



# *Comparing ISO 9001:2000 and Software CMM<sup>®</sup> v1.1*

**Mark C. Paulk**

*mcp@sei.cmu.edu -or- Mark.Paulk@ieee.org*  
**Software Engineering Institute  
Carnegie Mellon University  
Pittsburgh, PA 15213-3890**

® Capability Maturity Model and CMM are registered in the U.S. Patent and Trademark Office.  
SM Capability Maturity Model Integration, CMMI, IDEAL, Personal Software Process, PSP, Team  
Software Process, and TSP are service marks of Carnegie Mellon University.  
The Software Engineering Institute is a federally funded research and development center  
sponsored by the U.S. Department of Defense.  
©2002 by Carnegie Mellon University.



## *Topics*

➔ **SEI and the Software CMM**

**The ISO 9000 Family of Standards**

**Comparing ISO 9001:2000 and the Software CMM**

**Conclusions**



## *The Software Engineering Institute (SEI) at Carnegie Mellon*

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

***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**



## *The Capability Maturity Model<sup>®</sup> for Software (SW-CMM<sup>®</sup>)*

**A common-sense application of the concepts of Total  
Quality Management to software projects**

**A five-level prescriptive model for organizational  
transformation**

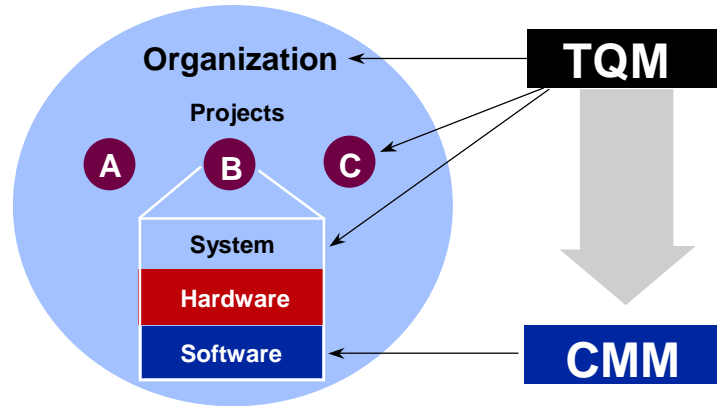
**A community-developed guide with descriptions of  
good engineering and management practices**

**The basis for reliable and consistent CMM-based  
appraisals**

***Mark C. Paulk, Charles V. Weber, Bill Curtis, and Mary Beth  
Chrissis, The Capability Maturity Model: Guidelines for Improving  
the Software Process, 1995.***



## Applying TQM to Software



Process improvement fits in an overall business context — CMM applies to software.



## Software CMM v1.1

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



## Evolution of Process Capability

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

Sept 2002

7

ISO 9001 vs CMM



## Topics

### SEI and the Software CMM

#### → The ISO 9000 Family of Standards

### Comparing ISO 9001:2000 and the Software CMM

### Conclusions

Sept 2002

8

ISO 9001 vs CMM



## *ISO, TC176, and Software Standards*

**The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC) are international standards bodies.**

**The American National Standards Institute (ANSI) is the official U.S. member of ISO and IEC.**

**The ISO 9000 series of standards is under TC176, which is responsible for quality management and quality assurance.**

**Software engineering standards are under ISO/IEC JTC1/SC7.**



## *The ISO 9000 Family of Standards*

**Developed to assist organizations, of all types and sizes, to implement and operate effective quality management systems.**

- **ISO 9000: Quality management systems – Fundamentals and vocabulary**
- **ISO 9001: Quality management systems – Requirements**
- **ISO 9004: Quality management systems – Guidelines for performance improvements**



## *Quality Management Principles*

**Customer focus**

**Leadership**

**Involvement of people**

**Process approach**

**System approach to management**

**Continual improvement**

**Factual approach to decision making**

**Mutually beneficial supplier relationships**



## *ISO 9001:2000 Major Clauses*

**4. Quality management system**

- general requirements, documentation requirements

**5. Management responsibility**

- management commitment; customer focus; quality policy; planning; responsibility, authority, and communication; management review

**6. Resource management**

- provision of resources; human resources; infrastructure; work environment

**7. Product realization**

- planning of product realization; customer-related processes; design and development; purchasing; production and service provision; control of monitoring and measuring devices

**8. Measurement, analysis, and improvement**

- general; monitoring and measurement; control of nonconforming product; analysis of data; improvement



## *Major Changes From 1994 to 2000*

**ISO 9002 and 9003 are discontinued**

**New architecture (20 clauses become 2+6+4+6+5=23)**

**Promotes the adoption of a process approach**

**Explicit requirements for customer satisfaction and continual improvement**

**Simplified terminology (easier to use)**

- subcontractor  $\Rightarrow$  supplier
- supplier  $\Rightarrow$  organization
- inspection and testing  $\Rightarrow$  product verification and validation
- quality system element  $\Rightarrow$  process
- quality system  $\Rightarrow$  interrelated processes



## *ISO 9001 and Software*

**ISO 9000-3 is a guideline for applying ISO 9001 to the development, supply, and maintenance of software.**

- originally released in 1991
- revision to match ISO 9001:2000 has been assigned to ISO/IEC JTC1/SC7 (software engineering standards) subcommittee

***TickIT* is a U.K. program (British Standards Institute) for applying ISO 9001 to software organizations.**

- U.S. and Japanese variants cancelled because of concerns on proliferation of sector-specific standards and interpretation issues



## *Topics*

**SEI and the Software CMM**

**The ISO 9000 Family of Standards**

**→ Comparing ISO 9001:2000 and the Software CMM**

**Conclusions**



## *Questions to Answer*

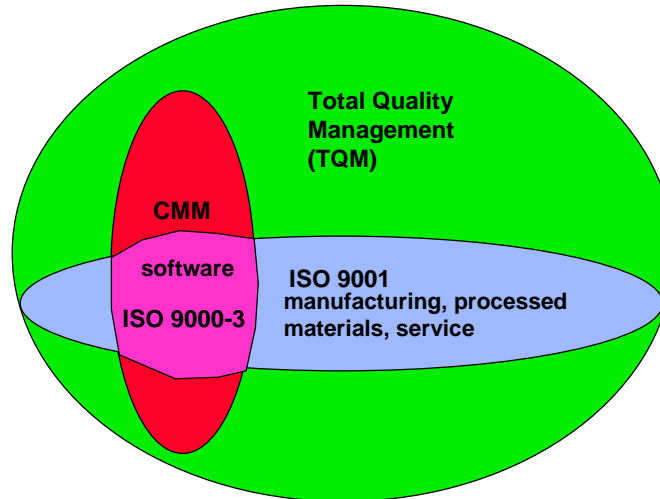
**What level in the CMM would an ISO 9001 compliant organization be at?**

**Can a Level 2 (or 3) organization be considered compliant with ISO 9001?**

**Should my organization focus on CMM-based improvement or on ISO 9001 certification?**



## *TQM, CMM, and ISO 9001*



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



## *ISO 9000:2000 Section 2.12*

Quality management systems and "excellence models" both

- enable an organization to identify strengths and weaknesses
- contain provision for evaluation against generic models
- provide a basis for continual improvement
- contain provision for external recognition

**ISO 9000:** requirements for quality management systems, guidance for performance improvement

**Excellence models:** criteria for comparative evaluation of organizational performance, applicable to all activities and interested parties



## *Common Themes Between ISO 9001 and Software CMM*

**Emphasis on process**

**Documented processes**

**Practiced processes**

**What, not how**

**Shared principles**



## *Process Management Premise*

***The quality of a (software) system is highly influenced by the quality of the process used to develop and maintain it.***

**Process is not the only success factor – you also need**

- **competent people**
- **appropriate business models and strategic plans**
- **product innovation**
- **integration across design and production (breaking down organizational barriers)**



## *Documented Processes*

**In the Software CMM, processes are documented:**

- procedures, standards, and methods
- organizational policies

**ISO 9001 process approach – a desired result is achieved more efficiently when activities and related resources are managed as a process.**

**Substitute “document” for “say” in the auditor’s proverb:**

- *Say what you do; do what you say.*



## *Practiced Processes*

**In the CMM, processes are followed, used, conducted, etc.**

- “that’s the way we do things around here”
- “used” processes are useful and usable

**CMM-based appraisals probe implementation through the process’s audit trail in document reviews and interviews.**

**ISO 9001 emphasizes records that document the achievement (or otherwise) of required quality and the effective operation (or otherwise) of the quality system.**



## *What, Not How*

Software CMM and ISO 9001 describe what a process should address rather than how the process should be implemented.

- Software CMM is over 400 pages long
- heart of ISO 9001 is about 12 pages long

Organizations have to define their own processes.

- Processes can be described with the minimum essential information – concise, elegant, useful, usable, used.
- Process (or quality) manuals can be 800-page monstrosities – baroque, complex, unusable, not useful (and not used).



## *Shared Principles*

**Customer focus (RM, IC.AC.1, SQM)**

**Leadership (Commitment)**

**Involvement of people (IC, PCM.GO.2)**

**Process approach (OPF, OPD, QPM, DP, PCM)**

**System approach to management (ISM, IC, SQM)**

**Continual improvement (OPF, PCM)**

**Factual approach to decision making (SPP,  
SPTO, ISM, QPM, SQM)**

**Mutually beneficial supplier relationships (SSM)**



## Mapping ISO 9001 to Software CMM

<b>Level 2</b>		<b>Level 3</b>		<b>Level 4</b>	
RM	√√	OPF	√√	QPM	√
SPP	√	OPD	√√	SQM	√√
SPTO	√	TP	√√		
SSM	√√	ISM	√	<b>Level 5</b>	
SQA	√√	SPE	√√	DP	√
SCM	√√	IC	√	TCM	
		PR	√	PCM	√

- √ partially addressed by ISO 9001
- √√ largely (not completely?) addressed by ISO 9001  
(perhaps by inference, judgment was used)  
(in the proper environment)



## The Level of an ISO 9001 Compliant Organization

**What level in the Software CMM would an ISO 9001 compliant organization be at?**

Conceivably at Level 1, if the focus is strictly on getting the ISO 9001 certificate

- many cases where a Level 1 organization has gotten ISO 9001 certification
- can certification for the wrong reasons be maintained under surveillance audits?

In principle, should be at least a strong Level 2 organization and probably Level 3



## *ISO 9001 Compliance for Level 2*

***Can a Level 2 (or 3) organization be considered compliant with ISO 9001?***

**There are ISO requirements that could be addressed better in Software CMM.**

- infrastructure; work environment; control/validation of production and service provision; customer property; preservation of product; control of monitoring and measuring devices; customer satisfaction; control of nonconforming product

**A Level 2 or 3 organization should have little difficulty in obtaining an ISO 9001 certificate.**



## *Topics*

**SEI and the Software CMM**

**The ISO 9000 Family of Standards**

**Comparing ISO 9001:2000 and the Software CMM**

**→ Conclusions**



## *Focus on Improvement*

***Should my organization focus on CMM-based improvement or on ISO 9001 certification?***

***A biased answer: improvement based on the Software CMM, with some specific additions from ISO 9001, provides competitive advantage.***

**Many organizations have started their improvement program with ISO 9001 certification, then adopted the Software CMM.**



## *The Danger of Focusing on Score*

**Both the Software CMM and ISO 9001 (9000-3, TickIT) can help organizations improve their software process.**

**Focusing on achieving a maturity level or certification without improving process performance is a real danger.**

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



## *General SEI Information*

**SEI Customer Relations +1 (412) 268-5800**

**SEI FAX number +1 (412) 268-5758**

### **Internet Address**

**customer-relations@sei.cmu.edu**

### **Mailing Address**

**Customer Relations  
Software Engineering Institute  
Carnegie Mellon University  
4500 Fifth Avenue  
Pittsburgh, PA 15213-3890**



## *Internet Access to SEI*

### **SEI Web pages**

- [www.sei.cmu.edu](http://www.sei.cmu.edu)
- [www.sei.cmu.edu/cmm/](http://www.sei.cmu.edu/cmm/)
- [www.sei.cmu.edu/cmm/cmm.articles.html](http://www.sei.cmu.edu/cmm/cmm.articles.html)
- [www.sei.cmu.edu/cmm/slides/iso9001cmm.pdf](http://www.sei.cmu.edu/cmm/slides/iso9001cmm.pdf)

