



Case Study:
The Metrics Program
Emirates Group IT



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Abstract

According to Tom DeMarco, “You cannot control what you cannot measure” [1]. Imagine going on a road trip of over a few hundred miles. This is easy because most of us really have done this several times. Now imagine that your car has no speedometer, no odometer, no fuel gauge, and no temperature indicator. Imagine also that someone has removed the mile markers and road signs from all the roads between you and your destination. Just to complete the experiment, take off your wrist watch.

What was once a simple journey now becomes an endless series of guesses, fraught with risk. How do you know where you are, how far you have gone, or how far you have to go? When do you gas the car? Should you stop here or try to make the next town before nightfall? You could break down, run out of gas, be stranded, take the wrong road, bypass your destination, or waste time trying to find your location and how to reach your destination. Clearly, some method of measuring certain indicators of progress is essential for achieving a goal.

This article highlights the basic principles of measures and metrics adopted by Emirates Group - IT to achieve their organizational goals.

Introduction

What is Metrics Management?

It is made up of two correlated words ‘Metrics’ and ‘Management’.

A very fundamental definition of Metrics is ‘A Standard for measurement’. Similarly for Management ‘it is an act of managing or judicious use of means to accomplish an end’.

Now we can easily conclude that Metrics Management means dealing with the management of different measures to achieve our goals. Just to elaborate on this, let’s take an example of an obstacle free road of X miles in length and car with a speed of Y miles per hour. If we need to cover X miles in our car, it will reach destination in X/Y hours. However it will remain our estimated projection of time unless we actually achieve our goal in X/Y hours. For this we have make sure that:

- a) the car doesn’t vary the speed from Y miles per hour.
- b) our assumption of an obstacle free road holds true throughout the journey.
- c) the car does not stop at any point during the journey.

The challenge will be to monitor the speed throughout the journey to achieve the desired objectives.

The Measurement Model

Emirates Group – IT has used the GQM Model to derive its own measurement model for defining, collecting and analyzing metrics. GQM is a top-down approach to establish a goal-driven measurement system for software development. In this model the team starts with organizational goals, defines measurement goals, poses questions to address the goals, and identifies metrics that provide answers to the questions. GQM defines a measurement model on three levels as illustrated in figure [1] below.

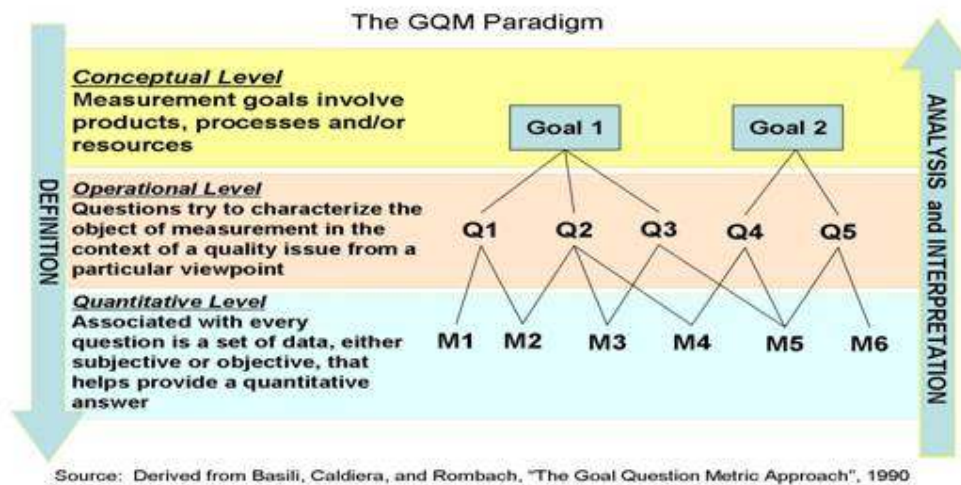


Figure 1: The GQM Paradigm

Developing a Metrics Program Plan

The first activity in developing a metrics program is planning. Metrics planning is usually based on the goal-question-metric (GQM) paradigm developed by Victor Basili (see Figure 2). The GQM paradigm is based on the following key concepts:

1. Processes, including software development, program management, etc., have associated goals.
2. Each goal leads to one or more questions regarding the accomplishment of the goal.
3. Each question leads to one or more metrics needed to answer the question.
4. Each metric requires two or more measurements to produce the metric (e.g., miles per hour, budget spent vs. budget planned, temperature vs. operating limits, actual vs. predicted execution time, etc.).
5. Measurements are selected to provide data that will accurately produce the metric.



Figure 2: Basili's Goal, Question, Metric Paradigm

Basili and other GQM experts stress the importance of planning data collection mechanisms and planning how the resulting measurement data should to be organized and presented in order to maximize its value to the stakeholders who will interpret the results in relation to the goals. The literature notes that when measurement programs fail, the primary cause of failure is often a lack of attention to how the measurement results will be used.

Define Goals

Planning begins with well defined and validated goals. Goals should be chosen and worded in such a way that they are achievable and verifiable - that is, their accomplishment can be measured or observed in some way.

There are two types of goals - business goals and measurement goals. Business goals drive the identification of measurement goals.



It is not important whether the business goals are developed under the umbrella of GQM, or as a function of organizational strategic planning. Business goals must exist; they must be identified and be the focus for establishing the measurement goals. Without them, the measurement program has no focus and without this alignment, it is unlikely that implementing the rest of GQM will have a significant impact. When business goals exist, then multiple projects or sub-groups within an organization have a basis for identifying the measurement goals relating to their role or scope of influence within the organization.

Goals should meet the following criteria:

- They should support the successful accomplishment of the project's overall or system-level goals.
- They should be verifiable, or measurable in some way.
- They should be defined in enough detail to be unambiguous.

Derive Questions

Each goal should evoke questions about how its accomplishment can be measured. By answering the questions, one should be able to conclude whether a goal is reached. Questions help identify interpretations of the goal that may exist among the stakeholders as well as constraints imposed by the environment.

For example, completing a project within a certain budget may evoke questions such as these: What is my total budget? How much of my budget is left? What is my current spending rate? Am I within the limits of my spending plan?

Typically, at the project level (or perhaps for a group of related projects), conceptual measurement goals are identified relating to product quality, process, resources, or the environment. The project team then identifies questions that the team (individually or collectively) feels should be asked to capture various perspectives of the goal and address whether the goal is being met. These questions would typically uncover all of the nuances and perceptions relating to the goal, addressing both perceptions of quality and the context or environment in which the object will evolve. This is essentially a process of stakeholders converging on a common understanding and interpretation of the goal at the appropriate level of abstraction. In other words, the individual project managers and software engineers provide their perspective of what the goal means in the given environment. They do this by posing questions and responding to them with their metrics. Figure 3 provides a simplified example illustrating some of the questions that might emerge for the specified goals.

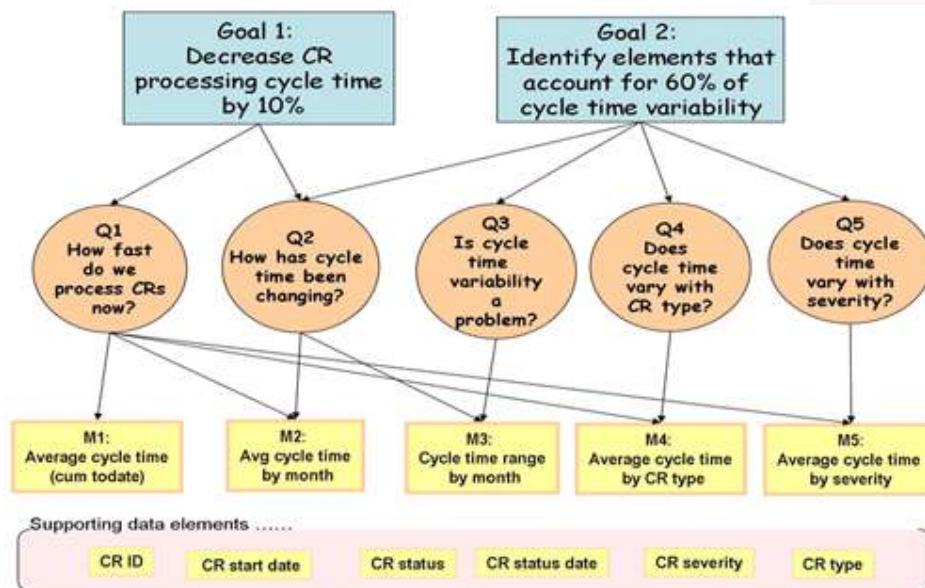


Figure 3: Sample of GQM Definition Phase



Develop Metrics

Metrics are the information needed to answer the derived questions. Each question can be answered by one or more metrics and these metrics are defined and associated with their appropriate questions and goals. Typically, each metric requires two or more measurements of data that must be collected and analyzed to produce the metric. Measurement collection should not cause a significant overhead of effort, therefore measurements are selected that will provide the necessary information with the least impact to the project workflow.

Choosing the correct type of measures is a critical and nontrivial step. Measurements that require too much effort or time can be counterproductive and should be avoided. In addition to choosing what type of data to collect or measure, the methods of processing or analysis must also be defined in this step. Anything can be measured, but how do you turn the measurements into a meaningful metric? How does the metric then answer the question? Is the question the right one to be asking?

The analysis method should be carefully documented. Do not assume that it is obvious. This activity is complete when you know exactly what type of data you are going to collect (what you are going to measure and in what units), how you are going to turn that data into metrics (analysis methods), and in what form (units, charts, colors, etc.) the metrics will be delivered.

So far, we have determined how to derive metrics. Now we are going to look at the main aspects of implementing the GQM paradigm and the one that defines the data collection process, analysis and decision making.

Preparing for Data Collection

Once the metrics are identified, one can determine what data items are needed to support those metrics, and how those items will be collected. The metric provides insight regarding how the data needs to be organized in order to be meaningful to the viewer / recipient of the information. A significant amount of planning is necessary to provide the detailed procedures for data collection that support the identified metrics. Most projects accomplish this detailed planning by preparing a *Measurement Plan* that includes at least the following:

- What data is to be collected?
- What will be the source of the data?
- How is it to be measured?
- Who will perform the measurement?
- How frequently should the data be collected?
- Who will be the recipient of the derived metrics and in what format will they be presented?

The plan also defines and describes all types of data collection forms and automated data collection tools that should be used. It addresses the question of how the data can be collected most efficiently and effectively and to whom it should be delivered.

Referring to the example in Figure 3: Change Request processing time; one cannot assume that all stakeholders have the same understanding of what constitutes CR processing time. Does it begin when the CR is first documented, or after it is diagnosed and categorized for action? When is processing considered to be complete? Which CRs are included for averaging - only closed out CRs, or also those on hold? The *Measurement Plan* anticipates and addresses such questions.

Once a plan is developed, the measurement procedures need to be tested and validated before implementing the program. Exercising the forms and procedures during a trial period will reveal flaws that can subsequently be corrected before full-scale implementation of the measurement program begins, or before adding the new procedures and data to an existing program.

In addition, it is important to train individuals involved in data collection to ensure that they understand why the data is needed, how it is going to be used and how their action contributes to the overall validity of the data collection process.

Collecting, Validating and Analyzing the Data for Decision Making

If the metrics program is well planned, implementing the program should be reduced to simply following the plan. There are four activities in the metrics implementation cycle, shown in Figure 4

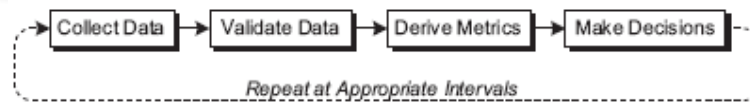


Figure 4: Metrics Implementation Cycle

Data is collected at specific intervals according to the plan. Data is then validated by examining it to ensure it is the result of accurate measurements, and that the data collection is consistent among members of the group if more than one individual is collecting it. In other words, is it being measured in the same way, at the same time, etc.? Once the data is determined to be valid, the metrics are derived by analyzing the data as documented in the metrics program plan. Metrics are then delivered to appropriate individuals and groups for evaluation and decision-making activities. This process is then repeated at appropriate intervals until the project is complete.

Analyzing the Data for Goal Attainment and Learning

Analysis is about organizing the data and preparing the metrics for presentation to the stakeholders to address the questions pertaining to the measurement goal. Typically, a Metrics Management team, together with the project team, develops an analysis plan as soon as they know what metrics are needed. The plan details how the data should be organized, what presentation formats are needed, who will review the data and when. Developing the analysis plan often helps with decisions about data collection. The term analysis meant to mean both analysis and interpretation, but some implementers of Metrics Program make a distinction between the two terms, primarily, to assert that the analysis can be done by the Metrics Management team (measurement expert), but the interpretation must be done by the project team who are the owners of the measurement goals.

Analysis and interpretation is an iterative step typically integrated with the progress reporting cycle of a project.

Evaluating a Metrics Program

It is likely that a metrics program will not be perfect in its first iteration. Soon after its initial implementation and at regular intervals after that, the metrics program should be evaluated to determine if it is meeting the needs of the metrics users, and if its implementation is flowing smoothly. If metrics prove to be insufficient or superfluous, the program plan should be modified to provide the necessary information and remove any unneeded activity. The objective of a metrics program is to provide sufficient information to support project success while keeping the metrics program as simple and unobtrusive as possible. The following are areas that should be considered when reviewing a metrics program:

- Adequacy of current metrics.
- Superfluity of any metrics or measures.
- Interference of measurements with project work.
- Accuracy of analysis results.
- Data collection intervals.
- Simplification of the metrics program.
- Changes in project or organization goals.

Metrics Repository

A final consideration is establishing a metrics repository where metrics history is kept for future projects. The availability of past metrics data can be a gold mine of information for calibration, planning estimates, benchmarking, process improvement, calculating return on investment, etc. At a minimum, the repository should store the following:

- Description of projects and their objectives.
- Metrics used.
- Reasons for using the various metrics.
- Actual metrics collected over the life of each project.
- Data indicating the effectiveness of the metrics used.



The Metrics Repository is essentially to document and share lessons learned, making the information available to future projects or for the next refinement of the improvement cycle.

At Emirates Group - IT, we analyze experiences from the individual projects in order to identify what improvements yield the biggest gain and under what circumstances. This information is then packaged for use in future projects in the form of guidelines, policies and procedures and, perhaps, support tools provided to the projects. This is difficult because future needs for measurement information are generally unknown. The more precisely you can describe your actual experiences and their specific context, the greater your chances for adaptive reuse.

The concept of a Metrics Repository for adaptive reuse is captured in what Basili has coined an “Experience Factory” (see Figure 5). It is an organizational concept established for institutionalizing the collective learning of the organization, the basis for their continual improvement.

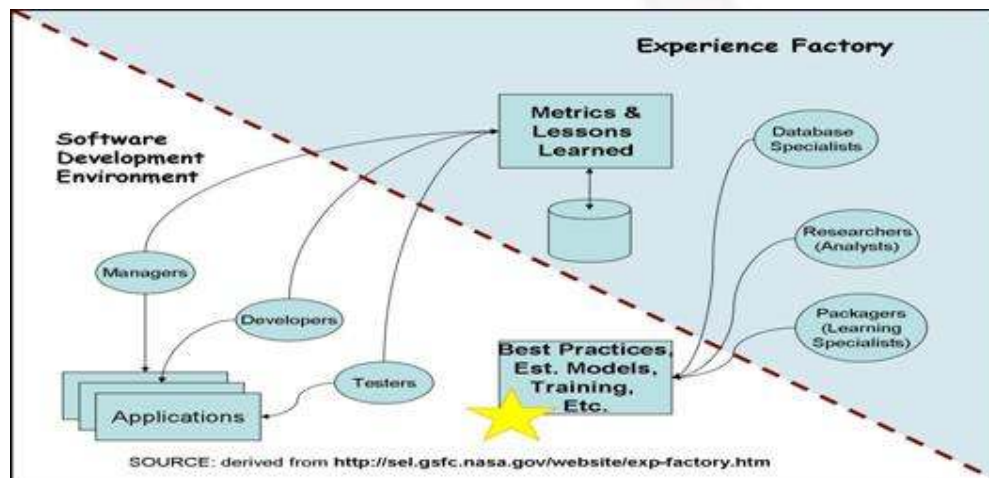


Figure 5: Concept of an Experience Factory

The concept was developed by Victor Basili and first implemented at the NASA Software Engineering Laboratory (SEL) in the late 1970s. The Experience Factory team focuses on organizing and preserving the information and data to optimize its reuse, and on presenting solid information back to the project groups to guide them in future projects.

ANTICIPATED BENEFITS OF IMPLEMENTATION:

The most obvious benefit of implementing a Metrics Program is the identification of meaningful metrics. However, additionally important benefits of this practice include:

- Achievement of improvement goals.
- Financial gains.
- Increased capability to perform improvement initiatives.
- Improved group synergy.
- Increased quality awareness and Quality Assurance (QA) involvement.

Emirates Group IT has used the Metrics Program to develop an integrated metrics set for quantitative management of performance, progress, cost, schedule, and resources across systems, software and hardware engineering disciplines. This approach has resulted in achieving CMMI for Software Level 3.



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