Assessing Integrated Measurement and Evaluation Strategies: A Case Study

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• Overview of integrated M&Estrategies
  • GOCAME
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Introduction (I)

For systematically carry out M&E projects and programs, software organizations should ...

- Establish clearly a set of activities and procedures
- Ensure that measures and indicators values are repeatable and comparable

It is necessary an integrated M&E strategy with three capabilities:
So we assume...

A strategy is suitable to carry out consistent and repeatable M&E projects if has and integrates three capabilities: conceptual base, process and methods/tools.

In this work our contribution is ...

- Understand and compare...
- Design the nonfunctional requirements...
- Implement the evaluation...
- Capability Quality of integrated M&E strategies

Develop improving actions for the M&E strategies
GOCAME Overview

GOCAME is an integrated M&E strategy which follows a goal-oriented and context-sensitive approach.

GOCAME has its terminological base defined as an ontology [Olsina et al. (5)], from which the C-INCA MI conceptual framework emerges [Olsina et al. (6)]

The GOCAME process embraces the following activities:

i) Define Nonfunctional Requirements;
ii) Design the Measurement;
iii) Design the Evaluation;
iv) Implement the Measurement;
v) Implement the Evaluation; and
vi) Analyze and Recommend [Becker et al. (4)]

WebQEM methodology provides an evaluation-driven approach, relying on experts and/or end users to evaluate and analyze different views of quality for software/web applications [Olsina et al. (7)]
GOCAME Overview

GOCAME process specification
GQM*Strategies Overview

It is an approach for evaluating goals and strategies (tactics) across all levels of an organization.

It is built on top of GQM (Goal-Question-Metric), which allows planning and implementing goal-oriented software measurement programs.  

The conceptual model (framework) consists of a set of terms grouped in a glossary. Terms are part of two primary components, namely: GQM*Strategies Element and GQM Graph.  

Two processes are defined, which may be performed in parallel:

1) Relate high-level business goals to operational objectives through the use of scenarios and tactics;
2) Relate measurement objectives to questions, and these, with their metrics.

GQM explicitly defines a methodology, covering several phases such as planning, definition, data collection and interpretation.
Case Study: Where are we?
Define Non-Functional Requirements

**Objective:** evaluate and compare the quality of capabilities of a M&E strategy, considering the three main capabilities.

**Information need:**
- **Purpose:** Understand and compare
- **Viewpoint:** Quality assurance leader
- **Category of the entity:** Integrated M&E strategy
- **Super-category:** Resource
- **Focus:** Capability quality

**Context properties:**
- **Application environment:** Academic and industrial environment
- **Availability of documentation:** Free access of public documentation
- **Level of integration (of the three) characteristics:** With simultaneous fulfillment
Define Non-Functional Requirements

1. Capability Quality (for M&E strategy)
   1.1. Process Capability Quality
      1.1.1. Activities Suitability
         1.1.1.1. Activities Description Availability
         1.1.1.2. Activities Description Completeness
         1.1.1.3. Process Breakdown Structure Granularity
         1.1.1.4. Activities Description Formality
         1.1.1.5. Role-to-Activity Allocation Availability
      1.1.2. Artifacts Suitability...
   1.1.3. Process Modeling Suitability...
         1.1.3.1. Functional View Suitability...
         1.1.3.2. Informational View Suitability...
         1.1.3.3. Behavioral View Suitability...
         1.1.3.4. Organizational View Suitability...
   1.1.4. Process Compliance...

1.2. Conceptual-Framework Capability Quality
   1.2.1. Conceptual Framework Suitability...
   1.2.2. Conceptual Base Suitability
      1.2.2.1. Conceptual Base Completeness
      1.2.2.2. Conceptual Base Structure Richness
   1.2.3. Conceptual Framework Compliance...

1.3. Methodology Capability Quality
   1.3.1. Methodology Suitability...
   1.3.2. Methodology Compliance...

The Non-functional requirements specification consists of 71 definitions:
17 (sub)characteristics, 31 attributes in the requirements tree, and 23 related attributes.

The degree to which a process is suitable and appropriate for supporting and performing the defined actions.

It represents the degree to which enunciated activities are described.

It represents the kind of the conceptual base structuredness level.
Case Study: Where are we?
Design the Measurement

Attribute: Activities Description Completeness

Attribute: Enunciated Activities

Attribute: Completely Described Activities

Attribute: Conceptual Base Structure Richness

Direct Metric:
Name: Degree of Conceptual Base Structure Richness (DCBSR)
Objective: to determine the extent to which the –strategy- conceptual base is rich from the semantic structuredness standpoint, as for example an ontology, taxonomy, dictionary, etc.

Measurement Method:
Name: DCBSR determination
Specification:
None → there is no conceptual base
Low → the conceptual base is represented as a dictionary or list of terms (glossary)
Medium → the conceptual base is represented as a taxonomy
High → the conceptual base is represented as an ontology

Categorical Scale:
Value Type: symbol
Scale Type: ordinal
Allowed values:
0 – None, there is no conceptual base
1 – Low, the conceptual base is represented as a dictionary or list of terms (glossary)
2 – Medium, the conceptual base is represented as a taxonomy
3 – High, the conceptual base is represented as an ontology

The metrics specification consists of 31 metrics: 16 are direct metrics, and 15 indirect metrics.
Case Study: Where are we?
Data collection was performed from Sep. to Dec., 2010 on published and accessible material scientific articles, books, graduate thesis, etc.

Implement the Measurement

Activities Description Completeness

<table>
<thead>
<tr>
<th></th>
<th>GOCAME</th>
<th>GQM+Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of Enunciated Activities (TEA)</td>
<td>47</td>
<td>101</td>
</tr>
<tr>
<td>Number of Minimally Described Activities (#MDA)</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Number of Partially Described Activities (#PDA)</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>Number of Completely Described Activities (#CDA)</td>
<td>0</td>
<td>0</td>
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</table>

Degree of Conceptual Base Structure Richness

<table>
<thead>
<tr>
<th></th>
<th>GOCAME</th>
<th>GQM+Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCDA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 si TAE= 0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[(#AMD<em>0,10+#APD</em>0,35+#ACD<em>0,55)/(TAE</em>0,55)]*100 si TAE&lt;&gt; 0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15,47 % 14,40 %

Conceptual Base Structure Richness

<table>
<thead>
<tr>
<th></th>
<th>GOCAME</th>
<th>GQM+Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of Conceptual Base Structure Richness</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

GOCAME High GQM+Strategies Low
Design the Evaluation

Attribute: Activities Description Completeness

**Elemental Indicator:**
- **Name:** Preference of Activities Description Completeness
- **Acronym:** P_ADC
- **Author:** Fernanda Papa
- **Version:** 0.1 **Weight:** 0.20

**Numerical Scale:**
- **Scale Type:** absolute
- **Unit name:** Percentage **Acronym:** %

**Function (Elementary Model):**
- **Name:** P_ADC function
- **Specification:** P_ADC = DADC

Global (Aggregation) Model:

**Function:**
- **Name:** LSP
- **Specification:**
  \[ G_i (r) = (W_1 * I_1^r + W_2 * I_2^r + ... + W_m * I_m^r)^{1/r} \]

**Numerical Scale:**
- **Scale Type:** absolute
- **Unit name:** Percentage (%)

**Decision Criteria/Acceptability Levels:**
- if \( 0 \leq X \leq 45 \): “unsatisfactory” → indicates change actions must take high priority.
- if \( 45 < X \leq 70 \): “marginal” → indicates a need for improvement actions.
- if \( 70 < X \leq 100 \): “satisfactory” → indicates satisfactory quality of the analyzed feature.

The indicators specification has 48 indicators

31 are elementary indicators, and 16 are partial and 1 global.

Attribute: Conceptual Base Structure Richness

**Elemental Indicator:**
- **Name:** Preference of Conceptual Base Structure Richness
- **Acronym:** P_CBSR
- **Author:** Fernanda Papa
- **Version:** 0.1 **Weight:** 0.20

**Numerical Scale:**
- **Scale Type:** absolute
- **Unit name:** Percentage **Acronym:** %

**Function (Elementary Model):**
- **Name:** P_CBSR function
- **Specification:**
  - High → 100%
  - Medium → 70%
  - Low → 30%
  - None → 0%
Case Study: Where are we?
Implement the Evaluation

Activities Description Completeness

**GOCAME**
- Measured value: 15,47%
- Indicator value: 15,47%

**GQM Strategies**
- Measured value: 14,40%
- Indicator value: 14,40%

Conceptual Base Structure Richness

**GOCAME**
- Measured value: High
- Indicator value: 100%

**GQM Strategies**
- Measured value: Low
- Indicator value: 30%

Thus all the indicators are calculated...
Case Study: Where are we?
Analyze and Recommend

1. Capability Quality (for M&E strategy)
   1.1. Process Capability Quality
   1.2. Conceptual-Framework Capability Quality
   1.3. Methodology Capability Quality

<table>
<thead>
<tr>
<th>GOCAME</th>
<th>GQM'Strategies</th>
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<tbody>
<tr>
<td>66.48</td>
<td>45.89</td>
</tr>
<tr>
<td>58.88</td>
<td>54.34</td>
</tr>
<tr>
<td>75.09</td>
<td>35.88</td>
</tr>
<tr>
<td>77.43</td>
<td>59.40</td>
</tr>
</tbody>
</table>

Recommendation action for improvement:
Define a template with the following fields: objective, description, pre-condition, post-condition, input and output, and fill them accordingly for each activity.

1.1. Process Capability Quality
   1.1.1. Activities Suitability
      1.1.1.1. Activities Description Availability
      1.1.1.2. Activities Description Completeness
      1.1.1.3. Process Breakdown Structure Granularity
      1.1.1.4. Activities Description Formality
      1.1.1.5. Role-to-Activity Allocation Availability

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<tr>
<td>58.88</td>
<td>54.34</td>
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<td>46.67</td>
<td>38.37</td>
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<tr>
<td>31.91</td>
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<td>15.47</td>
<td>14.40</td>
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<tr>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>100</td>
<td>61.39</td>
</tr>
<tr>
<td>0</td>
<td>17.80</td>
</tr>
</tbody>
</table>

Recommendation action for improvement:
Specify the terminological base as an ontology.

1.2. Conceptual-Framework Capability Quality
   1.2.1. Conceptual Framework Suitability
      1.2.1.1. Conceptual Framework Modularity
      1.2.1.2. Conceptual Framework Modeling Formality
   1.2.2. Conceptual Base Suitability
      1.2.2.1. Conceptual Base Completeness
      1.2.2.2. Conceptual Base Structure Richness
   1.2.3. Conceptual Framework Compliance
      1.2.3.1. Framework-to-C-Base Terminological Compliance

<table>
<thead>
<tr>
<th>GOCAME</th>
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<tbody>
<tr>
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<td>81.82</td>
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<td>0</td>
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<tr>
<td>84.31</td>
<td>81.82</td>
</tr>
<tr>
<td>84.31</td>
<td>81.82</td>
</tr>
</tbody>
</table>
Conclusion and Future Work

- **Integrated M&E Strategies** should be based on the three principles/capabilities (conceptual base, process and methods/tools) in order to make more robust the analysis and decision-making process.

- The literature does not consider the need for an integrated strategy, and the evaluation of these kind of strategies has been neglected.

- We presented a case study aimed at **understanding** and **comparing** integrated strategies for measurement and evaluation, considering a strategy as a **resource** from the **entity category** standpoint.

  → Nonfunctional requirements Design
  → Measurement
  → Evaluation
  → Analysis and Recommendations

**Establish improvement actions for the GOCAME strategy**
Questions...

Thank you for your attention!


