Goal Question Metric (GQM) and Software Quality

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Topics

• Relationship to software quality
• GQM in a nutshell
• Types of goals
• Mechanics of GQM
• Summary, important points, suggestions
Purpose

• Communicate information about GQM

• Point you to references

• Ask that you involve the relevant stakeholders if you try this approach
What does GQM have to do with Software Quality?

• **If** successful software development is related to
  – Appropriate development environments
  – Using disciplined processes
  – Defining, collecting – analyzing useful data
  – Acting on the analysis results

• **Then**
  – GQM is **a** method to help

• **Else**
  – Look elsewhere
History – background

- Victor Basili and David Weiss
  - NASA Goddard Space Flight Center
  - Quantify the (then) proposed methods of “preventing errors” in software

- But …

- Other disciplines have data – what about software
  - Confounding factors
  - Controlled studies are very expensive
More History

• Early 80’s – experimented with ways to collect data

• Tried “solution” at NASA / Goddard Space Flight Center

• 1984 – Victor Basili and David Weiss “A Methodology for Collecting Valid Software Engineering Data”
  – “How to” collect valid AND useful data

• This method “became” GQM
GQM is

• Top down
  – Goals
  – Questions related to goals
  – Define metrics to answer questions

Measurement system
GQM in a nutshell

1) What are the **goals**

2) What **questions** are needed to
   - Define/refine the goals
   - Learn about progress toward goal(s)

3. **What metrics** are needed
   - Answer the questions
   - Determine if the goal has been achieved
BUT WAIT

• There’s more
GQM - part 2

4) Define - deploy data collection mechanisms

5) Collect, check, analyze data \textit{in real time}
   – Adjust data collection mechanisms
   – Adjust projects

6) Determine if goal is achieved
Goals – two types

May be VERY HARD to differentiate

Our focus: Measurement goals
GQM “Tree”

• Three “levels”
  – “Conceptual” – Goals
    • What to accomplish
  – “Operational” – Questions
    • How to meet the goal
  – “Quantitative” – Metrics
    • Metrics to answer questions
Recap

• Top down
  – Represented as a tree

• Two phases
  – GQM definition
  – Deployment, analysis, process adjustment and check

• Two types of goals
  – Business
  – Measurement
Mechanics of GQM

1. Determine the goals
2. Create the questions
3. Define the metrics/measures
Determine the Goals

• Each goal addresses
  – Object – what is being examined
  – Purpose – why object is being examined
  – Focus – attribute being examined
  – Viewpoint – perspective of examination
  – Environment – context of scope of examination
Two ways to create goals

• Build a sentence addressing each topic
  – “… object, purpose, quality attribute, perspective/viewpoint, environment…”

• Use a table
Example – sentence format

Analyze the unit test process to understand the impact of adding additional tests to project K from the viewpoint of the project manager.
Example – sentence format

Analyze the **unit test process** to **understand the impact of adding additional tests** to **project K** from the viewpoint of the **project manager**.

**Object** – unit test process

**Purpose** - understand

**Focus** – impact of adding additional tests

**Viewpoint** – project manager

**Environment** – project K
### Example – table format

<table>
<thead>
<tr>
<th>Topic</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyze (The object to be measured)</td>
<td></td>
</tr>
<tr>
<td>For the purpose of (understanding, controlling, improving …)</td>
<td></td>
</tr>
<tr>
<td>With respect to (The quality attribute of interest)</td>
<td></td>
</tr>
<tr>
<td>From the viewpoint of (who measure the object)</td>
<td></td>
</tr>
<tr>
<td>In the context of (The environment for the measurement)</td>
<td></td>
</tr>
</tbody>
</table>
### Example – table format

<table>
<thead>
<tr>
<th>Topic</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyze (The object to be measured)</td>
<td>Unit test process</td>
</tr>
<tr>
<td>For the purpose of (understanding, controlling, improving …)</td>
<td>To understand</td>
</tr>
<tr>
<td>With respect to (The quality attribute of interest)</td>
<td>Impact of adding additional tests</td>
</tr>
<tr>
<td>From the viewpoint of (who measure the object)</td>
<td>Project manager</td>
</tr>
<tr>
<td>In the context of (The environment for the measurement)</td>
<td>Project K</td>
</tr>
</tbody>
</table>
## Another example – table format

<table>
<thead>
<tr>
<th>Topic</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyze (The object to be measured)</td>
<td>Customer call database</td>
</tr>
<tr>
<td>For the purpose of (understanding, controlling, improving …)</td>
<td>To understand</td>
</tr>
<tr>
<td>With respect to (The quality attribute of interest)</td>
<td>How many user interface defects are reported</td>
</tr>
<tr>
<td>From the viewpoint of (who measure the object)</td>
<td>Customer</td>
</tr>
<tr>
<td>In the context of (The environment for the measurement)</td>
<td>XYZ Project</td>
</tr>
</tbody>
</table>
Mechanics of GQM

1. Determine the goals

2. Create the questions

3. Define the metrics/measures
Questions

• Move from abstract (conceptual level) to operational level
• “Have we reached the goal?”
• Clarify the goals
• Involves all stakeholders

• Objective – shared understanding
Questions

• Goal: Analyze the unit test process to understand the impact of adding additional tests to project K from the viewpoint of the project manager.

• Q1: What is our test time now?
• Q2: How effective are we at finding defects?
• Q3: What about escapes?
• Q3: What happened when we last added tests?
• Q5: …
Meanwhile …

Goal: Analyze the unit test process to understand the impact of adding additional tests to project.

Is this what I REALLY want? Is this my goal?

Or … Do I want something else?
Goal: Analyze the unit test process to understand the impact of adding additional tests to project.
Goal 1: Analyze the unit test process to understand the impact of adding additional tests to project K from the viewpoint of the project manager.

Q1: What is our test time now?

Q2: How effective are we at finding defects?

Q3: What about escapes?

Q4: What happened when we last added tests?
Mechanics of GQM

1. Determine the goals
2. Create the questions
3. Define the metrics/measures
Define the metrics

- Move from the questions (operational level) to quantitative level
- Objective
  - Define what data will be collected
  - Create operational definitions
- Refine questions and (maybe) goals
Critical element

• Involve the people who will collect the data
• Learn
  – What is available
  – How to get it
  – Level of effort to obtain

  – Accuracy - validity
Types of metrics

• Objective - Counts of things or events
• Absolute - Size of something independent of other things
• Explicit - Obtained directly
• Derived - Computed from explicit and/or derived
• Dynamic – related to time
• Static – independent of time
Goal 1: Analyze the unit test process to understand the impact of adding additional tests to project K from the viewpoint of the project manager.

Q1: What is our test time now?

Q2: How effective are we at finding defects?

Q3: What about escapes?

Q4: What happened when we last added tests?

M1: Number of tests run per week

M2: Time for each test (pass)

M3: Number of tests that find a defect and stop

M4: Number of defects found in unit test

M5: Number of defects found in integration test that should have been found in unit test

M6: Number of tests added
Mechanics of GQM

1. Determine the goals

2. Create the questions

3. Define the metrics/measures
Sum up

- **Goal focused, data driven, improvement model**
- Top down approach to define
  - Goals
    - Improvement
    - Characterization
    - Understanding
  - Questions to answer about the goal
  - Metrics to provide answers to the questions
- Has two phases
  - Definition – define the Gs, Qs and Ms
  - Deployment, analysis, process adjustment and checking
Important points

• Creating the Gs, Qs and Ms is iterative
  – Questions refine goals
  – Metrics refine questions
  – Ability to obtain data refines metrics

• Requires stakeholder involvement
  – Especially those that record/capture the data
Suggestions

- GQM – it’s a project - have a plan
- Iteratively develop and implement
- You can pick the wrong metrics
- Analyze data early and often
- Define a data analysis process
  - Does the collected data answer the questions and address the goal?
  - Avoid using the data for things other than the questions and the goal. No data “mining”
Finally

- GQM is a TOOL
- Be cautious – if all you have is a
Food for thought

• “You can observe a whole lot just by watching.” Yogi Berra

• “Effort moves toward whatever is measured.” Tom DeMarco
References and other reading


3. DACS is a Department of Defense Information Analysis Center ([www.thedacs.com](http://www.thedacs.com))


Thank you for listening.
Questions – comments - suggestions