Assessing Integrated Measurement and Evaluation Strategies: A Case Study

María Fernanda **Papa**, Pablo **Becker**, Luis **Olsina**

Facultad de Ingeniería - UNLPam,

General Pico - La Pampa - Argentina

{pmfer, beckerp, olsinal}@ing.unlpam.edu.ar

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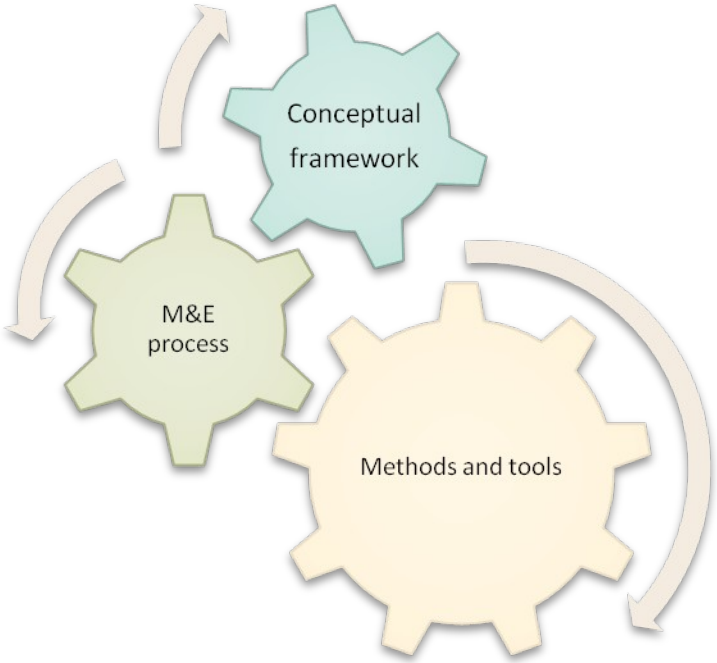
Introduction (I)

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:

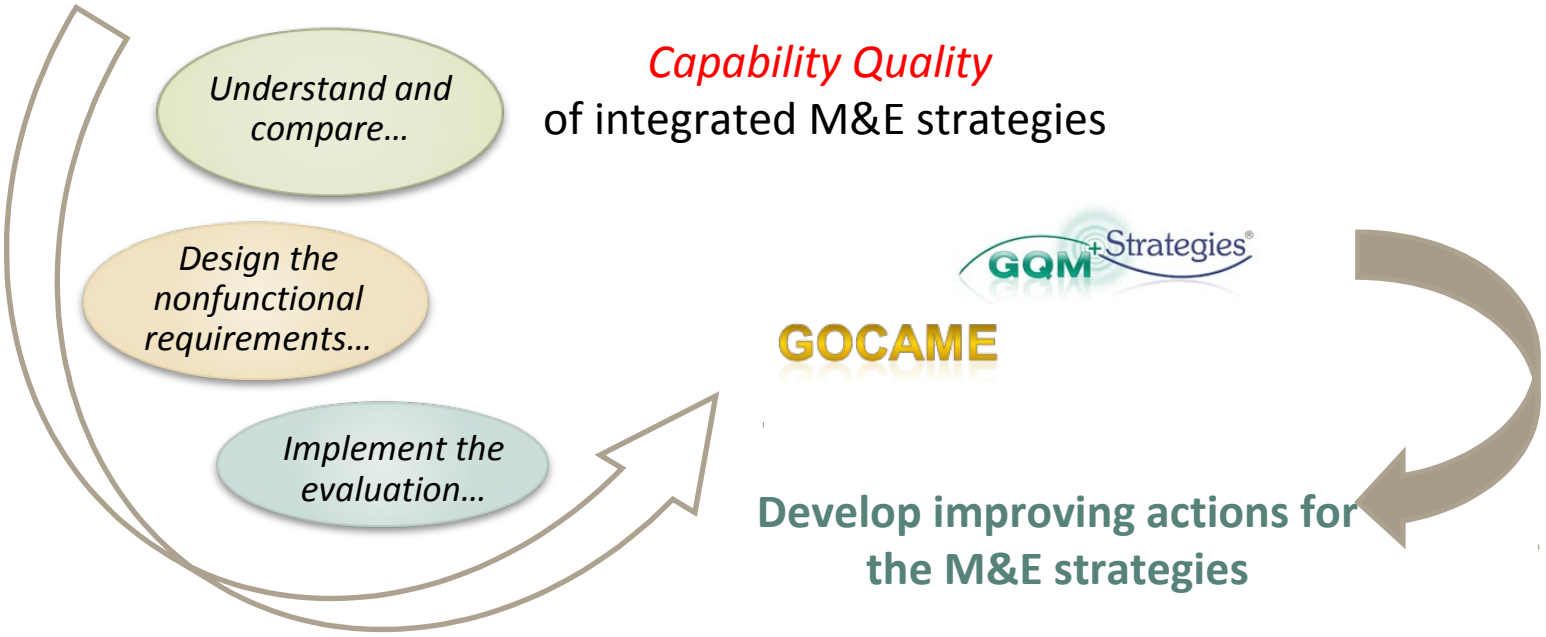


Introduction (II)

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 …

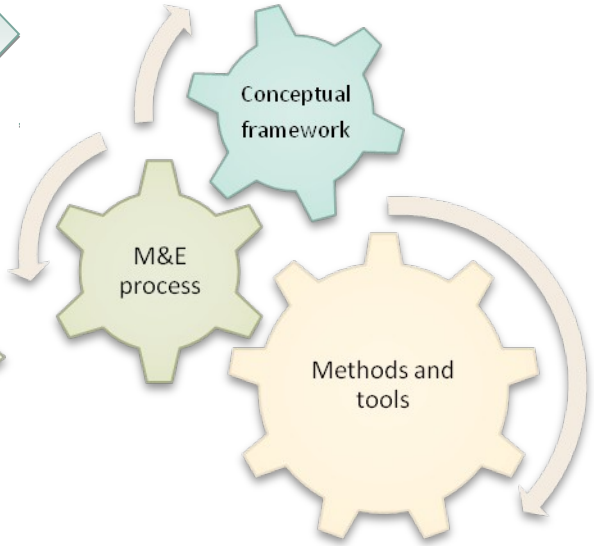


GOCAME Overview

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-INCAMI conceptual framework** emerges [*Olsina et al. (6)*]

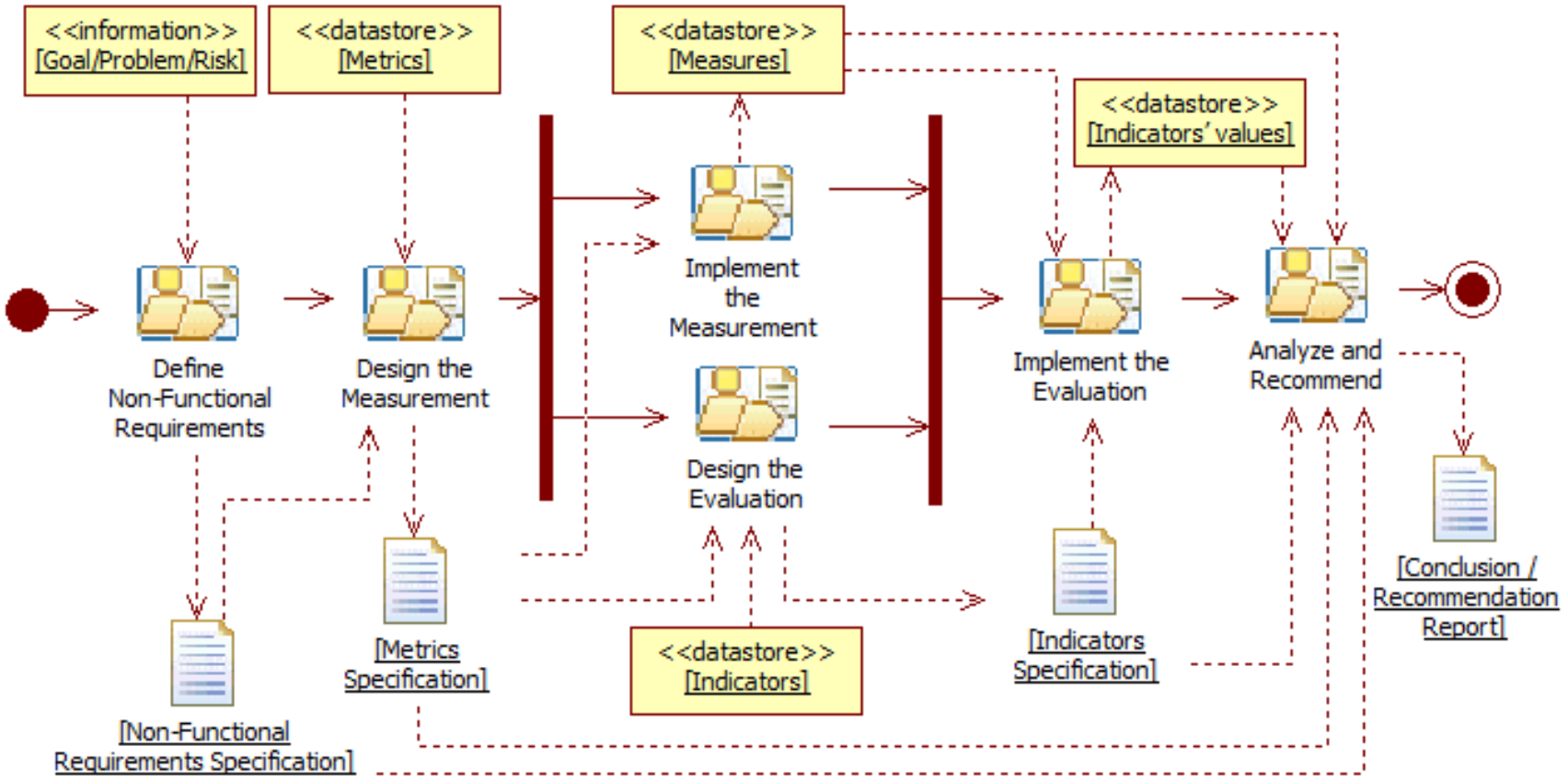
The **GOCAME process** embraces the following activities:
i) Define Nonfunctional Requirements;
ii) Design the Measurement;
iii) Design the Evaluation;
iv) Implement the Measurement;
v) Implement the Evaluation; and
vi) Analyze and Recommend [*Becker et al. (4)*]



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

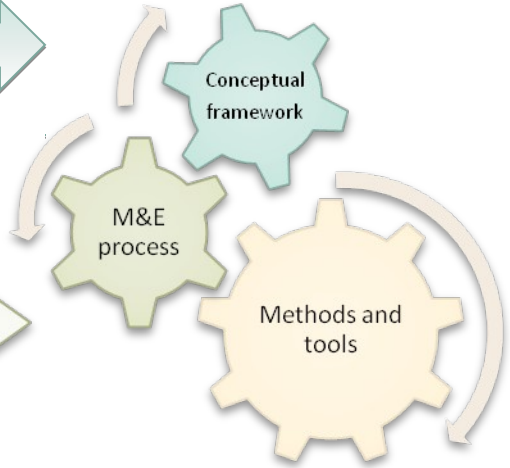


GQM+Strategies Overview

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. [*Basili et al. (1)*]

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*. [*Basili et al. (2, 3)*]

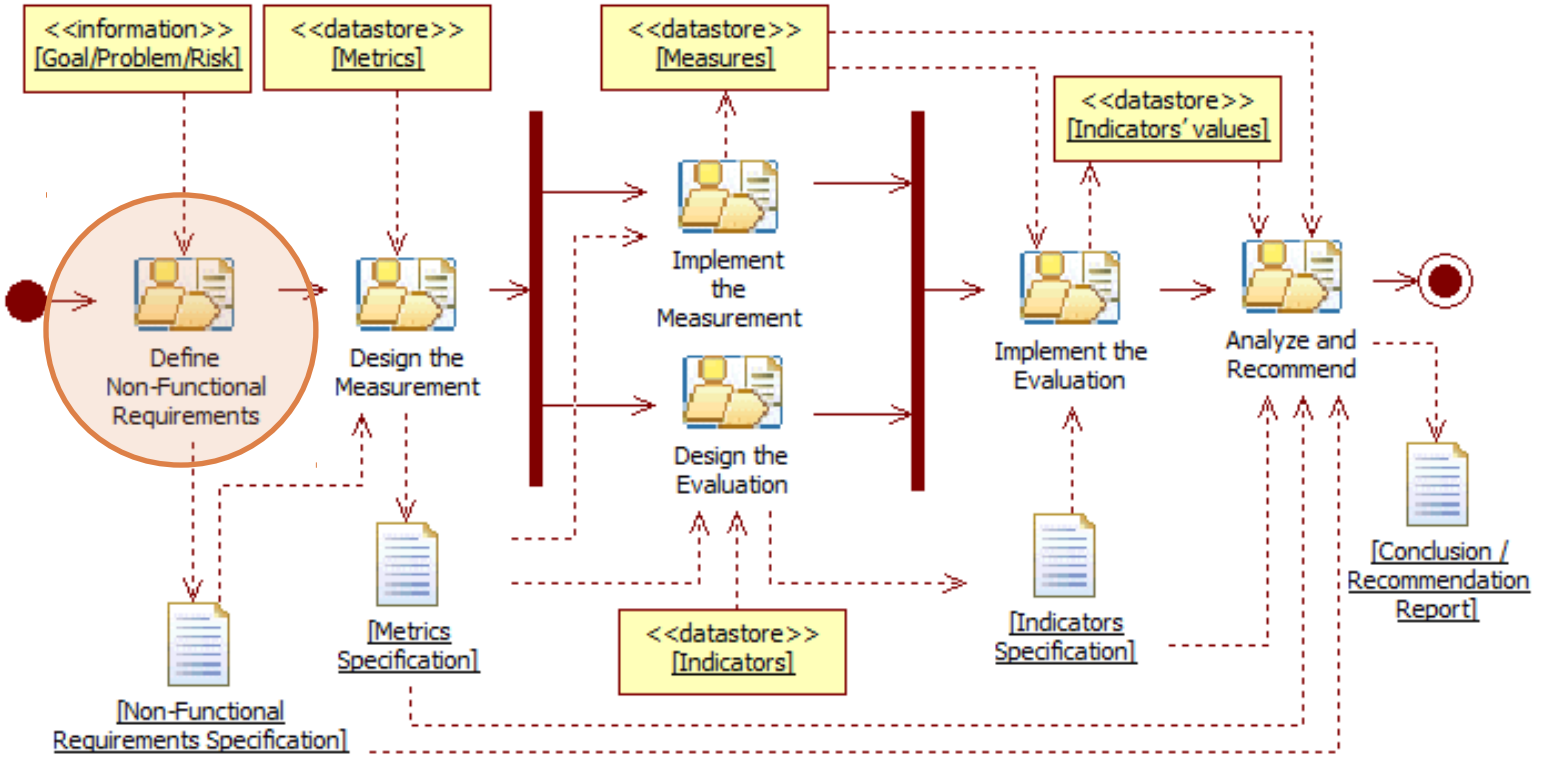


Two **processes** are defined, which may be performed in parallel:

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. [*Solingen (8)*]

Case Study: Where are we?

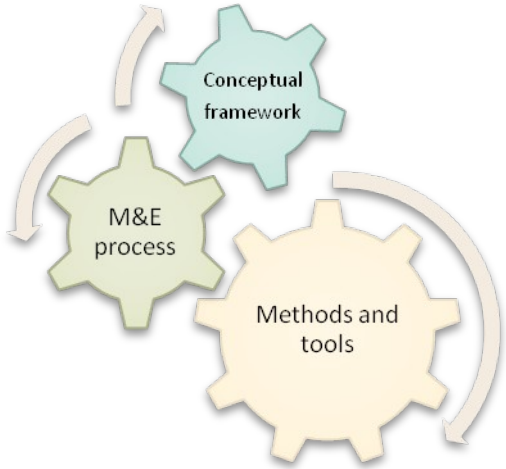


Define Non-Functional Requirements

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

Th… activ… that … nee…

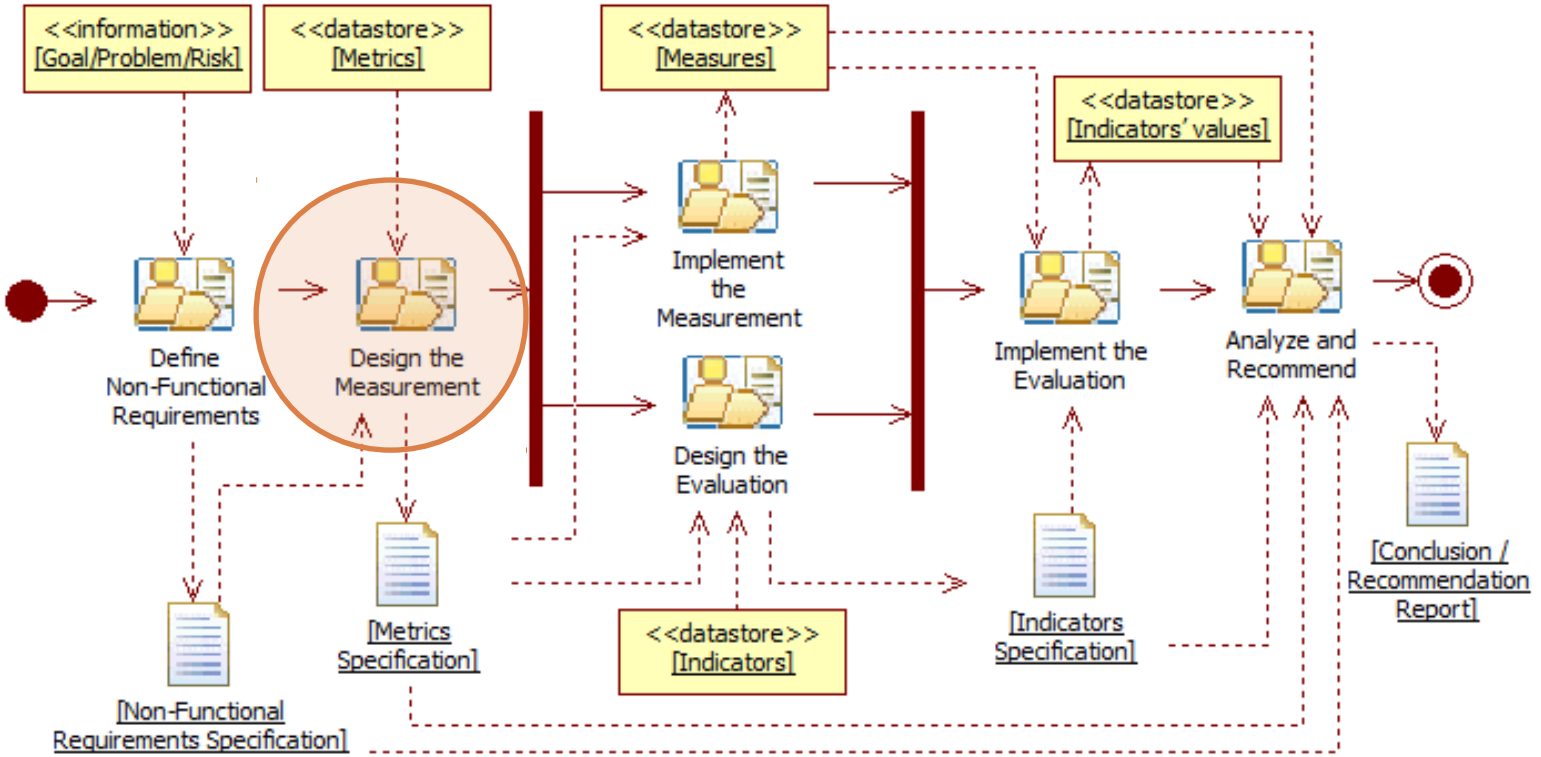
The **Non-functional requirements specification** consists of 71 definitions:

17 (sub)characteristics, 31 attributes in the requirements tree, and 23 related attributes.

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 :

DCBSR →
- 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)

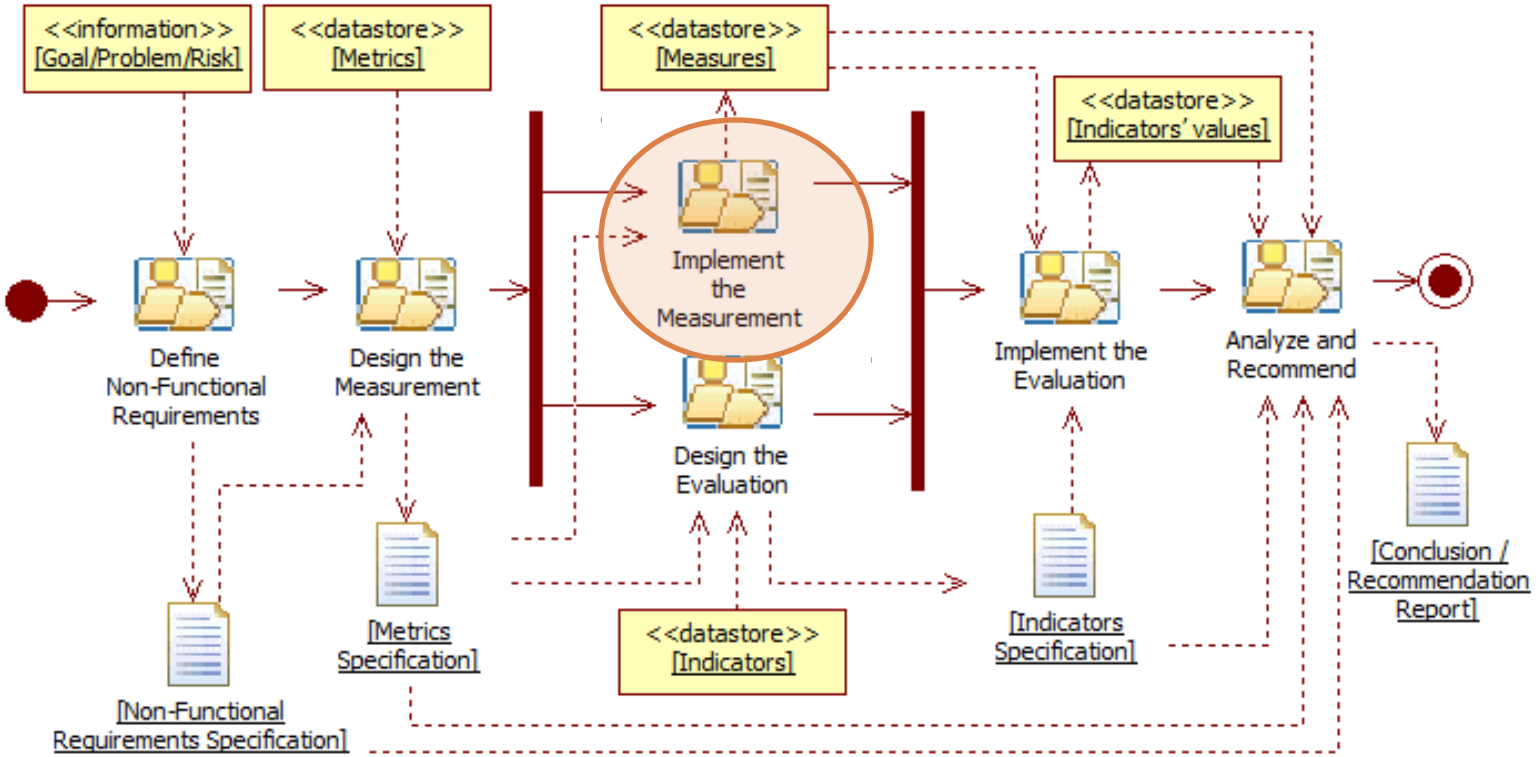
2 – Medium, the conceptual base is represented as a taxonomy

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?



Implement the Measurement

Data collection was performed from Sep. to Dec., 2010
on published and accessible material scientific articles, books, graduate thesis, etc.

The most relevant documents.

At least one member of the authors of the original research.

The current documents when they represented a contribution

Activities Description Completeness	GOCAME	GQM+Strategies
Total number of Enunciated Activities (TEA)	47	101
Number of Minimally Described Activities (#MDA)	5	3
Number of Partially Described Activities (#PDA)	10	22
Number of Completely Described Activities (#CDA)	0	0

GCDA

$$\begin{cases} 0 \textbf{ si TAE= 0} \\ [(\#AMD*0{,}10+\#APD*0{,}35+\#ACD*0{,}55)/(TAE*0{,}55)]*100 \textbf{ si TAE<> 0} \end{cases}$$

GOCAME 15,47 %

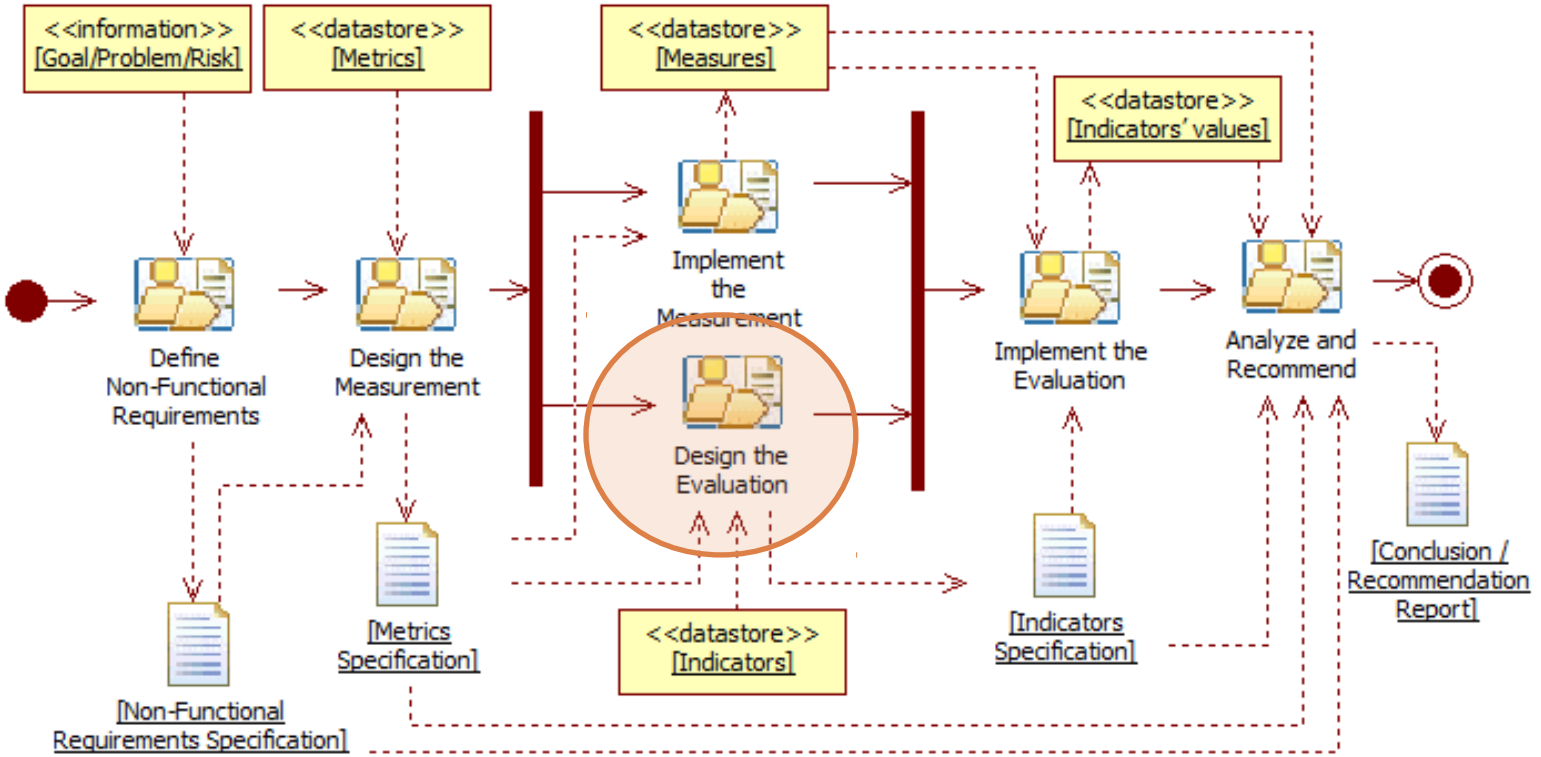
GQM+Strategies 14,40 %

Conceptual Base Structure Richness	GOCAME	GQM+Strategies
Degree of Conceptual Base Structure Richness	High	Low

GOCAME High

GQM+Strategies Low

Case Study: Where are we?



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:
$G_l(r) = (W_1 * I_1^r + W_2 * I_2^r + ... + W_m * I_m^r)^{1/r}$

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

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

Attribute: ***Conceptua***

Elemental Indicator:
Name: Preference of
Acronym: P_CBSR
Author: Fernanda Papa
Version: 0.1 **Weight:** 0.20

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

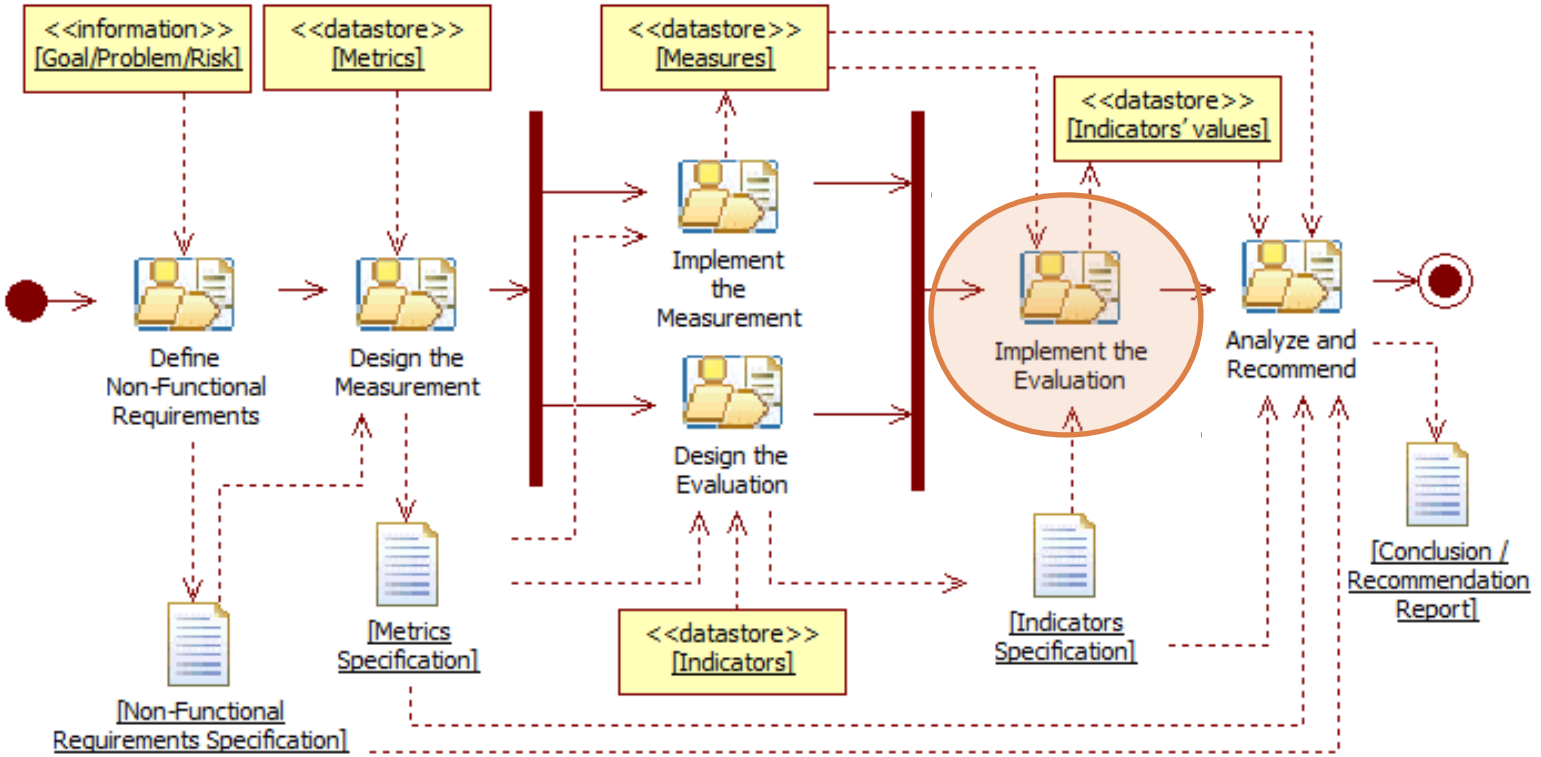
Function (Elementary Model):
Name: P_CBSR function
Specification:

P_CBSR
- High → 100%
- Medium → 70%
- Low → 30%
- None → 0%

The **indicators specification** has 48 indicators

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

Case Study: Where are we?



Implement the Evaluation

Activities Description Completeness

GOCAME — Measured value: 15,47%

GQM+Strategies — Measured value: 14,40%

P_ADC = DADC

Indicator value: 15,47%

Indicator value: 14,40%

Conceptual Base Structure Richness

GOCAME — Measured value: High

GQM+Strategies — Measured value: Low

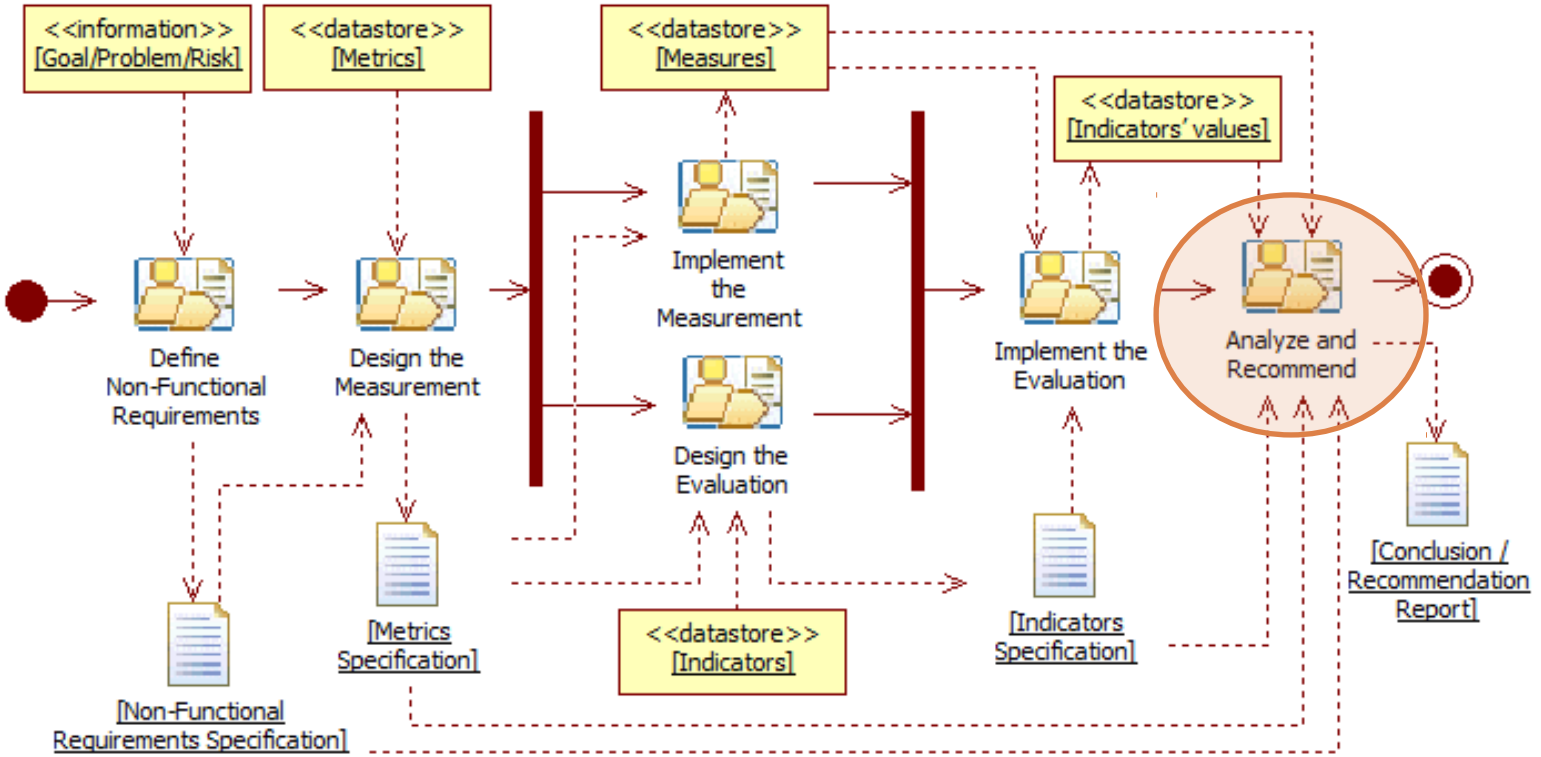
P_CBSR =
High→ 100%
Medium→ 70%
Low→ 30%
None→ 0%

Indicator value: 100%

Indicator value: 30%

Thus all the indicators are calculated...

Case Study: Where are we?



Analyze and Recommend

	GOCAME	GQM+Strategies
1. **Capability Quality** (for M&E strategy)	66.48	45.89
1.1.**Process Capability Quality**	58.88	54.34
1.2. **Conceptual-Framework Capability Quality**	75.09	35.8
1.3. **Methodology Capability Quality**	77.43	5

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.

	GOCAME	GQM+Strategies
1.1.**Process Capability Quality**	58.88	54.34
1.1.1.Activities Suitability	46.67	38.37
1.1.1.1. Activities Description Availability	31.91	24.75
1.1.1.2. Activities Description Completeness	15.47	14.40
1.1.1.3. Process Breakdown Structure Granularity	70	70
1.1.1.4. Activities Description Formality	100	61.39
1.1.1.5. Role-to-Activity Allocation Availability	0	17.81

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

	GOCAM	
1.2. **Conceptual-Framework Capability Quality**	75.09	
1.2.1. Conceptual Framework Suitability	75	
1.2.1.1. Conceptual Framework Modularity	50	0
1.2.1.2. Conceptual Framework Modeling Formality	100	50
1.2.2. Conceptual Base Suitability	68.53	18.52
1.2.2.1. Conceptual Base Completeness	21.33	1.33
1.2.2.2. Conceptual Base Structure Richness	100	
1.2.3. Conceptual Framework Compliance	84.31	81.82
1.2.3.1. Framework-to-C-Base Terminological Compliance	84.31	81.82

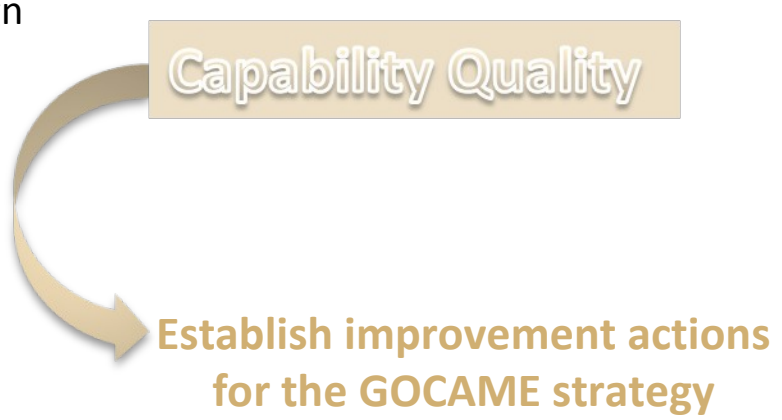
Conclusion and Future Work

- **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



Questions…

Thank you for your attention!

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