



Return on Investment for Process Improvement

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Introduction



- *Extremely conservatively, the first year payout from a 3-year investment at one Level 4 company is documented at full amortization*
- *Benefits at other companies meet/exceed this for relatively similar investments*
- *This brief uses both software and system engineering results, but concentrates on software*
- *You should be able to take away some very good reasons why doing business with higher-maturity organizations is smart*

Software Process Maturity

SW-CMMSM Version 1.1



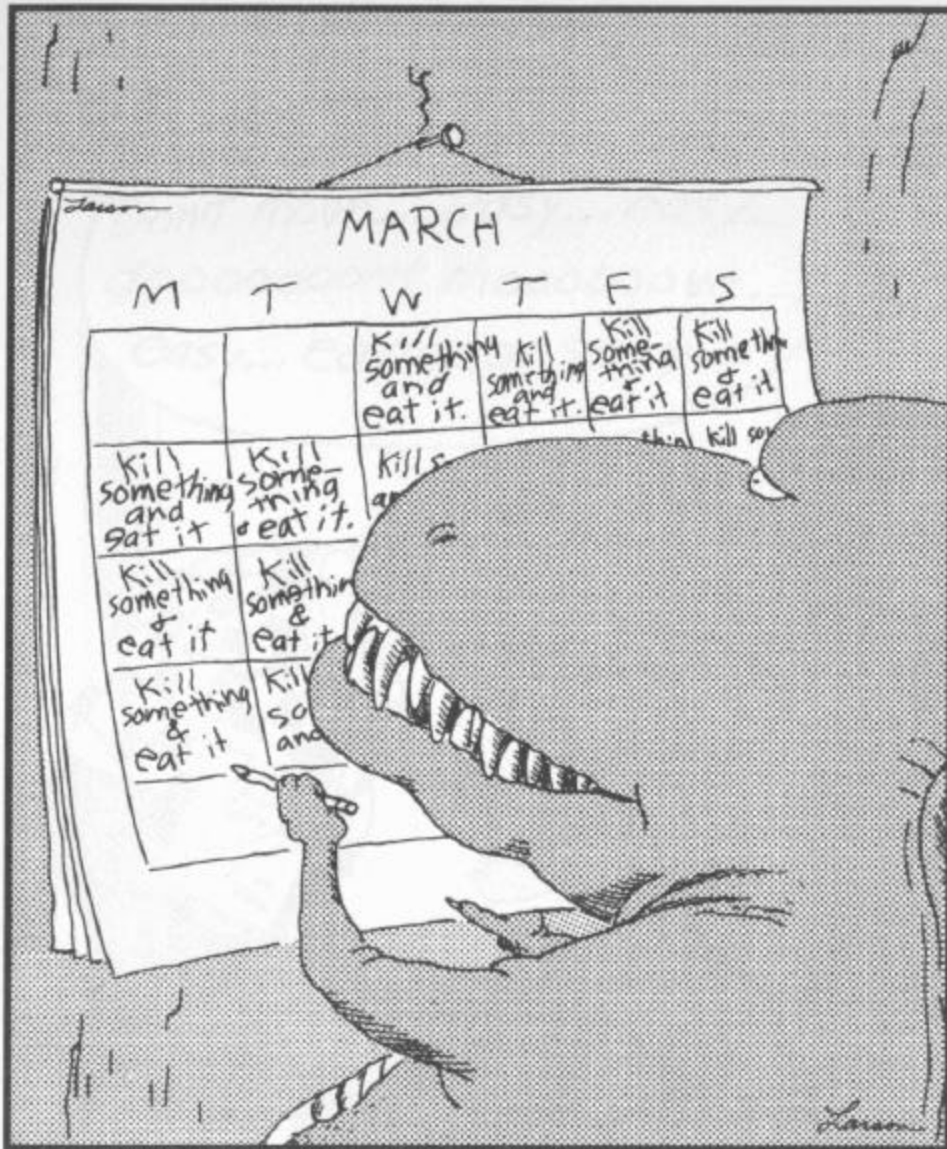
Level	Focus	Key Process Areas	Result
Optimizing 5	Continuous Improvement	Defect Prevention Process Change Management Technology Change Management	Productivity & Quality R I S K
Managed 4	Product and Process Quality	Quantitative Process Management Software Quality Management	
Defined 3	Engineering Process	Organization Process Focus Organization Process Definition Training Program Integrated Software Management Software Product Engineering Intergroup Coordination Peer Reviews	
Repeatable 2	Project Management	Requirements Management Software Project Planning Software Project Tracking & Oversight Software Subcontract Management Software Quality Assurance Software Configuration Management	
Initial 1	Heroes		

Software Capability Maturity Model (SW-CMM) is a service mark of Carnegie Mellon University



Some Background

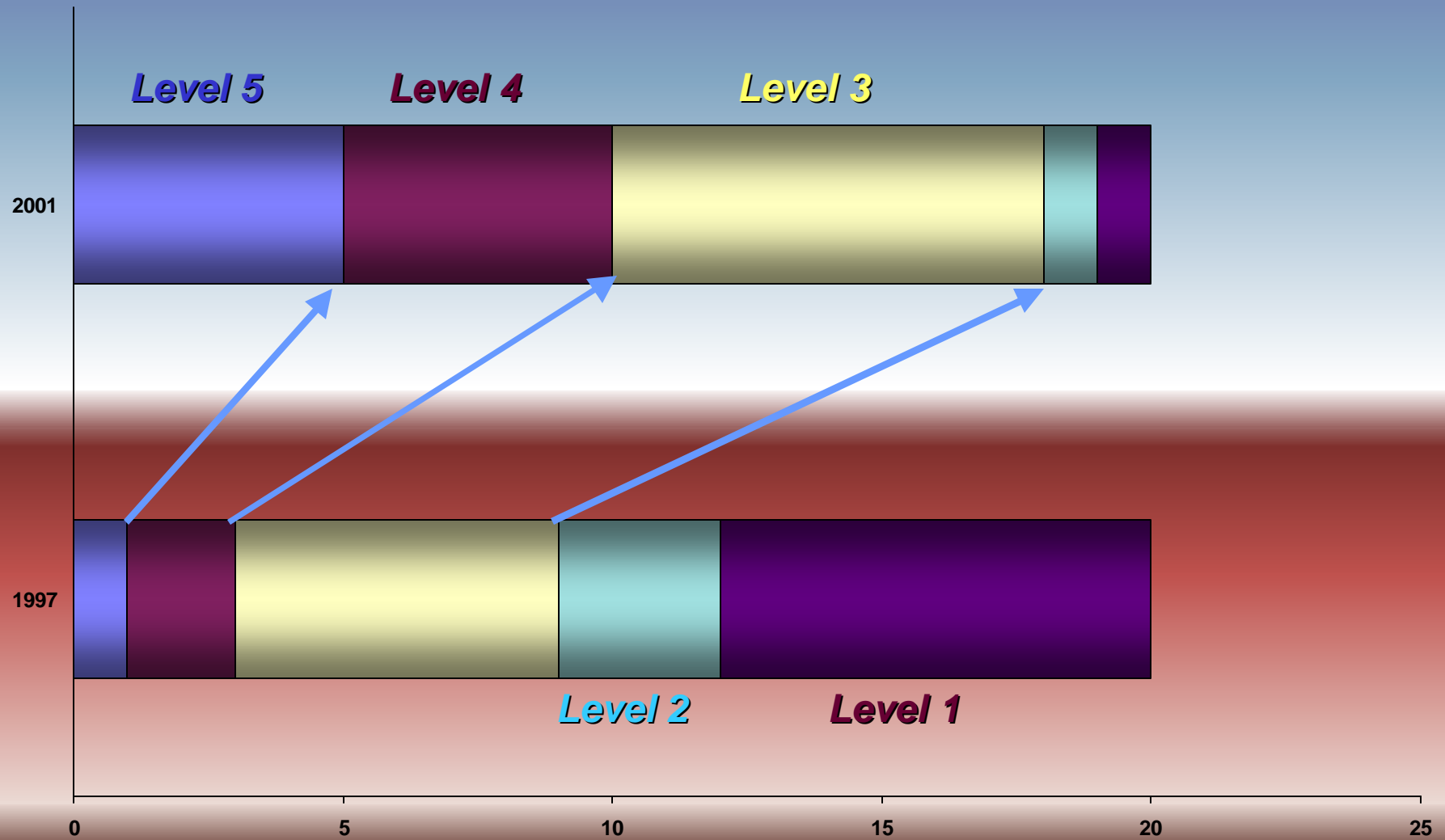
- *The concept of “quantitative management” is fully developed only at Levels 4 and 5.*
- *Finding reliable measures of productivity and quality from low-maturity organizations is therefore unlikely. What we are just now beginning to obtain are some early measurement comparisons from Level 4 and 5 companies.*
- *There has been, generically, a legacy of mistrust between Government and suppliers which discouraged suppliers from embarking on comprehensive metrics programs, fearing that the answers would be used against them. The advent of PSM is helping to reverse this attitude.*



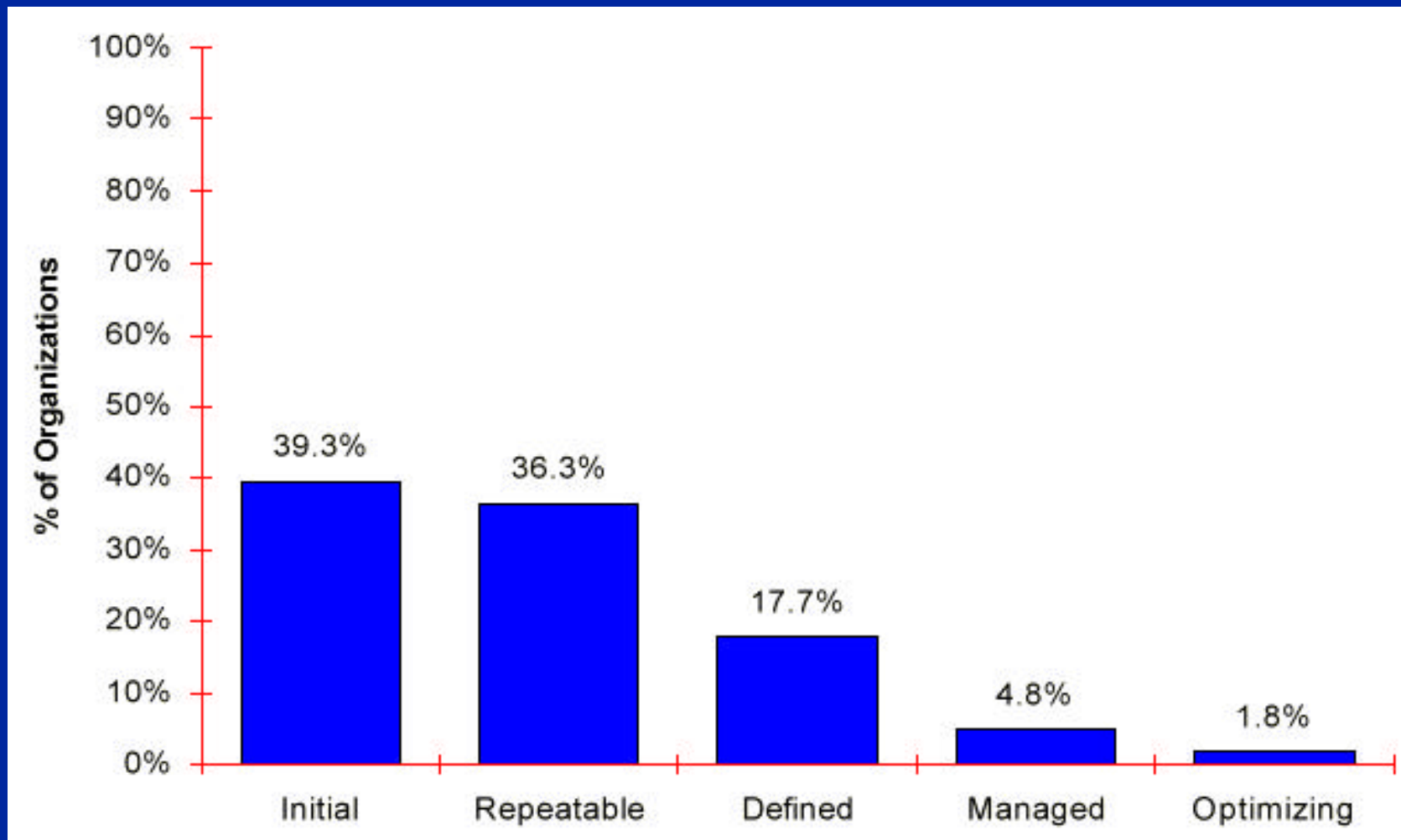
Jurassic calendars

***If you do what
you always did,
the way you
always did it....***

Then vs Now



SEI SW-CMM Process Maturity Profile As of December 1999

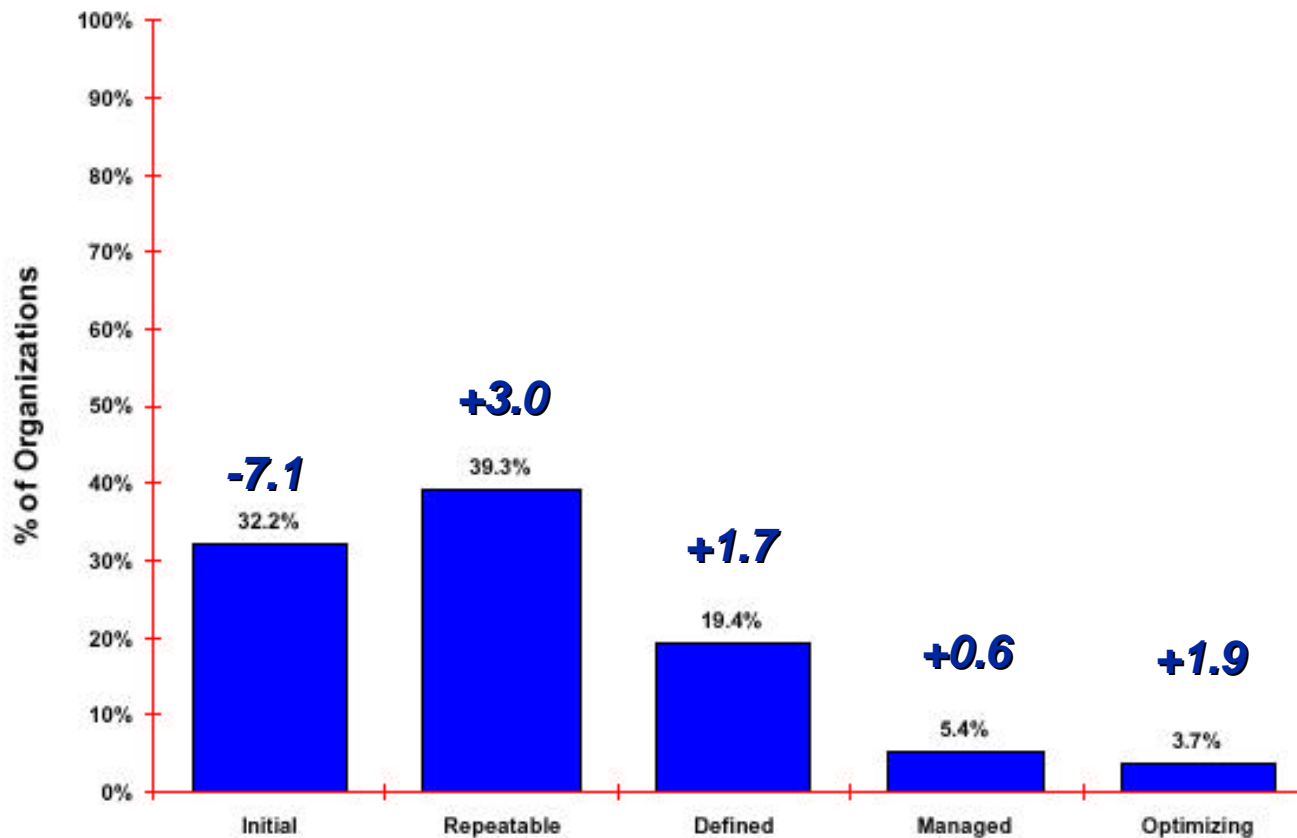


Reference: SEI Process Maturity Profile SEMA Report, March 2000



Organization Maturity Profile

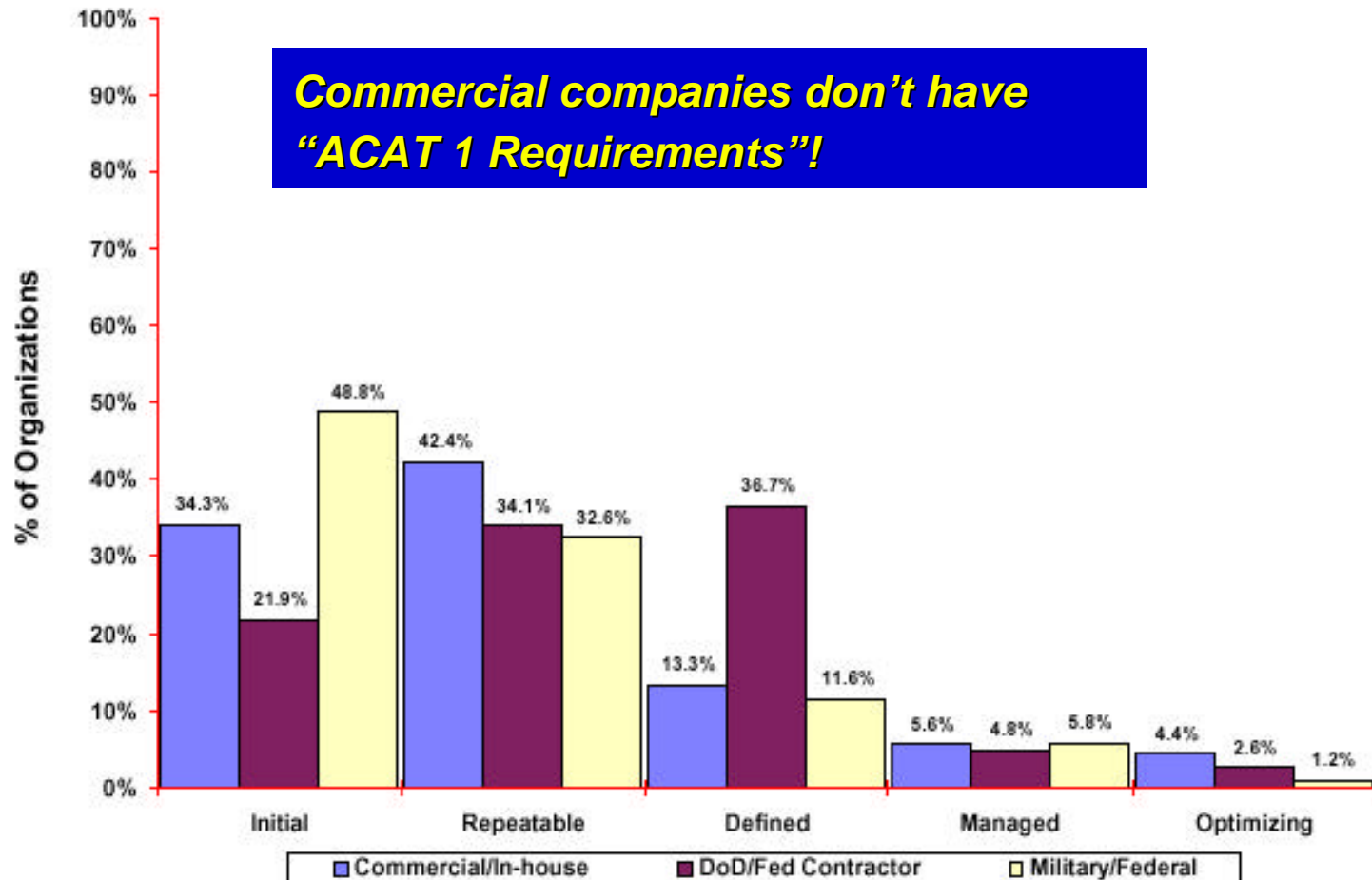
March 2001



Based on most recent assessment, since 1996, of 1012 organizations. For a perspective, please see page 18.



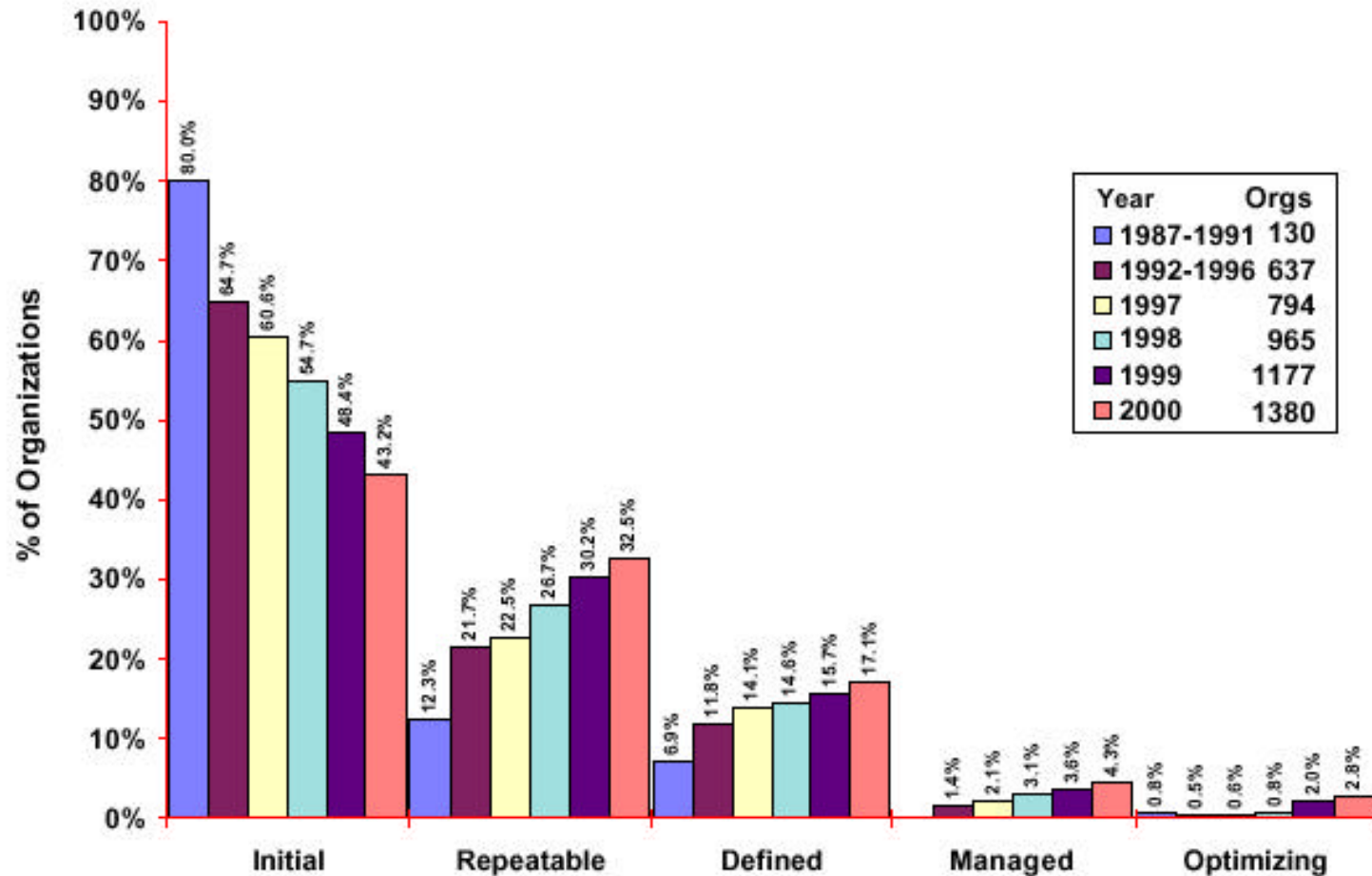
Maturity Profile by Organization Type



Based on most recent assessment, since 1996, of 1012 organizations



Trends in the Community Maturity Profile



Based on a cumulative view of the most recent assessments of organizations up through the year indicated. This accounts for the difference from the figures on page 10.

ROI Approach



- *Evaluate others' SPI/ROI presentations*
 - *Boeing*
 - *CSC*
 - *LM Federal Systems, Owego*
 - *Raytheon*
- *Identify ROI components and formulation*

Benefits Definition for Return on Investment (ROI)



- *Benefits from software process improvement efforts*
 - *Business Value*
 - *Productivity*
 - *Quality*
 - *Performance*
 - *Others*
- *Some of these benefits can be quantified and measured*
- *ROI = Benefits/Investments*

Benefits

Business Value



- ***Major contributor to new business:***
 - ***SEI Software Process Capability is a key factor considered during Government source selection***
 - ***Policy issued 26 October 1999 by the Under Secretary of Defense, Acquisition and Technology requires SEI Level 3 for prospective ACAT 1 contractors***
 - ***Contribution to program awards***

Software process capability has been a key factor considered during Government source selection and contract awards

Benefits

Business Value



- **Major factors considered during source selection:**
 - **Costs**
 - **Non-recurring (development, pre-production)**
 - **Recurring (production, life cycle)**
 - **Past performance**
 - **Technical and management approach**
 - **Risks**
 - **Cost, schedule, technical, quality**
 - **Process capability**

If our software process capability contributes only 5% to award fee pool, \$5M would be added from current pool



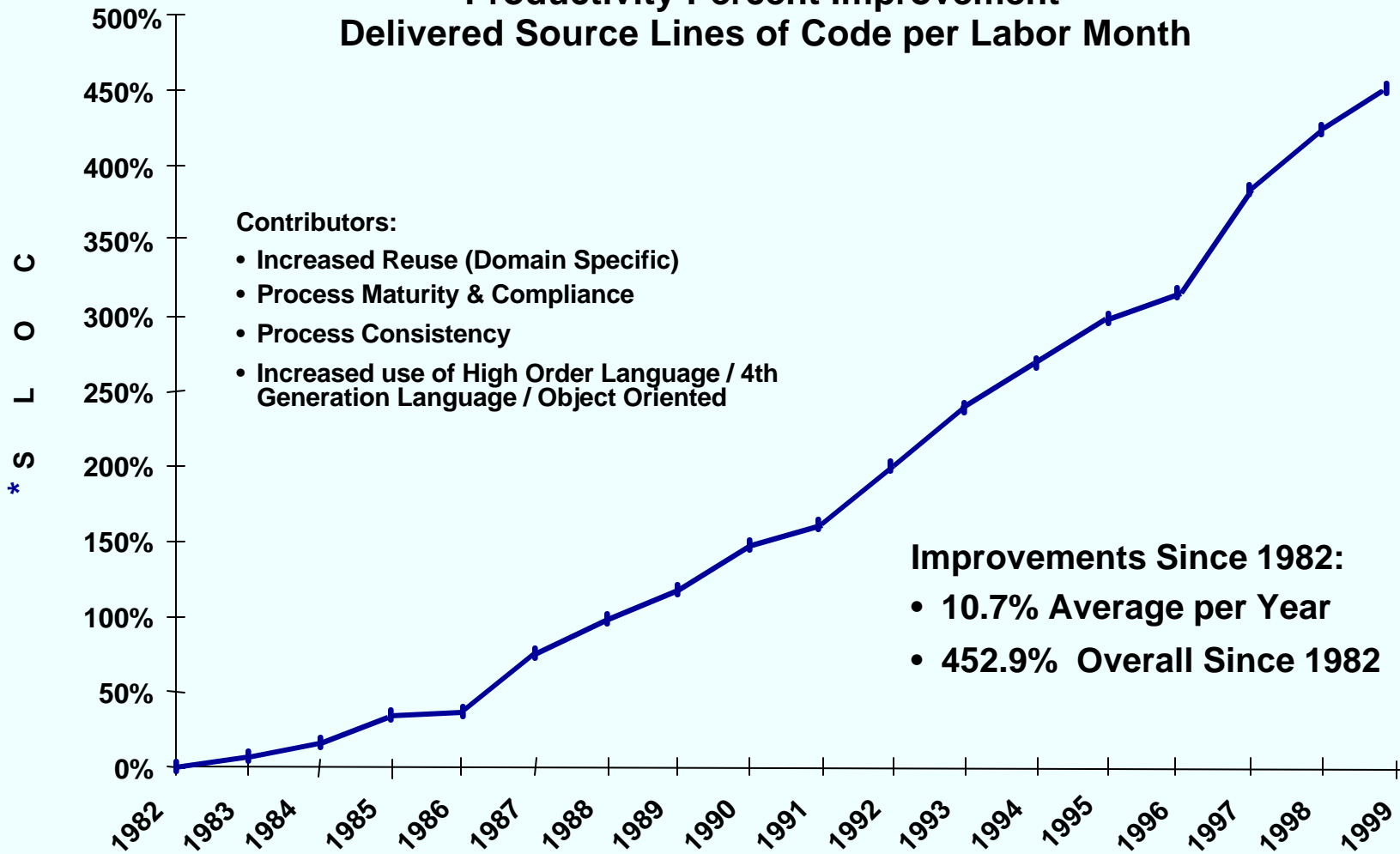
Productivity – Company “M”

- ***Cost Savings with current productivity rate (vs December 1999)***
 - ***Total ~ \$1,019K***
- ***Productivity: 3.5% average increase over past two years***

SI-Owego Productivity

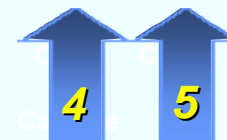


Productivity Percent Improvement Delivered Source Lines of Code per Labor Month

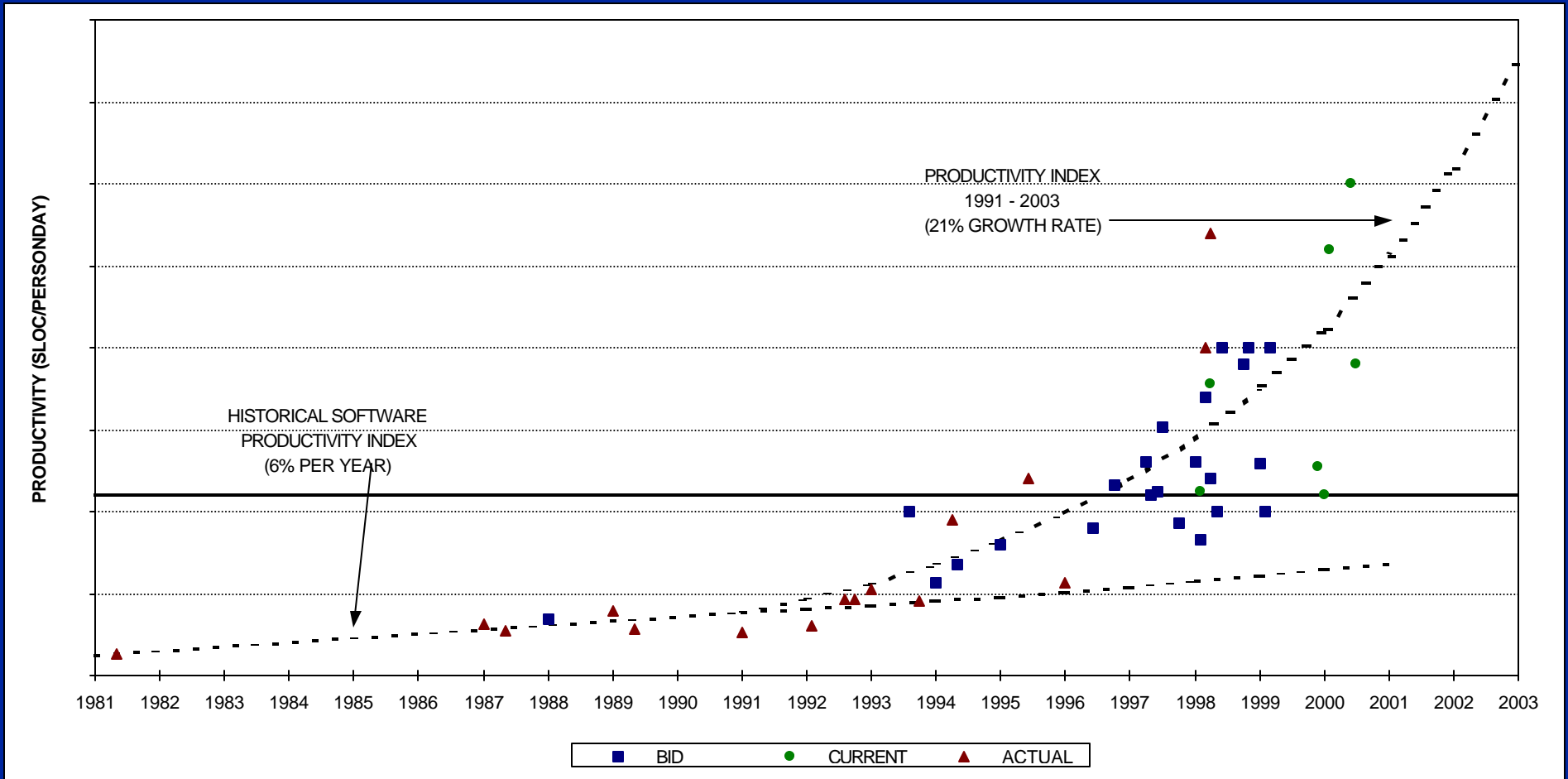


* SLOC/LM = Source Lines of Code/Labor Month

CMM 2 CMM 3



Syracuse Productivity

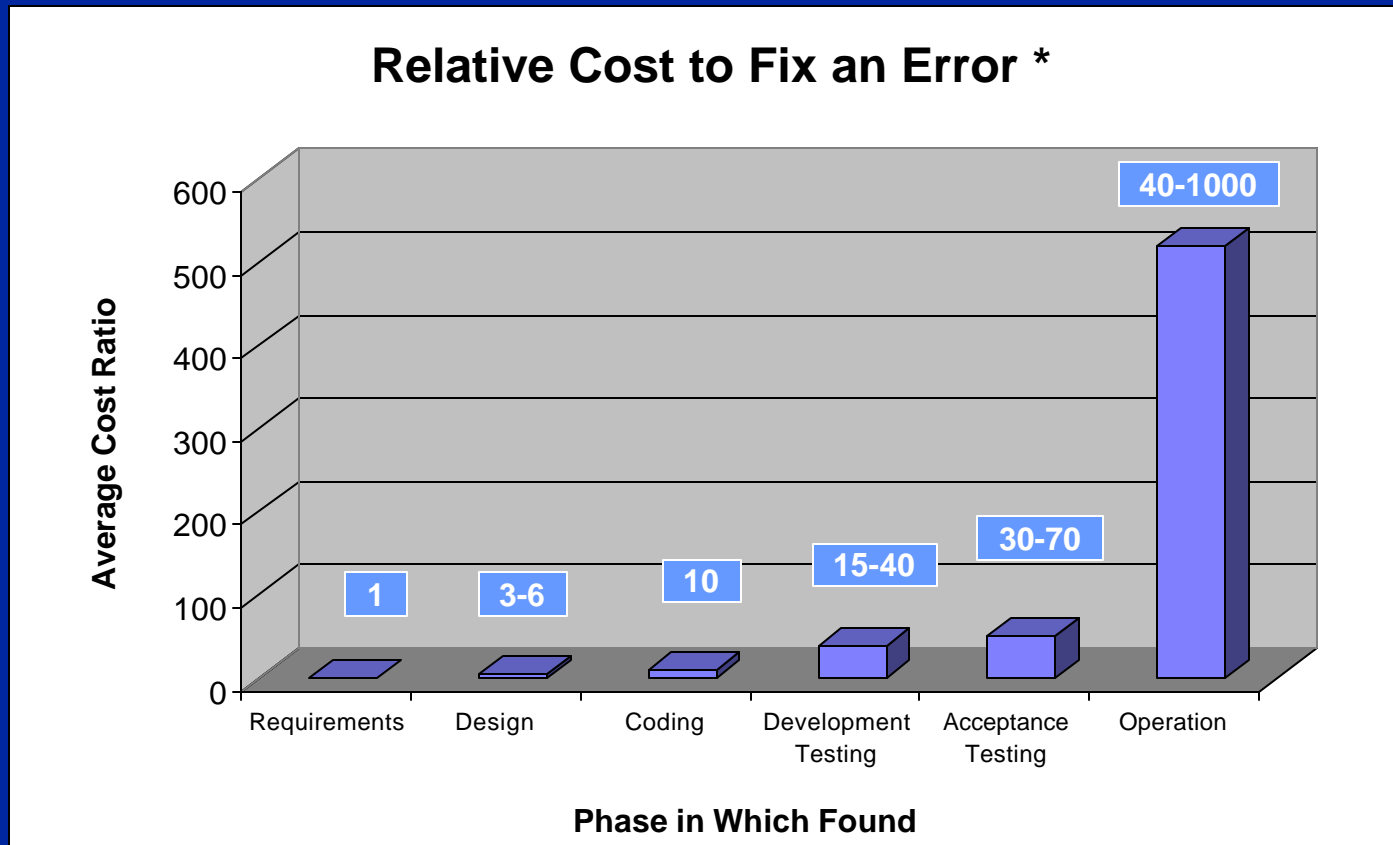


Quality – Company “M”



- **Using an average of \$3.0K to fix a problem found during functional test/ET&E, the following cost savings would be realized:**
 - **Total: \$685K**
- **Defects: 18% average decrease annually over past two years**
- **Other quality improvement observed through implementation of software inspection on Specification Changes (SC)**
 - **38% reduction in Program “A” SC Revisions**
 - **87% reduction in Program “A” Multiple SC Revisions**

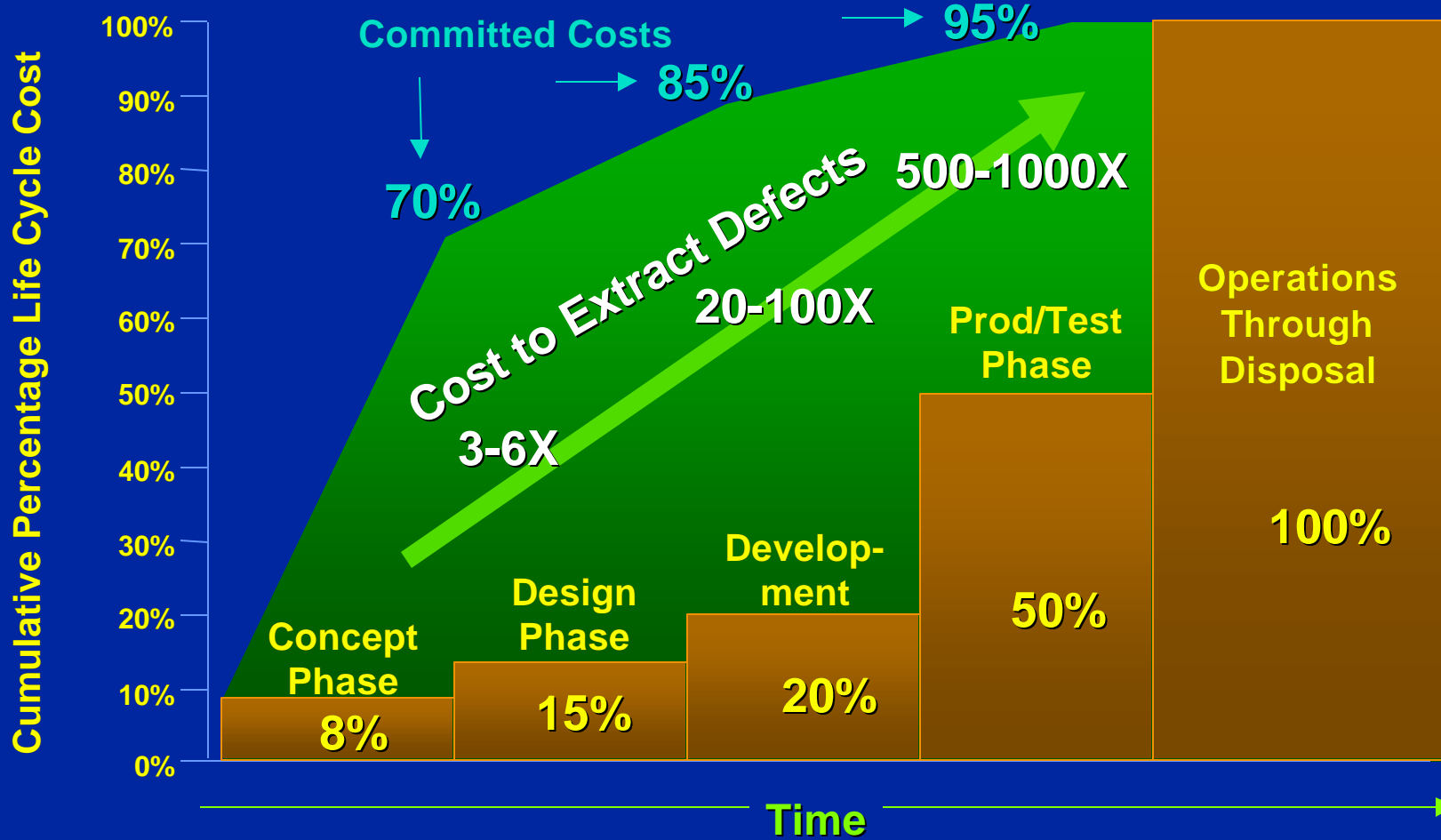
Quality – Barry Boehm



* Reference: Barry W. Boehm, Software Engineering Economics (Englewood Cliffs, NJ: Prentice-Hall)

The cost to fix a defect found during operation phase may be as high as 1000 times the cost to fix it during requirements phase*

Quality -- DSMC

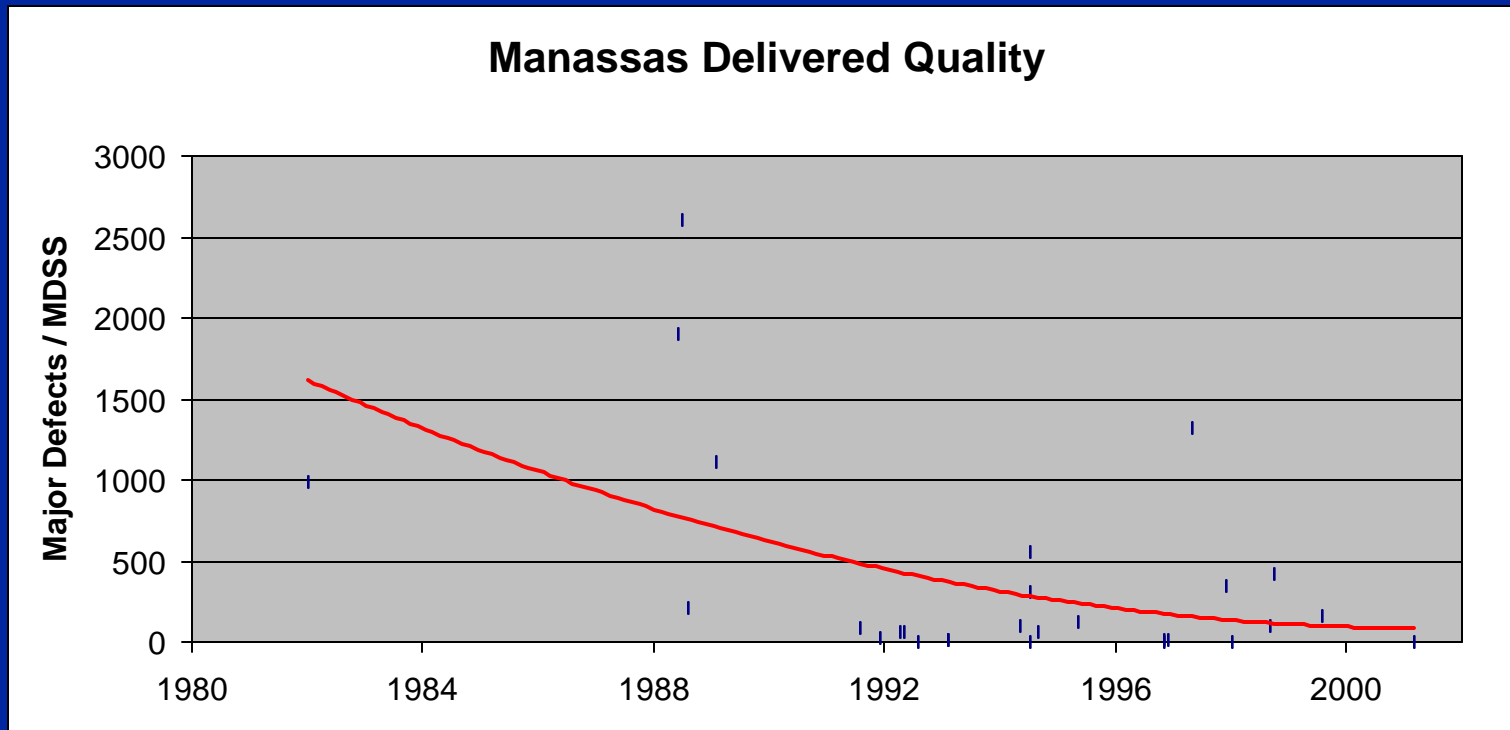


 Full Program Expenditures

Defense Systems
Management College - 9/1993

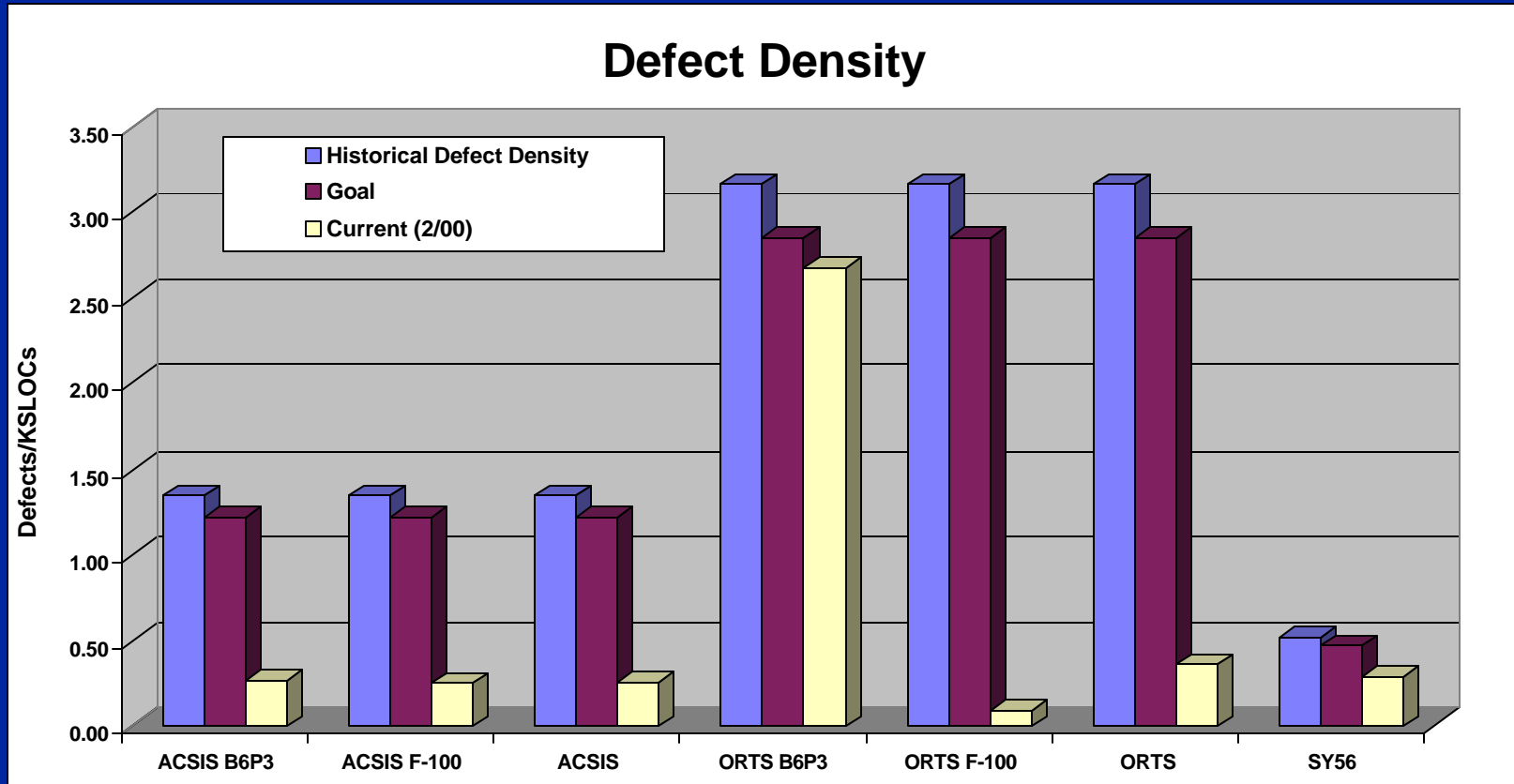
Quality – Manassas

Major Defects per Million Lines



Quality -- Moorestown

Major Reduction in Defects Delivered to System Test

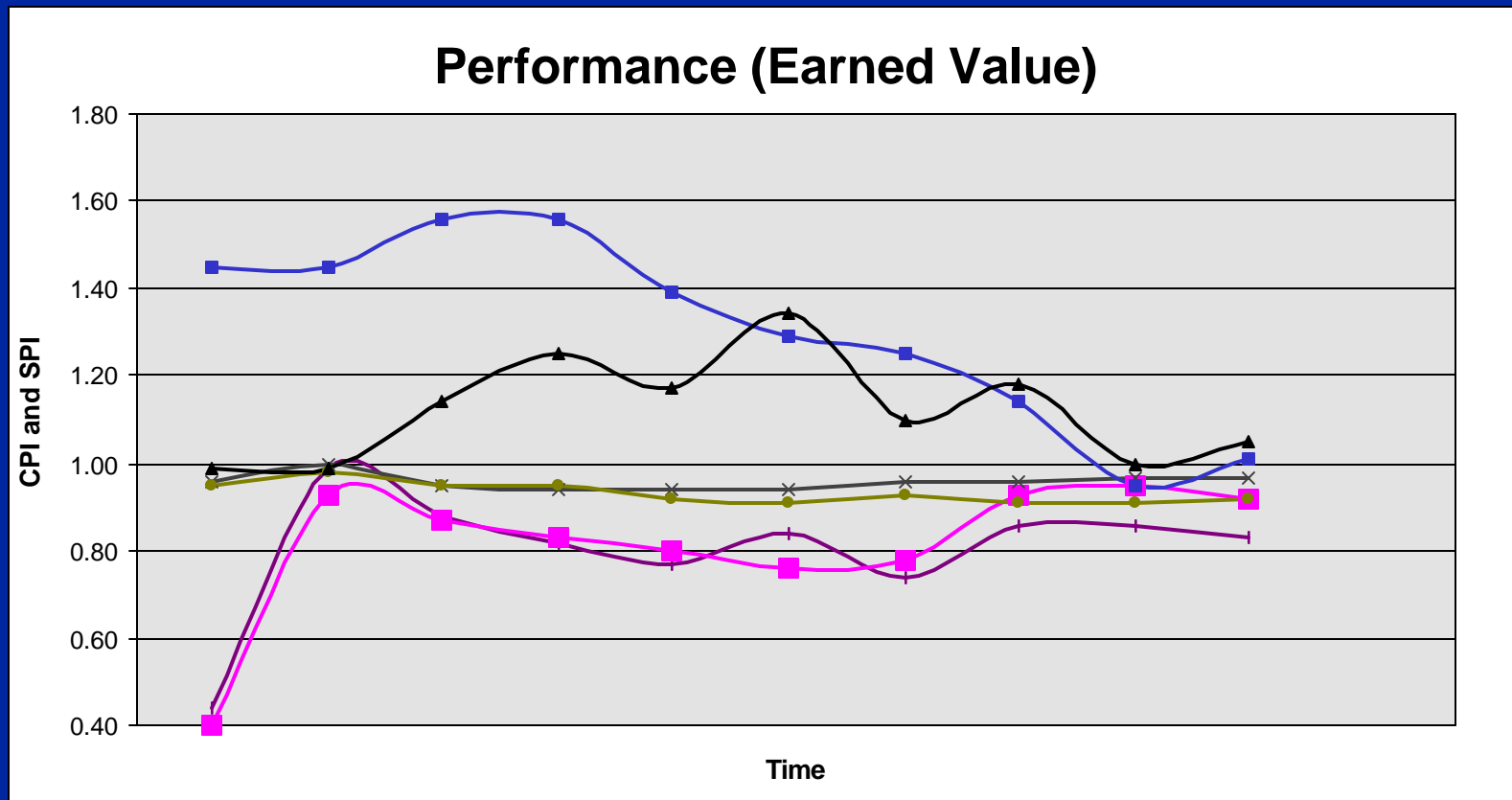


Reference: Product Quality Goal Status February 2000

CPI/SPI – Level 4 SW(only) Company



“M”



Reference: Organizational Metrics Analysis Report (OMAR) 4Q99

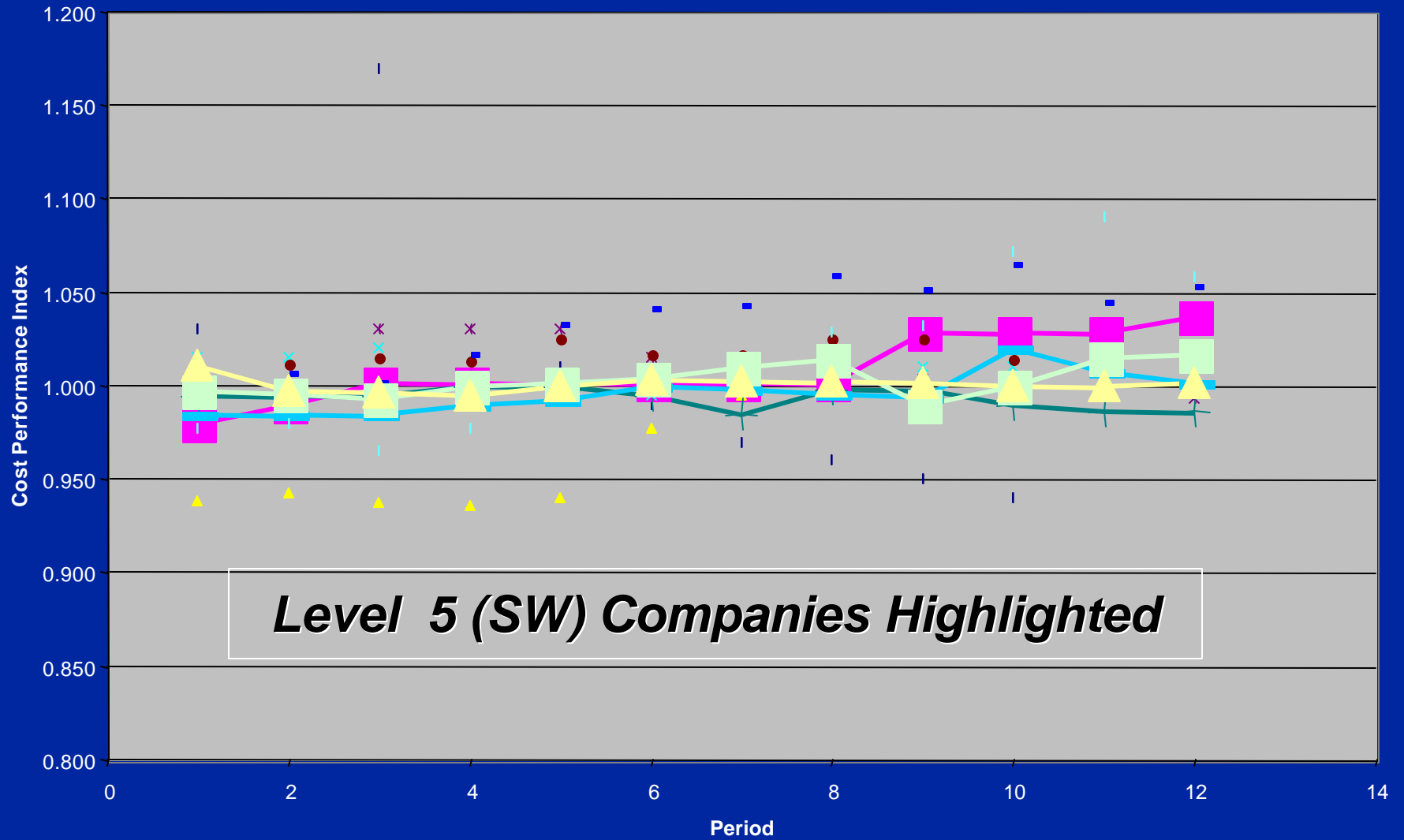


Basis for next slides

SI Business Area

- *Plots CPI or SPI by company by month for 143 programs worth over \$27B in total sales*
- *Each Program > \$50M, or of strategic interest*
- *Less than 95% complete (Development) or 99% complete (Production)*
- *Any Red or Yellow Program*
- *First set does not include 20 programs with hardware, subcontractor, (but NOT software) problems*

Programs w/o H/W, Subcontract issues - CPI

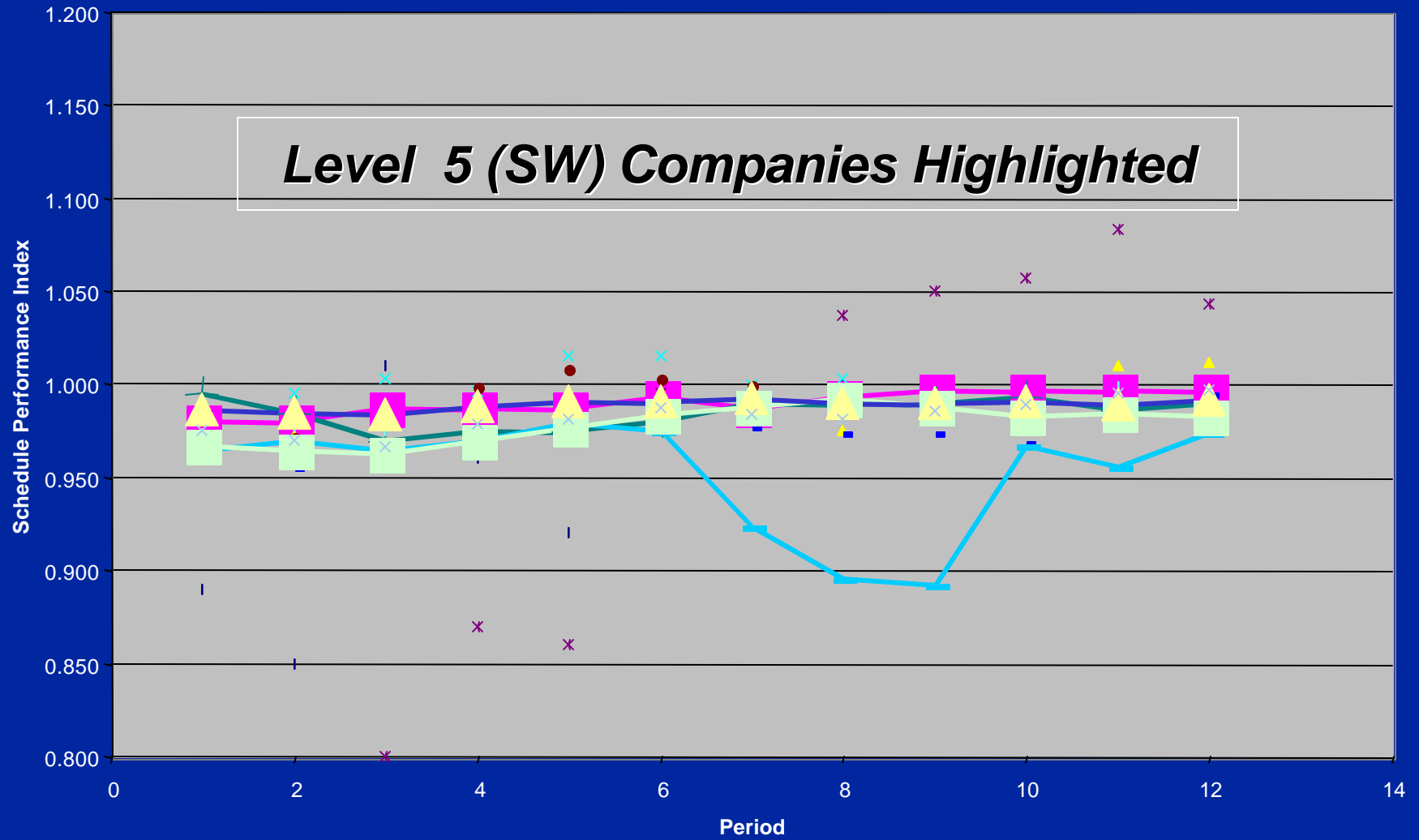


Level 5 (SW) Companies Highlighted

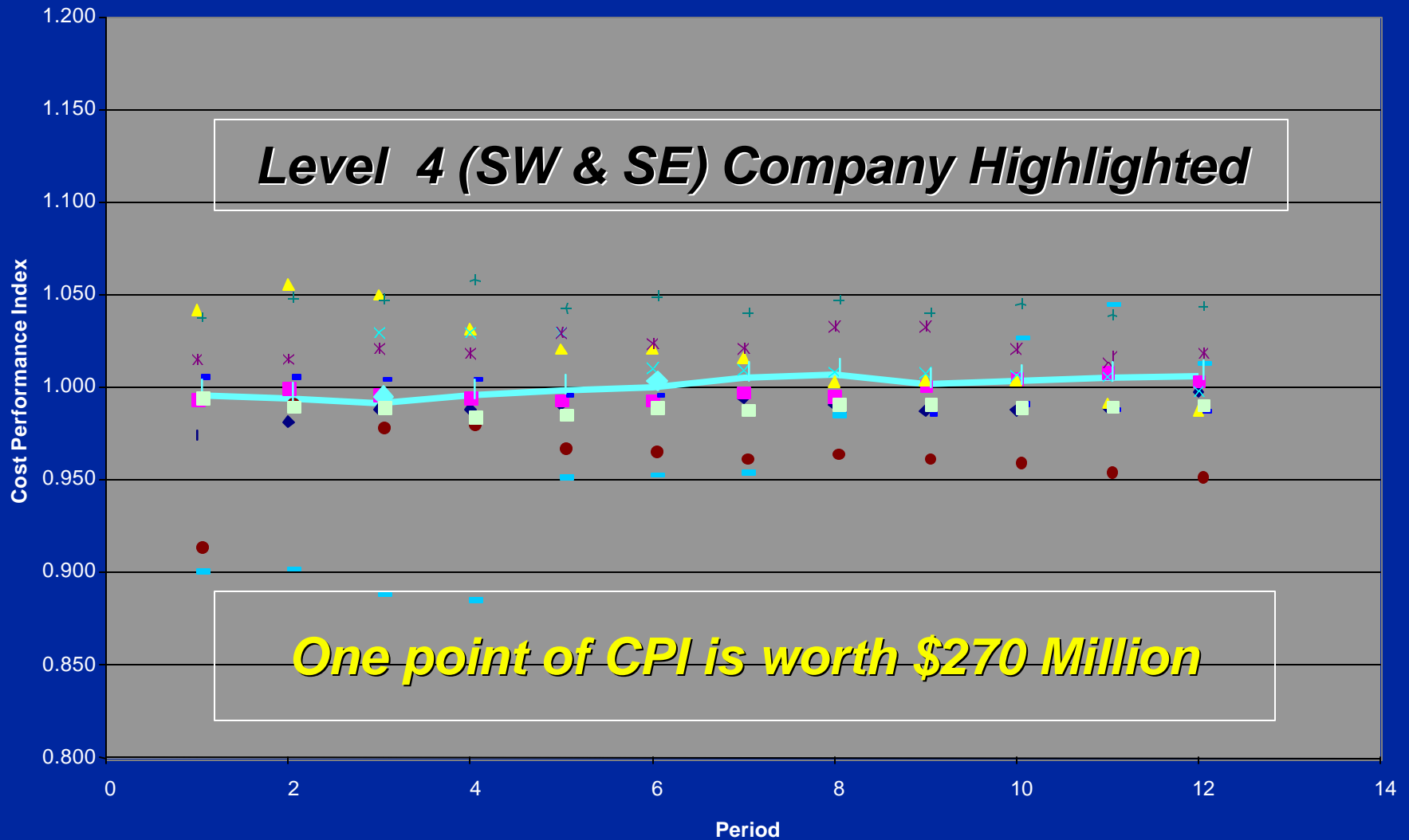
Programs w/o H/W, Subcontract issues - SPI



Level 5 (SW) Companies Highlighted



All Programs - CPI

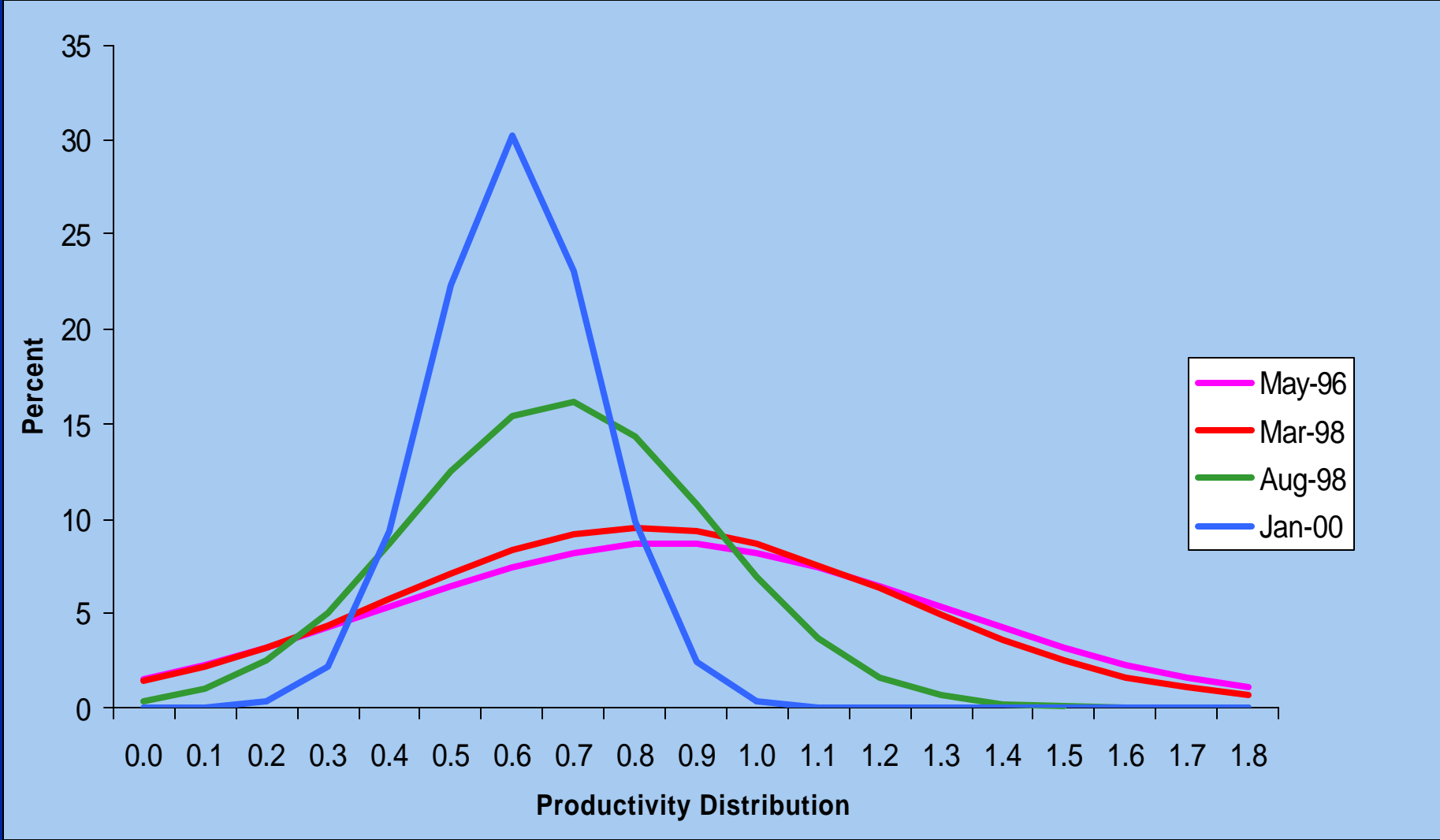


CPI/SPI Conclusions

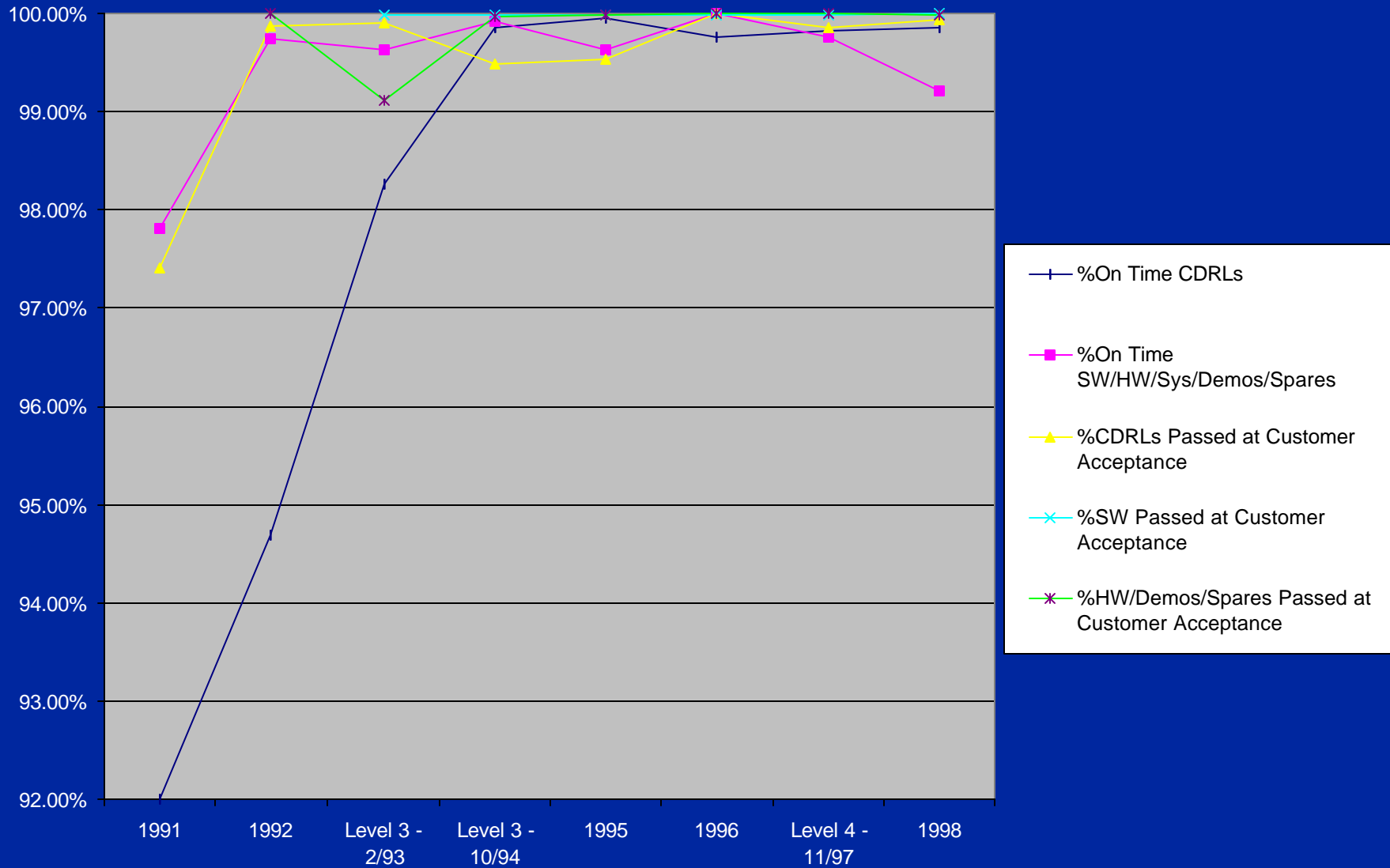


- *Higher maturity is a valid predictor of variability*
- *Complementary high SE maturity may add disproportionate value*
- *CMMI and IEP offer a rational path to higher predictability, lower variability, and higher quality*

Productivity Variation - LMIS



Mission Systems Process Improvement





Management & Data Systems System Integration business

- ***Only Software AND Systems Level 5 organization in the world***
 - ***Entire business is SW Level 5, SE Level 4***
- ***In last year,***
 - ***Productivity increase is greater than 20%***
 - ***Rework decrease is greater than 21%***
- ***Correlates with similar results at LM Information Systems, Orlando***

Other Benefits Realized



- *Improved communication and teamwork*
- *Increased awareness of training requirements*
- *Improved estimates to support new programs or baselines*
- *Provided a common organizational command media infrastructure with reusable process assets*
- *Increased technical awareness of software developers through a formal training program*
- *Improved planning and coordination of process improvement programs across the organization*
- *Increased focus on achieving organizational and project productivity and quality goals*
- *Improved data accuracy through metrics analysis*
- *Increased knowledge on process capability and correlation between process and product performance and quality*
- *Increased capability to absorb technology and process changes*

Summary



- ***Lockheed Martin's climb up the maturity ladder began in 1997 as a performance quality initiative, bolstered by strong conviction that savings would follow***
- ***Business leaders in high-maturity companies would not return to previous status quo***
- ***Government should consider***
 - ***Participating in our maturity assessments vs holding expensive "evaluations"***
 - ***Giving additional credit in source selection for high-maturity companies***