Set Up and Operation of a Design Process Measurement System

Included below is guidance for the selection and implementation of design and development process measurements. Specific measures can be found in the Supplemental Measurements Library located on the TL 9000 website (http://tl9000.org/resources/overview.html).

The Process Measurement System

A process is a set of activities that transforms inputs into outputs; a project is a unique occurrence of a process, with start and finish dates and with a specific goal to accomplish. Although the following discussion will focus on projects, it can easily apply to processes as well.

Usage of a process measurement system is an essential method to effectively monitor, manage and improve projects; the purpose of a measurement system is to help managers make better decisions.

Many good design process measurement models and guidebooks are available today, often supported by Users Groups or Support Centers (see references); most models identify a few basic elements for an organization willing to set up and operate its own process measurement system:

1. Define a set of measurements for the project at hand; this element is completed when a suitable measurement set is specified;
2. Put in place methods and tools to collect and report the selected measurements; this element is completed when measurement reports are issued on a regular basis;
3. Employ measurement results to help manage and improve the project; this element is completed when a number of management actions and improvement initiatives are routinely identified and implemented based on measurement analysis.

In addition, many models explicitly suggest systematically improving the measurement system. This is an ongoing effort that ensures the continued effectiveness of the measurement system according to the organizational needs.

Defining the Measurement Set

Element 1, the choice of a measurement set, is crucial to the success of the process measurement system. A poor choice of measurements can easily jeopardize the effectiveness of the whole measurement effort. Key to the choice of the measurement set is the establishment of the goals of the measurement activities. A suitable and economical measurement set is then derived from these goals.

Many aspects of a project can be measured such as costs, duration, inputs, outputs, defects, or adherence to plans. The usefulness of the measurements selected depends on the goals and perspective of the measurement users, and from the relevant issues of the specific project. The organization has to tailor the measurements in order to fit them to the specific project characteristics and needs.

Tailoring means:

- selecting a subset of measurements from a recommended measurement set;
- if needed, modifying individual measurements in the selected subset, e.g. changing the way of reporting, or changing some data definitions or formulas, or using the measurement only partially;

  For instance, for a given project the ‘milestone delay’ measurement could be selected from the recommended set, but it could be reported in the way of Milestone Trend Analysis (a graphical way) or as a list of delays per day or per week. Moreover, the reporting schedule for milestone delay could be different in different projects.

- if needed, adding new measurements to the selected subset.

Experience has shown that several factors can influence the tailoring of measurements to different degrees. The most important factors appear to be specific business goals and specific requests to measure or predict quality.

Other factors include:

- size, complexity and lead time of the specific project;
- availability of support tools, or existing current practices in the organization;
- needs for problem detection, project status tracking and process quality monitoring;
- needs for joint reviews, and/or regular reporting from organization to customer.

When first starting a process measurement system, it is recommended that a small set of measurements be defined which determine progress towards the measurement goals. The information should be straightforward to collect; otherwise it can negate the benefits of the measurement system. Over time, the measurement set can be expanded based on business needs and feedback from the existing process.

Useful guidance on tailoring measurements can be found in the references; among them, the GQM (Goal Question Metric), Software Productivity Center's 8-step Metrics Program, and PSM (Practical Software and Systems Measurement) methods put special emphasis on the tailoring process as the starting point of the measurement activities.

Collecting, Reporting and Analyzing Measurements

Elements 2 and 3 of the measurement system contribute to implementing the measurements selected in the tailoring process (element 1).

Collecting and reporting measurements is the technical part of the measurement effort, which requires adequate tools and needs to be integrated into the project life cycle activities. When starting up a process measurement system, take advantage of the measurements which are naturally part of the activities associated with the project. For example, tracking the number of defects found and how many have been fixed are natural by-products of testing activities.

The availability, timeliness, consistency, completeness and accuracy of the data determine the value of the resulting information. Moreover, the lag time between collecting and reporting should be as short as possible, so online access to the project databases is the preferred method of collecting project data.

Measurement analysis, on the other hand, is what enables the organization to reap the benefits of the investments made in the measurement system.

The analysis step should integrate quantitative measurement results and other qualitative project information, to provide managers with the feedback needed for effective decision making.

Useful guidance on collecting, reporting and analyzing measurements can be found in the references. Among them, the PSM guidebook is especially helpful and informative.

The next three sections are devoted to a short presentation of GQM, Software Productivity Center's 8-Step Metrics Program, and PSM.

Goal Question Metric

The GQM (Goal Question Metric) method originated in the early 1980s from the efforts of a number of researchers, led by V. R. Basili. They came to reject the notion of fixed sets of measurements, in favor of a method to help tailor measurements to specific organizational goals and environments.

Since these goals and environments will be extremely varied, so will be the selected measurements. The starting point for the measurement activities should be "What is the purpose of measurement?", and not "What measurements should we use?"

Identification of an explicit measurement goal is the cornerstone to GQM. This goal is then refined into several questions, and each question helps select measurements that provide information to answer that question.

As measurements are defined with an explicit goal identified, the information provided by the measurements will then be interpreted and analyzed with respect to that goal.

Software Productivity Center's 8-Step Metrics Program

Software Productivity Center, Inc. has devised the 8-Step Metrics Program, a guide to devising and implementing a measurements program. Although geared toward software, it can be applied to non-software processes as well.

The 8-Step Metrics Program consists of three basic components:

- Preliminary groundwork before starting a metrics program
- An infrastructure which describes the metrics to collect, how to collect them and how to use them.
- A method to follow and apply the metrics infrastructure to a project

The first aspect of the Software Productivity Center 8-Step Program is the groundwork before starting a metrics program:

- Identifying a sponsor
- Selling the program to senior management
- Creating a measurements team
- Determining how the metrics program will be documented and communicated to other staff members.

Performing these steps before starting a metrics program can save a lot of time and trouble in the long run and help make for a successful adoption of the program.

The infrastructure component is the second component of the 8-step metrics program. The goal of the eight steps is to create a process through which an ongoing metrics program can be utilized as a strategic management tool. These 8 steps are:

1. Document the Development Process
2. State the Goals
3. Define Metrics Required to Reach Goals
4. Identify Data to Collect
5. Define Data Collection Procedures
6. Assemble a Metrics Toolset
7. Create a Metrics Database

8. Define the Feedback Mechanism

The second component is the method to follow to apply the metrics infrastructure to a project. Software Productivity Center calls this method the Project Measurement Cycle. It includes:

- Choosing a project to measure
- Building team awareness
- Measuring the project
- Preparing the results
- Presenting the results and collecting feedback
- Implementing the changes
- Measuring again

The final component of the Software Productivity Center's 8-Step Program is the groundwork before starting a metrics program:

- Identifying a sponsor
- Selling the program to senior management
- Creating a measurements team
- Determining how the metrics program will be documented and communicated to other staff members.

Performing these steps before starting a metrics program can save time and trouble and help make for a successful adoption of the program.

Practical Software and Systems Measurement

The goal of the project is to provide Project Managers with the objective information needed to successfully meet cost, schedule, and technical objectives on projects.

Practical Software and System Measurement (PSM) is sponsored by the Department of Defense and US Army. PSM allows managers to identify the issues that are important to their projects, then implement a measurement program designed to provide insight into those issues throughout the project life.

Issues are areas of concern that may impact the achievement of a project objective. Issues include problems, risks, and lack of information.

Useful issue sources could be risk assessments, project constraints and assumptions, leveraged technologies, product acceptance criteria, external requirements and, of course, the project team's experience with similar projects.

Once the project specific issues have been identified, the next step is to map them to the PSM common issue areas. The seven common issue areas included in PSM are:

• Schedule and Progress • Resources and Cost • Product Size and Stability • Product Quality	• Process Performance • Technology Effectiveness • Customer Satisfaction

Common issue areas are then the entry points to the Measurement Selection and Specification Tables. These tables help select measurements from the basic PSM measurement set, comprising some twenty measurements categories and more than fifty individual measurements.

However, the choice is not limited to this recommended measurement set as it is possible to modify existing measurements and even add completely new ones.

PSM provides a free Guidebook and a free software tool, PSM Insight, to support the tailoring process and the measurement activities.

In using this tool, PSM's common issue areas are categories and measurements or, if preferred, the measurement analyst can develop new measurements to meet project information needs.

Data can be entered via the tool's customizable data entry screens or can be imported from a number of other sources. Once data is loaded into PSM Insight, its analysis capabilities can be used to generate measurement indicators, analyze and track trends, and report findings.

Measurement Usage

Design and development process measurements provide visibility within the organization about the implementation status and the quality of the product being delivered. They are intended to help identify the need for corrective action and to drive continual improvement within the organization's design and development processes.

The process measurements may include one or more of the following recommendations:

a) Defect Removal Effectiveness
b) Phase Transition Monitoring
c) Milestone Delay
d) Peer Review Defect Tracking
e) Requirements Traceability
f) Requirement and Design Stability
g) Test Execution

Definitions for each of these measurements are included in the Supplemental Measurements Library located on the TL 9000 website (http://tl9000.org/resources/overview.html)

As part of effective management of the design and development processes, thresholds should be established for the measurements (where appropriate) and progress toward these thresholds reviewed periodically (for example, at project status meetings). When available, historical measurement data can be used to help determine acceptable thresholds.

In case of deviations from established thresholds, causal analysis should be performed and corrective actions should be executed to bring the project measurements within the acceptable thresholds.

Design and development process measurements can also help organizations understand customer needs such as quality requirements, time to market schedule, etc. Process measurements may not be comparable across organizations and, therefore, may not be meaningful measurements to share with customers.

References

Models, standards and guidebooks on Process Measurement Systems:

a) PSM - Practical Software and Systems Measurement
(Department of Defense and US Army)

b) Systems Engineering Measurement Primer
(INCOSE - International Council on Systems Engineering)

c) ISO/IEC 15939 - Software Measurement Process Framework
(ISO/IEC JTC1/SC7 Software and Systems Engineering)

d) CMMI for Systems and SW Engineering - Measurement and Analysis
(Carnegie Mellon University - Software Engineering Institute)

e) IPQM - In-Process Quality Metrics Generic Requirements (GR-1315)
(Telcordia, formerly Bellcore)

f) Ideas and contributions from EIRUS (the European IPQM & RQMS Users Group, now merged with QuEST Forum) have been incorporated in this document

Other references on PSM:

g) the PSM Support Center website: www.psmsc.com

h) Practical Software Measurement: Objective Information for Decision Makers
(John McGarry, David Card, Cheryl Jones, Beth Layman, Elizabeth Clark, Joseph Dean and Fred Hall – Addison-Wesley 2002)

Reason for Reissue

Revision 2.2: Elimination of outdated Reference links

Revision 2.1: General update of web links