The Comprehensive Process Model Quality Framework (CPMQF)

WHAT IS PMQ? (Q1)

PMQ
=
FIT-FOR-PURPOSE (17)
=
Sum of weighted quality dimensions (1, 52)

WHICH QUALITY DIMENSIONS ARE BEING MEASURED?

ISO/IEC 9126 & 25010 (15, 16)	GoM (3)	CMQF (37)
	Syntactic correctness	Syntactic quality
Understandability User interface aesthetics	Clarity	Pragmatic quality Empirical quality
Understandability User interface aesthetics	Clarity	Empirical quality
Understandability	Clarity	Perceived empirical quality
Understandability User interface aesthetics Changeability	Clarity	Pragmatic quality Empirical quality
Understandability User interface aesthetics Changeability	Clarity	Pragmatic quality Empirical quality

WHICH QUALITY DIMENSIONS ARE NOT TYPICALLY BEING MEASURED?

Suitability
Accuracy
Interoperability
Compliance
Security
Maturity
Fault tolerance
Recoverability
Learnability
Operability
Time behavior
Resource utilization
Analyzability
Stability
Testability
Modularity
Adaptability

Basic guidelines
Semantic correctness
Relevance
Economic efficiency

Optional guidelines
Comparability
Systematic design

Semantic quality
Intentional quality
Applied domain knowledge quality
Applied model knowledge quality
Applied language knowledge quality
Perceived syntactic quality
Perceived semantic quality
Perceived intentional quality

HOW TO MEASURE PMQ? (Q2)

SYNTACTIC CORRECTNESS (28, 61)
- Classic soundness (58)
- EPC soundness (28)
- BPMN soundness (22)
- Relaxed soundness (7)
- Perspicuity (6)
- K-soundness (2)
- Weak soundness (25)
- Up-to-k-soundness (59)
- Generalized soundness (60)
- Lazy soundness (39)
- Easy soundness (59)

UNDERSTANDABILITY (14, 23, 61)

Understanding effectiveness
- *Correct recall* (14)
- *Correct answers* (14)
- *Correct problem solving* (14)
- *Correct verification* (14)

Understanding efficiency
- *Time used to answer questions* (44, 49, 50, 53)
- *Comprehension efficiency* (10, 49, 53)

Perceived difficulty to understand
- *Score for understandability* (10, 49, 50)

Modifiability

MODIFIABILITY (49, 53, 55)

Modifying correctness
- *Modifiability correct answers* (49, 53, 55)

Time effort for modifying
- *Modifiability time* (49, 53, 55)
- *Modifiability efficiency* (49, 53, 55)

WHAT DRIVES PMQ? (Q3) HOW TO MEASURE THESE DRIVERS? (Q4)

Abstract syntax
Size (5)
- Number of nodes (5)
- Number of activities (5)
- Number of gateways (5)
- Number of arcs (5)
- Number of XOR splits (5)
- Number of XOR joins (5)
- Number of OR splits (5)
- Number of OR joins (5)
- Number of AND splits (5)
- Number of AND joins (5)
- Number of start events (5)
- Number of events (5)
- Number of end events (5)
- Number of activities and gateways (5)
- Number of elements (5)
- Diameter (28, 30)

Complexity (62)
Coupling (62)
- Density (28)
- Connectivity coefficient (21)
- Average gateway degree (28, 30)
- Maximum gateway degree (28)
- (Process) coupling (48, 63)
- Cross connectivity (64)
- Adapted McCabe cyclomatic number (5)
- Halsted-based process complexity (5)
- Fan-in/fan-out (12)
- Interface complexity (5)
- Complexity index (21)

Modularity (28)
- Depth (28, 30)
- Sequentiality (28, 30)
- Structuredness (28, 30)
- Separability (28)

Connector interplay (28)
- Control flow complexity (3, 49)
- Gateway heterogeneity (28, 30)
- Gateway mismatch (28, 30)
- Extended Cardoso metric (21, 30)

Cyclicity (28)
- Cyclicity (28, 30)

Concurrency (28)
- Token split (28)

Cognitive weight (11)
- Cognitive complexity (11)

Cohesion (62)
- Process cohesion (48)

Modeling expertise (42)

Modeling experience
- Subjective time experience
  - *Survey* (32, 35)
- Subjective modeling intensity
  - *Survey* (35, 45)

Theoretical knowledge
- Theoretical test correctness
  - *Correct answers* (35)
- Subjective theoretical knowledge
  - *Self-assessment* (32, 45)

Domain knowledge (28, 45)

Level of education (65)

Primary notation (28, 45, 56)
- Representational paradigm
- Modeling language

Presentation medium (57)

Concrete syntax
Positioning of model elements
- Crossing arcs (9, 40)
- Graphical modularity (45)

Visual emphasis (18)
- Color
- Element size
- Solidity
- Difference from ordinary pattern
- Foreground/background differences
- Dynamic change

Labeling
- Amount of text
  - String length (35)
- Labeling style (31, 33)

HOW TO REALIZE PMQ? (Q5)

10 PROCESS MODELING GUIDELINES (34)

Error probability
Understandability
- Use no more than 31 nodes
- Use no more than 3 in- or outputs per connector
- Use no more than 2 start and end events
- Model as structured as possible
- Use design patterns to avoid mismatch
- Avoid OR-joins and OR-splits
- Minimize the heterogeneity of connectors
- Minimize the level of concurrency
- Use verb-object activity labels
- Decompose a model with more than 31 nodes

GATEWAY COMPLEXITY RULES (55)

Understandability
Modifiability
- Include no more than 18-22 gateways
- Minimize the number of OR-splits
- Include no more than 10 XOR, 7 AND and 4 OR gateways
- Each decision node should have fewer than 7-9 input/output sequence flows
- A difference in the number of input/output flows between splits and joins less than 16-20

PATTERNS

Abstract syntax modifications (19)

Understandability
- Compacting
- Composition
- Omission
- Collapse
- Restriction
- Extension
- Merging

Understandability
Error probability
- Block-structuring
- Duplication

Understandability
Reusability
- Horizontal modularization
- Orthogonal modularization

Understandability
Error probability
Maintainability
Reusability
- Vertical modularization

Concrete syntax modifications (20)

Understandability
- Explicit representation
- Alternative representation
- Layout guidance
- Enclosure highlight
- Graphical highlight
- Pictorial annotation
- Textual annotation
- Naming guidance

PROACTIVE MODELING (47)

Syntactic quality
- Make structural modeling a static rule
- Use change operations

Semantic quality
- Use process mining
- Use natural language modeling

REACHING GoM (51)

Basic guidelines

Syntactic correctness
- Document the meta-model
- Use a tool for automatic syntactic checks

Semantic correctness
- Use clearly defined domains and scopes
- Use internal and external feedback loops
- Try to capture the 'soft' process-related issues

Relevance
- Have sufficient constructs in the meta-model to represent the elements of the real world
- Use continuous feedback loops

Economic efficiency
- Use process scope definitions and clear objectives and targets
- Use business frameworks
- Select only relevant users to participate in feedback loops
- Re-use models
- Use reference models
- Use state-of-the-art modeling tools

Optional guidelines

Clarity
- Use defined levels of model abstractions
- Use structured layout conventions
- Develop support documentation
- Link external objectives to model
- Use a tool that follows pre-specified layout standards

Comparability
- Use layout conventions
- Conduct consistency checks among modeling team members
- Use a tool that supports automatic consistency checks
- Use clearly defined naming conventions

Systematic design
- Involve the relevant participants
- Develop a meta-model that enables to integrate different views
- Use a tool that supports multiple views

WHY IS PMQ IMPORTANT? (Q6)

TO ACHIEVE PROCESS MODEL PURPOSES
- COMMUNICATION (43)
- SPECIFICATION (43)
- REFERENCE (26)

THAT ENABLE ORGANIZATIONAL ACTIVITIES (52)
- Develop software (47, 64)
- Management initiatives (54)
- Training (64)
- Estimate cost and budgets (64)
- Identify bottlenecks (38)
- Minimize design flows (24)
- Optimize business processes (24, 38)
- Automate business processes (3)
- Standardize business processes (49)
- Discover process weaknesses (13)
- Detect defects early (49)
- Brainstorming (13)
- Conform processes with norms (26)
- Conform processes with best practices (26)
- Efficient process modeling (26)

THAT LEAD TO ORGANIZATIONAL BENEFITS
- Financial (e.g. cash flow optimization)
- Time-related (e.g. throughput time reduction)
- Soft (e.g. customer satisfaction)
- Legal (e.g. compliance to regulations)

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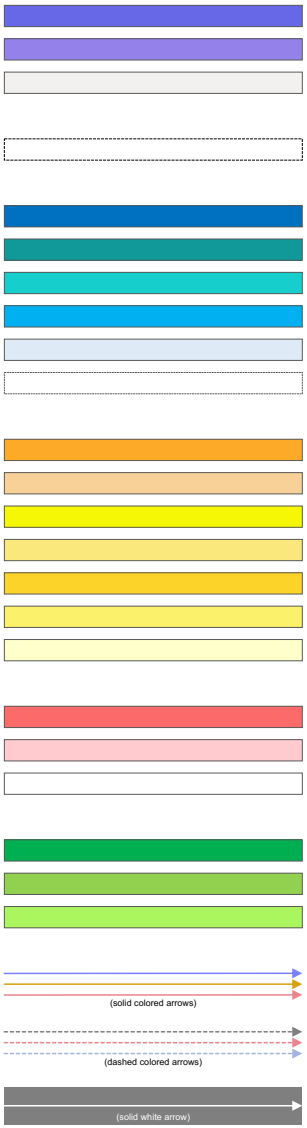
LEGEND



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