



Adozione del CMMI[®] Capability Maturity Model[®] Integration



*Software Engineering Institute
Carnegie Mellon University*



Valter Tozzetti, CMMI Lead Assessor,
SW CMM and CMMI Authorized Instructor
vtozzetti@pico2000.it

Adozione del CMMI

Capability Maturity Model Integration :

Agenda :

- Chi usa il CMMI
- I benefici ottenuti da chi lo adotta
- Il CMMI in Italia
- Implicazioni organizzative

Chi usa il CMMI?



- Le Organizzazioni Clienti
 - Valutazione della maturità dei fornitori
 - Valutazione delle offerte
 - Miglioramento dell'industria (DoD)
- Le Organizzazioni Fornitrici
 - Guida per il Process Improvement
 - La verifica del progresso ottenuto (Appraisal)

Perchè lo usano?



- Analizzare, definire e fare evolvere i processi dell'Organizzazione in accordo agli obiettivi di business
- Stabilire un linguaggio e un metro comuni per la gestione:
 - Del patrimonio di conoscenza (Knowledge management)
 - Delle differenti realtà produttive all'interno delle Organizzazioni e tra Aziende diverse
- Verificare, con un processo standard di auto-valutazione obiettiva (Appraisal) l'avanzamento ("as is") del programma di miglioramento rispetto agli obiettivi ("to be")

Il CMMI è diffuso solo nelle Aziende della Difesa?

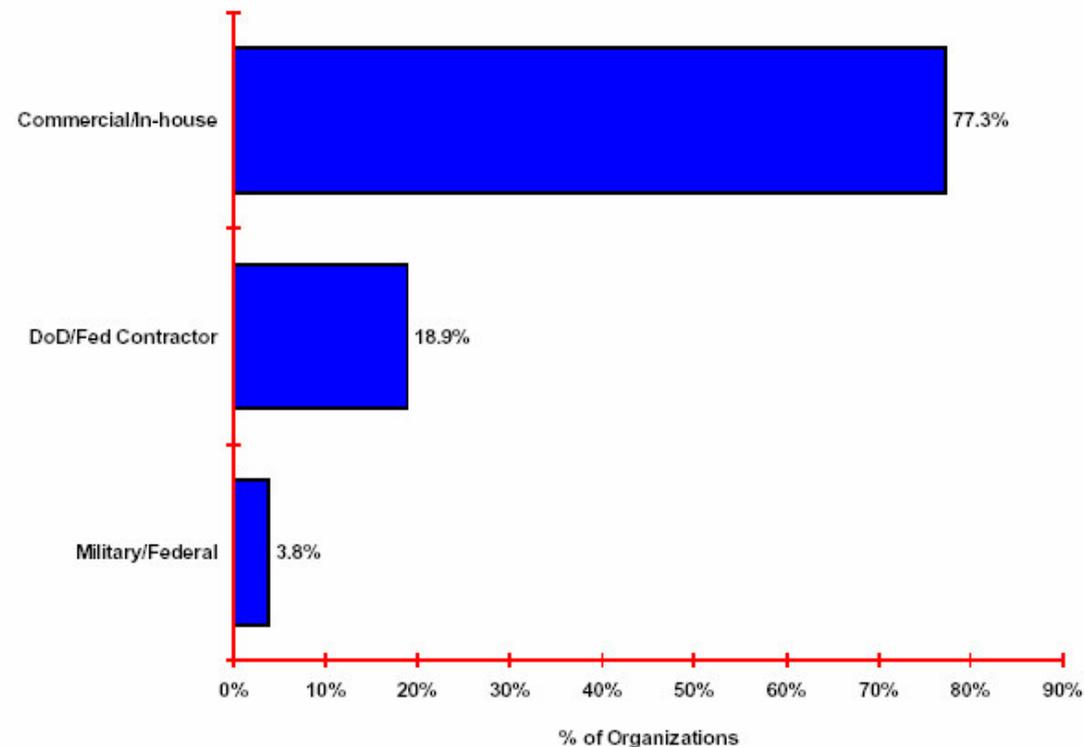


Carnegie Mellon University
Software Engineering Institute

Software CMM - CBA IPI, SPA and SCAMPI Appraisal Results



Reporting Organization Categories



Based on 1,543 organizations reporting organization categories

© 2004 by Carnegie Mellon University

August 2004

Process Maturity Profile - Page 7

25 Maggio 2005

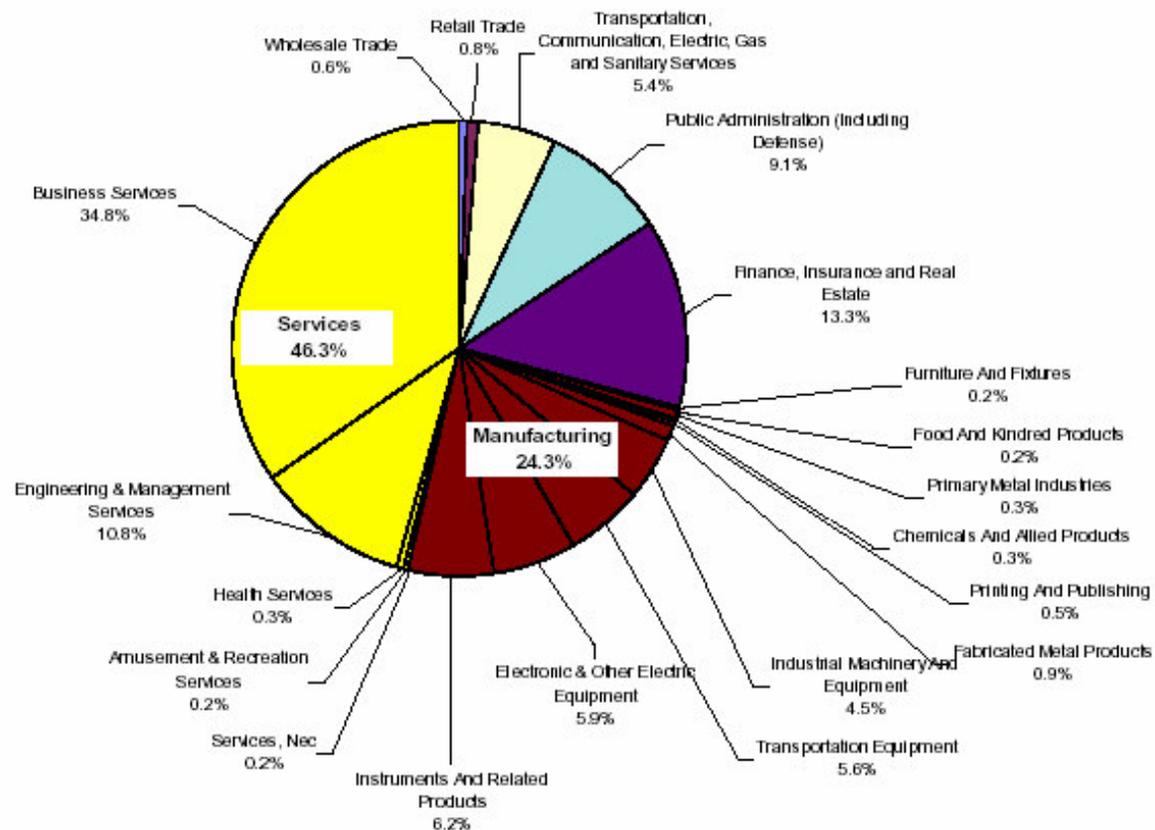
Pag. 5

Che tipo di Organizzazione usa il CMMI?



Organization Type

Based on Primary Standard Industrial Classification (SIC) Code



Based on 646 organizations reporting SIC code. For more information visit: <http://www.osha.gov/oshstats/sicser.html>

Il CMMI è diffuso solo negli USA?

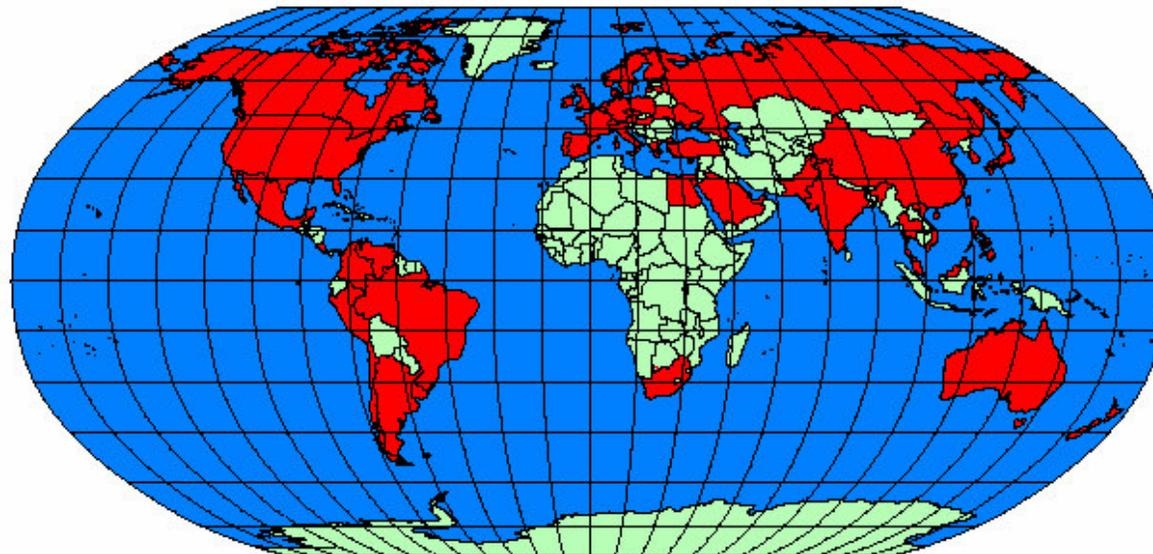


Carnegie Mellon University
Software Engineering Institute

Software CMM - CBA IPI, SPA and SCAMPI Appraisal Results



Countries Where Appraisals have been Performed and Reported to the SEI



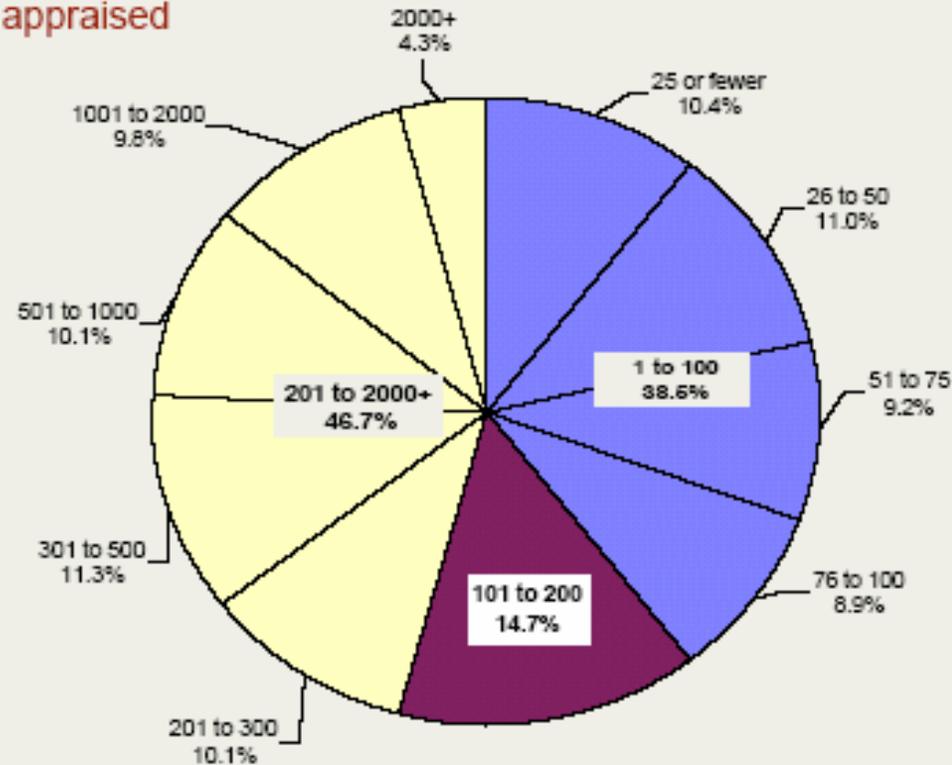
Argentina	Australia	Austria	Barbados	Belgium	Brazil	Canada
Chile	China	Colombia	Costa Rica	Cyprus	Czech Republic	Denmark
Egypt	Finland	France	Germany	Greece	Hong Kong	Hungary
India	Ireland	Israel	Italy	Japan	Korea, Republic of	Latvia
Malaysia	Mauritius	Mexico	Netherlands	New Zealand	Norway	Pakistan
Peru	Philippines	Poland	Portugal	Puerto Rico	Russia	Saudi Arabia
Singapore	South Africa	Spain	Sweden	Switzerland	Taiwan	Thailand
Turkey	Ukraine	United Arab Emirates	United Kingdom	United States	Uruguay	Venezuela
Viet nam						

Il CMMI è adatto solo alle “grandi Organizzazioni?”



Organization Size

Based on the total number of employees within the area of the organization that was appraised



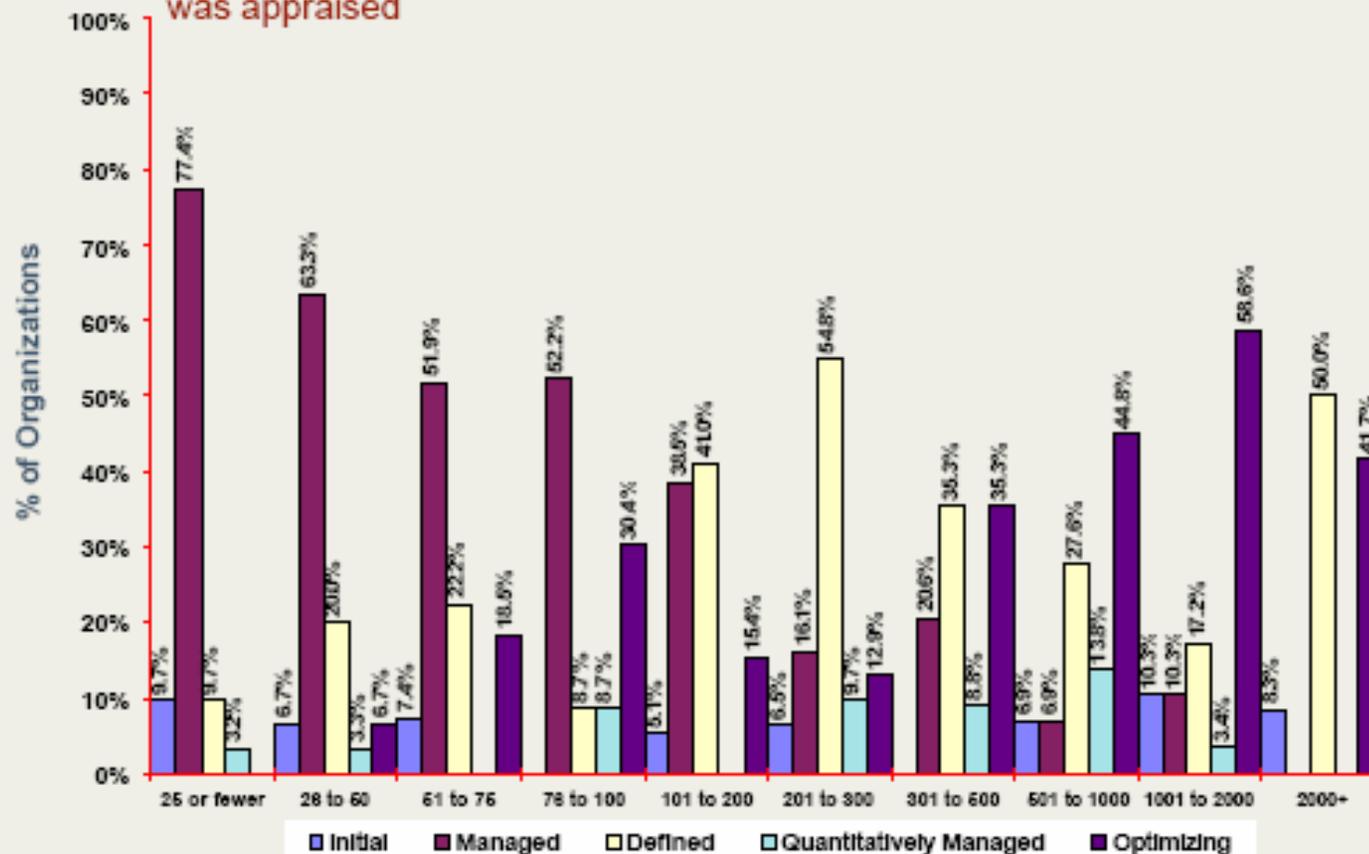
Based on 326 organizations reporting size data



Carnegie Mellon
Software Engineering Institute

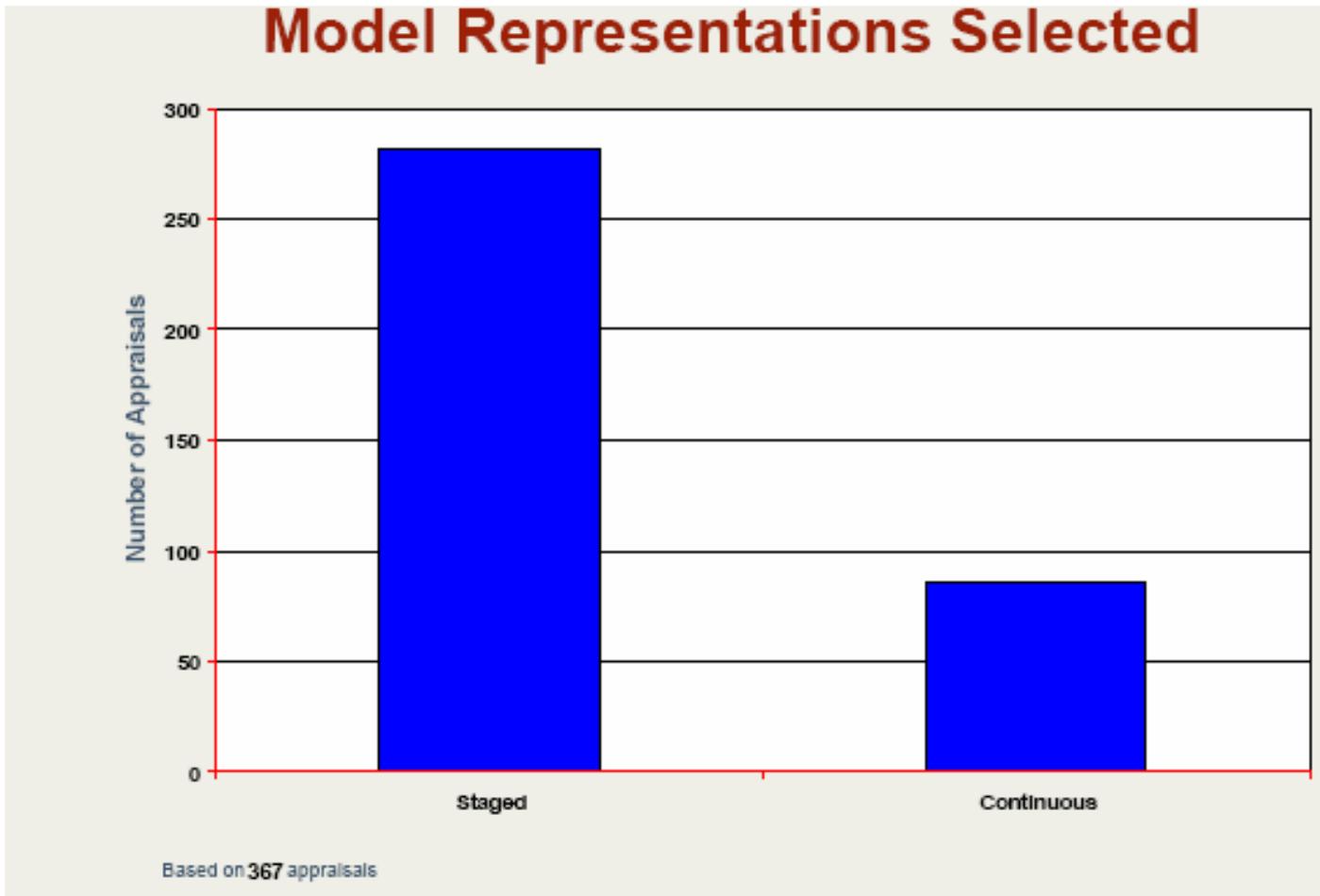
Maturity Profile by Organization Size

Based on the total number of employees within the area of the organization that was appraised



Based on 285 organizations reporting size data and maturity level rating

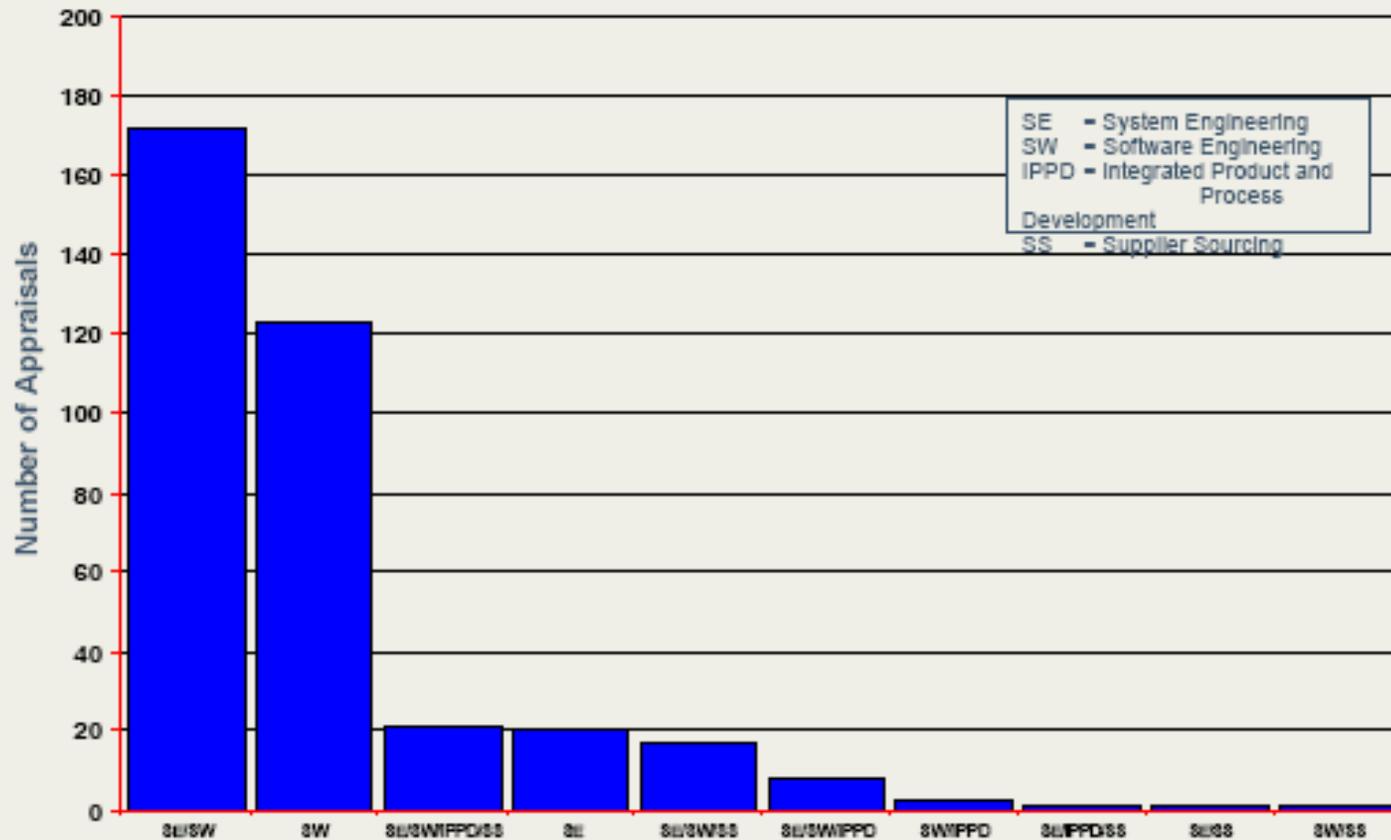
Le due rappresentazioni



Le discipline



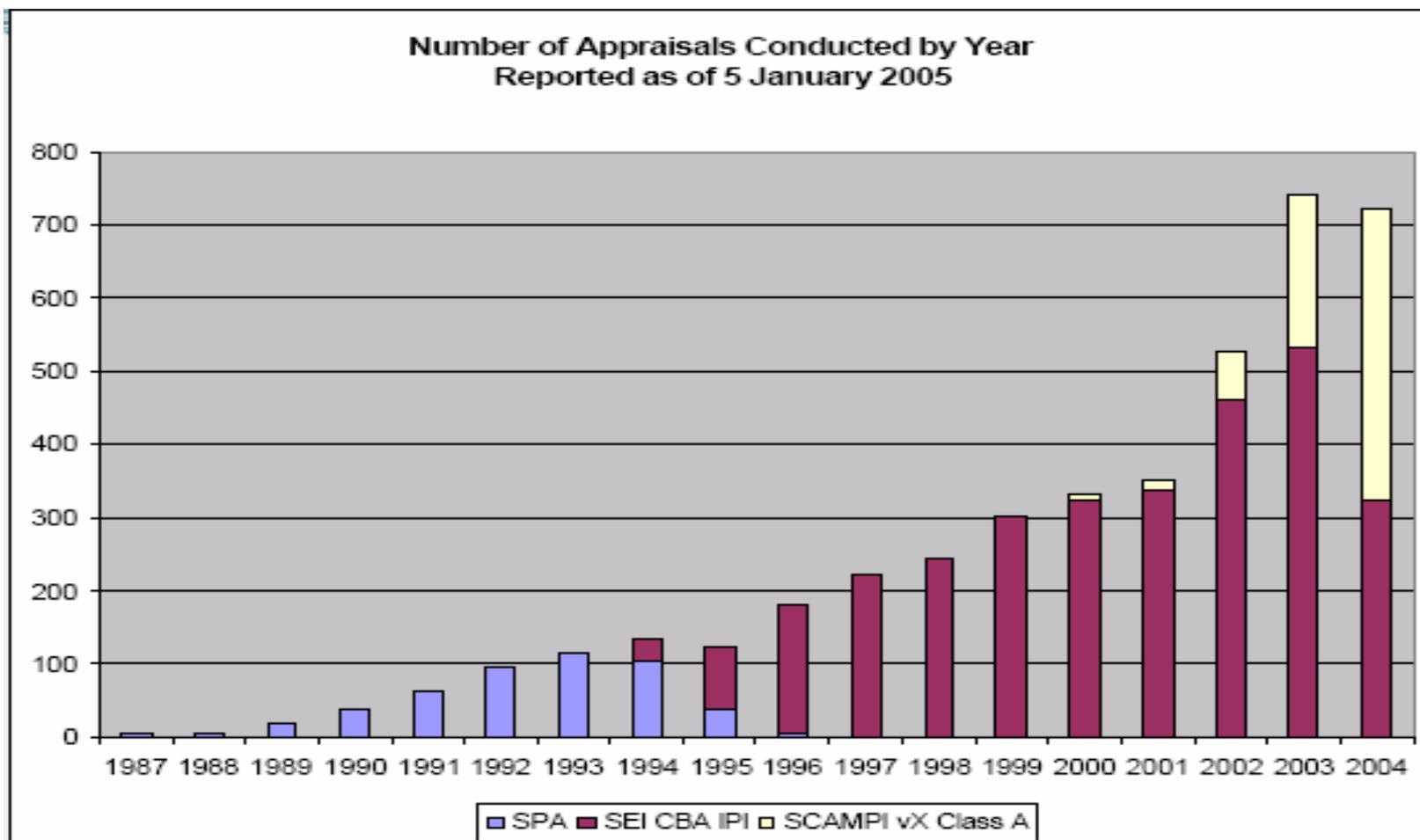
Disciplines Selected for Appraisals



Based on 367 appraisals reporting coverage

See <http://www.sel.cmu.edu/cmml/background/aspec.html> for Allowable Models & Combinations

Il processo di Appraisal



Benefici dell'uso del CMM



I risultati “classici” (1994-1999):

- Motorola,
- Boeing
- Lockheed Martin

e lo studio del SEI del 1994:

“Benefits of CMM-Based Software Process Improvement: Initial Results”

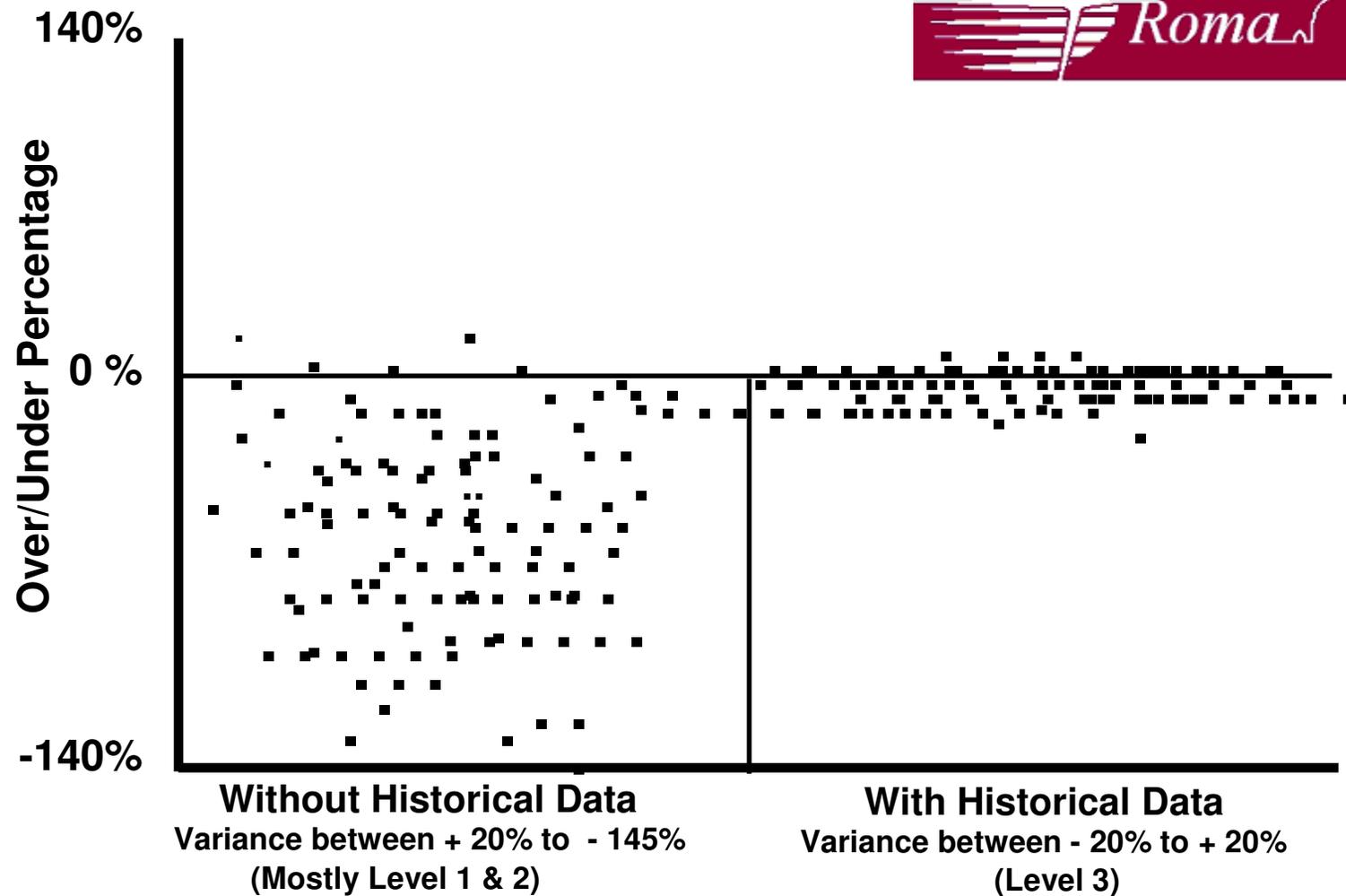
Motorola Government Electronics Division



CMM Maturity Level	Number of projects	Quality	Relative Cycle Time	Relative Productivity
1	3	n/a	1.0	n/a
2	9	890	3.2	1.0
3	5	411	2.7	0.8
4	8	205	5.0	2.3
5	9	126	7.8	2.8

Riferimento: Michael Diaz and Joseph Sligo, "How software process improvement helped Motorola," IEEE Software, Sept/Oct 97, p 75-81.

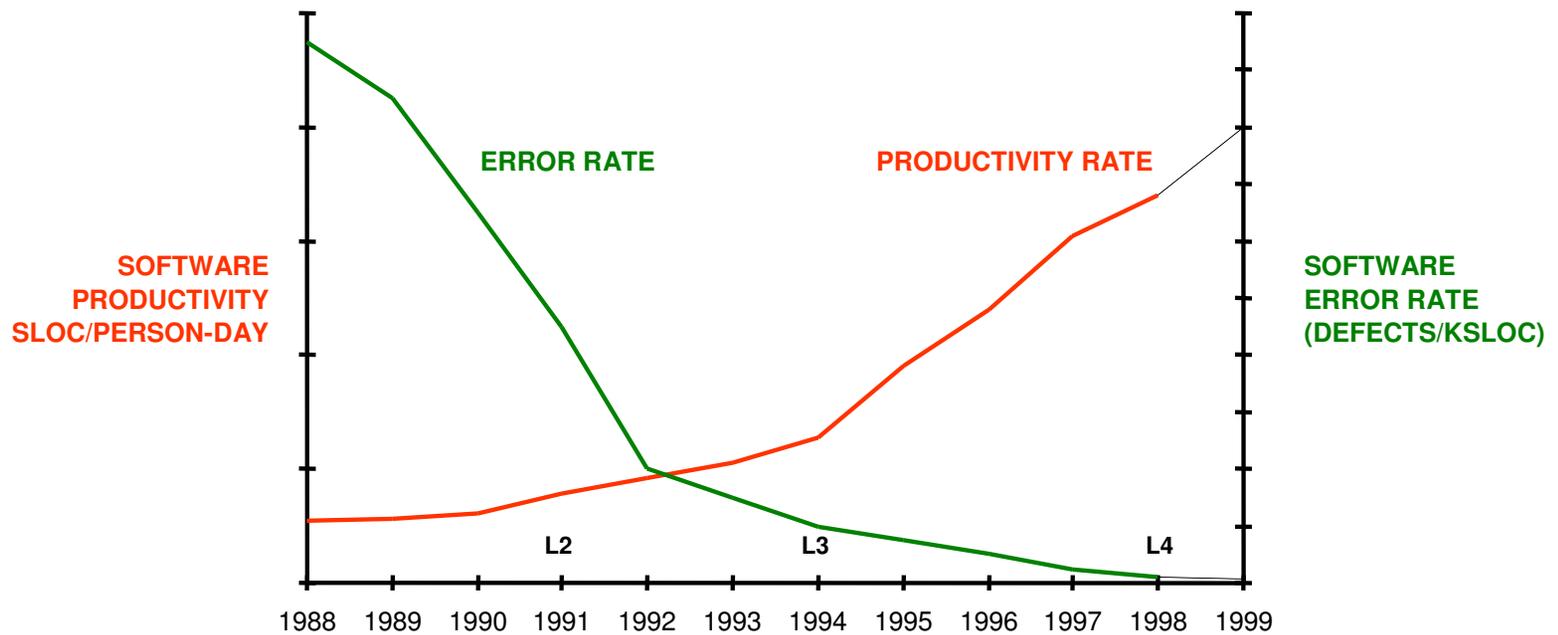
Boeing Effort Estimation



(Based on 120 projects in Boeing Information Systems)

Riferimento: John D. Vu. "Software Process Improvement Journey: From Level 1 to Level 5." 7th SEPG Conference, San Jose, March 1997.

SOFTWARE PRODUCTIVITY AND QUALITY PERFORMANCE



**Software Productivity and Quality Performance
 Application of Best Practices and Investment Results in
 Significant Improvements in Quality and Cost**

Risultati aggregati



Category	Range	Median	# of Data Pts
Years Engaged in SPI	1 - 9	3.5	24
Yearly Cost of SPI per Software Engineer	\$490 - \$2004	\$1375	5
Productivity Gain per Year	9% - 67%	35%	4
Early Defect Detection Gain per Year	6% - 25%	22%	3
Yearly Reduction in Time to Market	15% - 23%	19%	2
Yearly Reduction in Post-Release Defect Reports	10% - 94%	39%	5
Business Value (savings/cost of SPI)	4.0 - 8.8:1	5.0:1	5

Riferimento: *Benefits of CMM-Based Software Process Improvement: Initial Results* CMU/SEI-94-TR-13.

I risultati più recenti dell'impiego del CMMI



Dallo studio del SEI del Marzo 2004:

“*CMMI*® Why Make the Switch? Evidence
about the Benefits of *CMMI*®”

Le organizzazioni partecipanti allo studio del 2004



- Accenture
- Boeing Ltd, Australia
- Bosch Gasoline Systems
- CMS Information Services, Inc.
- Fort Sill Fire Support Software Engineering Center
- General Motors Corporation
- Harris Corporation
- J.P. Morgan Chase & Co.
- Lockheed Martin Management and Data Systems
- Lockheed Martin Maritime Systems and Sensors – Undersea Systems
- Lockheed Martin Systems Integration
- Motorola Global Software Group, India
- Northon Grumman Defense Enterprise Systems
- Raytheon North Texas Software Engineering
- Sanchez Computer Associates, Inc.
- Siemens Information Systems Ltd, India
- Thales Training & Simulation
- Thales Research & Technology
- Thales Air Traffic Management

Più 2 anonime

I sette parametri per misurare il miglioramento



- Aderenza al Processo
- Costi
- Tempi
- Produttività
- Qualità
- Customer Satisfaction
- Return on Investment

Impatto dell'aderenza al processo



- Work product completion improved dramatically (CMS Information Services, Inc.)
- Exceeded goal for reduction in cost of poor quality (Motorola Global Software Group, India)
- Improved adherence to quantitative management practices (Raytheon North Texas Software Engineering)
- Reduced cost of poor quality from over 45 percent to under 30 percent (Siemens Information Systems Ltd, India)
- Used Measurement and Analysis to significantly reduce the cost of quality in one year (reported under non disclosure)

Impatto sui Costi



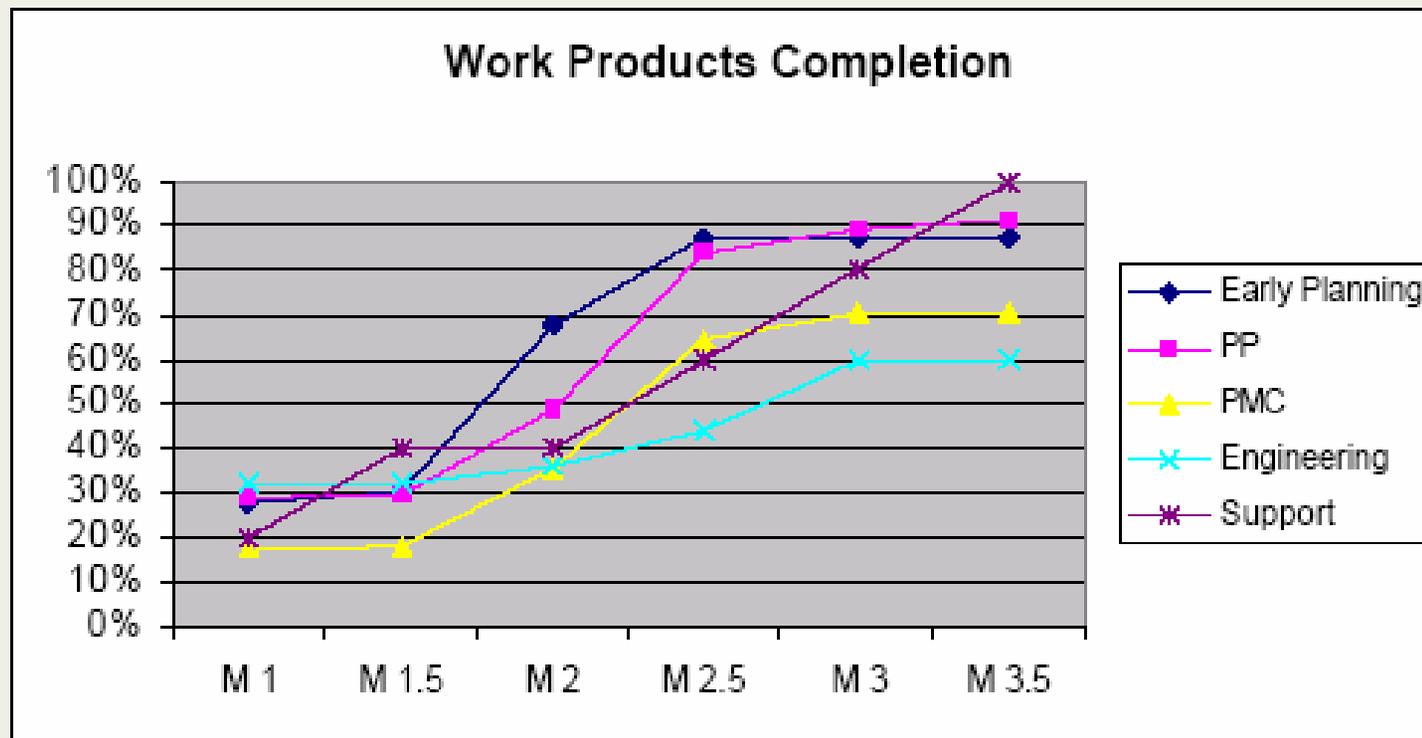
- 33 percent decrease in the average cost to fix a defect (Boeing, Australia)
- 20 percent reduction in unit software costs (Lockheed Martin Management and Data Systems)
- 15 percent decrease in defect find and fix costs (Lockheed Martin Management and Data Systems)
- 4.5 percent decline in overhead rate (Lockheed Martin Management and Data Systems)
- Improved and stabilized Cost Performance Index (Northrop Grumman Defense Enterprise Systems)
- Increased accuracy in cost estimation (Raytheon North Texas Software Engineering)
- 5 percent improvement in average cost performance index with a decline in variation (Raytheon North Texas Software Engineering)
 - As the organization improved from SW-CMM level 4 to CMMI level 5
- \$2.1 Million in savings in hardware engineering processes (reported under non disclosure)

Impatto sui tempi



- 50% reduction in release turn around time (Boeing, Australia)
- 60 percent reduction in work and fewer outstanding actions following pre-test and post-test audits (Boeing, Australia)
- Increased the percentage of milestones met from approximately 50 percent to approximately 95 percent (General Motors)
- Decreased the average number of days late from approximately 50 to fewer than 10 (General Motors)
- Increased through-put resulting in more releases per year (JP Morgan Chase)
- Improved and stabilized Schedule Performance Index (Northrop Grumman Defense Enterprise Systems)
- Met every milestone (25 in a row) on time, with high quality and customer satisfaction (Northrop Grumman Defense Enterprise Systems)
- Reduced variation in schedule performance index (Raytheon North Texas Software Engineering)
- Reduced schedule variance over 20 percent (reported under non disclosure)
- Achieved 95 percent on time delivery (reported under non disclosure)

Progress during PI Effort at CMS



Work product completion improved dramatically
CMS Information Services, Inc. – ML3

Impatto sulla produttività



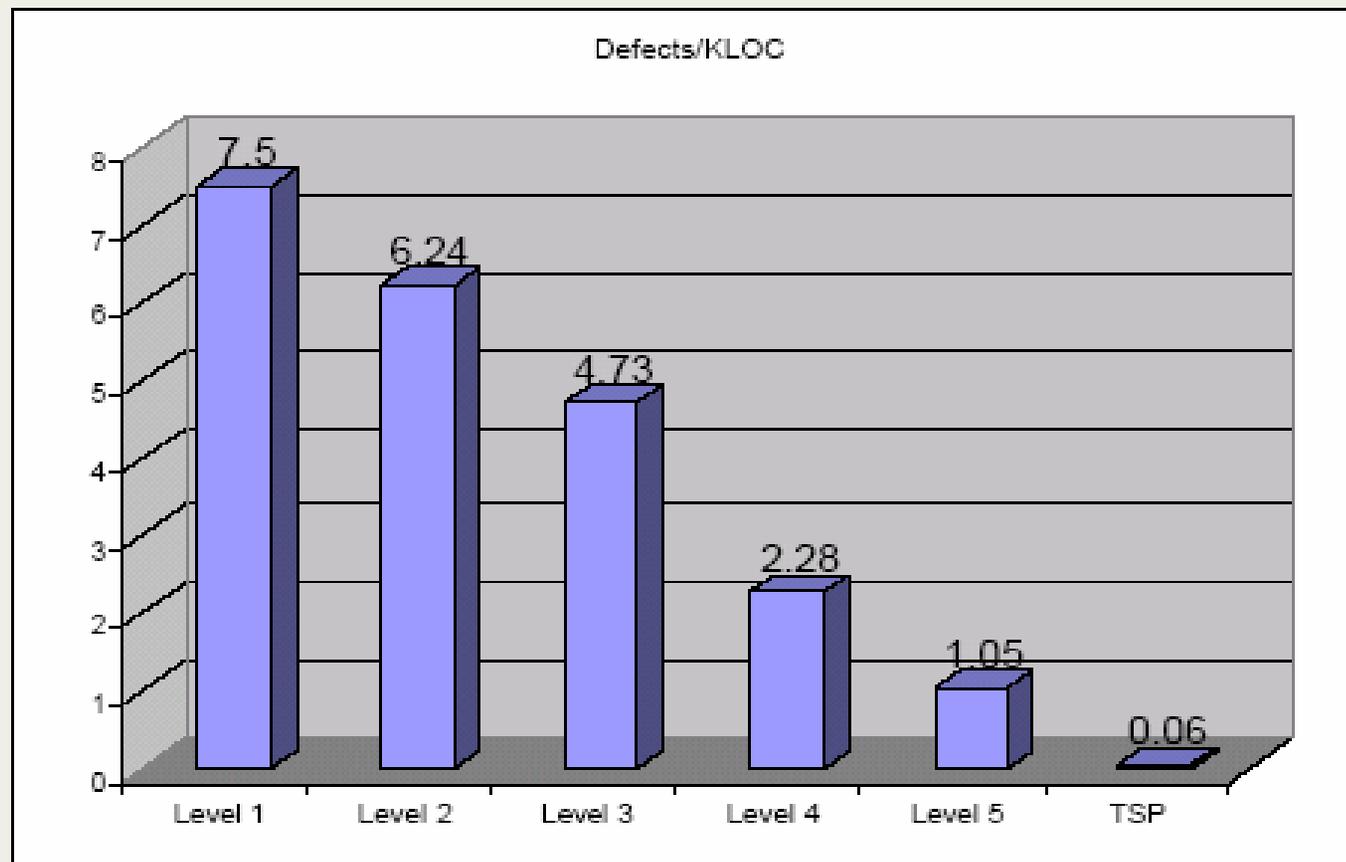
- Improved productivity substantially, with “significantly more rigorous engineering practices” due to CMMI (Fort Sill Fire Support Software Engineering Center)
- Increased productivity after adoption of CMMI (Harris Corporation)
- 30 percent increase in software productivity (Lockheed Martin Management and Data Systems)
- Improved software productivity (including reuse) from approximately 80 percent in 1992 baseline to over 140 percent at CMMI ML 5 (Lockheed Martin Systems Integration)
- 25 percent productivity improvement in 3 years (Siemens Information Systems Ltd, India)
- 11 percent increase in productivity, corresponding to \$4.4M in additional value (reported under non disclosure)

Impatto sulla qualità



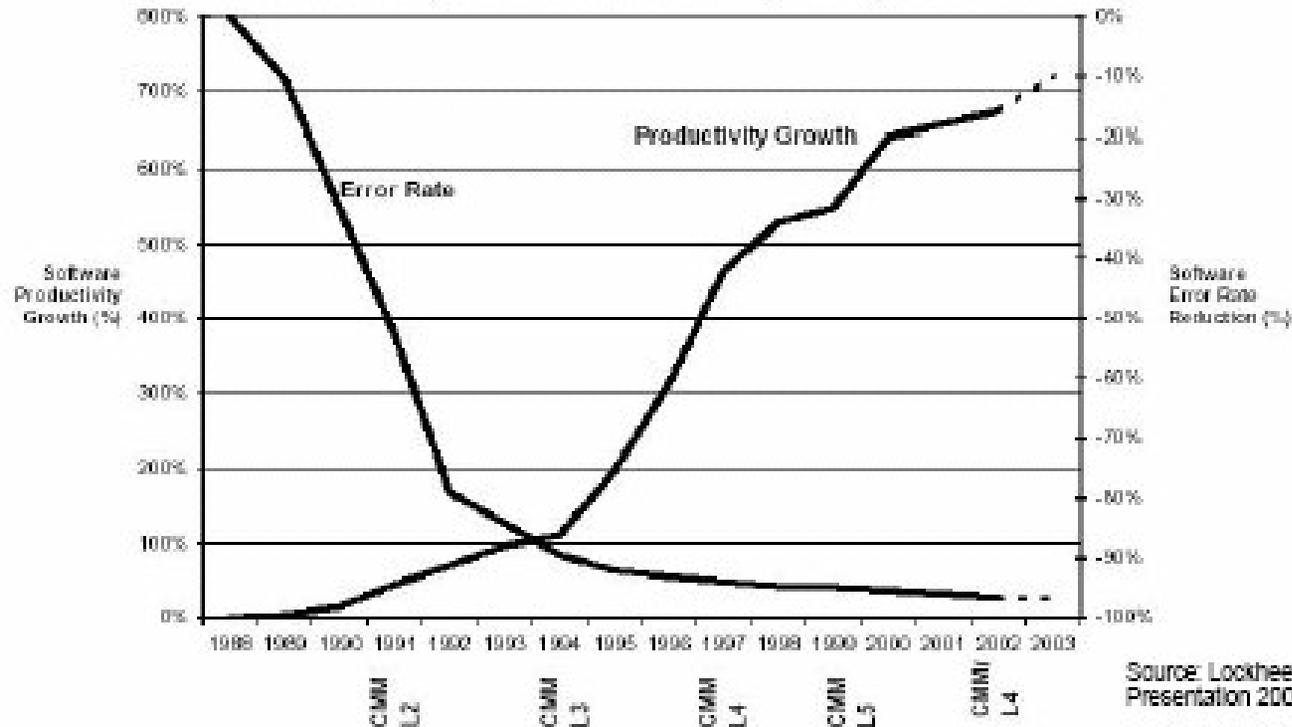
- Reduced software defects substantially, with “significantly more rigorous engineering practices” due to CMMI (Fort Sill Fire Support Software Engineering Center)
- Substantial decrease in code defects after adoption of CMMI (Harris Corporation)
- Reduced software-defects-per-million-delivered-SLOC by over 50 percent compared to defects prior to CMMI (Lockheed Martin Systems Integration)
- Reduced defect rate at CMMI ML5 approximately one third compared to performance at SW-CMM ML5 (Lockheed Martin Maritime Systems & Sensors – Undersea Systems)
- Met goal of 20 +/- 5 defects per KLOC (Northrop Grumman Defense Enterprise Systems)
- Only 2 percent of all defects found in the fielded system (Northrop Grumman Defense Enterprise Systems)
- Reduced identified defects from 6.6 per KLOC to 2.1 over 5 causal analysis cycles (Northrop Grumman Defense Enterprise Systems)
- Increased focus on quality by developers (Northrop Grumman Defense Enterprise Systems)
- Improved defect removal before test from 50 percent to 70 percent, leaving 0.35 post release defects per KLOC (Siemens Information Systems Ltd, India)
- 44 percent defect reduction following causal analysis cycle at maturity level 2 (reported under non disclosure)

Higher Product Quality



SPI Benefits at Lockheed Martin (1)

Lockheed Martin: NE&SS-Syracuse - Software Productivity & Quality Performance History



Source: Lockheed Martin SEPG Presentation 2003

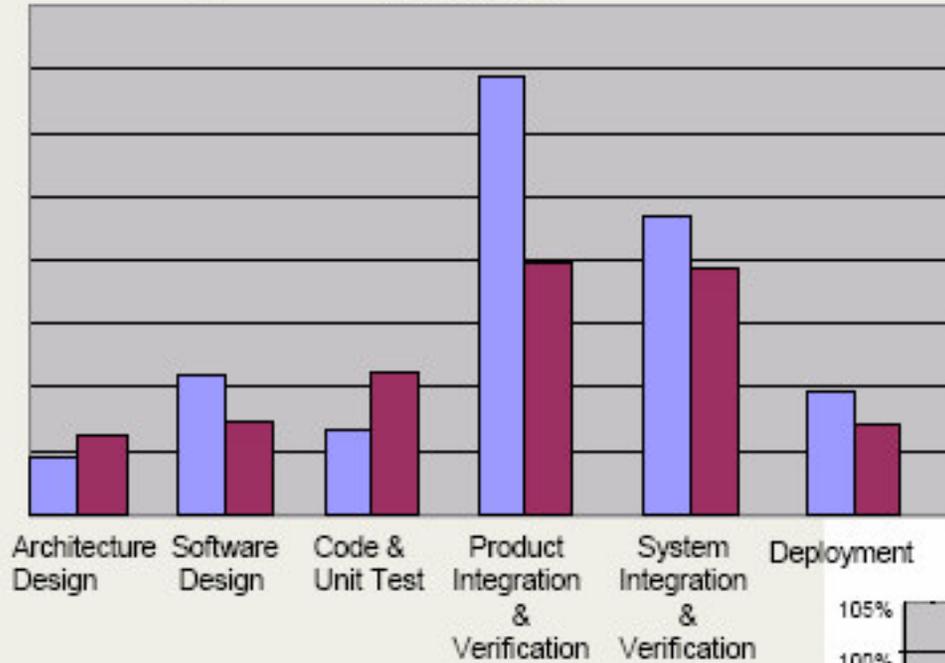
Software Productivity and Quality Performance Application of Best Practices and Investment Has Resulted in Significant Improvements in Quality and Cost. As error rates declined, productivity increased by 80+%.

Lockheed Martin IS&S



Improved Defect Find & Fix

Hours/KLOC



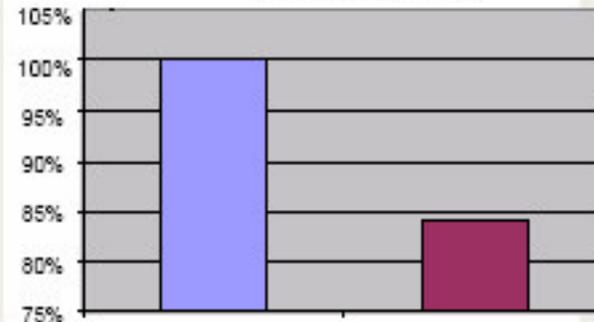
Improved Product Quality With Real Cost Savings

■ SW CMM ML3 Program
■ CMMI Level ML5 Program

15 % decrease in defect find & fix costs

Lockheed Martin IS&S

Dollars per Kloc



Impatto sulla Customer Satisfaction



- Increased award fees by 55 percent compared to an earlier SW-CMM baseline at maturity level 2 (Lockheed Martin Management and Data Systems)
- Received more than 98 percent of possible customer award fees (Northrop Grumman Defense Enterprise Systems)
- Earned a rating of “Exceptional” in every applicable category on their Contractor Performance Evaluation Survey (Northrop Grumman Defense Enterprise Systems)
- Improved average customer satisfaction rating 10 percent (Siemens Information Systems Ltd, India)

Impatto sul ROI



- 5:1 ROI for quality activities (Accenture)
- 13:1 ROI calculated as defects avoided per hour spent in training and defect prevention (Northrop Grumman Defense Enterprise Systems)
- Avoided \$3.72M in costs due to better cost performance (Raytheon North Texas Software Engineering)
 - As the organization improved from SW-CMM level 4 to CMMI level 5
- 2:1 ROI over 3 years (Siemens Information Systems Ltd, India)
- Processes for earlier defect detection, improved risk management, and better project control implemented after showing positive return on investment during pilot (Thales TT&S)
- 2.5:1 ROI over 1st year, with benefits amortized over less than 6 months (reported under non disclosure)

Process Improvement Payoff



Data Source	Process Improvement	ROI/Benefit Conclusions
Software Engineering Institute	Twelve medium to large-scale industrial, commercial or defense industry organizations examined in regards to improvement efforts. Implementation of CMMI or SW-CMM	<p>Samples across 12 organizations:</p> <ul style="list-style-type: none"> • 4.5% Decline in overhead rate • 20% Reduction in average cost variance • Increased % of milestones met from ~ 50% to ~ 95% • 30% Increase in software productivity • 5:1 ROI for quality activities • 13:1 ROI calculated as defects avoided per hour spent in training and defect prevention
Space and Naval Warfare Systems Center (SSC-SD)	Achieve a SW-CMM level 3 for the SmartNet scheduling tool for High Performance Computing Environments. Produce high quality, high reliability product, while maintaining high level of control in configuration management	<ul style="list-style-type: none"> • 45% reduction in Software Change Requests over 18 months • Better overall performance of the software, better documentation, reduced scheduled variance, higher quality, higher customer satisfaction, improved employee morale, better communication among team
Software Productivity Research	Four development projects using SW CMM in the Test Software Branches of the Oklahoma City Air Logistics Center (OC-ALC), Directorate of Aircraft, Software Division (LAS)	<ul style="list-style-type: none"> • 7:1 ROI and savings of \$11M over eight years • 90% reduction in defect rates compared to baseline project • 28% reduction in average cost of maintenance actions over 24 months.

Boeing Australia



Making transition to CMMI from SW-CMM and EIA 731;
early CMMI pilot in Australia

RESULTS on One Project

- 33% decrease in the average cost to fix a defect
- Turnaround time for releases cut in half
- 60% reduction in work from Pre-Test and Post-Test Audits;
passed with few outstanding actions

Product cost

Schedule /
cycle time

Quality

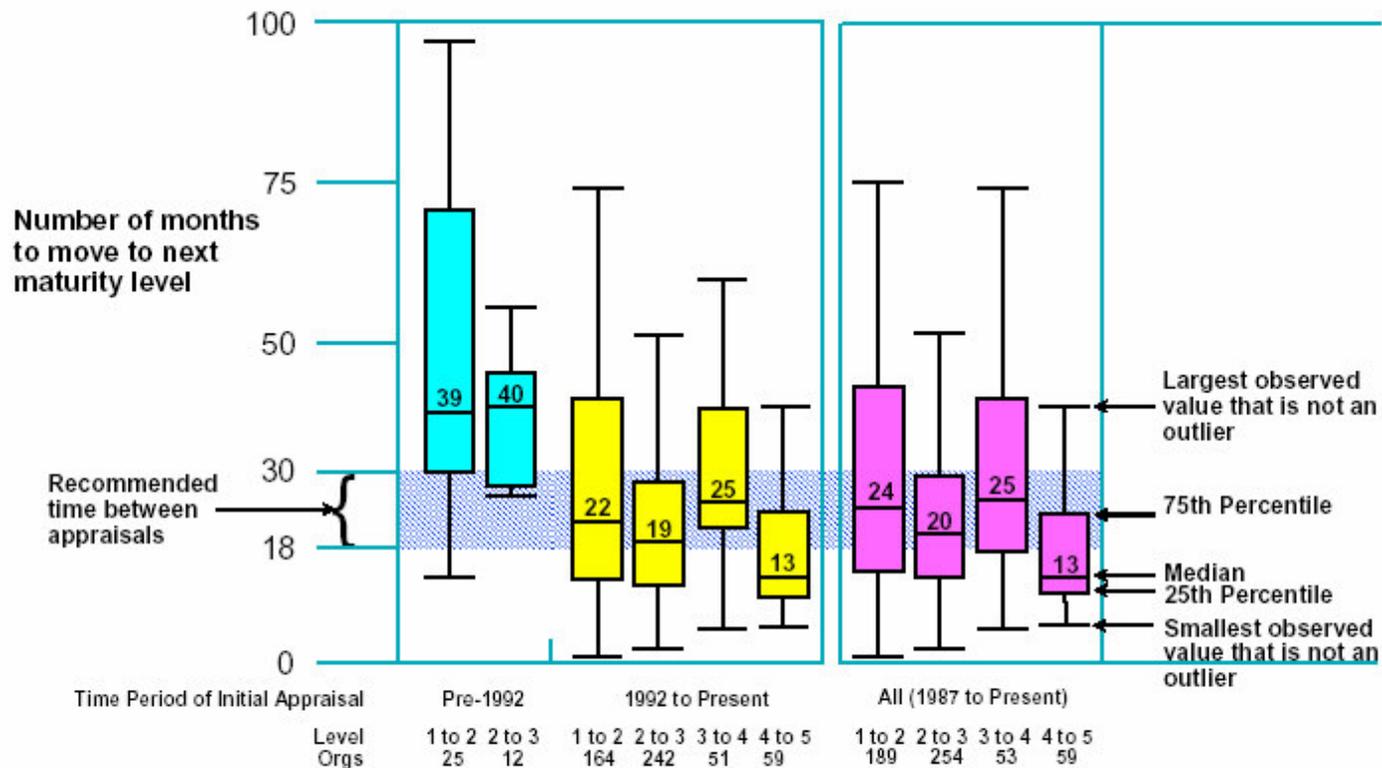
- Increased focus on product quality
- Increased focus on eliminating defects
- Developers seeking improvement opportunities

In Processes is there a Pay-Off? Terry Stevenson, Boeing Australia, Software Engineering
Australia 2003 conference.

La statistica dei tempi per conseguire i livelli di maturità



Time to Move Up



Conseguenze dell'adozione del CMM



- L'utilizzo del modello ha prodotto miglioramenti significativi: il DoD e gli altri Dipartimenti della Difesa delle nazioni NATO stanno richiedendo alle organizzazioni di dimostrare una maturità almeno di livello 3 per poter partecipare ai bandi di gara
- Il CMMI è un potente strumento al servizio delle organizzazioni che abbiano seriamente adottato la Gestione per Processi
- È indispensabile un forte impegno della Direzione per l'avvio e il sostegno continuo del percorso di definizione, misura e miglioramento dei processi nel rispetto dei requisiti del modello
- Nel confronto con la concorrenza sarà inevitabile tener ben presenti i requisiti di un modello che è diventato il riferimento per l'industria