
An Application of Risk-based Software Development Practices

October 2017

Distribution A: Approved for Public release; distribution is unlimited.
Risk-based Software Development Practices in CREATE
CREATE Core Software Development

Risks

1. Misaligned requirements management
2. Workflow management for distributed teams across the Services
3. Team communications across different security enclaves
4. Testing
5. Product support with limited resources
Software Development Practice Drivers

Notional Home Ground Chart for CREATE

The attributes of CREATE teams favor an Agile Development approach
## Risk 1: Misaligned Requirements Management

### Mitigating Practice. Express requirements as use-cases in language that customers and developers share.

### CREATE-Capstone Foundational Required Capabilities

<table>
<thead>
<tr>
<th>ID</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MG-00</td>
<td>Import Externally Generated Geometry (CAD, IGES, STEP)</td>
</tr>
<tr>
<td>MG-01</td>
<td>Create Parameterized Geometry</td>
</tr>
<tr>
<td>MG-02</td>
<td>Support Dependency-Based Associative Modeling</td>
</tr>
<tr>
<td>MG-03</td>
<td>Repair Externally Generated (eg CAD) Geometry</td>
</tr>
<tr>
<td>MG-04</td>
<td>Support De-featureing and Idealization of Geometry</td>
</tr>
<tr>
<td>MG-05</td>
<td>Provide Robust Surface Meshing Algorithans</td>
</tr>
<tr>
<td>MG-06</td>
<td>Provide Robust Volume Meshing Algorithms</td>
</tr>
<tr>
<td>MG-07</td>
<td>Provide Geometry-based Mesh Generation</td>
</tr>
<tr>
<td>MG-08</td>
<td>Support Multi-scale Models</td>
</tr>
<tr>
<td>MG-09</td>
<td>Support Legacy Component Integration</td>
</tr>
<tr>
<td>MG-10</td>
<td>Support Analysis Model Attribution</td>
</tr>
<tr>
<td>MG-11</td>
<td>Provide Accurate and Scalable Runtime Geometry</td>
</tr>
<tr>
<td>MG-12</td>
<td>Core Framework (Internal requirements to support all of the above)</td>
</tr>
</tbody>
</table>

### MG-06 Use-Cases

- **MG-06-UC-01**: Unstructured all-tetrahedral volume meshing
- **MG-06-UC-02**: Unstructured hexahedral-dominated hybrid meshing
- **MG-06-UC-03**: Boundary Layer meshing with triangular wedge elements in the viscous region transitioning to tet. No interference from other BL
- **MG-06-UC-04**: MG07-UC04 with complex geometries and multiple intersecting boundary-layers
- **MG-06-UC-05**: Boundary layer meshing with hex prism in the viscous region transitioning to hex/tet
- **MG-06-UC-06**: MG06-UC05 with complex geometries & multiple intersections
- **MG-06-UC-07**: Volume mesh handing for high order element (first approach)
- **MG-06-UC-08**: Matching volume meshes for periodic boundary condition
- **MG-06-UC-11**: Modeling and meshing for sliding planes for moving parts
- **MG-06-UC-12**: Support for ‘strand-meshing’ paradigm

### Use-Cases promote a shared view of requirements

1 Established in 2008
Risk 1. Misaligned Requirements Management

Mitigating Practice: Pursue Pilot Projects

Annually execute between 4 and 6 Pilot Projects to “shadow” acquisition programs engineering workflows—60+ Pilots since 2008!

Pilots build bridges of trust and go deeper than product demos
Risk 1. Misaligned Requirements Management

- **Mitigating Practice:** *Bring Senior Customer Engineers into the planning cycle for new processes/workflows*

Example: CREATE-AV Planning Process for new Stakeholder Processes/workflows

CREATE AV Planning Team=Senior Customer Engineers

1 – Identify Key Acquisition Processes (AP’s)

2 – Identify Products of AP’s

3 – Breakdown AP Workflows (WF’s)

4 – Identify HPC Insertion Points into WF’s

5 – Identify HPC Analysis Capabilities required to improve AP WF’s

6 – Prioritize and Group analysis capabilities

7 – Select Groups that represent greatest impacts to acquisition for HPC software development under CREATE-AV

Approved by CREATE AV Tech Advisory Board and BoD

Approved by CREATE AV Tech

Advisory Board and BoD

This demonstrates that the product solves the customer’s problem and that it can be used in the customer’s workflow
Risk 2. Software Development Workflow for Distributed Teams

• Mitigating Practice: *Balance flexible planning with milestone-based accountability.*

**CREATE**

- Disciplined Agile (DAD)
- Agile Methods
- CMMI Software Methods
- CMMI Process Improvement

*after* Boehm, “Getting Ready for Agile Methods with Care,” IEEE Software, 2002

CREATE: An disciplined agile approach with the features of Milestone/Risk and Agile Workflow Management
Risk 2. Software Development Workflow for Distributed Teams

The CREATE Approach—Disciplines Agile Development based on Scrum with Risk-based Milestones

Our approach couples flexibility with accountability

*Figure after info@matrix-soft.org*
Risk 2. Workflow Management for Distributed Teams

- Mitigating Practice: Require at least one new “version” every year

### Table: Annual Releases

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quarter</strong></td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>AV-Genesis Design</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>AV-Helios</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>AV-Kestrel</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>MG-Capstone</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>RF-SENTri</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Ships-IHDE</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Ships-NavyFOAM</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Ships-NESM</td>
<td>1</td>
<td>1.1</td>
<td>2</td>
<td>2.1</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Ships-RSDE</td>
<td>0.5</td>
<td>1</td>
<td>1.1</td>
<td>1.2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>GV-Mercury</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

Annual releases guarantee meaningful progress during the fiscal year.

Distribution A: Approved for Public release; distribution is unlimited.
Risk 3. Communications across different Security Enclaves

Mitigating Practice: Start with an extended view of the CREATE Product

Ensure that Customers see the “whole” product

- DSRC Servers
- DREN
- HPC Portal

Help customers see this

Developers focus on this

Core: CREATE executables

Ensure that Customers see the “whole” product
Risk 3. Communications across different Security Enclaves

Mitigating Practice: Make maximum use of secure communication technologies that promote sharing in a heterogeneous security environment.

Secure access without the installation of any software
Risk 4: Software testing

Mitigating Practice: Implement a testing program compliant with National Research Council guidelines

6 levels of testing in CREATE -AV!

- Not just binary “yes” or “no”
- Customer view of testing
- Verifies satisfaction of use-cases
Risk 4: Software Testing

Mitigating Practice: *Strive for continuous integration with automated regression tests for each commit*

CREATE-RF Continuous Integration Platform

Discover problems before they are hard to fix
Risk 5. Inadequate Product Support

Mitigating Practice: *Maximize the use of self-help and user forums in the support model.*

Self-help scales as the user base grows.
How Well Has this Worked?

- Over 1600 current user licenses
- Over 180 organizations across DoD/Gov’t, Industry, and Academia
- User organizations are split roughly 40% DoD/Gov’t, 50% Industry, 10% Academia
- Impacting ~70 DoD programs of record and major S&T, T&E, and R&D efforts across the major warfare domains of Air, Sea, Land, and EM spectrum throughout the acquisition cycle
- Constant positive growth of user licenses since (~7% growth in the past 6 months)
Richard P. Kendall, Ph.D.
Software Engineering Consultant
DoD High Performance Computing Modernization Program
(505) 660-0976
Richard.p.kendall4.ctr@mail.mil