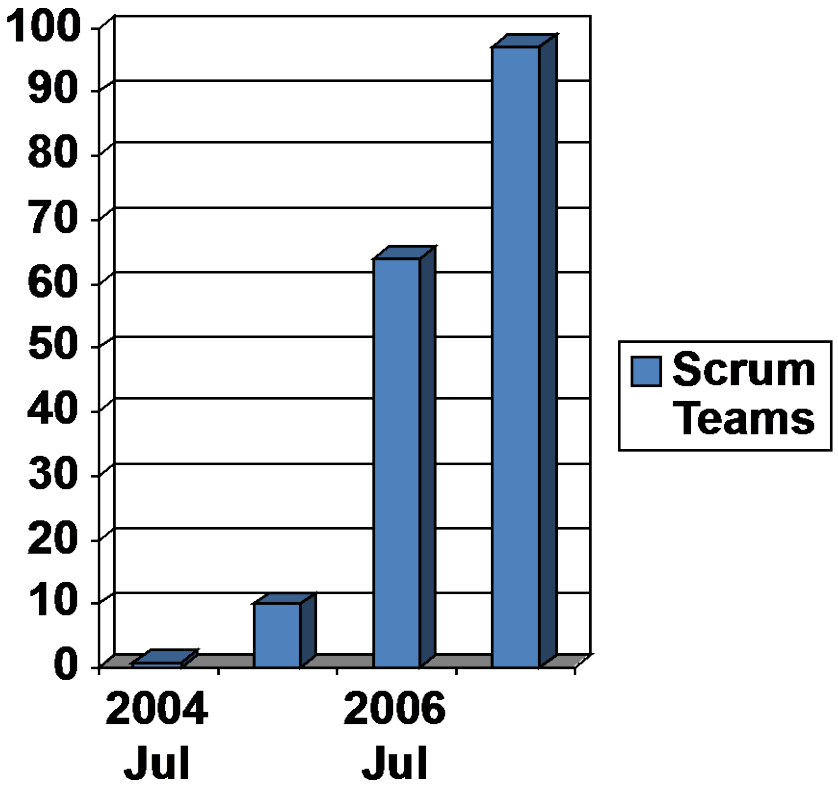
*Over 23,500 words from interview notes*

***People, Product, Process … all in a Project Context***

# Medical Case Study -- USA

- **1400 software people; 7M SLOC; 7 sites**
  - **4 in Europe, 2 in India**
- **500 medical applications; 500 financial; others**
- **Survivability-critical software problems**
  - **Reliability, productivity, performance, interoperability**
  - **Sarbanes-Oxley requirements**
  - **Management receptive to radical change**
- **Some limited experimental use of agile methods**
  - **Led by top software technologist/manager**
- **Committed to total change around Scrum and XP**

# Medical-USA Adoption Profile




- **July 2004 - July 2005**
  - **Recruit top people from all sites into core team(s)**
  - **Get external expert help**
  - **Develop architecture**
  - **Early Scrum successes with infrastructure**
  - **Revise policies and practices**
  - **Train, reculture everyone**
  - **Manage expectations**
- **July 2005 – July 2006**
  - **Begin full-scale development**
  - **Core teams as mentors**

# Key Practices – USA Medical

- **Include customers and marketers**
  - **New roles; do's/don'ts/opportunities; CRACK personnel; full collaboration and teamwork; expectations management**
- **Scrum; most XP practices; added company practices**
  - **6-12 person teams with team rooms, dedicated servers**
  - **Hourly smoke test; nightly build and regression test**
  - **Just-in-time analysis; story-point estimates; fail fast; detailed short-term plans; company architecture compliance**
  - **Embrace change in applications and practices**
  - **Global teams: wikis, daily virtual meetings, act as if next-door**
- **Release management**
  - **2-12 week architecting Sprint Zero; 3-10 1-month Sprints; Release Sprint; 1-6 month beta test**
  - **Next Sprint Zero concurrent with Release Sprint**
- **Initiative manager and team**
  - **Define practices; evolve infrastructure; provide training; guide implementation; evaluate compliance/usage; continuous improvement**

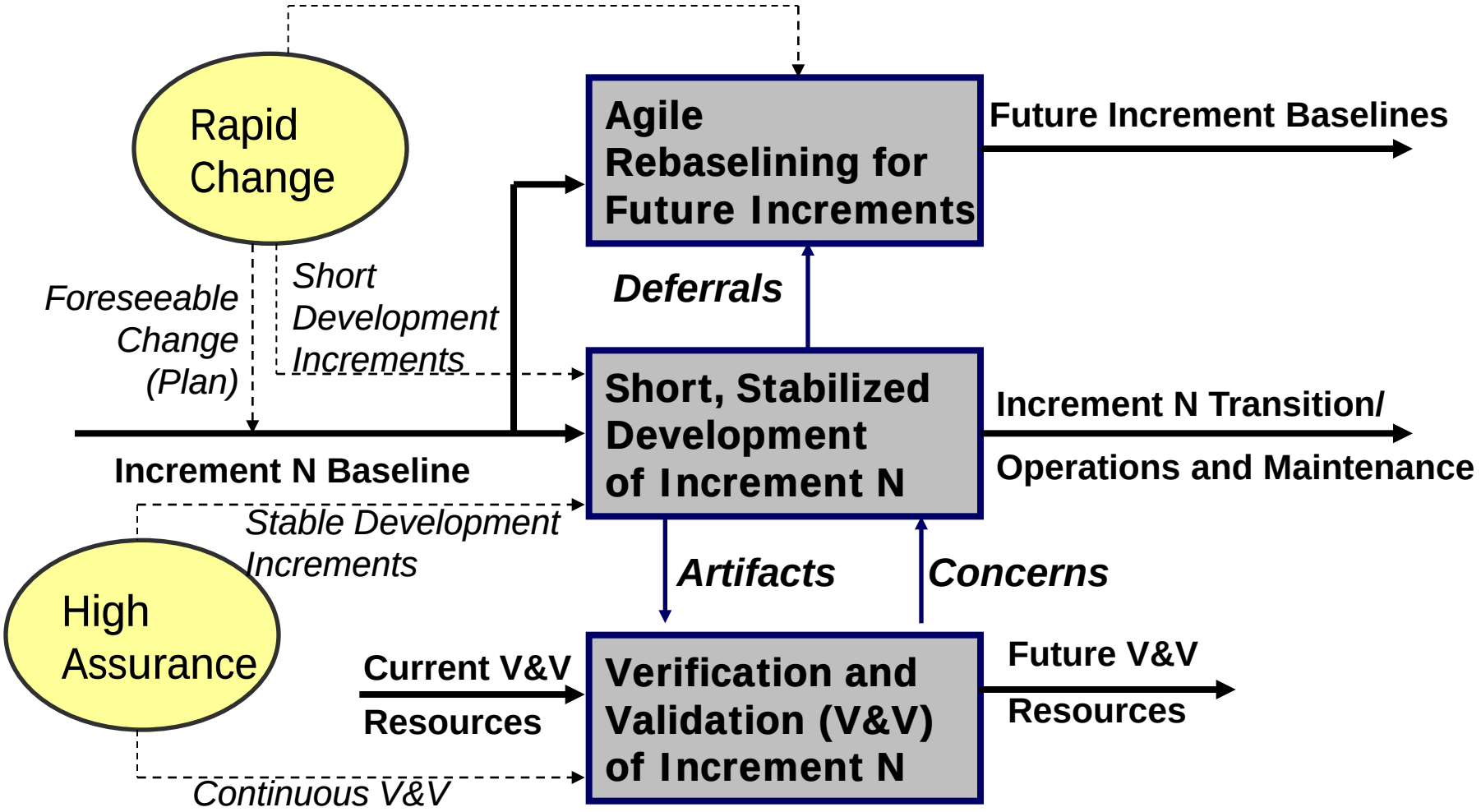
# CSFs: Outsourced Agile Development

- **Prepare organization for life-cycle takeover**
  - **Highly capable in-house development performers, customers**
    - **AFR 63-123: Committed, representative, authorized, collaborative, knowledgeable**
- **Evidence-based source selection**
  - **Reference checking; software engineering exercise**
  - **Scalability to support full operational capability**
  - **Committed key personnel**
- **Significant award fee to developer**
  - **Flowdown to performers**
    - **Explicit criteria (Reifer-Boehm 2006); Vested Outsourcing (Vitasek 2011)**

# CSFs: Outsourced Agile Life Cycle

- Similar to agile development outsourcing
  - Highly capable customers
    - AFR 63-123: Committed, representative, authorized, collaborative, knowledgeable
- Evidence-based source selection
  - Reference checking; software engineering exercise
  - Scalability to support full operational capability
  - Committed key personnel
- Evidence-based release decision reviews
  - Acquirers part of agile rebaselining team
- Significant award fee to developer
  - Flowdown to performers
    - Explicit criteria (Reifer-Boehm 2006); Vested Outsourcing (Vitasek 2011)

# Evolutionary Spiral Acquisition



# Summary

- **Critical success factors vary by life cycle type**
  - **In-house agile life cycle**
  - **Outsourced agile development**
  - **Outsourced agile life cycle**

→ **Other critical success factors**
  - **Avoiding a herd mentality**
  - **Process, product, people, project, and risk factors**
  - **Agility and safety**
  - **Avoiding one-size-fits-all process models**

# Is Everybody Doing Agile?

1991), has come to encompass a range of development techniques now more commonly called *agile* or *lean*.

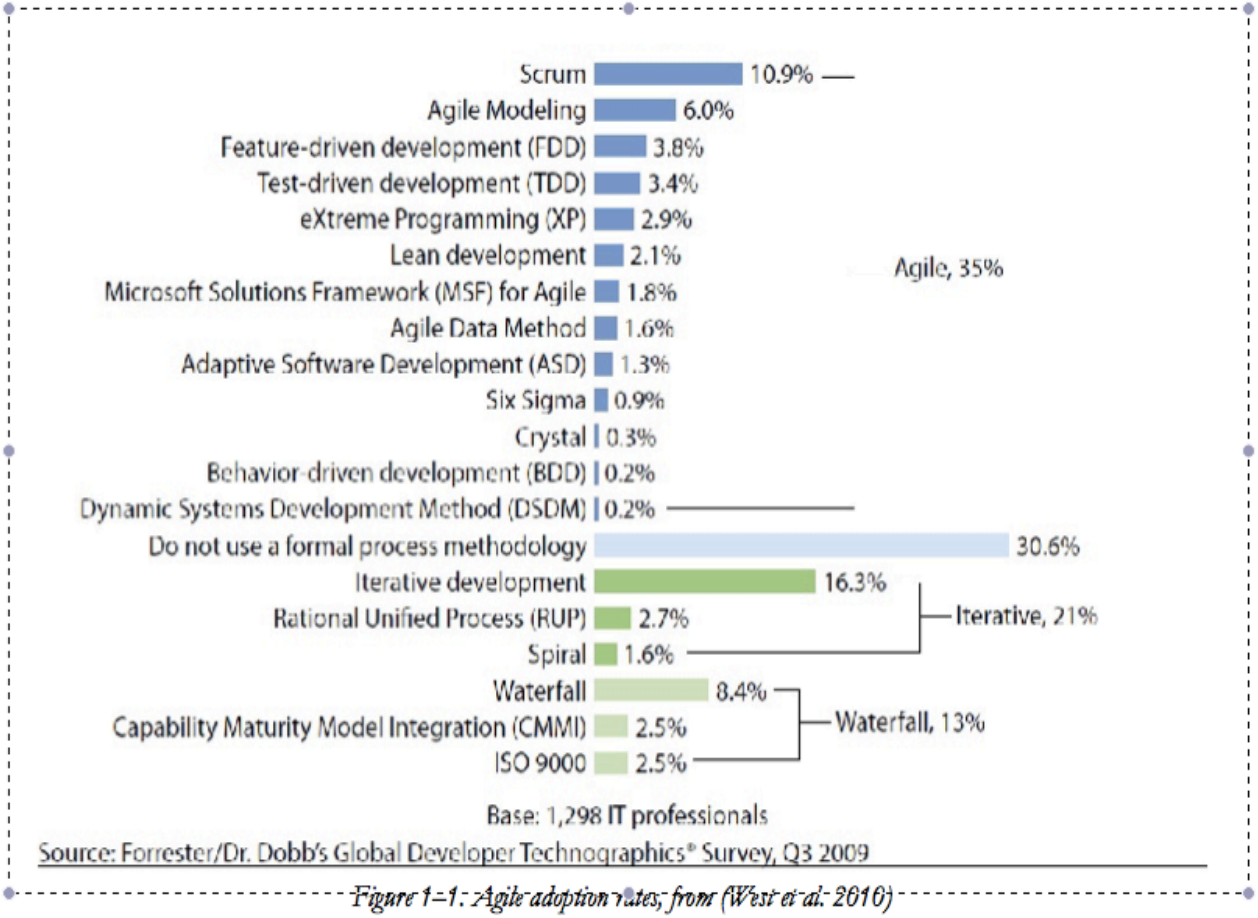



*Figure 1–1: Agile adoption rates, from (West et al. 2010)*

Research on agile/lean scheduling is particularly relevant now that agile/lean methods dominate the

# Relative Size of Agile and Architecture Home Grounds

By % of Projects

| Criticality, Size / Stability | Low (78%) | High (22%) |
|---|---|---|
| High | Either | Arch |
| Low (80%) | Agile | Both |

By % of Costs

| Criticality, Size / Stability | Low (28%) | High (72%) |
|---|---|---|
| High | Either | Architecture |
| Low (80%) | Agile | Both |

**Based on size distributions in financial sector (Highsmith 2002)**

- **65% small (<10 people)**
- **25% medium (11-50 people)**
- **10% large (>50 people)**

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# CORADMO-SE Rating Scales, Schedule Multipliers

| Accelerators/Ratings | Very Low | Low | Nominal | High | Very High | Extra High |
|---|---|---|---|---|---|---|
| **Product Factors** | **1.09** | **1.05** | **1.0** | **0.96** | **0.92** | **0.87** |
| Simplicity | Extremely complex | Highly complex | Mod. complex | Moderately simple | Highly simple | Extremely simple |
| Element Reuse | None (0%) | Minimal (15%) | Some (30%) | Moderate (50%) | Considerate (70%) | Extensive (90%) |
| Low-Priority Deferrals | Never | Rarely | Sometimes | Often | Usually | Anytime |
| Models vs Documents | None (0%) | Minimal (15%) | Some (30%) | Moderate (50%) | Considerate (70%) | Extensive (90%) |
| Key Technology Maturity | >0 TRL 1,2 or >1 TRL 3 | 1 TRL 3 or > 1 TRL 4 | 1 TRL 4 or > 2 TRL 5 | 1-2 TRL 5 or >2 TRL 6 | 1-2 TRL 6 | All > TRL 7 |
| **Process Factors** | **1.09** | **1.05** | **1.0** | **0.96** | **0.92** | **0.87** |
| Concurrent Operational Concept, Requirements, Architecture, V&V | Highly sequential | Mostly sequential | 2 artifacts mostly concurrent | 3 artifacts mostly concurrent | All artifacts mostly concurrent | Fully concurrent |
| Process Streamlining | Heavily bureaucratic | Largely bureaucratic | Conservative bureaucratic | Moderate streamline | Mostly streamlined | Fully streamlined |
| General SE tool support CIM (Coverage, Integration, Maturity) | Simple tools, weak integration | Minimal CIM | Some CIM | Moderate CIM | Considerable CIM | Extensive CIM |
| **Project Factors** | **1.08** | **1.04** | **1.0** | **0.96** | **0.93** | **0.9** |
| Project size (peak # of personnel) | Over 300 | Over 100 | Over 30 | Over 10 | Over 3 | ≤ 3 |
| Collaboration support | Globally distributed weak comm. , data sharing | Nationally distributed, some sharing | Regionally distributed, moderate sharing | Metro-area distributed, good sharing | Simple campus, strong sharing | Largely collocated, Very strong sharing |
| Single-domain MMPTs (Models, Methods, Processes, Tools) | Simple MMPTs, weak integration | Minimal CIM | Some CIM | Moderate CIM | Considerable CIM | Extensive CIM |
| Multi-domain MMPTs | Simple; weak integration | Minimal CIM | Some CIM or not needed | Moderate CIM | Considerable CIM | Extensive CIM |
| **People Factors** | **1.13** | **1.06** | **1.0** | **0.94** | **0.89** | **0.84** |
| General SE KSAs (Knowledge, Skills, Agility) | Weak KSAs | Some KSAs | Moderate KSAs | Good KSAs | Strong KSAs | Very strong KSAs |
| Single-Domain KSAs | Weak | Some | Moderate | Good | Strong | Very strong |
| Multi-Domain KSAs | Weak | Some | Moderate or not needed | Good | Strong | Very strong |
| Team Compatibility | Very difficult interactions | Some difficult interactions | Basically cooperative interactions | Largely cooperative | Highly cooperative | Seamless interactions |
| **Risk Acceptance Factor** | **1.13** | **1.06** | **1.0** | **0.94** | **0.89** | **0.84** |
| | Highly risk-averse | Partly risk-averse | Balanced risk aversion, acceptance | Moderately risk-accepting | Considerably risk-accepting | Strongly risk-accepting |

# CORADMO-SE Calibration Data

## Mostly Commercial; Some DoD

| Application Type | Technologies | Person Months | Duration (Months) | Duration / √PM | Product | Process | Project | People | Risk | Multi-plier | Error % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Insurance agency system | HTML/VB | 34.94 | 3.82 | 0.65 | VH | VH | XH | VH | N | 0.68 | 5% |
| Scientific/engineering | C++ | 18.66 | 3.72 | 0.86 | L | VH | VH | VH | N | 0.80 | -7% |
| Compliance - expert | HTML/VB | 17.89 | 3.36 | 0.79 | VH | VH | XH | VH | N | 0.68 | -15% |
| Barter exchange | SQL/VB/ HTML | 112.58 | 9.54 | 0.90 | VH | H | H | VH | N | 0.75 | -16% |
| Options exchange site | HTML/SQL | 13.94 | 2.67 | 0.72 | VH | VH | XH | VH | N | 0.68 | -5% |
| Commercial HMI | C++ | 205.27 | 13.81 | 0.96 | L | N | N | VH | N | 0.93 | -3% |
| Options exchange site | HTML | 42.41 | 4.48 | 0.69 | VH | VH | XH | VH | N | 0.68 | -1% |
| Time and billing | C++/VB | 26.87 | 4.80 | 0.93 | L | VH | VH | VH | N | 0.80 | -14% |
| Hybrid Web/client-server | VB/HTML | 70.93 | 8.62 | 1.02 | L | N | VH | VH | N | 0.87 | -15% |
| ASP | HTML/VB/SQL | 9.79 | 1.39 | 0.44 | VH | VH | XH | VH | N | 0.68 | 53% |
| On-line billing/tracking | VB/HTML | 17.20 | 2.70 | 0.65 | VH | VH | XH | VH | N | 0.68 | 4% |
| Palm email client | C/HTML | 4.53 | 1.45 | 0.68 | N | VH | VH | VH | N | 0.76 | 12% |

# Agility and Safety Failure Examples

- **Responding to change over following a plan**
  - **Source of software-induced rocket failures**
- **Easiest-first features; safety as deferrable feature**
  - **Can't make unsafe code safe via refactoring**
- **Nominal-case test-first**
  - **Fixing defects in next release**
- **Safety novices**
  - **No knowledge of hazard analysis, fault tree analysis, failure modes and effects analysis; redundancy and recovery techniques; COTS safety risk analysis**

# Agility and Safety: Under What Conditions?

- **Praxis-level development teams**
  - **Safety-savvy; thorough; collaborative; change-adaptive**
- **Architected agile process**
  - **With validated feasibility evidence, change control**
- **Providing adequate budget and schedule**
  - **For safe development practices, V&V**
- **Avoiding unsafe agile practices**
  - **Collective code ownership; change trumps following plans; simple design; next-increment defect fixing; safety as deferrable feature**
- **Using safety-enhancing agile practices**
  - **Pair development; coding standards; safety-oriented test-first; continuous integration**

# Summary

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  - **Agility and safety**
  - → **Avoiding one-size-fits-all process models**

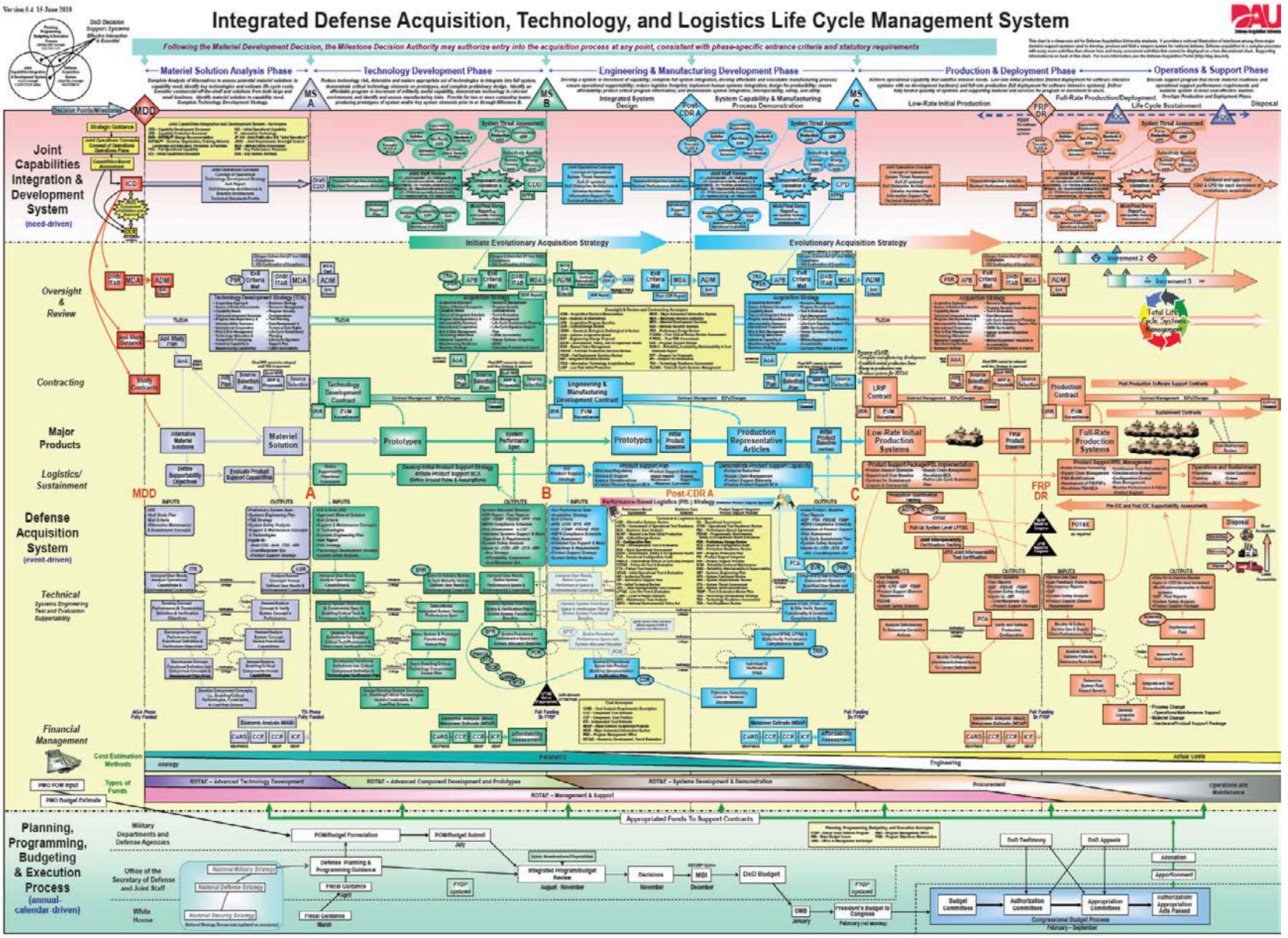
# The Procrustean Bed: Dangers of one-size fits-all process models

- Procrustes: Greek Mythology
  - Rogue smith and bandit
  - Hostel with one-size-fits-all bed
  - Guests too small: stretch them to fit
  - Guests too large: lop off the offending parts

# Build Your Own Procrustean Bed

- **Pure Waterfall, Vee: Fixed Price and Spec Contract**
  - **Lop off needed changes as requirements creep**
- **Pure Agile: Easiest First; Dedicated On-Site Customer**
  - **Later scalability and assurance problems; single-failure point**
- **Voice of the Customer: Accept All "Requirements"**
  - **Gold-plating; neglect voices of acquirer, developer, owner**
- **Piling on Incompatible Constraints: No Way Out**
  - **Project Example: Waterfall, COTS, Ada, GOTS Reuse**
- **Inflexible Standards: No Choice But Tailoring Down**
  - **MIL-STD-498: choice of 23, 6, or 1 DID denied**
- **Overconstrained Maturity Models: Excluding Expertise**
  - **Software CMM: Exclude software group from system rqts.**

# Procrustean Example: DoD Acquisition Process



# Progress: US DoDI 5000.02 2013-11-13

- **4 Swim Lanes + 2 Hybrids**
- **Model 1:** Hardware Intensive Program
- **Model 2:** Defense Unique SW-Intensive Program
- **Model 3:** Incrementally Fielded SW-Intensive Program
- **Model 4:** Accelerated Acquisition Program

- **Hybrid Program A** (Hardware Dominant)
- **Hybrid Program B** (Software Dominant)

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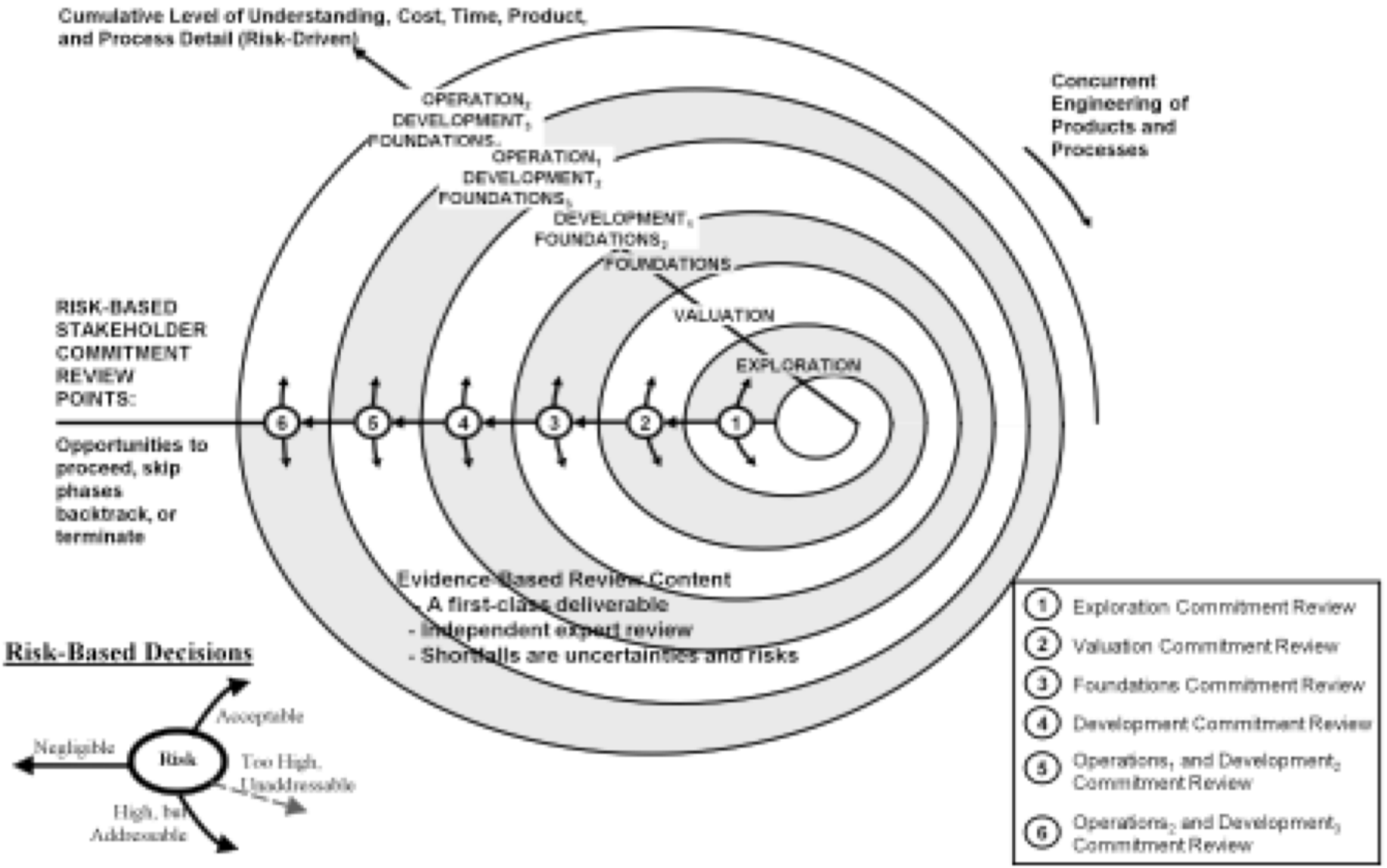
# The Incremental Commitment Spiral Model (ICSM)



# Common Risk-Driven Special Cases of the ICSM (Cases 1-4)

## Case 1: Use NDI

**Example:** Small accounting system
**Size, Complexity:** Size variable, complexity low
**Typical Change Rate/Month:** Negligible
**Criticality:** n/a
**NDI Support:** Complete
**Organizational Personnel Capability:** NDI-experienced (medium)
**Key Stage I Activities (Incremental Definition):** Acquire NDI
**Key Stage II Activities (Incremental Development/Operations):** Use NDI
**Time/Build:** n/a
**Time/Increment:** Vendor-driven

## Case 2: Agile

**Example:** E-services
**Size, Complexity:** Low
**Typical Change Rate/Month:** 1-30%
**Criticality:** Low to medium
**NDI Support:** Good, in place
**Organizational Personnel Capability:** Agile-ready, medium-high experience
**Key Stage I Activities (Incremental Definition):** Skip Valuation and Architecting phases
**Key Stage II Activities (Incremental Development/Operations):** Scrum plus agile methods of choice
**Time/Build:** <= 1 day
**Time/Increment:** 2-6 weeks

## Case 3: Architected Agile

**Example:** Business data processing
**Size, Complexity:** Medium
**Typical Change Rate/Month:** 1-10 %
**Criticality:** Medium to high
**NDI Support:** Good, most in place
**Organizational Personnel Capability:** Agile-ready, medium to high experience
**Key Stage I Activities (Incremental Definition):** Combine Valuation, Architecting phases. Complete NDI preparation.
**Key Stage II Activities (Incremental Development/Operations):** Architecture-based Scrum of Scrums
**Time/Build:** 2-4 weeks
**Time/Increment:** 2-6 months

## Case 4: Formal Methods

**Example:** Security kernel; Safety-critical LSI chip
**Size, Complexity:** Low
**Typical Change Rate/Month:** 0.3%
**Criticality:** Extra high
**NDI Support:** None
**Organizational Personnel Capability:** Strong formal methods experience
**Key Stage I Activities (Incremental Definition):** Precise formal specification
**Key Stage II Activities (Incremental Development/Operations):** Formally-based programming language; formal verification
**Time/Build:** 1-5 days
**Time/Increment:** 1-4 weeks

# Conclusions

- **Success-critical to achieve both agility and quality**
- **Hybrid architected-agile methods emerging**
  - **Incremental commitment framework**
  - **Early development, validation of scalable architecture**
  - **Concurrent engineering with synchronization milestones**
  - **Scrum plus organizational essentials**
- **Success stories emerging**
  - **Management commitment to objectives and strategy**
    - **With incremental feasibility checkpoints**
  - **Strong core team of technical and management leaders**
  - **Thorough preparation of organizations, people, infrastructure**
    - **Involvement, architecture, policies, practices, plans, training**
    - **Incentives to address both agility and quality**
  - **Continuous change monitoring and adaptation**