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Integrated Systems and Solutions
Management & Data Systems

Key Business Indicator Trends During the Journey from SW-CMM Level 2 to CMMI Level 5 at Lockheed Martin Management & Data Systems

Peter McLoone

Peter.j.mcloone@lmco.com

610 354 6986

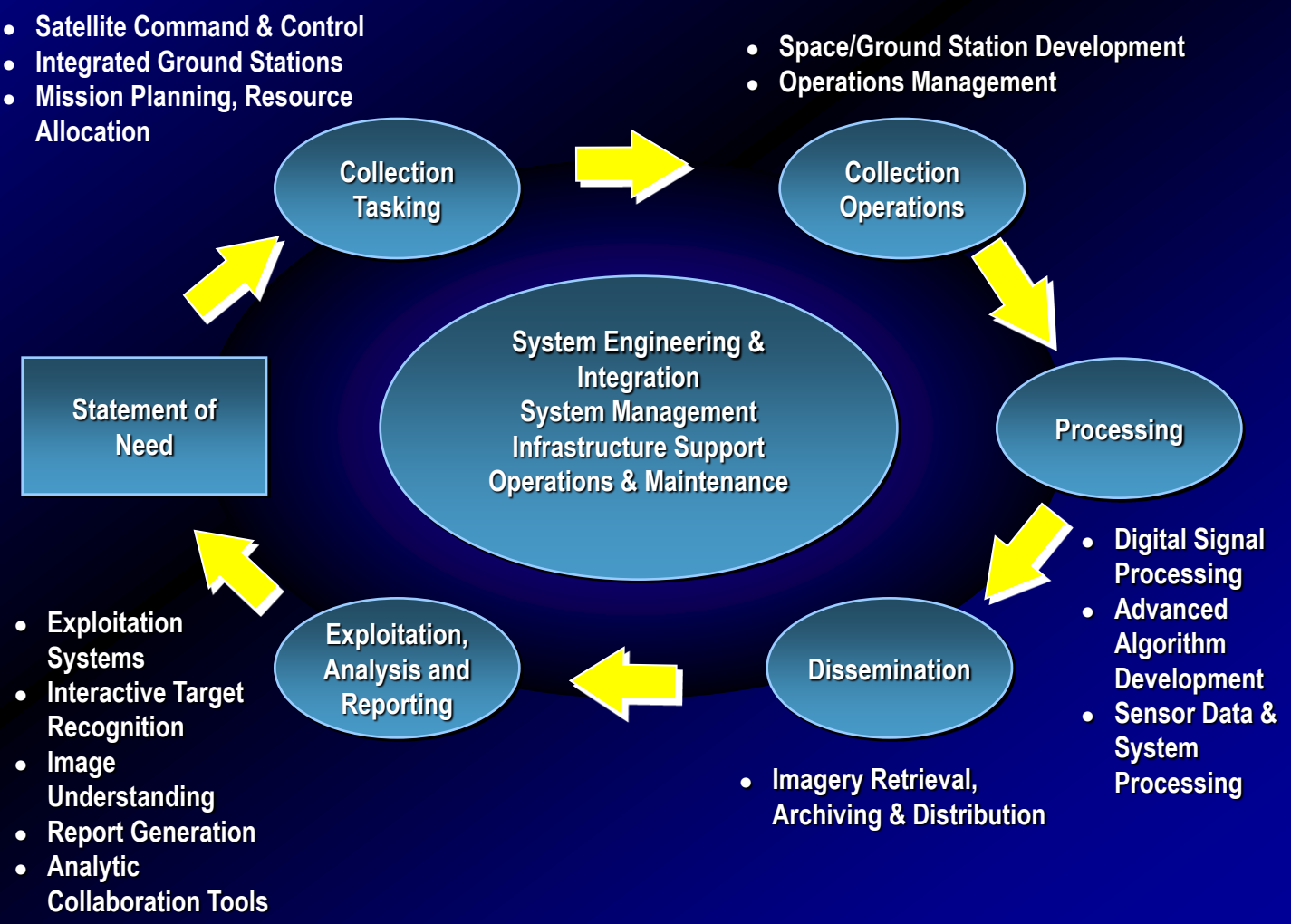
Management & Data Systems

Headquartered in Bethesda, MD, Lockheed Martin employs about 125,000 people worldwide and is principally engaged in the research, design, development, manufacture and integration of advanced technology systems, products and services.

Headquartered in King of Prussia, PA, the 9000 employees of Lockheed Martin M&DS have provided leadership in systems integration, systems engineering, software development and program management in support of vital national systems for more than 30 years.

M&DS Domain Strengths

Integrated End-to-End Capabilities in Intelligence, Surveillance and Reconnaissance Systems



M&DS Process Improvement History

- Long history of process orientation although most programs were classified and stovepiped
- 1993-1995: Software Capability Maturity Model Level 2 (Internal Assessment)
- 1996-1997: SW CMM Level 3; formally assessed in 1996
- 1998-1999: SW CMM Level 4; formally assessed in 1998
- 2000-2001: SW CMM Level 5, SE CMM Level 5 for 12 PAs, Level 4 for 1 PA; both formally assessed in 2000
- 2002- present: Capability Maturity Model, Integrated SE/SW Version 1.1 Staged Model Maturity Level 5; formally assessed in 2002

M&DS Business Objectives

- Annual Goal Setting Process conducted by senior management and driven by our Executive Office
- Uses M&DS Guiding Principles as a framework: Customer Satisfaction, Employee Fulfillment, Corporate Commitment, etc
- Result is a Balanced Scorecard like set of 40-50 Goals most having an underlying quantitative orientation
- Engineering related goals include productivity or product quality objectives such as:
  - Reduce defect density during testing by at least xx per cent
  - Improve systems engineering productivity by at least xx per cent
- Each goal is owned by a member of senior management who select a senior staff member to manage achieving each goal
- Each goal has a plan statused monthly at an executive review meeting with an emphasis on quantitative information
- Engineering goal plans usually include process changes to be implemented by a set of target programs. The process changes have usually been piloted.

Product Quality Goal Flowdown

- Reduce defect density during testing by xx per cent
- Strategy: Implement In Process Quality
  - Select and track visible product quality indicators
  - Implement Fagan type inspections from Systems Requirements Analysis forward
  - Perform Defect Causal Analysis on a regular basis
- Used the Defect Detection Profile as a fundamental indicator and allocated defect detection targets to each phase of development. Targets were established based on the modeling of historical data
- Inspections were a critical subprocess in all development phases through Code and Unit Test so it was an obvious candidate for statistical management. Control Charts of Preparation Rate, Meeting Pace Rate, and Defect Density were utilized.
- Target programs were identified, process changes infused, and results monitored

Defect Detection Profile/ Inspection Control Charts

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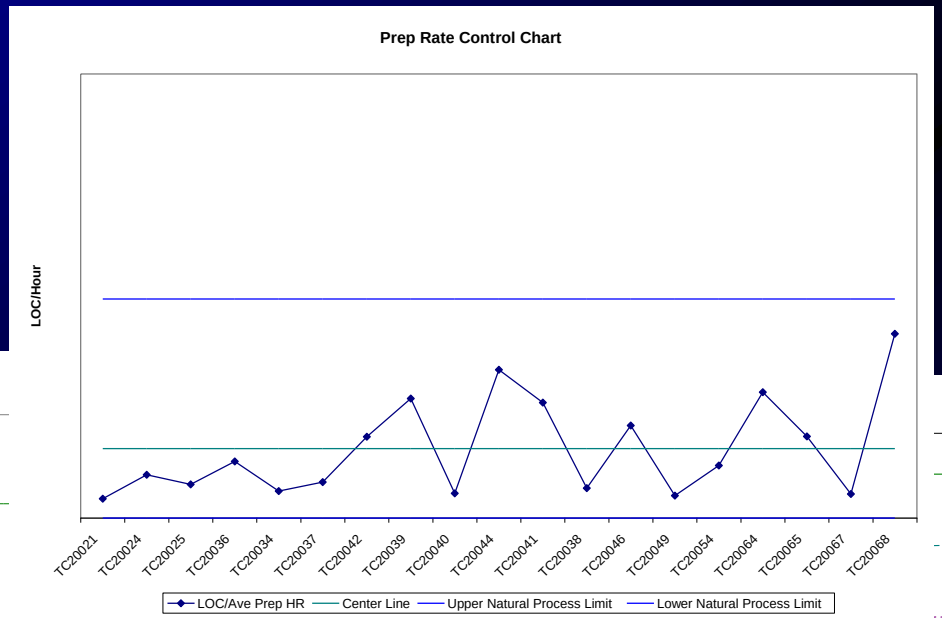
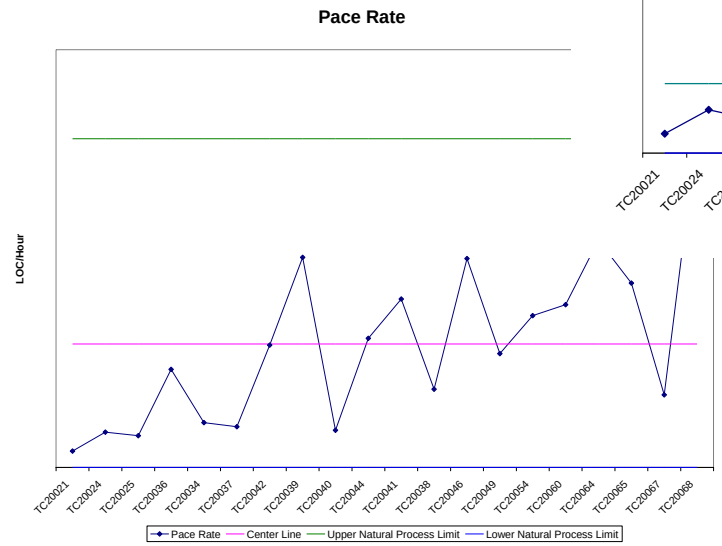
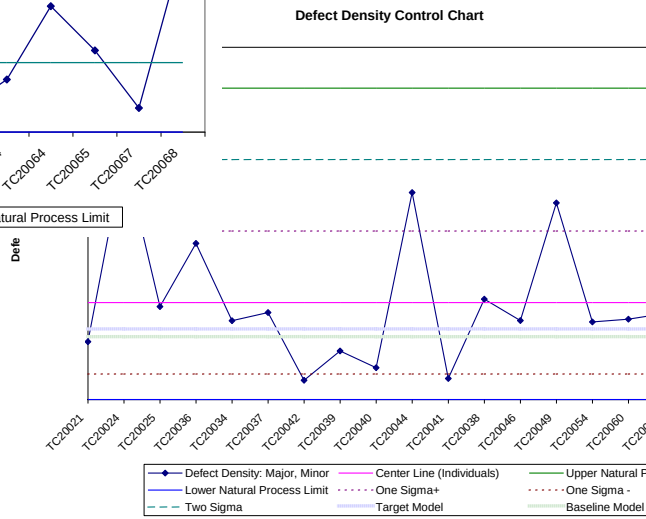
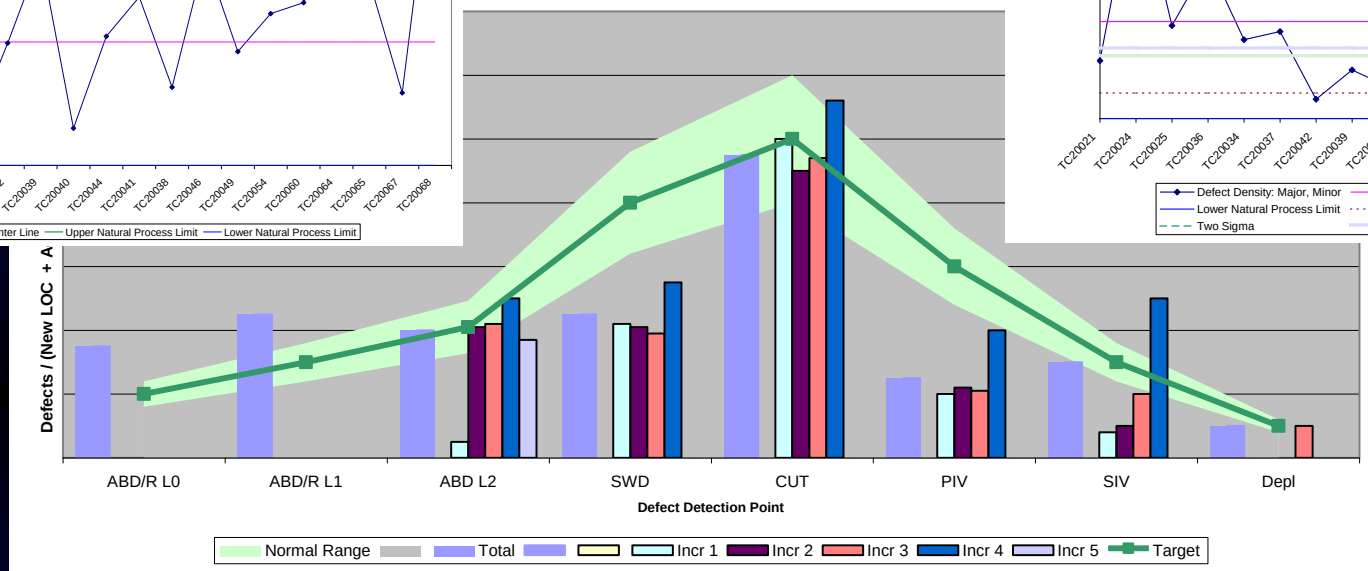








Quantitative Project Management

- Plan
- Perform
- Evaluate
- Improve

Planning

- Identify the project's information needs
- Prioritize the needs
- Select/define the most cost effective indicators that address the highest priority needs
- Determine decision criteria (thresholds and targets) for each indicator
- Determine reporting mechanisms
- Determine data storage and control mechanisms

Involve all Stakeholders and Write Down the Results

Performing

- Collect Data
- Produce Indicators
- Use Decision Criteria
- Evaluate Anomalies and Determine Corrective Action
  - Root Cause
  - Additional Data Analysis
- Report Results
- Implement Corrective Actions

Integrate into the Program's Business Rhythm

Evaluating & Improving

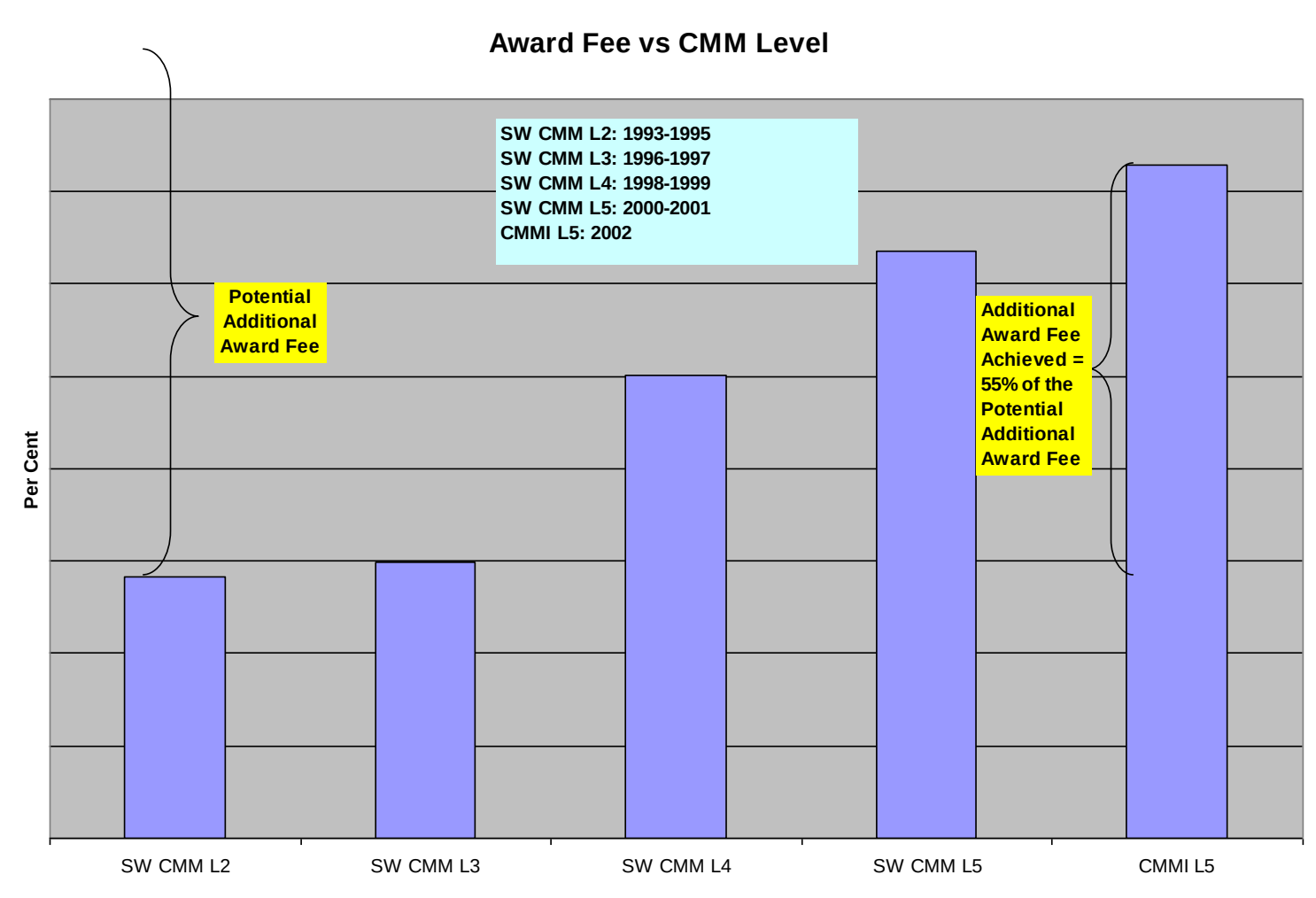
- Execution conforms to process definition
- The QM process is efficient and timely
- The indicators are accurate
- The indicators are complete
- The indicators are used proactively in decision making

Evaluating effectiveness must be a planned event

How Did We Do

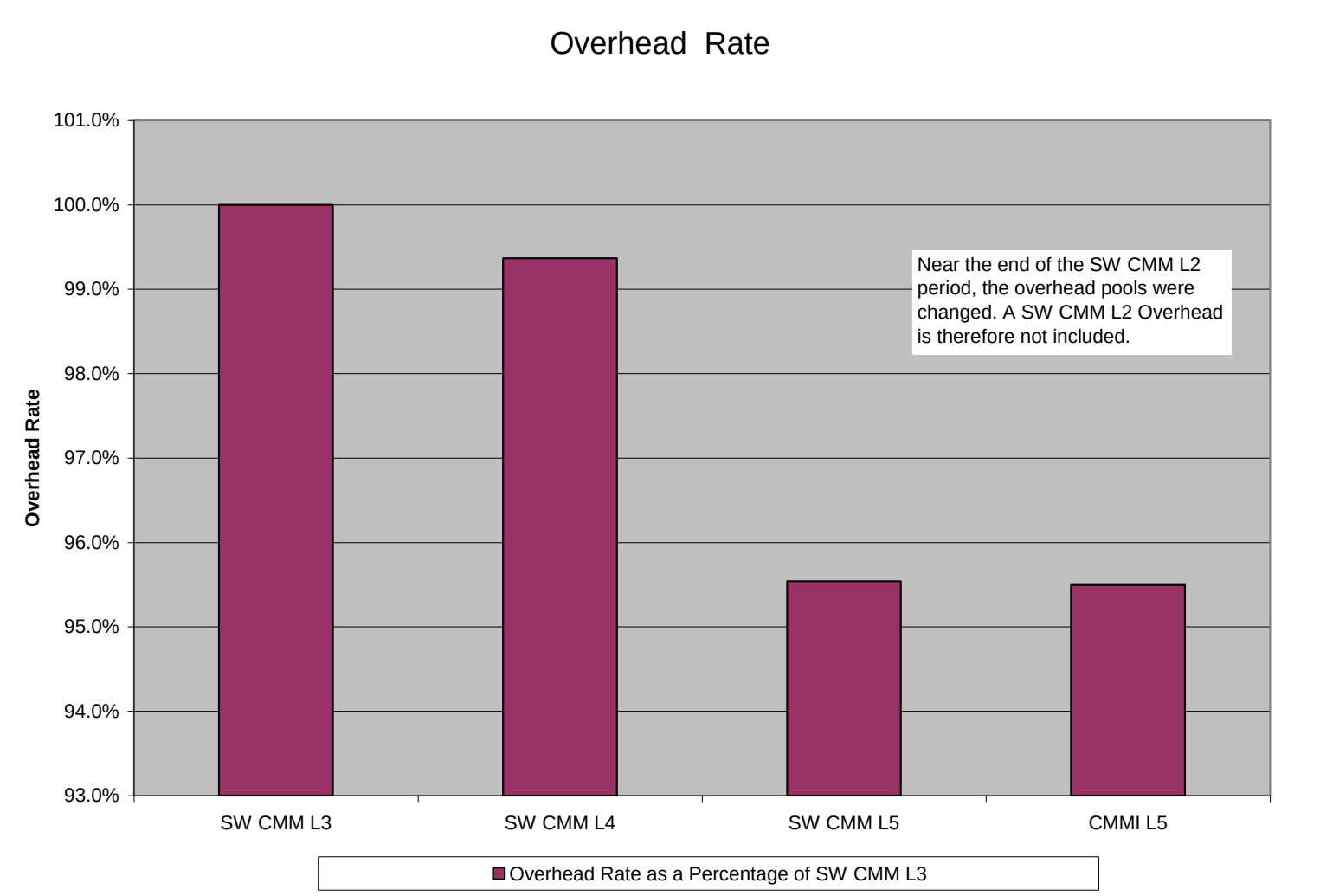
- In the beginning we were not smart enough to figure out ahead of time how to design a clever set of measures to track over the last ten years
- We do have a fairly consistent data collection discipline for financials although accounting methods do change as well over such a long period
- As we've moved up the maturity ladder, we've certainly evolved our engineering data collection a lot and have paid more attention to data quality problems
- But we still are able to evaluate and relate to maturity model levels:
  - Award Fee
  - Overhead Rate
  - Software Productivity
  - Software Unit Cost
  - Defect Find & Fix Cost

Award Fee



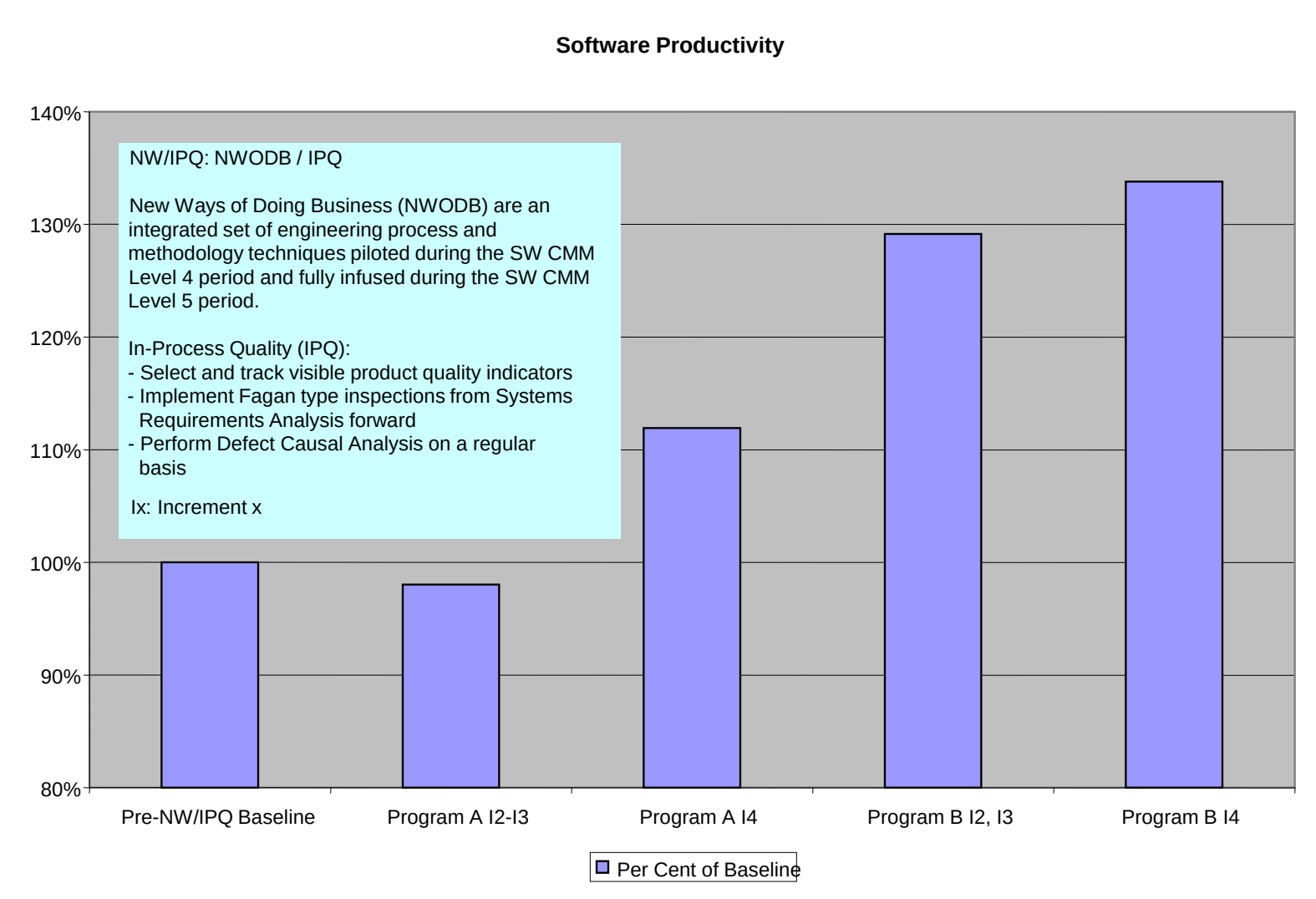
Customer Satisfaction Continues to Improve

Overhead Rates



CMMI Does Not Come with Overhead Baggage

Software Productivity

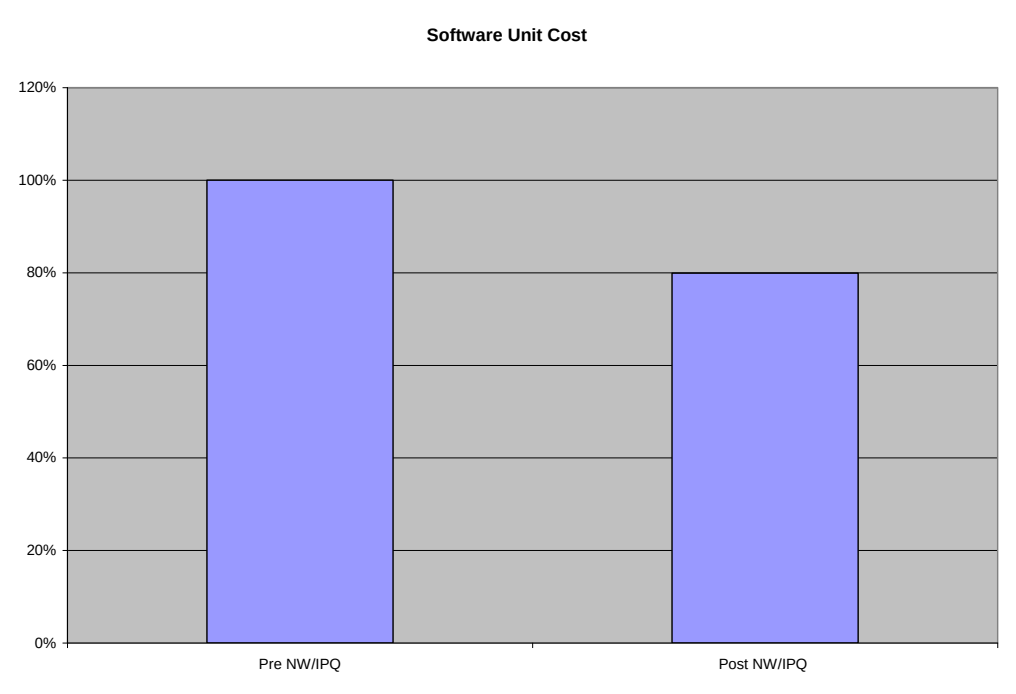


Steady and Consistent Improvement

Software Unit Cost

Average Engineering Hourly Rate
x Overhead Rate
x Hours per LOC
x Constant Dollar Adjustment Factor

Real Bottom Line Savings



Defect Find & Fix

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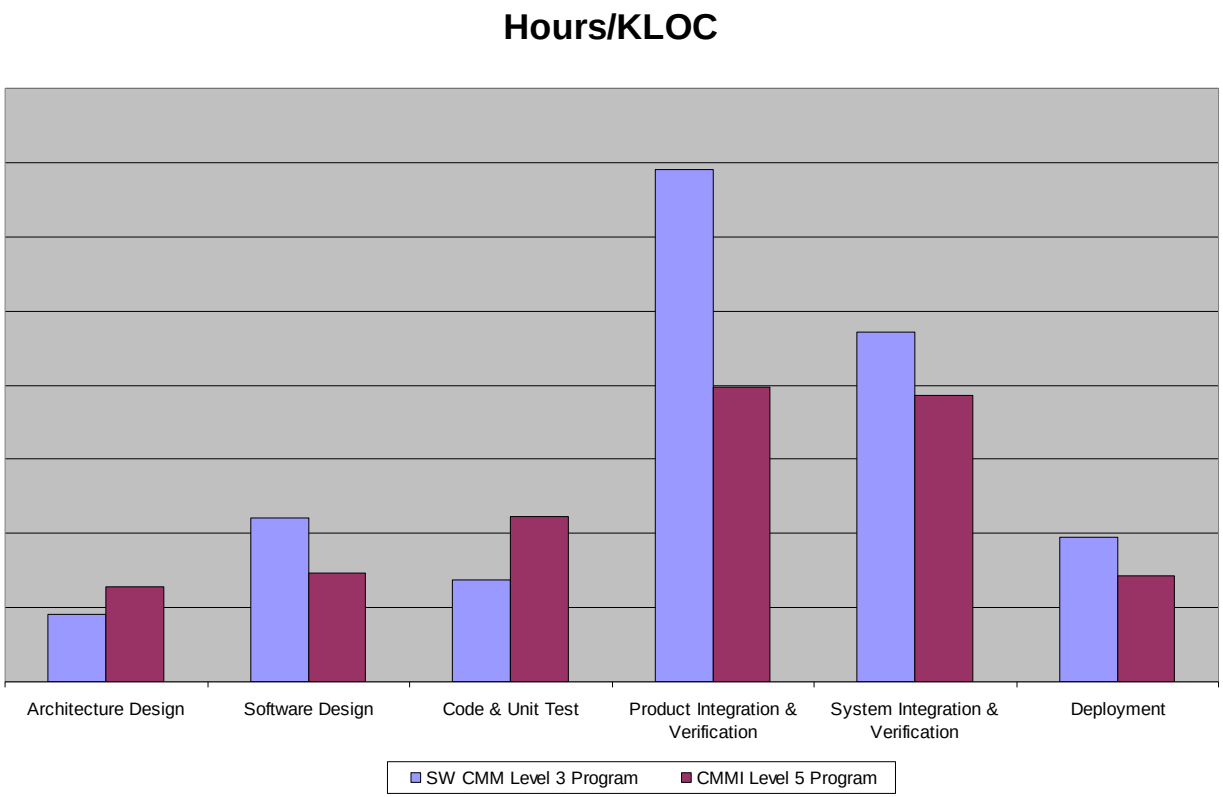
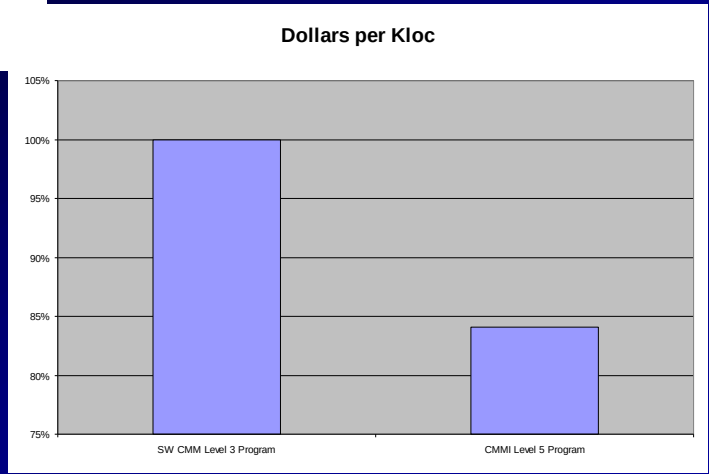


Improved Product Quality With Real Cost Savings



Conservative Assumptions:

- Deployment Find &Fix Time Same as Systems I & V
- L3 Program had same Find & Fix as the L5 Program
- L3 Program Defect Densities for AD, SD, and CUT could be adequately modeled using SWEEP and assuming total L3 Program Defect Density was the same as the L5 Program

Summary

- A study of several senior management visible measures consistency show value in pursuing CMM driven process improvement
- Our senior management believes this emphasis has had a positive effect on other functions within the company
- It does make a difference to our customers

Senior management commitment has been a key to success