Beyond CMMI-SE/SW V1.0

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Agenda

CMMI Project – Current Status (V1.0)

- **Policy**
- **Schedule**
- **Product Suite Elements**

CMMI Project – Future Status (V1.1)

- **Critical "ilities"**
- **Strategy for V1.1 and beyond**

"Process Improvement Improvements"
Representative Legacy CMM Benefits

CMMI Policy

The OSD CMMI Sponsors, at Steering Group recommendation and with Industry sponsor concurrence, have established the sunset schedule for the SW-CMM legacy model (SW-CMM v1.1) to be three years after formal release of CMMI-SE/SW/IPPD, which occurred in December 2000. The Electronic Industries Association G47, owners of EIA/IS-731, have also agreed to this sunset policy and schedule for that source document. The CMMI source model sunset will therefore occur in December, 2003.

In order to provide additional refinement and update based on the continuing CMMI pilot program while maintaining the overall stability of the Product Suite, CMMI v1.1 is planned for release later this year. The minor product suite update will include the provision for external evaluations using the CMMI models as well as assessments for internal process improvement.

CMMI Schedule

| December 4, 2000 | Released latest published models |

- **CMMI-SE/SW v1.02**
- **CMMI-SE/SW/IPPD v1.02**

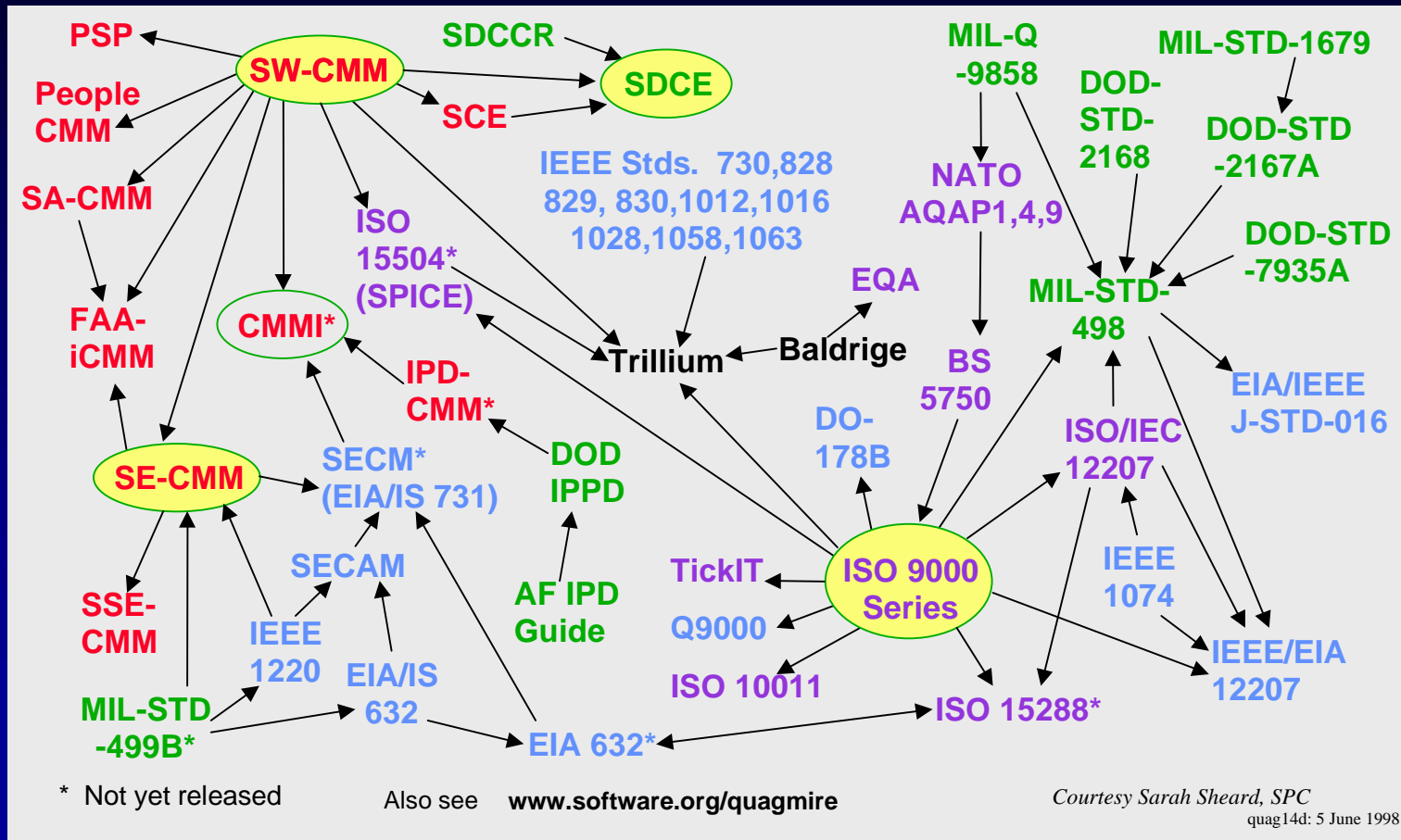| December 2000 | Released CMMI-SE/SW/IPPD/A for initial piloting |

| Winter 2001 | Publish models V1.1 |

| Fall 2003 | Complete sunset period for precursor models |

The Frameworks Quagmire

PSP

People CMM

SW-CMM

SDCCR

SDCE

SCE

MIL-Q -9858

MIL-STD-1679

DOD-STD-2168

DOD-STD -2167A

SA-CMM

IEEE Stds. 730,828 829, 830,1012,1016 1028,1058,1063

NATO AQAP1,4,9

DOD-STD -7935A

ISO 15504* (SPICE)

EQA

MIL-STD-498

FAA-iCMM

CMMI*

IPD-CMM*

Trillium

Baldrige

BS 5750

EIA/IEEE J-STD-016

SE-CMM

SECM* (EIA/IS 731)

DOD IPPD

DO-178B

ISO/IEC 12207

SSE-CMM

SECAM

AF IPD Guide

TickIT

ISO 9000 Series

IEEE 1074

IEEE 1220

EIA/IS 632

Q9000

IEEE/EIA 12207

MIL-STD -499B*

EIA 632*

ISO 10011

ISO 15288*

* Not yet released

Also see **www.software.org/quagmire**

Courtesy Sarah Sheard, SPC
quag14d: 5 June 1998

CMMI Design Goals and Benefits

Design Goals

- **Integrate the source models, eliminate inconsistencies, reduce duplication**

- **Reduce the cost of implementing model-based process improvement**

- **Be sensitive to impact on legacy efforts**

Benefits

- **Efficient, effective assessment and improvement across multiple process disciplines**

- **Reduced training and assessment costs**

- **A common, integrated vision of improvement for all elements of an organization**

- **Integration of systems engineering and software environments for additional productivity & quality gains**

Model Metrics

Release	PAs/ FAs	Goals/ Themes*	Activities/ Practices**
SW-CMM V1.1	18	52	316
SW-CMM V2C	19	62	318
EIA/IS 731	19	77	383
IPD-CMM V0.98	23	60	865
CMMI V1.0 SE/SW	22	70	417
CMMI V1.02 SE/SW/IPPD	24	76	460

(SW-CMM V2C, EIA/IS 731, IPD-CMM V0.98 bracketed: 61 / 199 / 1566)

* Ratable components

** Key to implementation effort

The CMMI Product Line Approach

SW

SE

IPPD

Assess

Training

Acquisition

Industry

SEI

Government

CMMI Product Suite
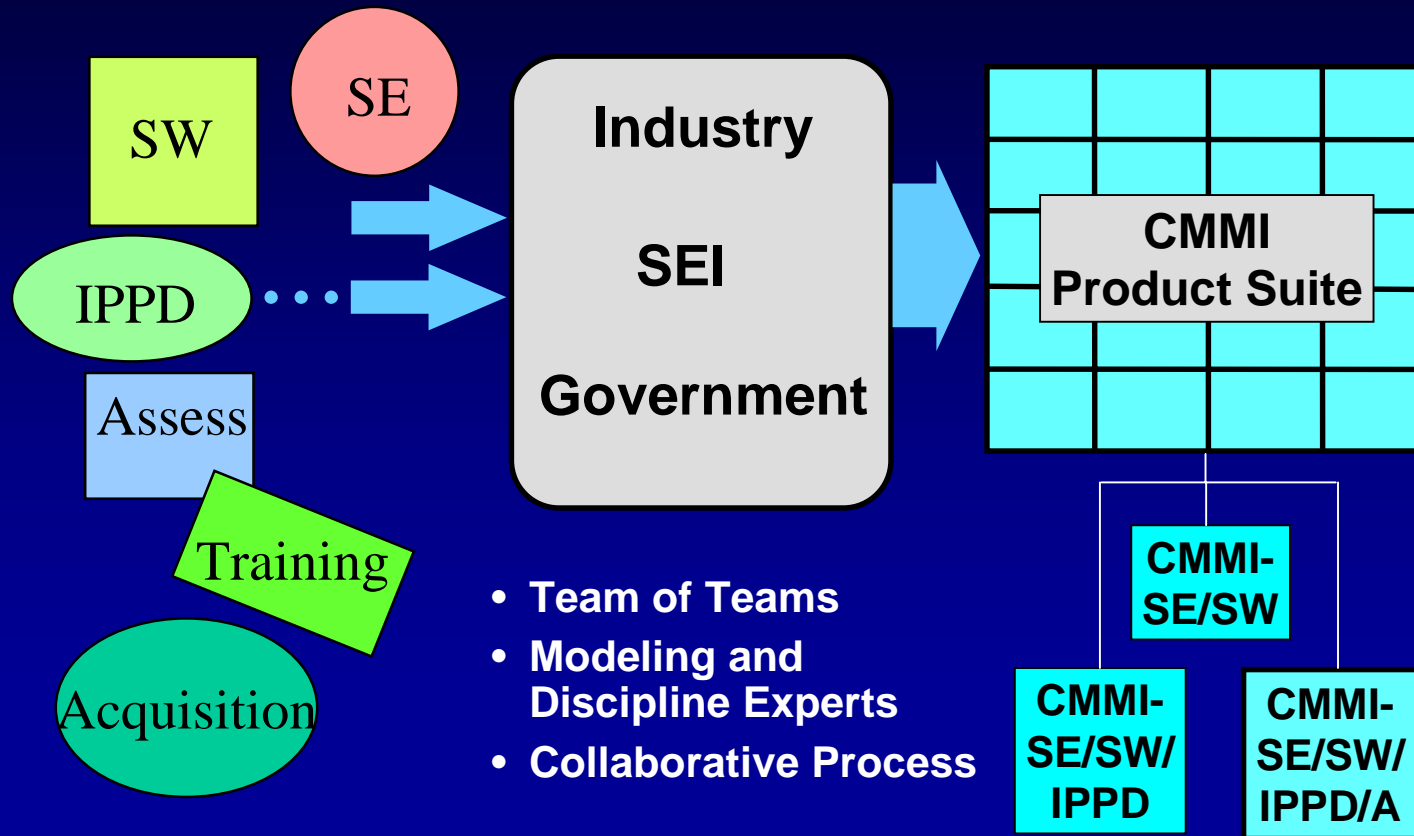
- **Team of Teams**
- **Modeling and Discipline Experts**
- **Collaborative Process**

CMMI-SE/SW

CMMI-SE/SW/IPPD

CMMI-SE/SW/IPPD/A

Anticipated Benefits at Northrop Grumman

- Extend Software Level 3 benefits to total project
    - Many projects have major non-software content
    - Therefore, the potential benefits are great

- Allow Integrated Product Teams (IPTs) to achieve their true potential
    - Integrated processes essential for effective team work

    "IPT members are not functioning as a team if they play by different rules."

    Electronic Sensors and Systems Sector

    NORTHROP GRUMMAN

Reference: Freeman, Hinkey, and Martak, "Integrated Engineering Process," SEPG Conference, March 1999.

Anticipated Benefits at Litton PRC

"Litton PRC recognized the value of repeatable systems and software engineering processes in 1996. Litton PRC now has systems engineering and software development processes integrated in a standardized, repeatable process environment. That environment was the foundation for achievement of our SEI SW-CMM Level 5 rating in March 2000. The achievement of continuous process improvement using this integrated approach has enabled us to reduce critical software errors to perform with markedly lower costs on more predictable schedules. We fully expect Capability Maturity Model Integration (CMMI) will yield comparable benefits of improved performance against cost and schedule objectives. The considerable potential benefits for our customers and our operations has driven Litton PRC's involvement in the development of the CMMI since its inception and the initiation of our transition to the CMMI-SE/SW model."
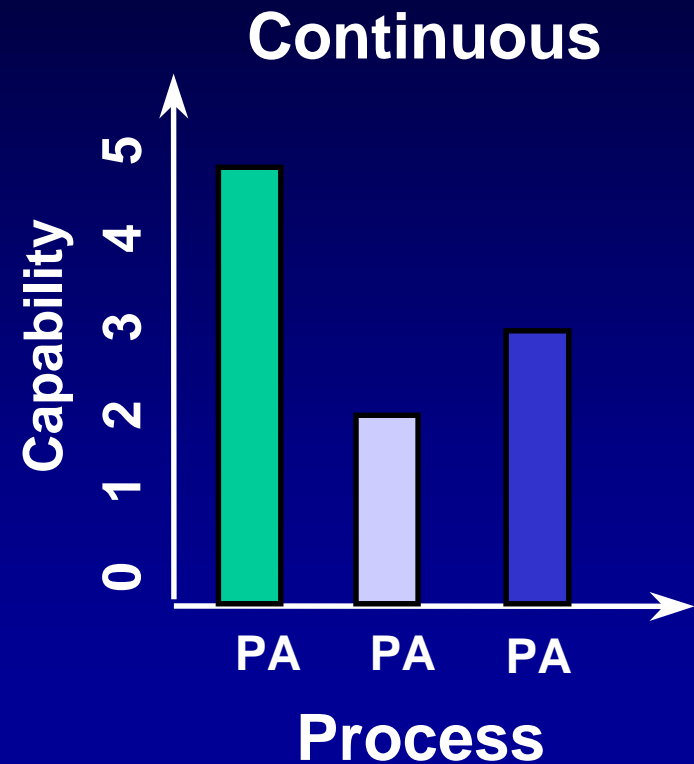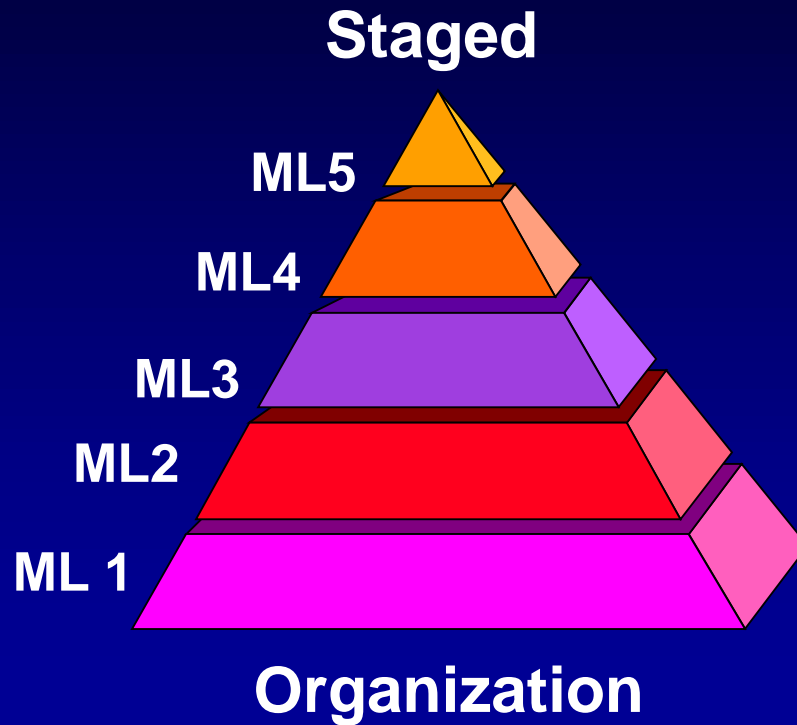
- Barry Rhine, President, Litton PRC

Anticipated Benefits at Raytheon

"Raytheon is totally committed to implementing CMMI. We believe that implementation of the integrated maturity model, including software, systems engineering, and IPPD, will further improve our software productivity, and provide more predictable development schedules and improved overall product performance. This will be a 'win-win' for our company and our customers, with a bonus 'win' for our employees, who we strongly believe will enjoy working on programs with an orderly and relatively problem-free integration & test activity"

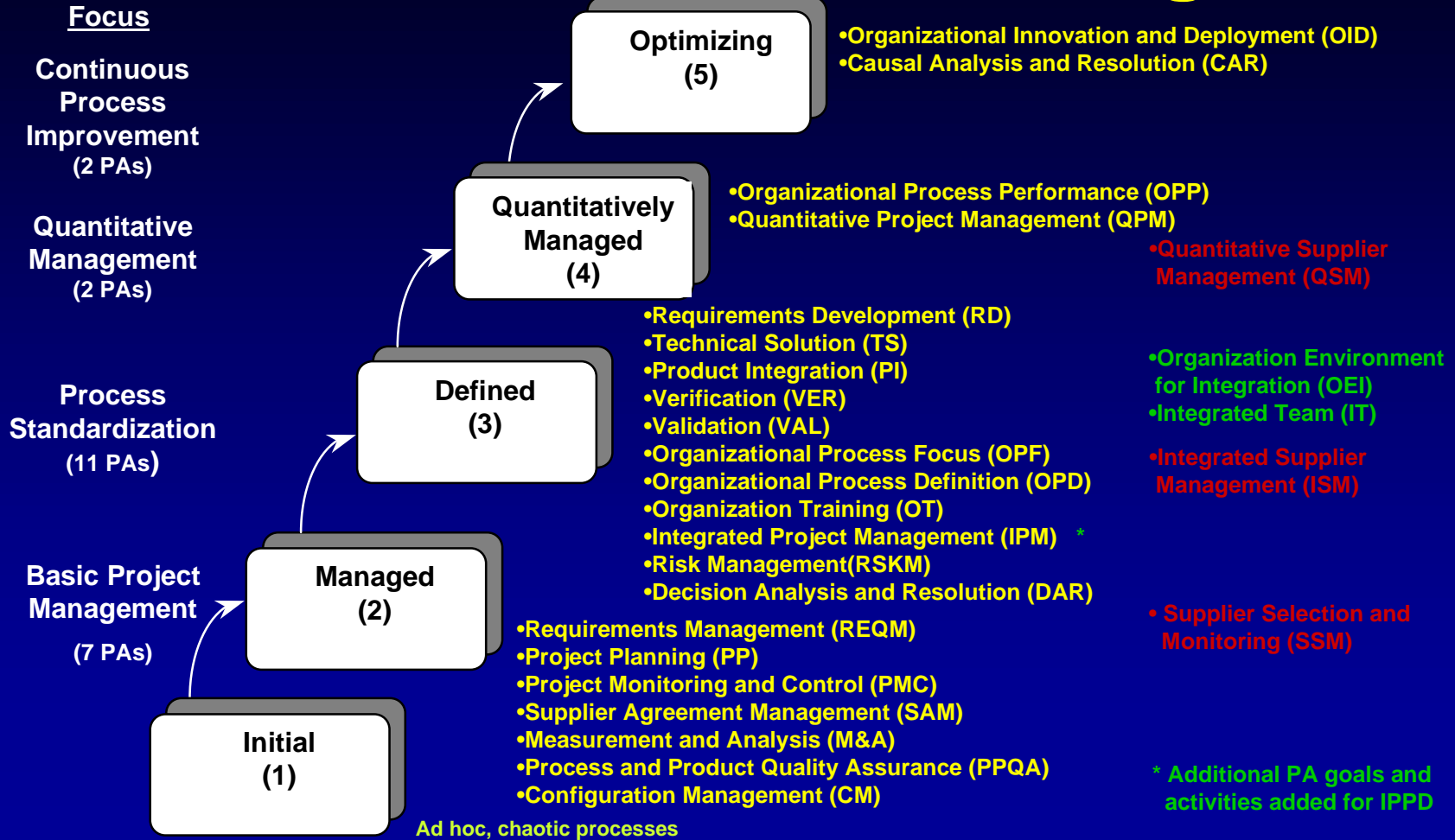- Jack Kelble, VP of Engineering, Raytheon Electronic Systems

CMMI-SE/SW/IPPD/A - Staged
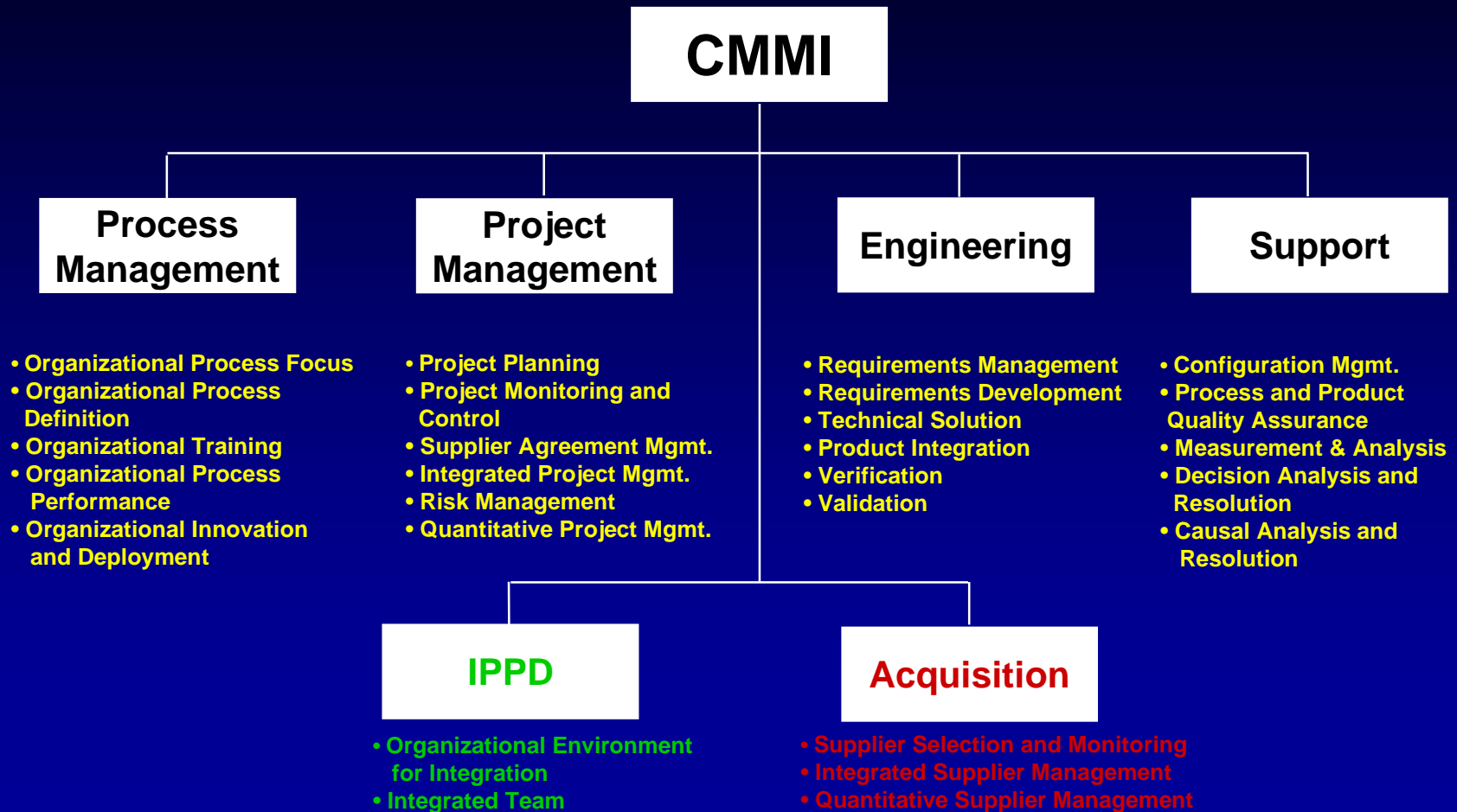
Focus

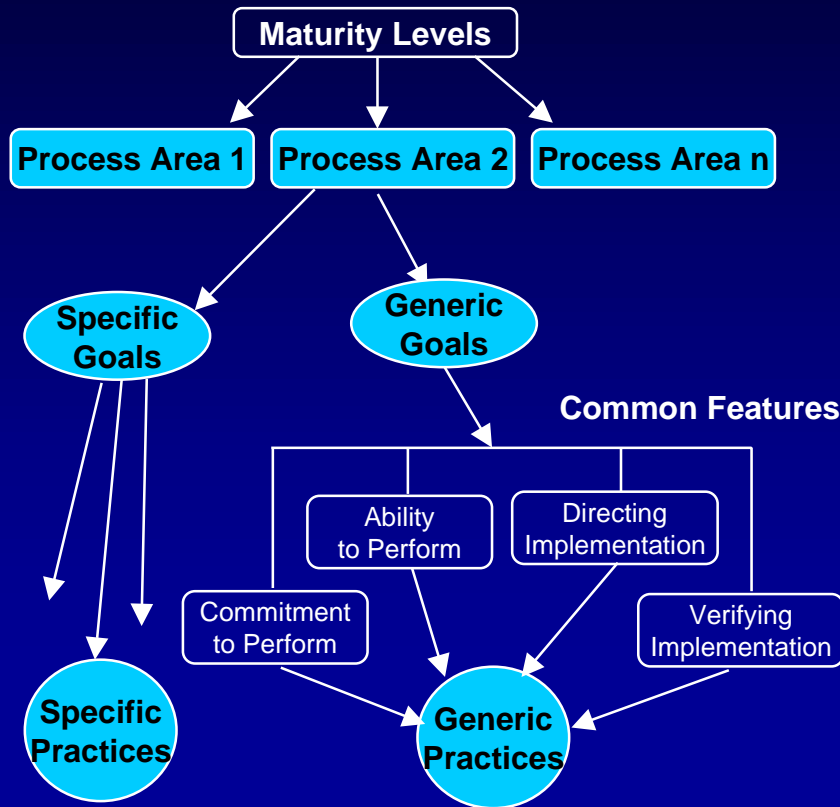**Continuous Process Improvement**
(2 PAs)

Optimizing (5)
- •Organizational Innovation and Deployment (OID)
- •Causal Analysis and Resolution (CAR)

Quantitative Management
(2 PAs)

Quantitatively Managed (4)
- •Organizational Process Performance (OPP)
- •Quantitative Project Management (QPM)

•Quantitative Supplier Management (QSM)

Process Standardization
(11 PAs)

Defined (3)
- •Requirements Development (RD)
- •Technical Solution (TS)
- •Product Integration (PI)
- •Verification (VER)
- •Validation (VAL)
- •Organizational Process Focus (OPF)
- •Organizational Process Definition (OPD)
- •Organization Training (OT)
- •Integrated Project Management (IPM) *
- •Risk Management(RSKM)
- •Decision Analysis and Resolution (DAR)

•Organization Environment for Integration (OEI)
•Integrated Team (IT)

•Integrated Supplier Management (ISM)

Basic Project Management
(7 PAs)

Managed (2)
- •Requirements Management (REQM)
- •Project Planning (PP)
- •Project Monitoring and Control (PMC)
- •Supplier Agreement Management (SAM)
- •Measurement and Analysis (M&A)
- •Process and Product Quality Assurance (PPQA)
- •Configuration Management (CM)

• Supplier Selection and Monitoring (SSM)

Initial (1)

Ad hoc, chaotic processes

* Additional PA goals and activities added for IPPD

CMMI-SE/SW/IPPD/A - Continuous

CMMI

Process Management

Project Management

Engineering

Support

- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment

- Project Planning
- Project Monitoring and Control
- Supplier Agreement Mgmt.
- Integrated Project Mgmt.
- Risk Management
- Quantitative Project Mgmt.

- Requirements Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation

- Configuration Mgmt.
- Process and Product Quality Assurance
- Measurement & Analysis
- Decision Analysis and Resolution
- Causal Analysis and Resolution

IPPD

Acquisition

- Organizational Environment for Integration
- Integrated Team

- Supplier Selection and Monitoring
- Integrated Supplier Management
- Quantitative Supplier Management

Capability Level:	Generic Goals (GG):	Generic Practices (GP):	
5 (Optimizing)	Institutionalize an Optimizing Process.	Ensure continuous process improvement. Correct common cause of problems.	
4 (Quantitatively Managed)	Institutionalize a Quantitatively Managed Process.	Establish quality objectives. Stabilize subprocess performance.	
3 (Defined)	Institutionalize a Defined Process.	Establish a defined process. Collect improvement information.	
2 (Managed)	Institutionalize a Managed Process.	Establish org. policy. Plan the process. Provide resources. Assign responsibility. Train people. Perform managed process.	Manage configurations. Identify & involve relevant stakeholders. Monitor and control the process. Objectively verify adherence. Review status with mgmt.
1 (Performed)	Achieve Specific Goals.	Identify work scope. Perform base practices.	
0 (Incomplete)	(None)	(None)	

CMMI Process Area Contents

Purpose

Introductory Notes

Goals: Specific and Generic } **Required**

Generic Practices

Specific Practices } **Expected**

Notes

Work Products

Subpractices } **Informative**

Amplifications

Elaborations

CMMI-SE/SW Compared to SW-CMM v1.1

Organizations using SW-CMM v1.1 should be able to transition to CMMI by focusing on the following changes:

- **Measurement and Analysis at ML2**

- **Risk Management & Decision Analysis and Resolution at ML3**

- **Expansion of Software Product Engineering**

- **Refocus of Measurement and Analysis CF to Directing Implementation CF**

Most SW-CMM v2 Draft C updates have been incorporated.

CMMI-SE/SW Compared to SECM

EIA 731 users should be able to transition to the CMMI-SE/SW model by recognizing:

- **Continuous representation (+ "equivalent" staged representation)**

- **Some lower-level differences**

- **Application of common SE/SW practices to SE community**

Assessment Class Attributes

Attributes	Class A	Class B	Class C
Usage Mode	• Benchmark • Baseline establishment	• Initial • Incremental • Self-assessment	• Quick Look • Incremental • Gap analysis
Relative: • Cost/Duration • Confidence • Accuracy	High	Medium	Low
Rating?	Yes	No	No

Reference: Assessment Requirements for CMMI (ARC)

Standard CMMI Assessment Method for Process Improvement (SCAMPI)

Based on CMM®-Based Appraisal for Internal Process Improvement (CBA IPI) and EIA IS 731 Appraisal Method

Satisfies all of the ARC requirements for a Class A method

Must be led by authorized SCAMPI Lead Assessor

Tailorable to organization and model scope

Artifacts:

- SCAMPI Method Description

- Appraisal questionnaire, work aids, templates

Assessment Expectations

We have simplified the method, but …

- **CMMI models have more process areas and more practices than each of the individual source models**

Our goal:

- **Assuming an organization of 3-6 projects, 6-9 team members, experienced Lead Assessor**

- **SCAMPI assessment of all process areas through Levels 2-5 in 2-3 weeks**

- **SCAMPI assessment of process areas through Level 3 in 2 weeks (100 hours)**

Training Opportunities

Introduction to CMMI (Staged)

Introduction to CMMI (Continuous)

Intermediate Concepts in CMMI

SCAMPI Lead Assessor Training

Instructor Training for CMMI
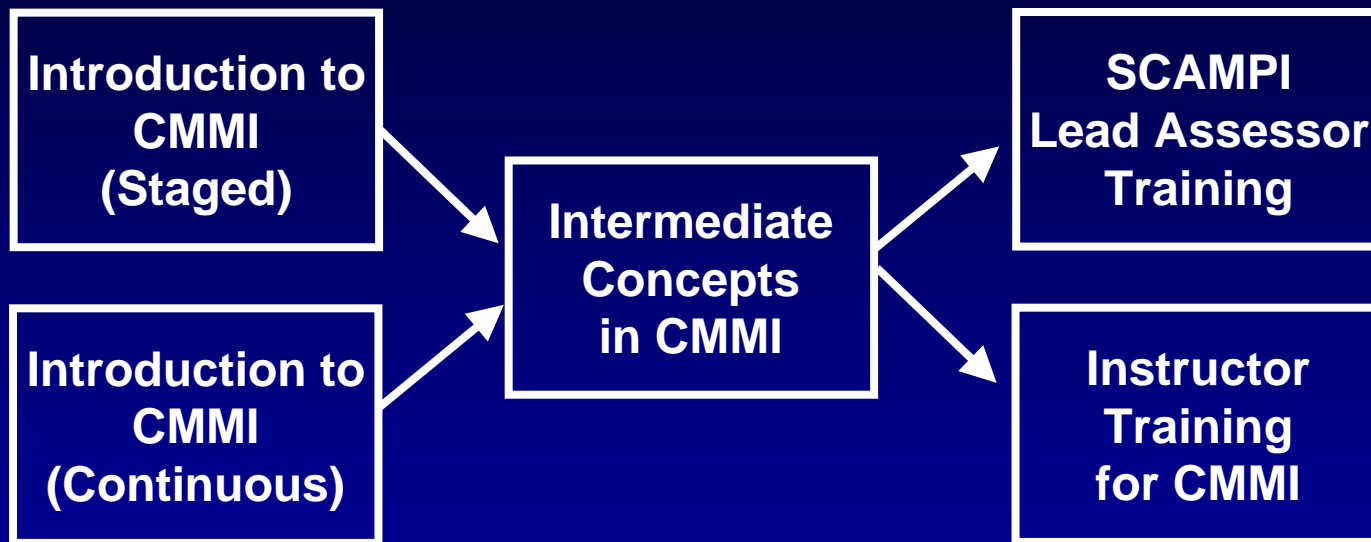
Strategy for CMMI v1.1 *and beyond*

Model:

- Maintain model stability

- Determine value of advanced practices and a single, combined representation

- Expand disciplines addressed in CMMI Models

- Improve understanding of Level 4 & 5

Method:

- Document an integrated appraisal method (assessments, evaluations)

- Enhance appraisal efficiency

- Improve training for both types of appraisals

Challenges for CMMI v1.1

Stability

- **No V1.0 transition effort (training,process improvement) is wasted**

Usability

- **Deficiencies noted in Change Requests are corrected to enhance utility**

Evolvability

- **Discipline additions (e.g. acquisition) can be made without impact to the core (common) model elements**
- **CMMI appraisals for both external sponsors and for internal process improvement must be consistent and repeatable**

"Process Improvement Improvement" [1]

The CMMI model builds upon the legacy:

- **Expanded model scope**
  - Risk Management
  - Verification and Validation
  - Requirements Development and Traceability

- **Better coverage of quantitative engineering management**

"Process Improvement Improvement" [2]

The CMMI Product Suite provides a foundation for *enterprise wide improvement* and adds:

- New emphasis on products and services as well as process

- Emphasis on both process capability and organizational maturity

- Early emphasis on Measurement and Analysis

CMM Integration Legacy

CMM Integration (CMMI[SM]) builds on the success of the CMM for Software (SW-CMM[®])

- improved productivity
- reduced cycle times
- earlier defect detection
- reduced defects in fielded products
- improved customer and employee satisfaction

CMM Integration (CMMI[SM]) builds on the knowledge of best systems engineering practices in product development
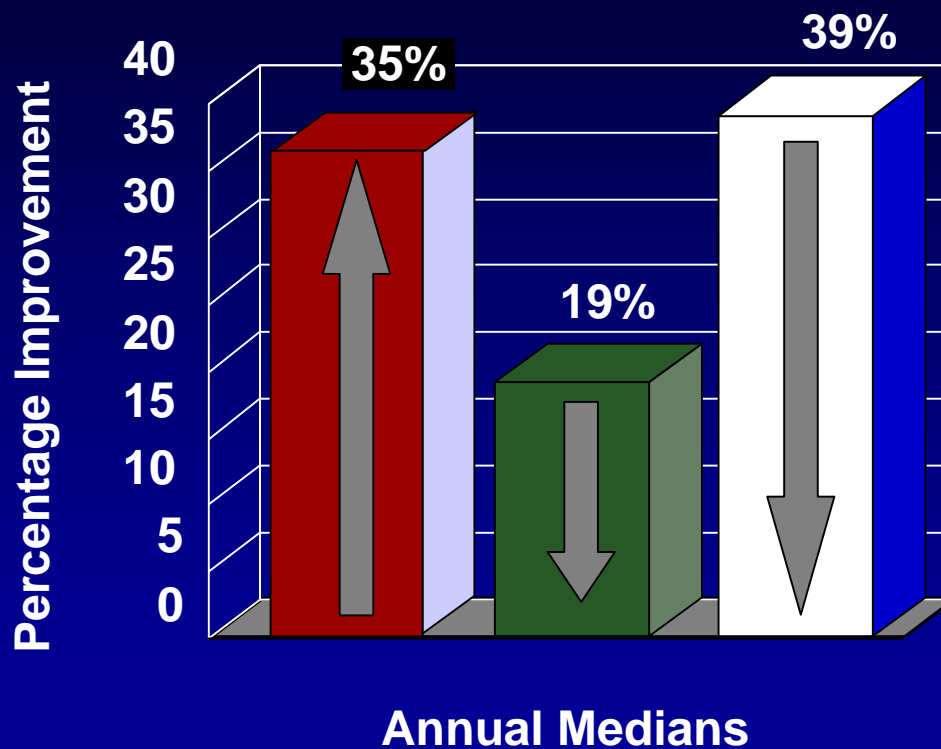
Benefits at Boeing [1]

Projects operating at
Maturity Level 3
increased productivity
by 62%...

**… while cycle times
improved 36%.**
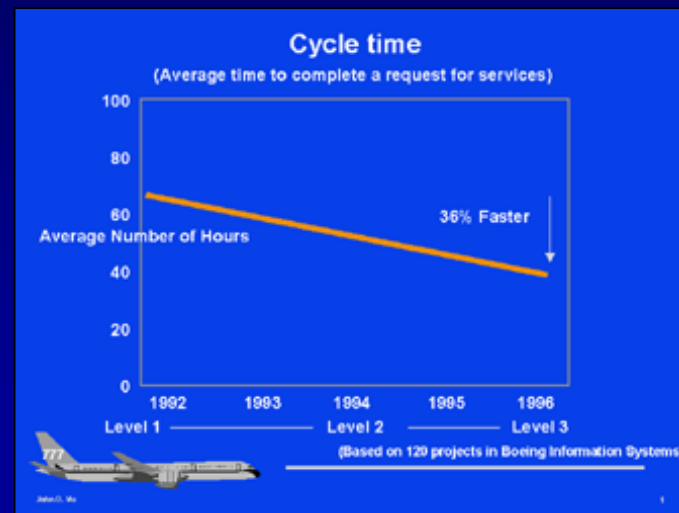
Reference: Scott Griffin, Chief Information Officer, The Boeing Company, SEPG Conference, 2000.

Benefits at Boeing 2

Customer Satisfaction Survey

Both customer...

… and employee
satisfaction increased
with rising maturity levels.

Employee Satisfaction

Benefits at Boeing [3]

Software Estimates
(Efforts = Labor Hours)
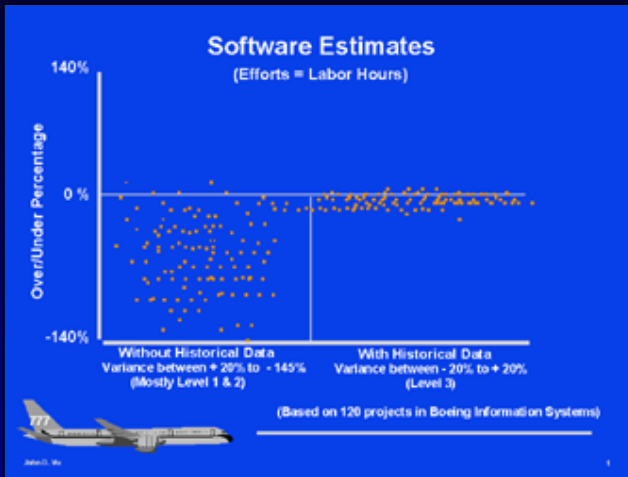
Planning was more accurate.

Post Release Defects

Defect Management
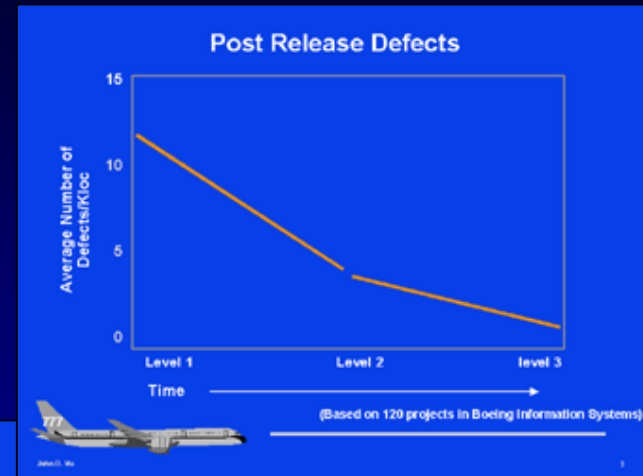
Defects could be detected much earlier.
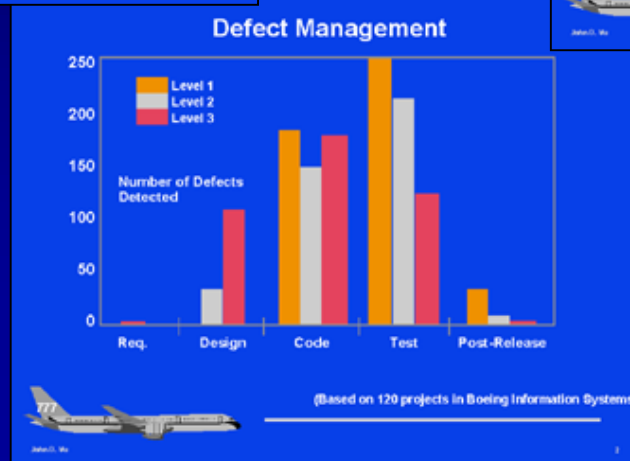
Product quality increased with rising maturity levels.

Benefits at Motorola [1]

Cost, cycle time, and defect density dropped sharply.
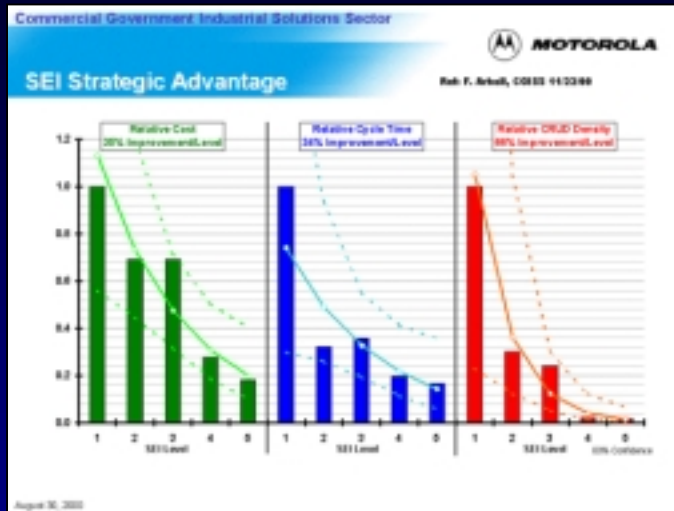
Quality, cycle time, and productivity improved dramatically.

Benefits at Motorola 2

"Achieving [the CMM Level 5] rating provides our customers with the assurance that they are receiving high-performance solutions that improve operations across the enterprise. This team of engineers demonstrated a commitment to excellence that sets themselves and Motorola above their contemporaries."

- Leif Soderberg, Motorola Senior VP and SSG General Manager

"These engineers have continued Motorola's legacy of excellence in engineering and business practices. Their efforts have ensured the on-time delivery of numerous solutions and this rating validates years of solid work and commitment."

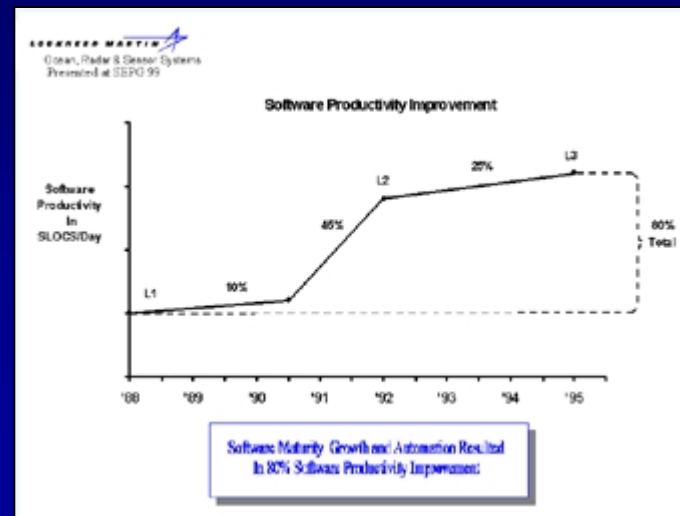- Mark Fried, Motorola Corporate VP and General Manager of ISD

Benefits at Lockheed Martin
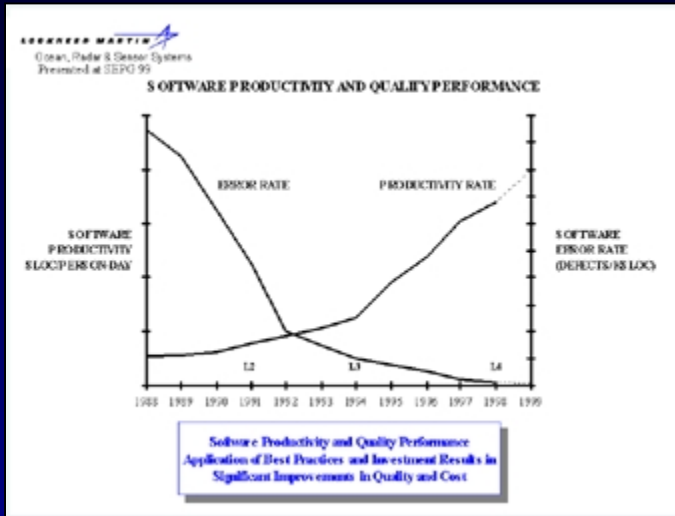
As errors declined...

...productivity
increased by 80%.

Reference: SEPG Conference, 1999.

Benefits of Continuing Process Improvement

SEI SW-CMM Level 5: For the Right Reasons*

Defects are now nearly all found and fixed before testing begins.

Defects escaping into the field have been reduced from 11% to practically 0%.

Programs consistently reach customer satisfaction and performance targets.

Peer reviews increase total project costs by 4%, but reduced rework during testing by 31%. R.O.I. is 7.75:1.

*Reference: Yamamura and Wigle, Boeing Space and Transportation Systems, *Crosstalk*, Aug, 1997.

For More Information About CMMI

- ## Go to CMMI Website
  http://www.sei.cmu.edu/cmmi

  http://www.sei.cmu.edu/cmmi/products/
  public-release.html

- ## Contact SEI Customer Relations
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