

Trends in Software Process and Quality

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Topics

➔ Software Engineering Institute

The Capability Maturity Model for Software

Using the Software CMM Properly

Benefits of Software Process Improvement

ISO 9001 and Software

ISO/IEC 15504 for Software Process Assessment

Conclusion

The Software Engineering Institute (SEI)

Federally funded research and development center (FFRDC) established in 1984

Affiliated with Carnegie Mellon University

Mission - to provide leadership in advancing the state of the practice of software engineering to improve the quality of systems that depend on software

Vision - to bring engineering discipline to the development and maintenance of software

Standish Group - CHAOS Study

In the U.S. in 1995, \$250 billion / year spent on information technology for 175,000 software projects

- 31% of projects canceled before completion
- 53% of projects cost 189% of original estimates
- spend \$81 billion for canceled software projects

Only 16% of software projects completed on-time and on-budget

<http://www.standishgroup.com/chaos.html>

Software Process Management Premise

The quality of a software system is largely governed by the quality of the process used to develop and maintain it.

This premise implies

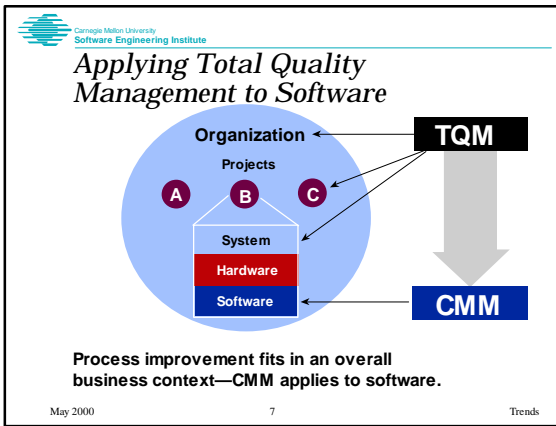
- focus on process as well as product
- focus on (organizational) process capability as well as (project) performance

Inspired by successes of Total Quality Management (TQM)

Picking a SPI Framework

Many possible choices

- SEI's Capability Maturity Model(s)
 - software
 - systems engineering
 - people
 - software acquisition
- ISO 9001 (Quality Management Systems)
- ISO/IEC 15504 (Software Process Assessment)
- Baldrige, Bootstrap (Europe), ISO/IEC 12207 (Software Life Cycle Processes), Software Productivity Research, Trillium (telecom), ...
- or improvement "philosophies" such as Deming, Juran, Crosby, Six Sigma, Goal/Question/Metric, ...



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Software CMM v1.1 Key Process Areas

Level	Focus	Key Process Areas	
5 Optimizing	Continuous process improvement	Defect Prevention Technology Change Management Process Change Management	Quality Productivity
4 Managed	Product and process quality	Quantitative Process Management Software Quality Management	
3 Defined	Engineering processes and organizational support	Organization Process Focus Organization Process Definition Training Program Integrated Software Management Software Product Engineering Intergroup Coordination Peer Reviews	
2 Repeatable	Project management processes	Requirements Management Software Project Planning Software Project Tracking & Oversight Software SubContract Management Software Quality Assurance Software Configuration Management	Risk Waste
1 Initial	Competent people and heroics		

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Evolution of Process Capability

Level	Process Characteristics	Predicted Performance
5 Optimizing	Process improvement is institutionalized	
4 Managed	Product and process are quantitatively controlled	
3 Defined	Software engineering and management processes defined and integrated	
2 Repeatable	Project management system in place; performance is repeatable	
1 Initial	Process is informal and unpredictable	

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The CMM Is 500 Pages Long!

The key practices, subpractices, examples, etc., add value by guidance for interpreting the CMM.

- Much of the guidance is directed at large projects and large organizations.

Documentation is important.

- Documents need not be lengthy or complex.

Training, resources, tools, policies, oversight, measurement, etc., are important.

- Institutionalization need not be intrusive.
- Culture is simply "the way we do things around here."

A "One Size Fits All" Model

Every organization and project has unique needs.

There are no "shall" statements in the CMM.

The key process areas and goals represent the CMM "requirements."

Interpretation, tailoring, and professional judgment are needed to apply the CMM correctly in any environment.

Using the CMM Improperly

Improper uses of the CMM include

- checking off (sub)practices for conformance
- mandating processes from above: not involving the true process owners – the workers
- riding roughshod over reasonable concerns
- confusing

Value judgments are embedded in the terminology you use to describe your processes!

documented	detailed
guidance	onerous
disciplined	law
measured	inflexible
	bureaucracy
	judgmental

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Fundamental Questions

Why do software process improvement?

- What is the impact on the bottom line?
- Will this give us a competitive advantage?
- What is the business case?

Will the CMM help my organization improve?

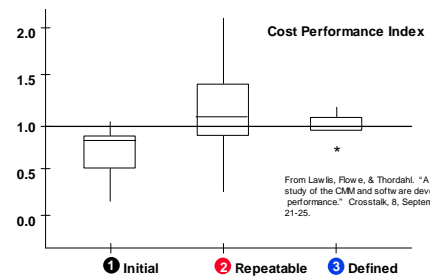
- What about other approaches?

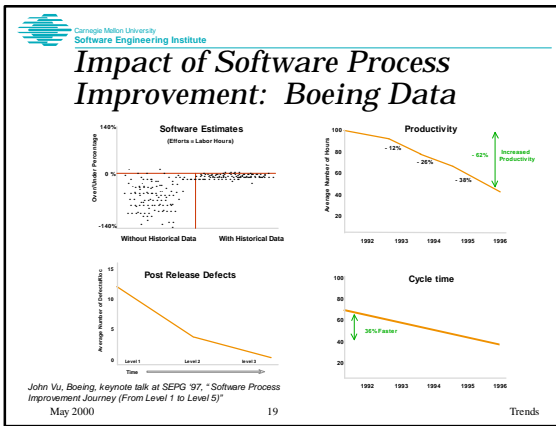
"Face Validity"

Added value has been demonstrated in many case studies of successful improvement based on the CMM.

- Small companies and small projects have succeeded (and failed) to improve.
- Large companies and large projects have succeeded (and failed) to improve.
- Acceptance of the CMM by commercial and non-US organizations is growing rapidly.
- SEPG Conference has grown to over 2000 people practicing CMM-based improvement.
- SEPG conferences established in Europe, India, Australia, ...

AFIT Study



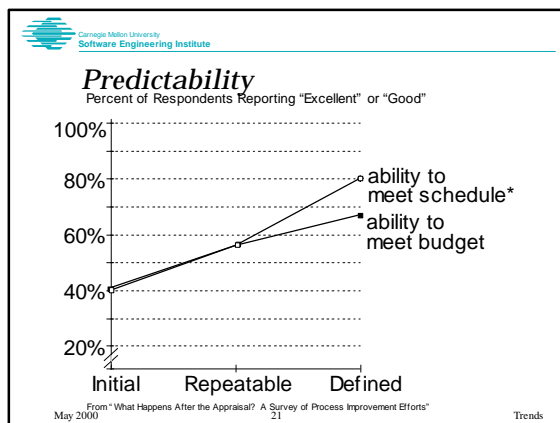


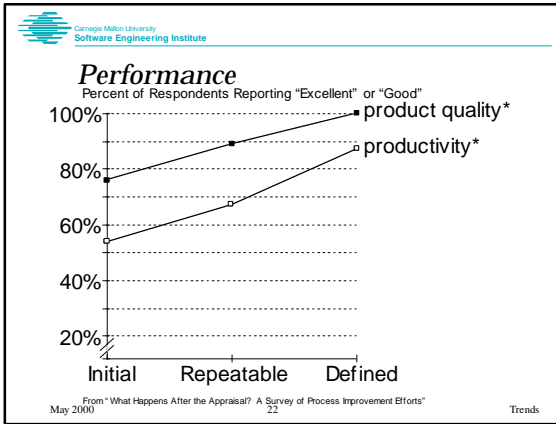
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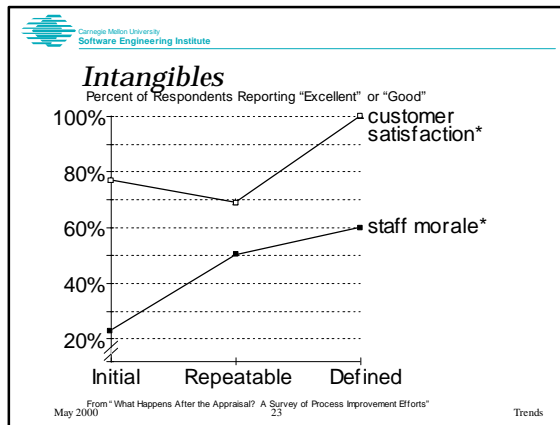
"Trends" in Quality Results

Maturity Level	Design Faults / KSLOC (Keene)	Delivered Defects / FP (Jones)	Shipped Defects / KSLOC (Krasner)	Relative Defect Density (Williams)	Shipped Defects (Rifkin)
5	0.5	0.05	0.5	0.05	1
4	1	0.14	2.5	0.1	5
3	2	0.27	3.5	0.2	7
2	3	0.44	6	0.4	12
1	5-6	0.75	30	1.0	61

Samuel Keene, "Modeling Software R&M Characteristics," Unpublished report.
Capers Jones, "Software Benchmarking," IEEE Computer, October 1995, pp. 102-103.
Herb Krasner, "Self-Assessment Experiences at Lockheed," Third Annual SEPG Workshop, 7 November 1996.
Karl D. Williams, "The Value of Software Improvement... Results! Results! Results!" SPIRE97, 4 June 1997.
Stan Rifkin, "The Business Case for Software Process Improvement," Fifth SEPG National Meeting, 26-29 April 1993.
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Quality Concepts of ISO 9000

An organization should achieve and sustain the quality of the product or service produced so as to meet continually the purchaser's stated or implied needs.

An organization should provide confidence to its own management that the intended quality is being achieved and sustained.

An organization should provide confidence to the purchaser that the intended quality is being, or will be, achieved in the delivered product or service provided.

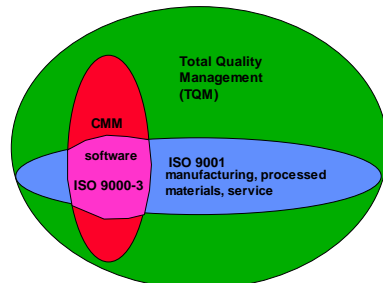
ISO 9000:2000 Revision

Major revision of ISO 9000 family of standards planned for 2000

Four primary standards:

- ISO 9000: Quality management systems - Concepts and vocabulary
- ISO 9001: Quality management systems - Requirements
 - *proposal to move ISO 9000-3 to JTC1/SC7*
- ISO 9004: Quality management systems - Guidelines
- ISO 10011: Guidelines for auditing quality systems

TQM, CMM, and ISO 9001



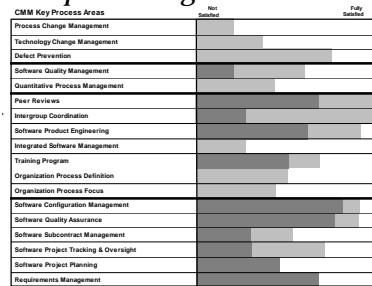
"All models are wrong. Some models are useful." George Box.

Problematic Clauses in the Software World

There is a wide range of interpretation by auditors for

- design review (4.4.6)
- evaluation of subcontractors (4.6.2)
- purchasing data (4.6.3)
- verification of purchased product (4.6.4)
- control of inspection, measuring, and test equipment (4.11)
- control of nonconforming product (4.13)
- preventive action (4.14.3)
- statistical techniques (4.20)

KPA Profile for an ISO 9001 Compliant Organization



ISO 9001 Issues Poorly/Not Covered by the CMM

Control of customer-supplied product (4.7)

- commercial-off-the-shelf (COTS)
- product evaluation
- reuse

Handling, storage, packaging, preservation, and delivery (4.15)

- only go as far as product build

Servicing (4.19)

- maintenance (sustaining engineering) covered in general, but not specifically

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ISO/IEC 15504 -- "Software Process Assessment"

Proposed international standard for software process assessment (and improvement)

- type 2 technical reports completed
- intended to harmonize the many different approaches to software process assessment
- for use in both process improvement and capability determination
- international standard planned for 2001 timeframe

WG10 = ISO/IEC JTC1/SC7/WG10

SPICE = Software Process Improvement and Capability dEtermination

A Reference Model for Processes and Process Capability

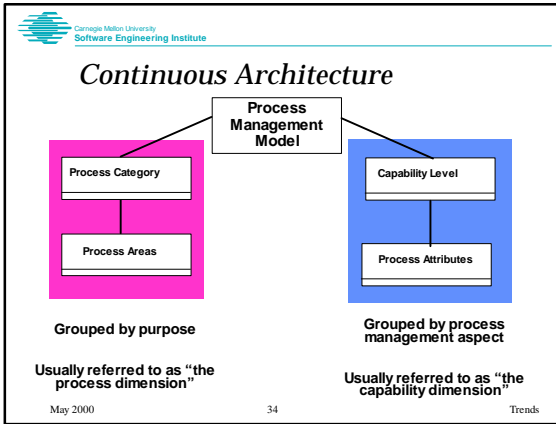
Documents the set of universal software engineering that are fundamental to good software engineering

Key concepts

- processes (do the right thing)
- process capability (do it right)

SEI trials of the original SPICE architecture

- Systems Engineering CMM
- CMM v2 prototypes



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ISO/IEC 12207 -- "Software Life Cycle Processes"

A common framework for software life cycle processes

- with well-defined terminology

Contains processes, activities, and tasks that are to be applied during the acquisition of

- a system that contains software
- a stand-alone software product
- software service
- during the supply, development, operation, and maintenance of software products

WG7 = ISO/IEC JTC1/SC7/WG7

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ISO/IEC 15288 -- "Systems Life Cycle Processes"

Currently a working draft

Being developed by JTC1/SC7/WG7

- same working group that developed ISO/IEC 12207
- additional systems engineering resources being provided by INCOSE and EIA

WG7 = ISO/IEC JTC1/SC7/WG7

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ISO/IEC 15504, 12207, and 15288 Revision & Integration

ISO/IEC 15504 as emerging standard for software process assessment planned for 2002

- processes for assessment standard should be life cycle processes from other ISO standards
- integrated with ISO/IEC 12207 (software) and ISO/IEC 15288 (systems)

ISO/IEC 12207 is being amended and revision is being planned that will support ISO/IEC 15504 better in terms of architecture of standards

ISO/IEC 15288 is currently a working draft

ISO/IEC 15504 Capability Dimension

Apply nine generic process attributes to rate selected ISO/IEC 15504 processes

- originally 26 generic practices
- conceptually similar to CMM maturity levels, but applied to process rather than organization

Six capability levels

- level 0 = *incomplete*
- level 1 = *performed*
- level 2 = *managed*
- level 3 = *established*
- level 4 = *predictable*
- level 5 = *optimizing*

Two Perspectives

A “staged” architecture, e.g., the SW-CMM

- focuses on building organizational capability
- identifies the vital few issues to focus on
- describes a roadmap for process improvement

A “continuous” architecture, e.g., ISO 15504

- focuses on building process capability
- provides a reference model for rating processes
- describes the terrain of process management

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What Does the Future Hold?

Shift in SEI focus from Software CMM to CMM
Integration

Release of Software CMM v2 halted in favor of
CMM Integration (CMMI) work

- prototype of CMMI model released Aug 1999
- v1 of CMMI model planned for Summer 2000

The Current Situation for CMMI

Explosion of CMMs and CMM-like models

- systems engineering
- software acquisition
- people
- integrated product development
- etc.

Multiple models within an organization

- multiple assessments
- multiple training
- multiple expenses

Source Models for CMMI

Capability Maturity Model for **Software V2**,
Draft C

EIA Interim Standard 731, **System Engineering**
Capability Model

Integrated Product Development Capability
Maturity Model, draft V0.98

The Danger of Focusing on Score

“Standards” such as the CMM, ISO/IEC 15504,
and ISO 9001 can help organizations improve
their software process.

Focusing on achieving a maturity level or
certification without addressing the underlying
process is a real danger.

Maturity levels and certification should be
measures of improvement, not goals of
improvement.

- need to tie improvement to business needs

In Conclusion

Any model or standard can be used effectively
for process improvement -- if used with the
proper spirit.

Some models and standards are arguably more
effective in particular environments.

- Software CMM, for example, is written to guide
software process improvement

A systematic approach to process management
and improvement leads to performance
excellence in achieving business objectives.

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ISO/IEC 15504 Information

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