SEI Webinar Series: The Next Generation of Process Evolution

By Dr. Gene Miluk
Today’s Speaker

Gene Miluk is currently a senior member of the technical staff at the Software Engineering Institute (SEI), a unit of Carnegie Mellon University in Pittsburgh, Pa. For the past 19 years he has been working with client organizations undertaking software process improvement, software acquisition improvement and technology transition. He is an SEI-certified SCAMPI Lead Appraiser, an SEI-Certified SCAMPI High Maturity Appraiser, a CMMI instructor, a Team Software Process (TSP) instructor and an SEI-Certified TSP Mentor Coach. He is also a Six Sigma Black Belt and a Certified SCRUM Master.
Polling Question 1

Are you new to CMMI and Process Improvement?
• Yes
• No
Polling Question 2

Does your organization already have CMMI based process improvement effort?

• Yes
• No
• Don’t Know
Polling Question 3

Do you work in a small to medium enterprise (less than 15 software developers)?

• Yes
• No
Presentation Goals

Background
- What is AIM
- Does it work?

Importance
- Why is it important to you
- Why does it provide superior performance

Value
- The AIM Value Proposition
Background:

History
- SEI CMM
- CMMI
- TSP

Clients Integrate CMMI/TSP
- Hill AFB, EDS, NAVY, AIS
- Declare Exceptional results

Mexico National Initiative
Creating a competitive advantage

- Certification methods to verify the performance of the companies
  - MoProSoft (National Standard)
  - CMMI
  - TSP *
AIM: High Performance

Integrated Operational Solution
CMMI and AIM

CMMI is a model that describes many of the best practices for development.
- about “what” not “how-to”
- an improvement roadmap
- a capability benchmark

AIM is a process that integrates many CMMI best practices.
- about “how-to” not “what”
- an improvement tool
- a performance benchmark
How to Implement CMMI?
Implementation

Implementation Approaches

1) Traditional CMMI approach

2) Non Traditional AIM/TSP approach

Focused Implementation: Building Organizational Capability Project-by-Project, Team-by-Team

My experience with using IDEAL:
- Takes too long (SEI time to move up)
- Costs too much
- Engineers don’t embrace it
- Hard to sell Management Value Proposition

SEI IDEAL™ Model

Based on Org Change Principles:
- Action Research
- Socio-tech Systems
- Plan Do Check Act
- Cascading Sponsorship
- Parallel learning Structures (SEPG)

Focused Implementation:

- Training
- Launch

EPG identifies gaps and potential improvements, and executes improvement strategies
Traditional Approach to Transition

Comprehensive System Change Model (IDEAL) Traditional Approach

SEI IDEAL™ Model

Based on Org Change Principles:
- Action Research
- Socio-tech Systems
- Plan Do Check Act
- Cascading Sponsorship
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My experience with using IDEAL:
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Focused Implementation: Building Organizational Capability Project-by-Project, Team-by-Team

Training  Launch

Corporate

Divisions, Departments, or Groups (4)

Projects (20)

Project data, improvement proposals, gaps

EPG identifies gaps and potential improvements, and executes improvement strategies
Major Differences in Approach to Transition

• Concentrated Process
  - Comprehensive Packaged Operational System of Integrated Processes
  - Proven Performance
  - Integrated Operational Measurement System (Individual level)

• Focused Implementation Strategy
  - Unit oriented (Project/Team)
  - JIT Concentrated 3 level Training
  - Accelerated Learning Laboratory
  - Effective Project/Team Launch Process
  - Coaching and continued support
AIM: Operational Plans Implemented Processes

Measurement Framework

<table>
<thead>
<tr>
<th>Schedule</th>
<th>Effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Quality</td>
</tr>
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</table>

The TSP Development Process

1. Produce Development Strategies
2. Assign Roles and Define Team Goals
3. Produce Development Budgets
4. Build Training and Next Phase Plans
5. Build the Quality Plan
6. Build Discipline- and Corporation- Specific Plans

The TSP launch process produces the necessary planning artifacts, e.g., goals, rates, estimates, task plans, milestones, quality plan, risk mitigation plan, etc.
The most important outcome is a committed team.

Resource Tracking

Cumulative plan and actual resource hours show a burn rate and potential source of risk.

Earned Value Tracking

Cost variances from planned values throughout the project.

Quality Tracking

Error rate and defect density over time.

TSP Weekly Status Report

Weekly data: tasks completed, tasks in progress, etc.

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New Version of TSP

• Maximizes CMMI compatibility
  – New Scripts
  – New Roles
  – New Forms
• Provides /Accelerates CMMI Infrastructure
  – OSSP (Project Notebook)
  – Measurement System and Library
  – PAL
  – Training
• Provides for Organizational Infrastructure
  – EPG
  – Addresses: OPF, OPD, and OT
Comprehensive Proven Packaged Solution

- Development Methodology
- Operational Processes
- Tool Support
- Training
- Implementation Methodology
- Coaching

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Performance

Warrants:

Superior Project performance:

1. Quality
2. Productivity
3. Time to Market

CMMI Compliance:

1. Faster
2. more cost effective
3. Predictable
4. Measurable performance
Evidence?

Who is using it?
Actual Cost and Schedule Performance

From an SEI study published in 2000
- fifteen projects in four organizations
- CMM ML1, ML2, ML3, and ML5
- TSP improved effort and schedule predictability at all maturity levels

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<tr>
<th>Effort (Cost) Performance</th>
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<tr>
<td>Study baseline</td>
<td>+17% to +85%</td>
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<tr>
<td>TSP</td>
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<table>
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<th>Schedule Performance</th>
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<tr>
<td>Study baseline</td>
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<tr>
<td>TSP</td>
<td>-8% to +20%</td>
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Source: CMU/SEI-TR-2000-015
Actual Delivered Product Quality

Average Defect Density of Delivered Software

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<th>Defects/KLOC</th>
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<tr>
<td>TSP</td>
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</table>

Source: CMU/SEI-TR-2003-014
Actual Cost of Poor Quality

TSP System Test Performance Comparison w/Table

Source: CMU/SEI-TR-2003-014
Key Process Insertion Differences

Project A:
- Disciplined team design process used to create sound developer work packets
- Personal Software Process used consistently by developers
  - SEI developed course for software developers which provides process at an individual level for producing software components and documentation (user & technical)
  - Peer Reviews conducted on the most critical 20% of the software

Project B:
- We decided that this project was “too far along” to benefit from process insertion

Project Test Time / Cost

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<th>Project B</th>
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<tr>
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<td>$78.0K</td>
<td>$612K</td>
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<tr>
<td>Normalized (per KLOC)</td>
<td>$0.95K</td>
<td>$4.05K</td>
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<tr>
<td>Time to Accept (months)</td>
<td>3.7</td>
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<tr>
<td>Normalized (months per 100 KLOC)</td>
<td>4.5</td>
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Project Quality

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<td>Duration (months)</td>
<td>31.8</td>
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<tr>
<td>Size (KLOC)</td>
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<td>151</td>
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<td>Developer Defect Density</td>
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<td>Peer Review Exit Density</td>
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<tr>
<td>Delivered Defect Density</td>
<td>1.55</td>
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Organizations Using TSP

Advanced Information Services, Inc.
Centro De Investigacion En Matematicas
Chinasoft International, Inc.
COMputing TechnologieS, Inc.
Davis Systems
DEK International GmbH
Delaware Software, S.A. de C.V.
Delivery Excellence
Grupo Empresarial Eisei, S.A. de C.V.
Herbert Consulting
Hitachi Software Engineering Co., Ltd.
Idea Entity Corp.
InnerWorkings, Inc.
Instituto Tecnologico y de Estudios Superiores de Monterrey
It Era S.A. de C.V.
Kernel Technologies Group, S.A. de CV
Knowldege Partner QR Pvt. Ltd.
Kyushu Institute of Technology
L. G. Electronics
LogiCare
Motiva, LLC
National Aeronautics & Space Administration
Next Process Institute Ltd.
Praxis High Integrity Systems
Process & Project Health Services
Procesix
PS&J Consulting - Software Six Sigma
QuarkSoft
Sandia National Laboratories
Science Applications International Corporation (SAIC)
Siemens AG
SILAC Ingenieria de Software S.A. de C.V.
SKIZCorp Technology
Software Engineering Competence Center (SECC)
Software Park Thailand
STPP, Inc.
TOWA INTEGRADADORA S.A. de C.V.
TRX
Universidad Autonoma De Zacatecas
Universidad de Monterrey
Universidad Regiomotana A.C.
University of Aizu
U.S. Air Force (CRSIP/STSC)
U.S. Census Bureau
U.S. Navy Air Systems Command (NAVAIR)
U.S. Naval Oceanographic Office (NAVO)
What about CMMI?
The Next Step in Process Evolution: CMMI and TSP/PSP

Panel
Kathy Smith, EDS
Jeff Schwalbe, NAVAIR
Dave Webb, Hill AFB
Girish Seshagiri, AIS

Summary
- The Software Group at Hill Air Force Base continues to follow CMMI Level 5 Practices
- TSP has been used on specific projects since 1998 with great success
- Hill has found CMMI and TSP to be strong allies
- Hill has used TSP to “kick start” CMMI High Maturity Teams
- Additional TSP scripts, forms, and reports are needed to meet the full intent of the CMMI

PSP/TSP Program - High Level Goals
- The EDS program goal is to increase developer’s quality and productivity through the use of personal best practice processes developed by the Software Engineering Institute (SEI).
- PSP/TSP builds on the EDS CMMI capability already in place, and enables CMMI Level 4 and 5 performance at the developer level.
- Collecting accurate data that is used at the developer level enables all EDS Level 4 and 5 activities.
Time to Move Up in CMMI Maturity

**NAVAIR AV-8B TSP/CMMI Experience**

AV-8B is a NAVAIR System Support Activity. They integrate new features into the Marine Harrier aircraft.

They used TSP to reduce the time to go from CMMI Level 1 to CMMI Level 4.

**Typical**

3-6 Years

**AV-8B**

2.5 Years

**Pilot Project**

**TSP Implements 75% of CMMI through ML5**
Last Two Topics

1. Investment
2. Value Proposition
# Investment Level vs. Elapsed Time

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<tr>
<th>Invest Level *</th>
<th>Year 1</th>
<th>Year 2</th>
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<th>Year 6</th>
<th>Year 7</th>
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</table>

**Investment Level**

- **Organization 1, Size 150, 5% investments**
- **Organization 2, Size 200, 5% investments**
- **Organization 3, Size 400, 8% investments**
- **Organization 4, Size 50, 10-15% investments**
- **Organization 5, Size 500, 15% investments**
- **Organization 6, Size 35, 15% investments**

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CMMI Cost Details

- Company A: $4.5M, 18 Months, 350 People, Level 2
  - Complete Outsourcing of CMM Support
- Company C: NTE 5% of Budget, 1 Year, 30 People, Level 3 (SW)
  - Extensive Capture of Cost to Implement
- Company B: 2% of Budget, 1 year, 560 People, Level 2, Then 3
  - Extensive Outsourcing of CMM Support
- Company D: 1.5-2.5%, 12 Months, 180 People, Level 2 (SW)
  - Extensive Outsourcing of CMM Support
- Company J: $900K, 2 Year, 400 People, Level 3 (SW)
- Company D: 2% of Annual Budget, 150 People, No Assessment
  - 5 Years to Best Productivity; All Costs Not Captured
- Company F: $1M, 150 People, Level 2, Then 3
- Company M: Staffing at 3-5%, Up to 5% for Metrics Expense
- Company H: 2% of Budget, 60% of Company at Level 4
- Company I: Implement costs: $2.5M, 2.5 years, Level 3 (SW/SE), not all costs included, 15% workforce initial pilot. Sustainment costs: 15.25 work-years government, 4 full and part-time contractors. 3600 employees.

50% of Costs Devoted to Training

Recurring Costs for PI

Note:
- Recurring Costs of Process Improvement
- Annual Cost: To Continue to Next Level, or $ to Bootstrap New Pilot
- Assume Man-year $200k
- Some Data Mixes SE and SW

Process Improvement is Worthwhile Investment for High Risk, High Payoff Processes
AIM Approach

Planning
- Planning
- Projects selection
- Kick-Off

Training
- Executive seminar
- Leading Dev. Teams
- PSP fundamentals

Piloting
- Launch / Re-Launch
- Coaching
- Checkpoint
- Post Mortem

Closure
- Benefits analysis
- Lessons Learned
- Next steps

2 projects,
2 cycles each
Suggested roadmap

Project starts

Planning → Training

Pilot 1

Pilot 2

Closure

Project management and change management

Apr → May → Jun → Jul-Aug → Sep-Oct → Nov-Dec → Jan → Feb

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Investment Costs and Return

The principal costs are
- training the team
- coaching support for the team

The initial cost to implement AIM on a team using an external consultant is approximately 40 to 50 consulting days.

The cost to implement on team using internal resources is approximately $20,000 to $50,000 per year.

The principal benefits are
- 30% improvement in productivity, cycle time, etc.
- 4X reduction in test cost and schedule from quality improvement
- 4X reduction in post-deployment support due to improved quality

Conclusion

Teams easily recover the investment within the first year.

Savings in subsequent years is substantial.

Each team recovers the cost of introduction on one or more additional teams each year.

Organizations have reported ROI of 5:1, 10:1, and 20:1.
Benefits of AIM

1. Fast Track to CMMI Maturity- New Business Opportunities
2. Superior Performance- Competitive Advantage
3. Packaged, Proven, Predictable Solution- Low Risk
4. Expands the CMMI Market
5. Creeping Commitment- Manage PI Investment
6. Establishes a culture of excellence
The Value Proposition

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>AIM</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost</strong></td>
<td>Variable - 2% to 10% but for how long and with what benefits?</td>
<td>Fixed, known, manageable with predictable results</td>
</tr>
<tr>
<td><strong>Timeframe to</strong></td>
<td>Years</td>
<td>Months</td>
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<tr>
<td><strong>measureable results</strong></td>
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<tr>
<td><strong>ROI</strong></td>
<td>Realized in years</td>
<td>Realized in months Compounded over years</td>
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<tr>
<td><strong>Risk – MTBCEO</strong></td>
<td>High - may need to re-establish sponsorship</td>
<td>Low - builds sponsorship</td>
</tr>
<tr>
<td><strong>Risk – compliance</strong></td>
<td>High - alienation, frustration</td>
<td>Low - builds ownership and commitment</td>
</tr>
<tr>
<td><strong>vs. performance</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pace</strong></td>
<td>Strategic</td>
<td>Strategic and tactical</td>
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Questions
Comprehensive Proven Package

- Development Methodology
- Operational Processes
- Implementation Methodology
- Tool Support
- Coaching
- Training

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The TSP launch process produces necessary planning artifacts, e.g. goals, roles, estimates, task plan, milestones, quality plan, risk mitigation plan, etc. 

*The most important outcome is a committed team.*
The TSP Development Process

The TSP process elements are adapted to the organization’s process.
Measurement Framework

Four base measures
Apply to all processes and products
Estimates made during planning
Directly measured by team members while working

Schedule

Effort

Size

Quality

Source: CMU/SEI-92-TR-019
Defects

Defects are the measure of quality in the TSP.

Any change to an interim or final work product, made to ensure proper design, implementation, test, use, or maintenance, is a defect in the TSP.

Defects are logged as they are found and fixed.

Defect tracking takes place throughout the process.

### TSP Defect Recording Log - Form LOGD

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<tr>
<th>Name</th>
<th>Prasad Perini</th>
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Investment Level vs. Elapsed Time

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<td>15%</td>
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<td>Organization 6, Size 35, 15% investments</td>
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Level 2

Level 3
Benefits of CMMI Within the Defense Industry

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA  15213

May 2010
CMMI: Major Benefits to DoD

“Does CMMI work?” We asked our nation’s defense contractors, as well as government agencies, to share results from their performance improvement efforts using CMMI. The results spoke for themselves: “Yes, CMMI works!”

The following slides include information from six defense organizations that responded.*

*Results reported in this presentation are not attributed to protect confidentiality.
CMM Cost Details

- Company A: $4.5M, 18 Months, 350 People, Level 2
  - Complete Outsourcing of CMM Support
- Company C: NTE 5% of Budget, 1 Year, 30 People, Level 3 (SW)
  - Extensive Capture of Cost to Implement
- Company B: 2% of Budget, 1 Year, 560 People, Level 2, Then 3
  - Extensive Outsourcing of CMM Support
- Company O: 1.5-2.5%, 18 Months, 180 People, Level 2 (SW)
- Company J: $900K, 2 Year, 400 People, Level 3 (SW)
- Company D: 2% of Annual Budget, 150 People, No Assessment
  - 5 Years to Best Productivity; All Costs Not Captured
- Company F: $1M, 150 People, Level 2, Then 3
- Company M: Staffing at 3-5%, Up to 5% for Metrics Expense
- Company H: 2% of Budget, 60% of Company at Level 4
- Company I: Implement costs: $2.5M, 2.5 years, Level 3 (SW/SE), not all costs included, 15% workforce initial pilot. Sustainment costs: 15-25 work-years government, 4 full and part-time contractors. 3600 employees.

50% of Costs Devoted to Training

Recurring Costs for PI

- Recurring Costs of Process Improvement
- Annual Cost
  - To Continue to Next Level, or $ to Bootstrap New Pilot

Assume Man-year $200k

Some Data Mixes SE and SW

Process Improvement is Worthwhile Investment for High Risk, High Payoff Processes
CMM Cost Details

• Company A: $4.5M, 18 Months, 350 People, Level 2
  • Complete Outsourcing of CMM Support
• Company C: NTE 5% of Budget; 1 Year, 30 People, Level 3 (SW)
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50% of Costs Devoted to Training
Figure 1-1  Development practices by size of application

Personal Software Process (PSP) have the greatest success. However, all of the methods in the boxes have been used for applications of the sizes shown, with reasonable success.

Moving down, the Defect Prevention and Defect Removal boxes show the best combinations of reviews, inspections, and tests. As you can see, larger applications require much more sophistication and many more kinds of defect removal than small applications of fewer than 1000 function points.
3rd Annual CMMI Technology Conference and User Group

Kent Schneider, President
Defense Enterprise Solutions
Northrop Grumman Information Technology
November 18, 2003
Key Process Insertion Differences

Project A:
• Disciplined team design process used to create sound developer work packets
• Personal Software Process used consistently by developers
  ▪ SEI developed course for software developers which provides process at an individual level for producing software components and documentation (user & technical)
• Peer Reviews conducted on the most critical 20% of the software

Project B:
• We decided that this project was “too far along” to benefit from process insertion
## Project Test Time / Cost

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<td>Integration / Acceptance Test Cost</td>
<td>$78.00K</td>
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<td>Normalized (per KLOC)</td>
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<td>Time to Accept (months)</td>
<td>3.7</td>
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<td>Normalized (months per 100 KLOC)</td>
<td>4.5</td>
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## Project Quality

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<td>Duration (months)</td>
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<td>Delivered Defect Density</td>
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## AIM: CMMI + TSP + Six Sigma Summary

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<td><strong>CMMI</strong></td>
<td>• baseline maturity&lt;br&gt;• Provide organizational practices&lt;br&gt;• officially characterize the process maturity of an organization (SCAMPI A)</td>
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<td><strong>TSP</strong></td>
<td>• improve organization, team, and individual performance&lt;br&gt;• build and deploy the process and measurement foundation for high-performance and high-maturity implementation of CMMI&lt;br&gt;• strategy for accelerating CMMI adoption</td>
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<td><strong>Six Sigma</strong></td>
<td>• analyze data and identify improvement goals and opportunities&lt;br&gt;• define improved processes and measures&lt;br&gt;• Improvement toolkit for EPG</td>
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</table>
Implementation Approaches

1) Traditional CMMI approach

2) Non Traditional AIM/TSP approach
Comprehensive System Change Model (IDEAL) Traditional Approach

The Process Change Method
1. Organize and Prepare
2. Conduct Organizational Scan
3. Establish Technical Working Groups
4. Understand Project’s Current State
5. Redesign the Process
6. Develop Solution
7. Conduct Pilot(s) and Evaluate
8. Facilitate Organizational Learning

A Process Improvement Infrastructure
Core Teams are typically formed and given responsibilities and roles for managing, facilitating, and implementing a change effort from start to finish.

Enablers
- Management Steering Group (MSG)

Facilitators
- Engineering Process Group (EPG)

Doers
- Technical Working Group (TWG)

Staffing the Process Infrastructure

TWG … Gameplan
SEI IDEAL™ Model

Based on Org Change Principles:
- Action Research
- Socio-tech Systems
- Plan Do Check Act
- Cascading Sponsorship
- Parallel learning Structures (SEPG)

My experience with using IDEAL:
- Takes too long (SEI time to move up)
- Costs too much
- Engineers don’t embrace it
- Hard to sell Management Value Proposition
Benefits of the Integrated Strategy

Organization Benefits

- Faster, lower cost, repeatable approach to implementing CMMI
- Measurable and trackable improvement strategy
- Local ownership and responsibility
- Direct route to higher maturity and high performance
- Scalable from large to small organizations
- Improves the culture by changing the behavior
- Better work-life balance
- Employer of choice

Project Benefits

- Immediate business value and results on each project
- Organization sets the pace; which projects; how many projects
- Each project pays for itself within first year
- Improves performance from the bottom up
Benefits to SEI Partners

Benefits to SEI’s CMMI and TSP Partners

• Integration of SEPM products
• Faster, systematic, performance-based improvement offering
• Addresses the “how-to” with operational practices, methods, measurement and analysis, training, tools, etc.
• Expands Market
Time to Move Up in CMMI Maturity

Number of months to move to next maturity level

Recommended time between appraisals

Time Period of Initial Appraisal: 2002 to 2005, 2006 to Present, All (2002 to Present)

Level Orgs: 1 to 2, 2 to 3, 3 to 4, 4 to 5

NOTE: Due to the way the interval between levels is measured, the time to move from ML1 to ML2 is understated. A reasonable expectation would be somewhere between 12 to 24 months.
NAVAIR AV-8B TSP/CMMI Experience

AV-8B is a NAVAIR System Support Activity. They integrate new features into the Marine Harrier aircraft. They used TSP to reduce the time to go from CMMI Level 1 to CMMI Level 4.

11 months to CMMI L3
2009

Typical 3-6 Years

AV-8B 2.5 Years
TSP Implements 75% of CMMI through ML5

Based on a SCAMPI C of the latest version of TSP and CMU/SEI-2004-TR-014

Unrated - out of scope for TSP.

Not Addressed - project practice that TSP does not cover.

Partially Addressed - project practices that TSP addresses with some weakness of omission.

Supported - organizational practices that TSP supports.

Directly Addressed - TSP practices meet the intent of the CMMI specific practice (SP) without significant reservations.
## Pilot Project

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Next Generation Process Evolution
Dr. Gene Miluk July 2010
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