CMMI® for Small Business

NDIA CMMI® Working Group
NDIA Systems Engineering Division

CMMI Technology Conference

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Small Business in the Defense Industry

The defense industry is critically dependent on small business for the technology and rapid innovation needed for future defense business.

“…In one of the few studies of its kind, the Pentagon’s industrial policy office in 2005 identified the critical, innovative technologies which are needed for 21st century wars and found that 35 to 45 percent of the companies supplying those key technologies had fewer than 100 employees.”


However, small businesses can be challenged to compete and thrive in the defense market.

“… Only the largest firms have access to the resources and expertise to bid on the most complex programs, and it is difficult for all but the largest size to survive losing them. As a result, competition is reduced at the front end of programs, and all but eliminated in the sustainment phase…. Small businesses are largely locked out of the process or accorded contracts only on the goodwill of one of the larger firms…. The end result of this process is the gradual erosion of competition and innovation in the defense industrial base.”

Is CMMI for Small Business?

The NDIA CMMI Working Group was tasked to investigate common questions on the applicability of CMMI to small business

- Is CMMI appropriate for small businesses?
- Is CMMI a barrier to competition in the defense market?
- What data substantiates the adoption of CMMI by small business?
- What challenges do small businesses face for adoption?
- How can acquirers use CMMI to manage their acquisition risks with small suppliers?
What is a Small Business?

There is no single definition of what constitutes a small business.

The SBA characterizes small businesses in terms of size and revenue, by domain

- Size standards defined by North American Industrial Classification System (NAICS)
- Typically ~250 employees, < $25M in revenue

SEI research characterizes a small setting as:

- Small business < 100 people
- Small organization within a large organization, < 50 people
- Small project < 20 people

For this study, we did not set thresholds, but focused on employee size across a wide range of data partitions

- As small as a few people
- As large as several thousand people
- ‘Small’ may be in the eye of the beholder

NDIA Small Business Division
http://www.ndia.org/Divisions/Divisions/SmallBusiness/Pages/default.aspx

U.S. Small Business Administration size standards:
http://www.sba.gov/contractingopportunities/officials/size/index.html
Prior Studies and Research

Many prior initiatives have investigated CMMI for small business. Example resources include:

**CMMI in Small Settings Toolkit Repository**
Suzanne Garcia (SEI), Sandra Cepeda (AMRDEC SED/CSSA), Gene Miluk (SEI), Mary Jo Staley (AMRDEC SEC/CSC)
http://seir.sei.cmu.edu/toolkit/index.html

**Improving Processes in Small Settings (IPSS)**
International Process Research Consortium (IPRC)
“Proceedings of the 1st International Researcher’s Workshop on Process Improvement in Small Settings”
http://www.sei.cmu.edu/publications/documents/06.reports/06sr001.html

“An exploratory study investigating the organizational and technical impacts of applying disciplined system development processes (CMMITM) in small to medium sized enterprises.”
http://gradworks.umi.com/32/24/3224161.html

The CMMI WG conducted interviews and discussions with several of these researchers and subject matter experts.
There are plenty of anecdotes, speculations, and opinions on the applicability of CMMI for small business – what does the data tell us?

- SEI CMMI® Process Maturity Profile*
- SEI Published SCAMPI℠ Appraisal Results (PARS)*
  [http://sas.sei.cmu.edu/pars/](http://sas.sei.cmu.edu/pars/)
- Organizational change research
  Dr. Leigh Riley, [leigh@acmeprocessgroup.com](mailto:leigh@acmeprocessgroup.com)
- 1st International Research Workshop for Process Improvement in Small Settings
  [http://www.sei.cmu.edu/library/abstracts/reports/06sr001.cfm](http://www.sei.cmu.edu/library/abstracts/reports/06sr001.cfm)
- Surveys, questionnaires, …

*Caveats: Most CMMI data is reported and collected from appraisals based on size of the organizational unit – which may or may not be directly reflective of the size of the company overall. Other companies may also be using CMMI beyond just those conducting and reporting SCAMPI-A appraisals.
CMMI Adoption

CMMI appraisals are conducted worldwide…

<table>
<thead>
<tr>
<th>Organization Size (Employees)</th>
<th>Qty</th>
<th>%</th>
<th>Qty</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25</td>
<td>1206</td>
<td>100.0%</td>
<td>3653</td>
<td>100.0%</td>
</tr>
<tr>
<td>26-50</td>
<td>17.3%</td>
<td>22.4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51-75</td>
<td>12.6%</td>
<td>17.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>76-100</td>
<td>8.3%</td>
<td>17.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>101-200</td>
<td>17.3%</td>
<td>17.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;200</td>
<td>2.2%</td>
<td>17.3%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

…in small and large organizations and projects

Services (72.1%)
- Business Services
- Engineering and Management Services
- Health Services
- Other Services

Manufacturing (15.7%)
- Electronic and Electric Equipment
- Transportation Equipment
- Instruments & Related Products
- Industrial Machinery
- Other Mfg Industries

Other (12.2%)
- Finance, Insurance, Real Estate
- Public Administration/Defense
- Transportation, Communication, Utilities

Based on primary Standard Industrial Classification (SIC) codes reported in CMMI-based appraisals.

…in a wide range of businesses

…at all levels of process maturity

http://www.sei.cmu.edu/cmmi/casestudies/profiles/cmmi.cfm

Adoption Trends in Small Business
Comparison: SEI Process Maturity Profile, Sep 2009 vs. Sep 2010

**Sep 2009**

<table>
<thead>
<tr>
<th>Organization Size (Employees)</th>
<th>Commercial In-House</th>
<th>Contractor for Military/Government</th>
<th>Military/Government Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤100, 53.5%</td>
<td>22.7%</td>
<td>8.5%</td>
<td>5.7%</td>
</tr>
<tr>
<td>101-200, 18.9%</td>
<td>44.3%</td>
<td>31.7%</td>
<td>28.0%</td>
</tr>
<tr>
<td>&gt;200, 25.2%</td>
<td>26.7%</td>
<td>14%</td>
<td>53.6%</td>
</tr>
<tr>
<td>&gt;2000, 1.9%</td>
<td>91.3%</td>
<td>5.6%</td>
<td>3.1%</td>
</tr>
<tr>
<td>501-1000, 3.3%</td>
<td>1.7%</td>
<td>10.1%</td>
<td>9.7%</td>
</tr>
<tr>
<td>1001-2000, 3.3%</td>
<td>1.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Organization Size (Employees) (3863 organizations reporting)

**Sep 2010**

<table>
<thead>
<tr>
<th>Organization Size (Employees)</th>
<th>Commercial In-House</th>
<th>Contractor for Military/Government</th>
<th>Military/Government Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤100, 60.2%</td>
<td>22.4%</td>
<td>8.0%</td>
<td>5.3%</td>
</tr>
<tr>
<td>101-200, 17.3%</td>
<td>45.6%</td>
<td>31.5%</td>
<td>25.8%</td>
</tr>
<tr>
<td>&gt;200, 1.6%</td>
<td>26.7%</td>
<td>49.3%</td>
<td>58.1%</td>
</tr>
<tr>
<td>501-1000, 5.0%</td>
<td>1.0%</td>
<td>1.0%</td>
<td>2.9%</td>
</tr>
<tr>
<td>301-500, 6.1%</td>
<td>1.5%</td>
<td>8.9%</td>
<td>7.2%</td>
</tr>
<tr>
<td>201-300, 7.3%</td>
<td>1.1%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Organization Size (Employees) (4863 organizations reporting)

Greatest growth in CMMI adoption worldwide continues to be:
- small
- commercial
- overseas

### Quantity and Percentage

<table>
<thead>
<tr>
<th>Organization</th>
<th>Commercial In-House</th>
<th>Contractor for Military/ Government</th>
<th>Military/ Government Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>Qty 354</td>
<td>% 33.6%</td>
<td>Qty 2566</td>
</tr>
<tr>
<td>Non-USA</td>
<td>Qty 586</td>
<td>% 55.7%</td>
<td>Qty 183</td>
</tr>
<tr>
<td>USA</td>
<td>Qty 113</td>
<td>% 10.7%</td>
<td>Qty 63</td>
</tr>
<tr>
<td>Non-USA</td>
<td>Qty 1053</td>
<td>% 100.0%</td>
<td>Qty 2812</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organization</th>
<th>Commercial In-House</th>
<th>Contractor for Military/ Government</th>
<th>Military/ Government Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>Qty 425</td>
<td>% 35.2%</td>
<td>Qty 3354</td>
</tr>
<tr>
<td>Non-USA</td>
<td>Qty 651</td>
<td>% 54.0%</td>
<td>Qty 223</td>
</tr>
<tr>
<td>USA</td>
<td>Qty 130</td>
<td>% 10.8%</td>
<td>Qty 76</td>
</tr>
<tr>
<td>Non-USA</td>
<td>Qty 1206</td>
<td>% 100.0%</td>
<td>Qty 3653</td>
</tr>
</tbody>
</table>

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NDIA CMMI Working Group
What’s the CMMI maturity profile for small businesses?

Process Maturity Profile, CMMI for Development SCAMPI Class A Appraisal Results
Are Small U.S. Businesses Using CMMI?

- U.S. organizations of all sizes are conducting SCAMPI-A appraisals, including very small organizations.
- Large % of U.S. appraisals conducted in all domains are by small organizations (<100 people): commercial (59.5%), govt. contractors (42.3%), govt (65.6%)
- CMMI use overseas is overwhelmingly commercial. Within U.S., predominantly govt contractors (60.6%) but with significant usage in commercial industry (30.9%).

Based on data from published SCAMPI appraisal results for organizations – which could be part of a large company.
Are small businesses using CMMI in the U.S. defense contracting market?

Data from SCAMPI appraisal results is for organizational units (OUs) – which could be part of a larger company. Overall company size is not available from SCAMPI results filed with SEI.

From the data set of 691 appraisals by U.S. government contractors:

- 428 were by OUs < 200 people
- Known large companies were removed from this data set
- *Best judgment is 265 appraisals (62%) were conducted by truly small companies < 200 people
- This 265 appraisals reflects 38% of the complete data set (all sizes, 691 appraisals)

Even though these reflect estimates, they substantiate significant usage of CMMI by small companies in the U.S. defense market.
What countries conduct the most small appraisals?
Number of appraisals reported with organization size < 100

<table>
<thead>
<tr>
<th>Country</th>
<th>Appraisals</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>1161</td>
</tr>
<tr>
<td>United States</td>
<td>783</td>
</tr>
<tr>
<td>India</td>
<td>313</td>
</tr>
<tr>
<td>Spain</td>
<td>138</td>
</tr>
<tr>
<td>Brazil</td>
<td>132</td>
</tr>
<tr>
<td>Japan</td>
<td>115</td>
</tr>
<tr>
<td>Korea, Republic Of</td>
<td>102</td>
</tr>
<tr>
<td>Taiwan</td>
<td>100</td>
</tr>
<tr>
<td>France</td>
<td>93</td>
</tr>
<tr>
<td>Mexico</td>
<td>86</td>
</tr>
<tr>
<td>Argentina</td>
<td>69</td>
</tr>
<tr>
<td>Malaysia</td>
<td>60</td>
</tr>
<tr>
<td>Egypt</td>
<td>36</td>
</tr>
<tr>
<td>Thailand</td>
<td>36</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>34</td>
</tr>
<tr>
<td>Colombia</td>
<td>34</td>
</tr>
<tr>
<td>Chile</td>
<td>33</td>
</tr>
<tr>
<td>Italy</td>
<td>27</td>
</tr>
<tr>
<td>Canada</td>
<td>25</td>
</tr>
<tr>
<td>Pakistan</td>
<td>24</td>
</tr>
<tr>
<td>Germany</td>
<td>20</td>
</tr>
<tr>
<td>Turkey</td>
<td>18</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>14</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>14</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>13</td>
</tr>
<tr>
<td>Philippines</td>
<td>12</td>
</tr>
<tr>
<td>Australia</td>
<td>11</td>
</tr>
<tr>
<td>Singapore</td>
<td>10</td>
</tr>
</tbody>
</table>

Small US Appraisals (Orgs ≤ 50)
Distribution by Org. Size
Other Observations

Under-representation of small organizations (CMMI data) relative to small US businesses overall (Census data) may represent a marketing opportunity.

There is more proportional interest among small commercial orgs. than other orgs. ($p = 0.000$ on a $\chi^2$ test).
A Mixed Method Analysis to Refine an Organizational Change Model for Technology Organizations, Doctoral Dissertation, University of Phoenix, Dr. Leigh Riley, 2010

Survey and analysis of organizational change factors ensuring successful implementation of CMMI®-Dev by IT organizations

Further analyses will be published next year as an addendum to the Protean Model®
### Ranking of Organizational Change Factors by Size of the Organization

<table>
<thead>
<tr>
<th>Rank</th>
<th>Small</th>
<th>Medium</th>
<th>Large</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Senior Leadership Support</td>
<td>Senior Leadership Support</td>
<td>Communication</td>
</tr>
<tr>
<td>2</td>
<td>Operational Leadership</td>
<td>Communication</td>
<td>Senior Leadership Support</td>
</tr>
<tr>
<td>3</td>
<td>Communication</td>
<td>Operational Leadership</td>
<td>Measuring of Progress</td>
</tr>
<tr>
<td>4</td>
<td>Training the Leadership</td>
<td>Training the Employees</td>
<td>Training the Employees</td>
</tr>
<tr>
<td>5</td>
<td>Training the Employees</td>
<td>Measuring of Progress</td>
<td>Aligning the Initiative with Strategic Goals</td>
</tr>
<tr>
<td>6</td>
<td>Measuring of Progress</td>
<td>Aligning the Initiative with Strategic Goals</td>
<td>Articulating the Benefits</td>
</tr>
<tr>
<td>7</td>
<td>Managing Initiative as a Project</td>
<td>Incremental Improvements</td>
<td>Managing Initiative as a Project</td>
</tr>
<tr>
<td>8</td>
<td>Aligning the Initiative with Strategic Goals</td>
<td>Providing Support Mechanisms</td>
<td>Operational Leadership</td>
</tr>
<tr>
<td>9</td>
<td>Providing Support Mechanisms</td>
<td>Managing Initiative as a Project</td>
<td>Providing Support Mechanisms</td>
</tr>
<tr>
<td>10</td>
<td>Articulating the Benefits</td>
<td>Training the Leadership</td>
<td>Training the Leadership</td>
</tr>
<tr>
<td>11</td>
<td>Incremental Improvements</td>
<td>Articulating the Benefits</td>
<td>Incremental Improvements</td>
</tr>
<tr>
<td>12</td>
<td>Involving Employees</td>
<td>Involving Employees</td>
<td>Involving Employees</td>
</tr>
<tr>
<td>13</td>
<td>Changing the Performance Management System</td>
<td>Changing the Performance Management System</td>
<td>Changing the Performance Management System</td>
</tr>
</tbody>
</table>

Factors for effective organizational change are similar across different sizes of businesses, but initiatives may have shifting priorities (e.g., tactical to strategic)
Improving Processes in Small Settings (IPSS)

- “Proceedings of the 1st International Researcher’s Workshop on Process Improvement in Small Settings”
  [http://www.sei.cmu.edu/publications/documents/06.reports/06sr001.html](http://www.sei.cmu.edu/publications/documents/06.reports/06sr001.html)
  International Process Research Consortium (IPRC), Software Engineering Institute
  - Phase 1: Qualitative study
  - Phase 2: Quantitative research

Barriers to entry:
- Lacking core competencies, basic practices
- PI costs within operating budget
- Clear roles/responsibilities, flat hierarchy
- Infrastructure
- Staff culture

**Phase-1 Results**

- CMMI SME implementation issues:
  - Size - CMMI is considered too large by SMEs
  - Linkage to SME problems is not immediately evident
  - Lack of SME implementation knowledge, infrastructure and resources to translate process framework into value added operational processes
- CMMI Alternative Approaches:
  - CMMI-SME Front-end: Provide direct link of SME development problems to the appropriate practices in the model
  - CMMI-SME Back-end: Link of model components to off the shelf “whole” product solutions appropriate for SME implementation
  - The optimum packaging for the CMMI-SME would provide “line of sight” connectivity from SME problem to model components to implementation solutions

**Pain Associated with Improving Existing Products or Developing New Products**

<table>
<thead>
<tr>
<th>Category</th>
<th>Average Response</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Above Average “Pain”</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The time it takes to get to market / recognize revenue</td>
<td>7.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Trying to accelerate corporate growth</td>
<td>6.7</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Average “Pain”</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development of new products or features</td>
<td>6.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Capitalization / funding new product efforts</td>
<td>6.0</td>
<td>2.8</td>
</tr>
<tr>
<td>Compliance issues with partners</td>
<td>5.6</td>
<td>1.9</td>
</tr>
<tr>
<td>Quality assurance / quality control issues</td>
<td>5.4</td>
<td>2.1</td>
</tr>
<tr>
<td>Incorporating increasing systems or software into new or improved products</td>
<td>5.3</td>
<td>2.4</td>
</tr>
<tr>
<td>Historical New Product Failures</td>
<td>5.2</td>
<td>2.2</td>
</tr>
<tr>
<td><strong>Below Average “Pain”</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISO or QS 9000 Compliance</td>
<td>4.6</td>
<td>2.3</td>
</tr>
</tbody>
</table>

Reference: Applicability of CMMI to Small and Medium Enterprises
Dr. Rick Hefner and Maggie Glover. SC SPIN, April 2010.
Acquirers (such as prime contractors) often use CMMI practices to select, manage, and support their small suppliers.

Typical uses of CMMI within CMMI WG member companies:

- CMMI maturity level requirements rarely specified to subs unless levied by external customer
- Use CMMI practices in key areas to evaluate supplier risks
- Checklists or tools used for supplier selection
- May require suppliers to follow prime contractor’s processes
- Provide direct support to suppliers – training, mentoring, tools, etc.

Resources –
Publications, briefings, social networks

Many small businesses and their consultants share their CMMI experience in publications and conference briefings.

Over 40,000 Google hits on “CMMI” “small business”

Other good resources:

- SEI – tech reports, guidance, adoption info, case studies, …
  http://www.sei.cmu.edu/cmmi
- NDIA CMMI Conference briefings
  http://www.dtic.mil/ndia/
- SEI SEPG Conference briefings
  http://www.sei.cmu.edu/sepg/
- CrossTalk articles http://stsc.hill.af.mil/crosstalk/
- SPIN meetings
- Newsgroups, social networks (Yahoo!, Linked In, Facebook, …)
- RSS feeds
- Webinars - “Process Improvement at the Edges”

There is no shortage of good people willing to help – just ask!
Resources –
Guidance for Effective CMMI Adoption

SEI Resources:
• CMMI in Small Settings Toolkit Repository
  http://seir.sei.cmu.edu/toolkit/index.html
• Reports & Technical Notes – Interpretative Guidance, …
  http://www.sei.cmu.edu/cmmi/casestudies/reports/
• CMMI Roadmaps – goal-driven process area guidance
  http://www.sei.cmu.edu/library/abstracts/reports/08tn010.cfm
• Using the Software CMM in Small Organizations
  - Mark Paulk papers: SW-CMM, but still good guidance (if you can find it)

NDIA Resources:
• The Effective Use of CMMI – NDIA position paper
• The Economics of CMMI – CMMI WG white paper

Consultant Resources … and many others
Summary and Recommendations

Perceptions that CMMI is too burdensome for small businesses is not supported by data on CMMI adoption

- Greatest growth areas: small, commercial, overseas
- No evidence that CMMI is a barrier to competition

Small businesses face many of the same obstacles as large companies

- Sponsorship, commitment, resources, alignment with business objectives, …
- Tailored processes and priorities adapted to meet the needs of the business
- Small businesses often have fewer resources to address these challenges
- But they also have advantages: agility, innovation, simplicity, institutionalization

Follow proven guidance for using CMMI effectively

- Focus on business value - *The Economics of CMMI®*
- Set performance goals, measure progress against them, use CMMI to improve
- Learn from others - take advantage of the many resources available to help
For More Information....

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