

Benefits of CMMI Within the Defense Industry

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Outline

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This report was created with the cooperation of the Systems Engineering Division (SED) of the National Defense Industrial Association (NDIA) and their member companies and DoD organizations.





Purpose of Presentation

Present new evidence about effective implementations of CMMI

- Examples are provided by the defense industrial base and DoD organizations.
- New examples are based upon the measures that practicing organizations use to track value to their businesses.
- Examples are provided by organizations that have tracked and measured performance improvements from using CMMI over many years.
- Many of the organizations emphasize high maturity results and show that they enabled superior performance.
- Their data indicate why CMMI is important to the DoD & its suppliers.

The new data presented in this report demonstrates that effective implementation of good practices aided by use of CMMI can improve cost, schedule, and quality performance.





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.





Background on the Data for this Presentation

Organizational and project leaders decided which measures were most useful to them when tracking the results of CMMI-based improvements.

A common thread was their interest in measuring the effect CMMI had on schedule, effort and cost, and quality.

The summarized results demonstrate the wide scope of business values and goals of the participating organizations.

The source studies in this presentation used current data as follows:

- 2010: Organizations 1, 2A, 3, & 6
- 2009: Organizations 5 & 7
- 2008: Organization 2B



Quantitative Measures: Schedule Performance Results Summary



Measure Used By The Organization	Performance Result
On-time deliverables (Organization 2a)	On-time deliverable increase of 4.9% (organization went from 95% to 99.9% of projects delivered on time)
Earlier Defect Detection and Repair (Organization 1)	6.35 times less defect discovery and repair hours after start of system testing; potential savings of 5 – 6.5 months in schedule delay after system tests begin for average sized project
Schedule performance index (Organization 7)	Increased from .78 to .93 over three years (a 19.2% improvement in estimation and execution of schedule)



Quantitative Measures: Effort (Rework) and Cost Performance Results Summary



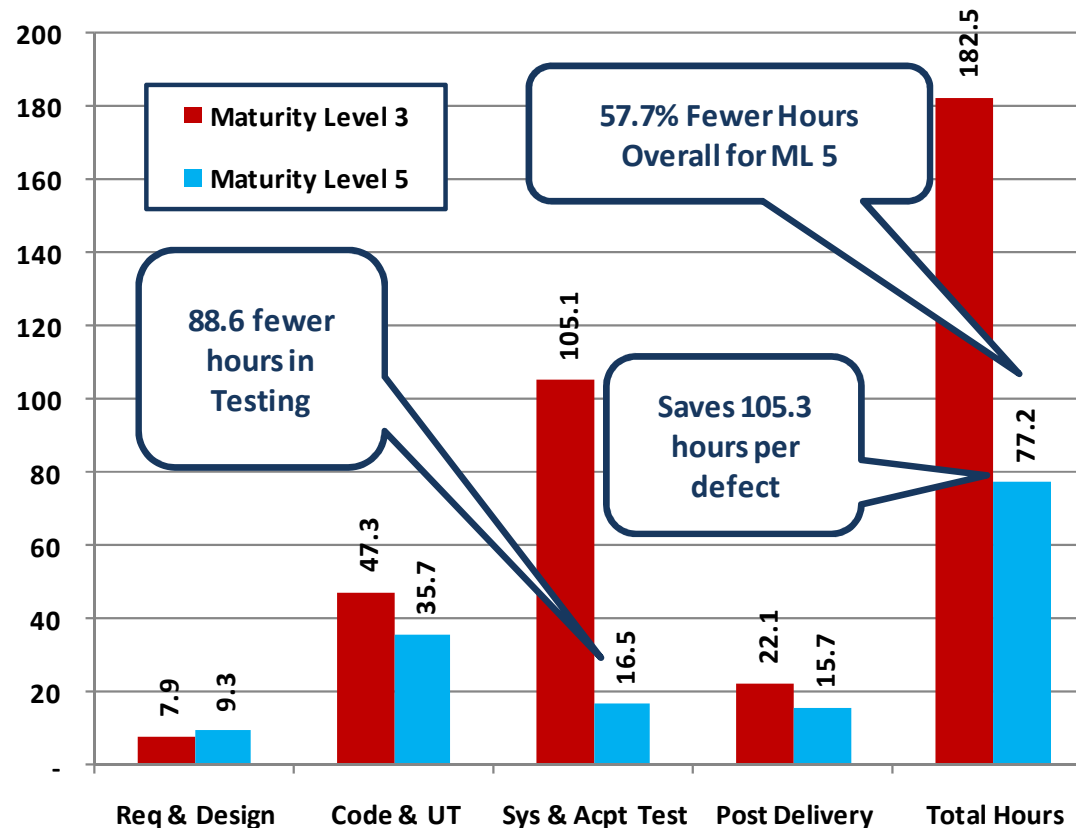
Measure Used By The Organization	Performance Result
Total hours for defect repair (Organization 1)	58% fewer hours needed to repair defects for ML5 versus ML3; Result: a potential cost savings of \$1.9 to \$2.3 M per average-sized project (defined as 233 KESLOC [Kilo Equivalent Source Lines of Code])
Hours per KLOC to find and fix defects for CMMI ML5 relative to the SW-CMMI ML3 baseline (Organization 6)	Defect find and fix cost down 22%
Effort hours needed to repair high severity defects in integration and test phases (Organization 4)	24% reduction in effort hours per defect
Cost performance index (Organization 4)	Increased from .88 to .96 over two years
Overhead rates for CMMI ML5 relative to the SW-CMMI ML3 baseline (Organization 6)	Reduced by 7.3%
Software development cost for CMMI ML5 relative to the SW-CMMI ML3 baseline (Organization 6)	Reduced by 28%



Selected Results: High Maturity Reduces Costs for Repair (Organization 1)



Average Hours per Defect per Phase



High Maturity Projects Discover defects earlier

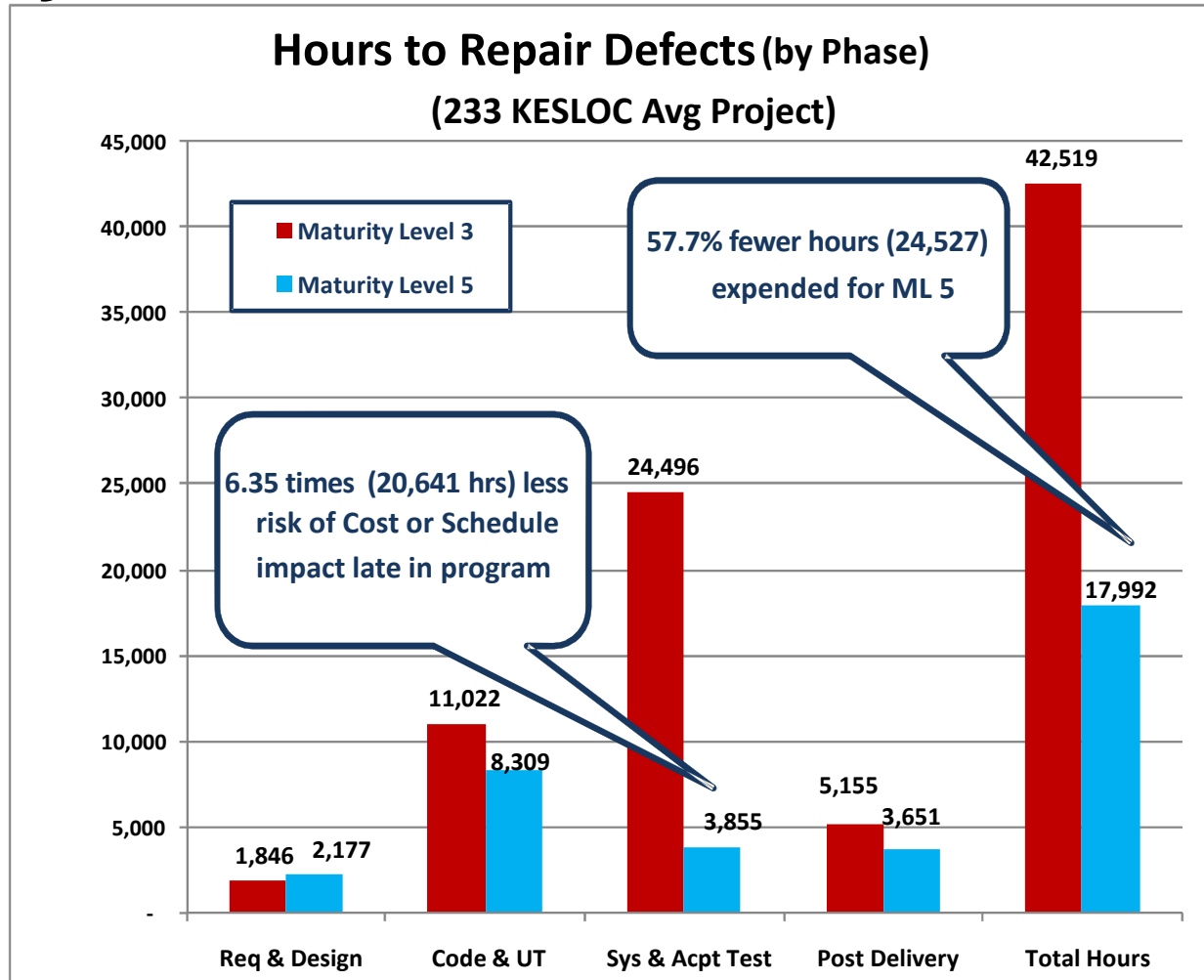
Early detection and repair lowers Costs

57.7% fewer hours for ML5 projects expended to repair defects versus ML3

- 105.3 fewer hours per defect
- 88.6 fewer hours during Testing alone
 - When largest risk to schedule occurs



Selected Results: Effort to Repair Defects by Phase (Organization 1)



Potential Cost Savings From \$ 1.9 M to \$2.3 M per average sized program



Quantitative Measures: Quality Performance Results Summary



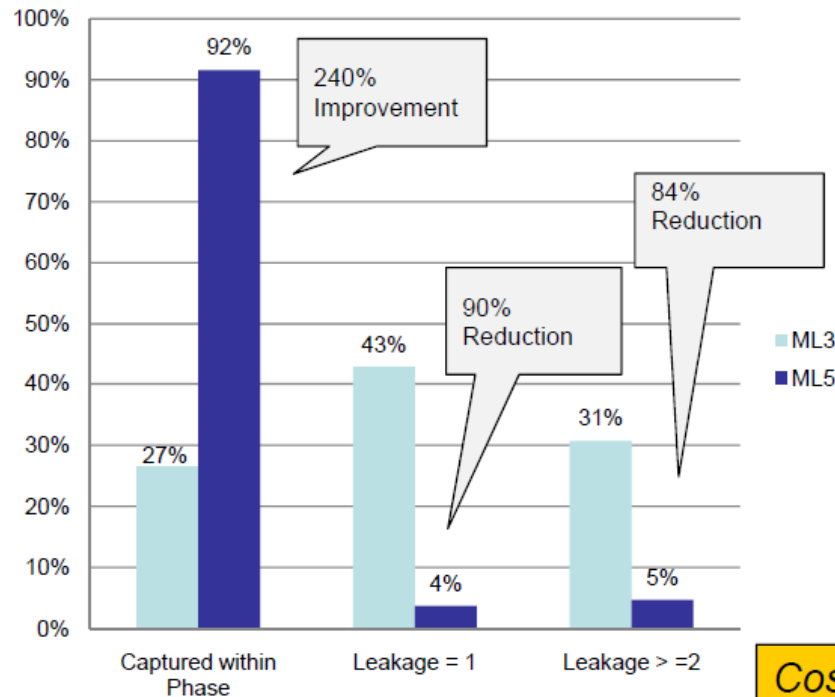
Measure Used By The Organization	Performance Result
Defect density by severity, ML5 compared to ML3 (Organization 1)	62.5% fewer high-severity defects with ML5 projects
Defect density in circuit board design (Organization 2a)	65% improvement
Defect containment by phase (Organization 3)	The fix of defects within the phase they were injected increased by 240%
Defect containment, ML5 compared to ML3, by phase per KLOC (thousands of lines of code) (Organization 2b)	Defect containment improved 13%
User acceptance test defects per KLOC (Organization 7)	Less than 0.15 defects per KLOC
% of defects removed prior to system test (Organization 7)	>85%



Selected Results: Quality Performance

(Organization 3)

**Defects Phase Containment / Leakage
(High Severity Defects -
Priority 1, 2 & 3)**



Within ML5 projects:

- Defect containment (within phase) is increased by 240%
- Leakage is reduced by 90% for defects discovered "1 phase later"

84% reduction in defects leaked "2 or 2+ Phases"

Optimizing verification activities:

- Peer reviews
- Unit testing
- Integration testing

Cost avoidance realized:

- Less rework late in the life cycle when it is most expensive to repair
- Resulting in reduced schedule risk



Quantitative Measures: Productivity Results Summary



Measure Used By The Organization	Performance Result
Productivity Gain with ML5 (Organization 1)	42% gain with ML5 organizational practices over 9 years
Organizational productivity vs. Galorath SEER SEM Estimation Model (Organization 1)	Production hours reduction: 33.0% at ML3; 37.4% at ML5
Productivity for CMMI ML5 relative to the SW-CMM ML3 baseline (Organization 6)	Productivity up 25.2%



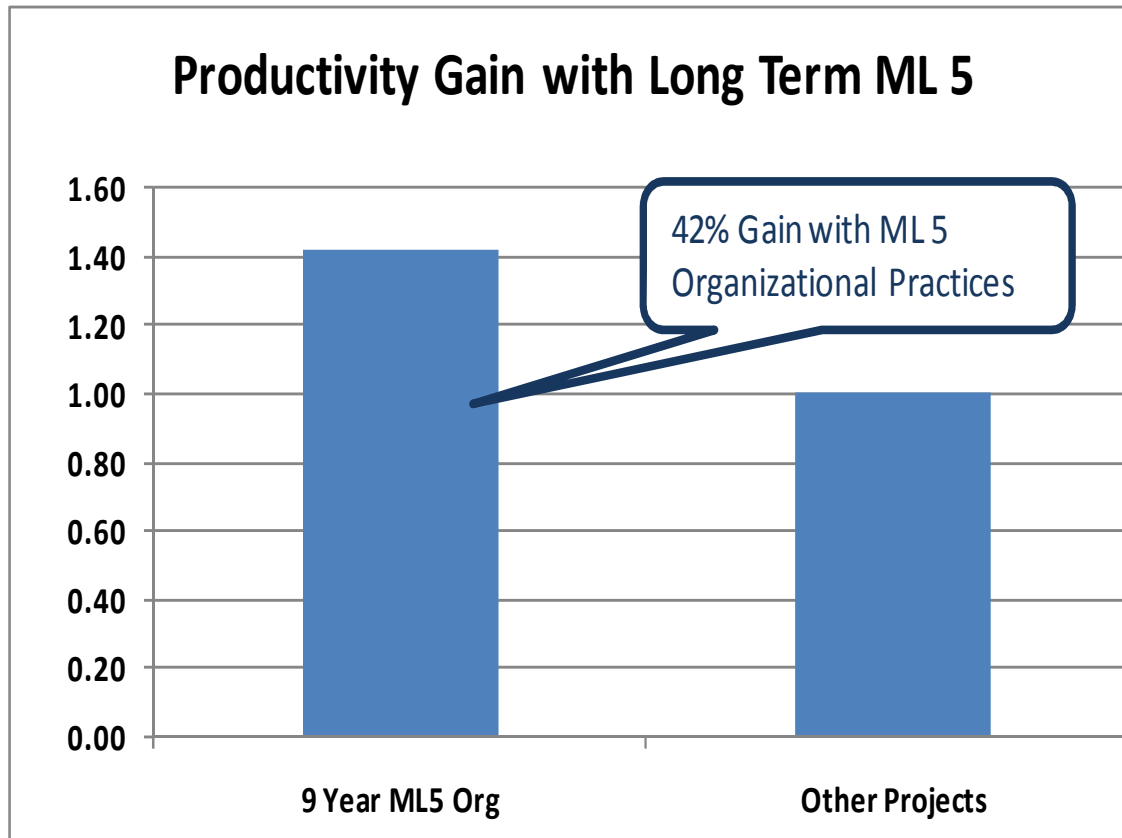
Selected Results: Software Productivity

(Organization 1)



Average project size was 233 KESLOC

Largest = 1,360 KESLOC
Smallest = 29 KESLOC



Average customer project savings due to increased productivity

- Equivalent of 406 work months per project (33.8 work years)



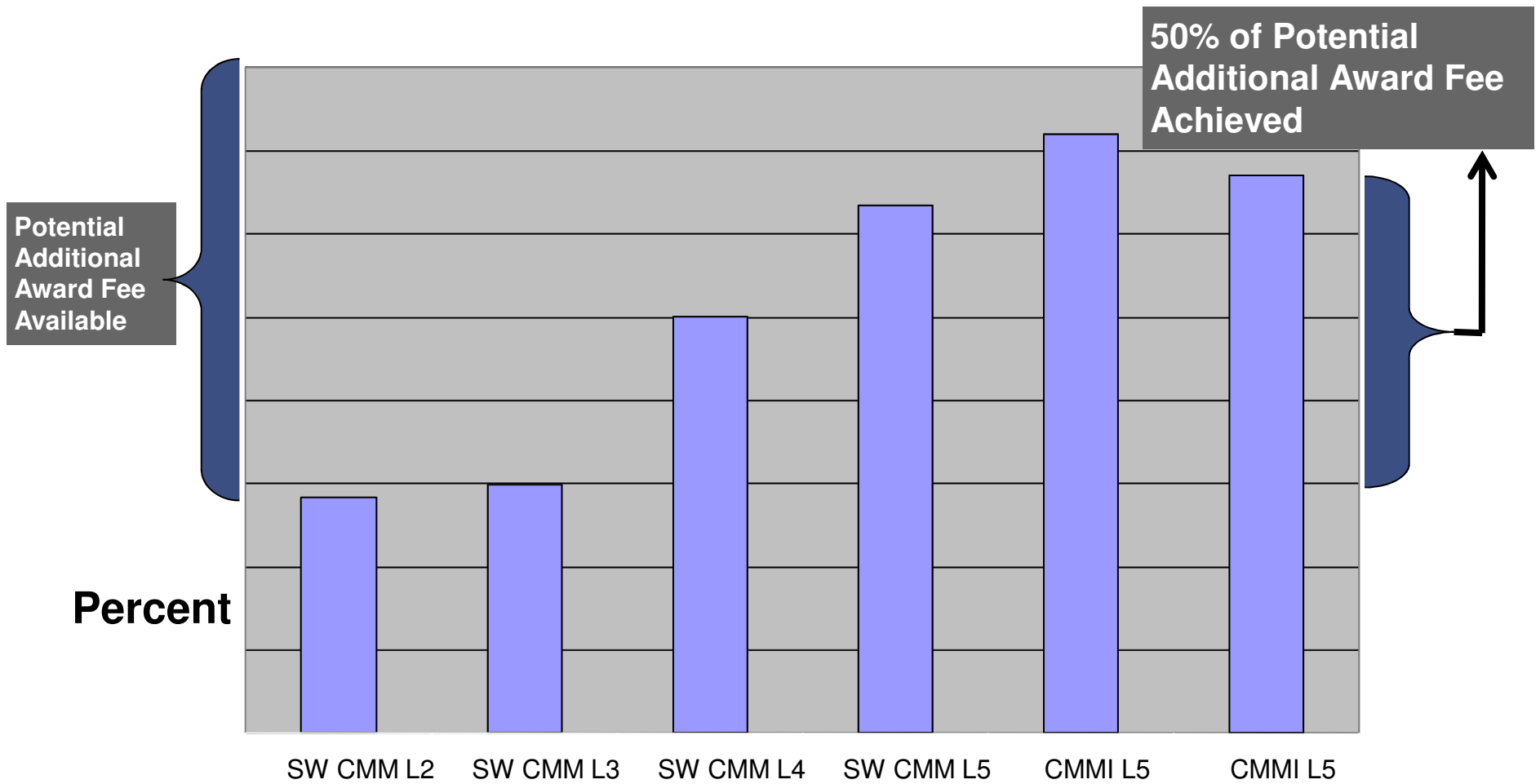
Quantitative Measures: Customer Satisfaction Results Summary



Measure Used By The Organization	Performance Result
Award fee (used as an indicator of customer satisfaction) for CMMI ML5 relative to the SW-CMM ML2 baseline (Organization 6)	50% of potential additional award fee achieved
Cost savings to customer in a cost-plus contract (Organization 1)	Rose from 5.7 M to 7.1 M (25%)



Selected Results: Award Fee (Organization 6)



Customer Satisfaction Continues to Improve



Quantitative Result: Return on Investment

(Organization 2a)



Organization 2a reported their quantified ROI from CMMI Maturity Level 5 activity to be **24 : 1**.

Using the data in *Performance Results of CMMI® -Based Process Improvement* (CMU/SEI-2006-TR-004) they were able to compare their ROI performance to others in industry:

- Median ROI 4 : 1
- Lowest ROI 1.7 : 1
- ➔ • **Organization 2a** **24 : 1**
- Highest ROI 27.7 : 1



These results are a consequence of meaningful process improvement aligned with the business and engineering objectives.



CMMI Provides Many Qualitative Benefits as Well*



Organizations also gathered various qualitative measures to compliment their quantitative measurements. They found qualitative benefits such as:



- Reduced overtime and less intense pressure
- Clear roles and responsibilities for business execution
- Common language (i.e., defined processes, measures) across business units
- Decrease in replanning
- Products with lower levels of defects and lower risk; one organization offers a lifetime warranty on products
- Improved program insight, control, and tracking
- Reduced training: process documentation enables knowledge transfer to new generation of workers
- Process transformation (via consistency, integration, coordination)
- Personnel retention and job satisfaction

*based on published benefits from a wide variety of organizations





The Bottom Line

Why improve processes? - Because processes are the foundation for all other business improvements, and critical for

- lasting improvements
- successful technology insertion

If a performance management system is not in use, leadership is unaware of what is and is not working.

CMMI is a proven approach to performance management – with more than a decade of results showing it *does* work.

Organizations have provided data that shows CMMI

- enables the delivery of lower-defect products, with predictable cost, schedule, and quality
- improves business performance
- serves as competitive discriminator





Results Depend on Implementation

Simply deciding to “do CMMI” is not enough to achieve benefits.

Defining good processes, using them, measuring the results, and making improvements based on what you learn are all key to reaping the benefits described in this presentation.

The CMMI models are a foundational part of a comprehensive approach to process improvement that helps organizations understand

- **why** they should improve
- **what** frameworks and tools would best fit their needs
- **how** to implement them



Recent Research on CMMI: Just the Tip of the Iceberg!



The collage features several key research outputs:

- SoftwareTech NEWS** (March 2007, Vol. 16, No. 1): "Performance Results from Process Improvement" featuring the CMMI logo and various charts.
- CROSSTALK** (July 2007): "GETTING A HANDLE ON PROCESS" featuring the CMMI logo.
- ASSESSMENT AND CONTROL of SOFTWARE RISKS** by Capers Jones (September 1994): A technical report cover showing a group of people in a meeting.
- Benefits of CMM-Based Software Process Improvement: Executive Summary of Initial Results** (September 1994): A white paper by James Herbsleb, Anita Carleton, James Rozum, Jane Siegel, and David Zubrow.
- Performance Results of CMMI-Based Process Improvement** (August 2008): A white paper by Diane L. Gillies, Dennis R. Goldmann, and Kathy Ford.
- Demonstrating the Impact and Benefits of CMMI: An Update and Preliminary Results** (Dennis R. Goldmann, Diane L. Gillies): A white paper.
- Technical Report CMU/SEI-94-TR-013 ESC-TR-94-013 August 1994**: A white paper by James Herbsleb, Anita Carleton, James Rozum, Jane Siegel, and David Zubrow.
- Approaches to Process Performance Modeling: A Summary from the SEI Series of Workshops on CMMI High Maturity Measurement and Analysis** (January 2005): A white paper by Robert W. Goldstein II and Dennis R. Goldmann.
- Software Engineering Institute | Carnegie Mellon** website screenshot showing navigation links (HOME, OUR WORK, OUR SOLUTIONS, PRODUCTS & SERVICES, LIBRARY, NEWS, CAREERS, ABOUT US) and a search bar.
- Performance Results of CMMI** website page showing a navigation menu (Overview, Getting Started, Research, Tools & Methods, Consulting, Case Studies, Our People) and a "Collaborate with Us" button.
- Performance Results of CMMI** website page showing a "Related Links" section with a link to "CMMI Executive Overview".





CMMI Research - References

Bibliographic information cited in this presentation:

<p>Gibson, Diane; Goldenson, Dennis R.; and Kost, Keith. <i>Performance Results of CMMI-Based Process Improvement</i> (CMU/SEI-2006-TR-004). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, August 2006.</p>	<p>Journal Issue: "Performance Results from Process Improvement." SoftwareTech News. Vol. 10, Number 1. March 2007.</p>
<p>Goldenson, Dennis R. and Gibson, Diane L. <i>Demonstrating the Impact and Benefits of CMMI@: An Update and Preliminary Results</i>. (CMU/SEI-2003-SR-009). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, October 2003.</p>	<p>Journal Issue: "CMMI: Getting a Handle on Process." CrossTalk. Vol. 23, Number 1. Jan/Feb 2010.</p>
<p>Herbsleb, James D.; Carleton, Anita; Rozum, James A.; Siegel, Jane; and Zubrow, David. <i>Benefits of CMM-Based Software Process Improvement: Initial Results*</i> (CMU/SEI-94-TR-013). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, August 1994. (*Also see SEI Special Report: <i>Benefits of CMM-Based Software Process Improvement: Executive Summary of Initial Results</i>, CMU/SEI-94-SR-013)</p>	<p>Stoddard II, Robert W. and Goldenson, Dennis R. <i>Approaches to Process Performance Modeling: A Summary from the SEI Series of Workshops on CMMI High Maturity Measurement and Analysis</i> (CMU/SEI-2009-TR-021). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon University, January 2010.</p>
<p>Jones, Capers. <i>Assessment and Control of Software Risks</i>. Upper Saddle River, NJ: Prentice-Hall, 1994 (ISBN 0-13-741406-4).</p>	<p>Website about CMMI at the Software Engineering Institute: <http://www.sei.cmu.edu/cmmi/index.cfm></p>

Looking Ahead



The road ahead for CMMI implementation

- **A continued focus on high maturity**

More and more organizations are striving for and achieving high maturity – and are collecting data demonstrating the benefits. Once at ML 4 or 5, organizations must maintain their focus on good implementation practices for continuous improvement.

- **Implementation of CMMI for Services (CMMI-SVC)**

CMMI-SVC extends the benefits of CMMI to a new audience. Service providers can use the model concept that has proven useful in the development community to specifically address their interests and concerns.

- **Implementation of CMMI for Acquisition (CMMI-ACQ)**

CMMI-ACQ helps organizations improve relationships with their suppliers and improve acquisition processes. The model can enable increased control of projects, better management of global sourcing of products and services, and more successful acquisition solutions.

- **Integration with other improvement paradigms (TSP, ISO, Lean Six Sigma)**

Organizations are finding that integrated improvement initiatives can produce outstanding results. Choosing CMMI doesn't mean discontinuing improvement efforts already in place or avoiding new ones that show promise.





Summary

- Many stakeholders are involved in the development and maintenance of CMMI models, with participants from commercial industry, government, and the DoD. Broad adoption has occurred worldwide. Adopters range from small and midsize organizations (these are the majority) to large and very large organizations.
- Organizations that provide products and services to the DoD use CMMI to improve programs, systems, product and service management, systems and software engineering, work processes, and training solutions.
- Quantitative and qualitative results have been documented by defense contractors and others, as shown in this report. There is a great deal of additional data showing the benefits of CMMI from a broad range of industries, including banking and finance, manufacturing, medical, and others.
- CMMI enables performance improvement focused on business objectives, but the level of success depends on the implementation.



Who Benefits from CMMI Today?

