PML, ISO 9000 and TR-179 Mapping
Quantifying the Value of Improving Software Process Maturity

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PML, ISO 9000, and TR-179 Mapping

Agenda

- Goals and Objectives
- Quality System Standards and Tools
  - PML, ISO, TR179, COCOMO2, Checkpoint
- Mapping of PML, ISO, TR179 into Checkpoint
- Quantification of PML using COCOMO2
- Quantification of Defect Levels using Checkpoint
- Calculation of Value Added: Customers & Suppliers
Goals and Objectives

- Develop a model that can be used by Customers to quantify the value added of process improvements.
- Base model on the fact that process improvement is used to reduce delivered defects to Customers.
- Quantify the models of process improvement using PML, ISO, and TR179 to remove the subjectivity.
- Provide an initial method that can evolve with Customer needs.
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Software Quality Standards and Tools

- TR-NWT-179: Bellcore's Software Quality Program
  Generic Requirements

- ISO 9000-3: Guidelines for the application of ISO 9001 to
  the development, supply and maintenance of software

- QPS 88.001: Bellcore's Process Maturity Level (PML)

- Checkpoint: SPR Software Estimation tool (Capers Jones)

- COCOMO 2: Software Estimation tool and algorithms
  (Prof. Barry Boehm, USC)
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Quality System Standards: ISO 9000-3

- Internationally accepted quality standard which defines requirements for a baseline quality management system

- Demonstrate a supplier's capability to develop, supply, and maintain conforming product

- Achieves customer satisfaction by assuring conformity at all stages from design to servicing
Bellcore's Software Quality Program Generic Requirements define the highest level quality management system.

Demonstrate a supplier's capability to develop, supply, and maintain conforming product for the Telecommunications industry.

Achieves customer satisfaction by helping to assure the highest levels of quality and reliability.
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Quality System Standards: PML

- Provides compact and adequate coverage of TR179's major requirements.

- Aligns with TR179, ISO 9000-3, and SEI's Capability Maturity Model (CMM)

- 116 questions - 51 (L2), 42 (L3), 11 (L4), 8 (L5) and 4 (L6).

- Used to quantify the maturity of a supplier's quality management system

- At L6, the supplier could be a candidate for Baldrige award (necessary but not sufficient condition)
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Relationship among Quality System Standards

Note: not to scale
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Quality System Tools: COCOMO2 (USC Affiliate's Initiative)

- Published algorithms to estimate project effort and schedule
- Uses project personnel experience, sizing, and complexity
- Maps to the SEI maturity levels (PMAT variables)
- Based on newest development paradigms
- Later versions will encompass quality, systems dynamics, and phase/task analysis
- Used for process improvement - determine what schedule is needed and get the process changed to make it happen
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Quality System Tools: COCOMO2 PMAT Variables

- Estimates software development project effort based on SEI CMM process maturity level
- Assign values to the 18 SEI CMM Key Process Areas (KPA)
- Algorithm easily applied to several Bellcore projects
- Bellcore PML levels correspond to PMAT levels
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Quality System Tools: Checkpoint

- SPR's proprietary algorithm to estimate effort and schedule
- Uses personnel experience, sizing, and complexity
- Current model encompasses quality and phase/task analysis
- Large model with hundreds of variables
- Used for process improvement - determine what schedule is needed and get the process changed to make it happen
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Quality System Tools: Checkpoint Variables

- Project level
- Complexity: problem, code and data
- Language type and size (kloc or function points)
- Chart of Accounts
- Project Management
  - structure, responsibilities, cohesiveness, experience, methods, and tools
- Development/User/Maintenance Personnel Experience
- Development Methods
- Quality Assurance Process
- Defect Removal Effectiveness
- Product Restrictions
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Approach

- Map Checkpoint Variables into accepted quality system standards: PML, ISO 9000, and TR-179
- Create models to reflect a supplier's varying conformance to these quality system standards
- Use models to calculate Value Added by achieving higher levels of software process quality
- Document the models for Customers

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Mapping of Quality System Standards into Checkpoint

- Reviewed each quality requirement and identified the appropriate set of Checkpoint variables

- Resulting mapping is a Many-to-Many relationship

- Checkpoint calculations can now be done for ISO 9000-3, TR179, and each of the PML Levels so that delivered defects can be estimated
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**Mapping of Quality System Standards into Checkpoint**

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Model Conformance Levels of Quality System Standards

Increasing Process Maturity

PML 6  World Class
PML 5  Optimizing
PML 4  Managed
PML 3  Defined
PML 2  Repeatable
PML 1  Initial

Checkpoint Level

TR179
ISO 9000-3

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Quantification of PML using COCOMO2

- **PMAT** is an interim calculation, final results obtained with Checkpoint
- **PMAT** is summation of the percent adherence to the 18 KPAs (scale: EH=0, VH=1, H=2, N=3, L=4, VL=5)
- A PML level is mapped to each PMAT value:
  - PML 5 = PMAT 0
  - PML 4 = PMAT 1 etc.
- Typical size project is assumed
- Project effort is obtained from COCOMO2 for each PML level (only COCOMO2 variable changing is PMAT)

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Going from PML to PMAT to Value Added
Value Added Calculation

Value Added = f(PML_N) - f(PML_M)

PML 6
PML 5
PML 4
PML 3
PML 2
PML 1

Defects

Value Added
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Summary

- Customers receive the most benefit by a supplier progressing to PML level 3 (significant decrease in delivered defects)
  
  » After PML level 3, Customers continue to get moderate improvement in delivered defects

- Suppliers receive the most benefit by progressing to PML level 6 (maximum development cost reduction)

- Significant development cost and delivered defect improvements by going from ISO to TR179 compliant

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Effect of PML on Delivered Defects

Delivered Defects

PML

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Effect of PML on Development Cost

Percent Difference from PML 1 Cost

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Next Steps

- Need to perform a similar mapping of SEI CMM levels into Checkpoint variables to obtain benefit to Supplier and Customer of moving up the SEI levels.

- For each SEI level need to determine a COCOMO2/Checkpoint model.

- Need to continue validating COCOMO2/Checkpoint model results against actual Value Added cases.