PART SIX

Implement Process

The previous parts of this Guide describe the performance of the measurement process, including tailoring and applying measures to address project-specific issues. However, before the process can be performed it must be implemented effectively within an organization.

This part of the Guide is organized into six chapters:

- **Chapter 1,** *Implement Process* **Overview,** describes the implementation process at a high level.

- **Chapter 2,** *Obtain Organizational Support***,** explains how the organization can achieve commitment to measurement.

- **Chapter 3,** *Define Responsibilities***,** describes the typical roles and responsibilities for measurement.

- **Chapter 4,** *Provide Resources***,** outlines the tools, training, and other resources usually required.

- **Chapter 5, Lessons Learned,** reviews some common problems and solutions, based on actual experiences in implementing measurement programs**.**

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Implement Process Overview

Implementing a measurement process within an organization is similar to implementing any new initiative. Measurement usually represents a significant change in how an organization does business. The issues and concerns related to this change must be addressed directly.

Three key tasks must be performed to effectively introduce measurement into an organization, as illustrated in Figure 6-1. While the figure shows these tasks as sequential, they may actually be accomplished in parallel.
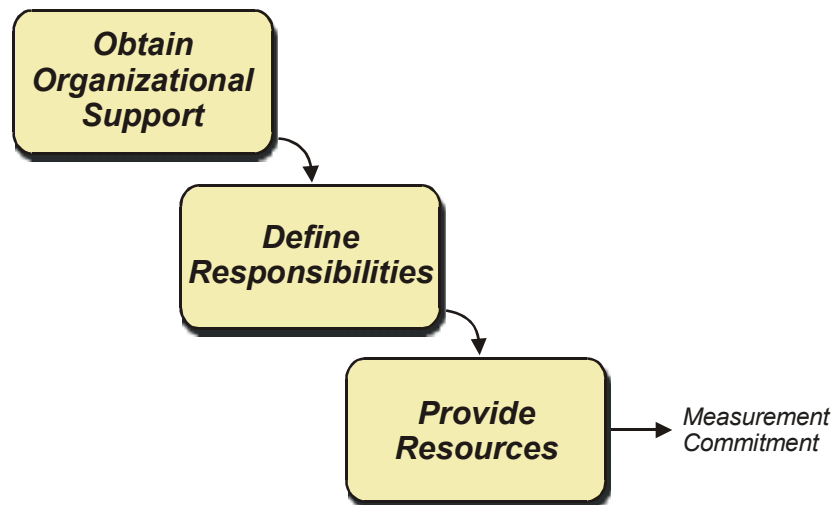
Figure 6-1. Measurement Implementation Tasks

The objective of the first task, *Obtain Organizational Support*, is to develop support for measurement at all levels within the organization. Measurement programs that are mandated by an organization's management will seldom succeed without buy-in and support from most of the organization members. Members of the organization at all levels need to understand how measurement will directly benefit their projects and their own work processes.

The second task is to *Define Responsibilities* within the organization. All participants must have a clear understanding of their roles in the measurement process and their accountability for fulfilling their duties. Individuals must be assigned responsibility for policies, plans, and definitions; data generation; establishing and maintaining a measurement database; and analysis and reporting functions. Depending on the project size and structure, these responsibilities may be held by a number of people or by a single individual.

During *Provide Resources*, the resources required to implement the measurement process within the organization are established. Personnel and tools are usually the major resources in a measurement effort. Once the appropriate resources are in place, collecting, analyzing and reporting of measurement data can begin. The following sections explain these tasks in more detail.

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Obtain Organizational Support

Implementing measurement in an organization often requires a major cultural change. Just as with any other change, uncertainties associated with the introduction of measurement may cause anxiety. Concerns about change can be overcome by communicating to the staff a clear understanding of the measurement process and how the measurement results will be used at all levels within the organization. Some people may fear that measurement results will be used improperly to evaluate individual performance. Others may be concerned that the measurement process will highlight problems that were not visible before measurement. Measurement is most effective in an organizational culture that encourages people to articulate problems and risks. This requires a major shift in attitude for many organizations.

Management support, involvement, and leadership are critical to successfully implementing a measurement process. Support must go beyond having senior managers state that measurement is "a good idea." Support involves establishing measurement policies, providing adequate resources, creating a focus on measurement by communicating objectives and defining critical success factors, reviewing measurement data and analyses through routine feedback loops, and acting on these analyses.

With effective management leadership, the entire organization will usually recognize the importance of measurement and begin to actively support the process. Involve the technical staff in defining measures and the measurement process to encourage ownership. Invite staff to suggest specific data relevant to the objectives and issues and to develop collection methods for their data.

Addressing the issue of "what's in it for me?" also helps to build support at all levels. Management benefits by experiencing fewer surprises and being able to make decisions based on more and better information. Measurement often benefits staff by making management more proactive (rather than reactive), and by providing a basis for more realistic planning.

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Define Responsibilities

The size and structure of each organization determines how measurement responsibilities are assigned. The number of people involved and the allocation of measurement tasks vary considerably from organization to organization. Depending on the size and scope of the project, the measurement team may consist of a part-time measurement analyst or a group of people. Regardless of how many people are involved and the nature of their involvement, one person must take responsibility for each of the following:

- Measurement policies, plans, and definitions

- Data generation

- Measurement database

- Analysis and reporting

These areas of responsibility are discussed below.

Measurement Policies, Plan, and Definitions

Most organizations establish policies and define procedures to help institutionalize measurement. These policies and procedures usually govern the generation and approval of measurement plans for projects. Policies, procedures, and especially plans change over time. As issues change, measures may be defined, modified, or retired. Those changes must be communicated accordingly. Any organization that wants to consolidate project data for organizational purposes also must establish some common definitions, or document the differences in definitions among projects.

Organizations often establish a measurement council with broad representation to coordinate measurement activities. This council usually takes responsibility for the policies, procedures, and common measurement definitions. Project managers usually maintain their own plans. The measurement council often operates like a configuration control board, with internal procedures for managing documentation changes.

Data Generation

The project plan should assign responsibility for the generation of data. Data generation should be integrated into the project teams' normal activities whenever possible. Many different individuals may contribute data items. Each must fully understand their responsibilities as described in the project measurement plan. Data providers must be accountable for providing accurate data in a timely manner. Team leaders or functional managers are often charged with ensuring the accuracy, timeliness and completeness of the data.

Measurement Database

Data may be stored in a project or organizational database. The organization may want to consolidate some project data into a common database, even if each project maintains its own database. Responsibility for the

project database is usually assigned in the project's measurement plan. Responsibility for the organizational database is usually established in organizational policies and procedures.

Regardless of whether the data resides in a single database or in distributed databases, questions of control, accountability and security must be addressed.

- Who will design the database, provide security, select appropriate tools, and control programs?

- Who has access to what data? Who has the authority to modify data?

- Who will ensure that data is properly normalized, validated, and edited prior to entry?

Understanding these issues and assigning appropriate responsibilities ensures that quality data will be available.

Analysis and Reporting

The project's measurement plan should establish responsibility for analyzing the data and producing reports. On a small project, the project manager may perform this function. On larger projects, quality assurance or a specialized measurement analyst may assume this role. The organizational policies and procedures usually designate the analyst for organizational-level data.

The analyst must ensure that the analysis is sufficiently thorough and detailed to address the decision-maker's information needs. The analyst must work with the manager to understand the issues and with the project team to understand the project environment.

Carefully define and clearly communicate responsibility for each role (both project-level and organizational-level) in the measurement process to improve the likelihood of success.

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Provide Resources

Experience indicates that a measurement program requires one to five percent of the project budget. The actual cost of a specific measurement program is determined by the scope of data collected and the ability of planners to integrate data collection and analysis into existing technical and management processes.

Measurement costs include labor and tools to generate, process, analyze, and report data. Because project teams with mature engineering processes use measurement data internally to manage their projects, there should be little additional cost to collect and report this data to the parent organization or to an external acquirer. If a project team is not using measurement, their life-cycle process may not be very mature.

As with any initiative, there are some startup costs associated with implementing a measurement program. The cost of measurement for individual projects, such as training and data collection, will diminish as measurement becomes an established activity within the organization. It is important to view the measurement process as a long-term investment. Within a relatively short period of time after it is established, measurement should become self-supporting by avoiding costs in excess of the measurement investment.

In some organizations, measurement costs for individual projects may be reduced by establishing a measurement team as an organizational resource. As long as there is a primary analyst assigned to work independently on each project, the measurement team can share resources, tools, and expertise.

Measurement Tools

Once the specific measurement requirements and procedures have been defined, the tools to collect, process, and analyze the data must be identified. On small projects, the measurement process can be supported on a personal computer with off-the-shelf office software. On larger projects (or those that require more advanced analysis techniques) additional measurement tools are usually required. Do not purchase a specific tool before determining if it supports the information needs of a project. The project issues and the measurement process drive the tool requirements. Do not allow the availability of an existing set of measurement tools to dictate the measurement process.

Several classes of tools are commonly applied to the measurement process, as described in Figure 6-2.

Type of Tool	Support Function
Database, Graphing and Reporting	Store and manage measurement data to produce graphical and text-base reports
Estimation Models	Provide predictive capabilities, such as cost estimation models and reliability models
Statistical Analysis	Provide enhanced analytical capabilities such as regression
Schedule and Project Management	Assist in project scheduling and tracking resource allocations and expenditures
Financial Management	Support collection and storage of funding Data
Product Analysis	Generate automated analyses of specific product characteristics (e.g., complexity)
Data Collection	Automatically extract measurement data from elements of the engineering process

Figure 6-2. Tools Supporting Various Measurement Functions

Some general guidelines for selecting measurement-support tools are:

- Select tools that can be customized to meet specific project needs.

- Evaluate tools that are already available within the organization.

- When selecting engineering tools, consider their ability to provide data about the engineering tasks and products they support.

- Do not tailor a measurement program based solely on the availability of data from existing tools.

- Select tools that automate the mechanics of data-handling efforts such as collecting, processing, analyzing, exporting/importing, and reporting.

- Select tools that run on a common platform.

- When working on a project that provides data to an acquirer, coordinate measurement tool selection between the acquirer and the supplier. Be sure to evaluate electronic data transfer and database access.

Measurement Training

Personnel at all levels of the organization require measurement training that provides the skills required for their roles. Figure 6-3 gives an example of general training requirements for different roles in an organization.

Role				Measurement Training Requirement
Executive Managers	*Project Manager*	*Measurement Analyst*	*Project Team*	
●	●	●	●	Engineering
●	●	●	●	Measurement Overview
	●	●	●	Data Collection and Management
		●		Measurement Analysis

Figure 6-3. Training Tailored to the Participants' Roles

Executive managers (organizational level and enterprise level) may require training in the relationship of the measurement program to the organization's engineering processes and products. These managers must understand the capabilities and limitations of the measurement process to provide information that meets their objectives.

Project managers and staff (including technical managers) must understand the measurement results presented to them. They must understand the engineering processes and products in order to interpret the results and take effective actions. They also need to have confidence in the data collection process.

Measurement analysts need training or experience in the appropriate engineering processes and in basic measurement skills. Additional training may be required for more advanced analysis, such as estimation, modeling, and statistical analysis.

Project team members must be trained as data providers. They cannot perform their roles in the measurement process if they do not understand the data collection requirements and the relationship of that to engineering processes and products. They also need to understand how the measurement data will be used to address the information needs of the project or organization.

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Lessons Learned

There are a number of lessons learned in implementing issue-driven measurement. These are summarized in Figure 6-4 and discussed in more detail below.

Lessons Learned *Using Measurement Results*
Start small
Provide all participants with an adequate level of understanding
Ensure acceptance of the measurement process
Ensure that the measurement process is cost-effective
Use the results of the measurement process to make decisions

Figure 6-4. Lessons Learned in Implementing Measurement

Start Small

A common mistake in measurement implementation is trying to do too much too quickly. Successful measurement programs often begin with only a few measures to address key issues. A comprehensive measurement program is built and evolves over time.

The measurement capability of an organization should grow at a pace that can be effectively learned and implemented by the participants. Design each measure to provide an adequate level of information on each issue with the fewest and least costly data elements that can be collected. Begin data collection and analysis on a small scale as soon as possible to demonstrate the value of the measurement process. Even implementing a few key measures to address the highest-priority issue provides important new information.

Provide All Participants with an Adequate Level of Understanding

Measurement is a new skill for most managers and engineers. All users at all levels must understand what measurement data represents. This understanding is vital to the proper interpretation of the measurement analysis results. Ensure that everyone in the organization understands both the capabilities and limitations of the measurement process.

Provide all participants with the tools and training that will help them tailor the measurement results and obtain useful information. Participants at different levels within the same organization have different information needs. Project managers need data and tools to make decisions on a realistic delivery schedule. The enterprise-level and organizational-level managers need the same information to make investment

decisions. Each level of management should understand how to use the basic measurement data to derive the information they require.

Define the data to be collected rigorously and gain consensus from all stakeholders. The measurement program is a resource to help managers make informed decisions, not to automate decisions. Accurate data collection and recording are key to producing reliable measurements. Assign accountability for timeliness, accuracy and completeness so that data is collected effectively, consistently, and reliably.

Ensure Acceptance of the Measurement Process

Acceptance begins with a demonstration of management commitment. Orientation or training helps to ensure that all participants understand their responsibilities in the measurement process and the benefits that they can obtain. However, commitment and acceptance must be sustained over time. Involving the project team in the definition of the measurement program helps ensure acceptance. Make measurement results visible; show how the results support both project and higher-level management objectives.

During the initial implementation, it is especially important to focus on getting good data and to ensure that the measurement results are not used to evaluate individuals or compare projects. Discuss results with the data providers before reporting them to management. Focus discussions on obtaining insight, and relate results to project activities. Share measurement results with all stakeholders including the acquirer, organizational management, project management, and the project team.

Ensure that the Measurement Process is Cost Effective

The measurement process must be cost effective to succeed. Measures and reports should address key project issues. Do not collect data or distribute reports that are not needed or are not used.

Automate data collection and reporting whenever possible. Data collection should be an automatic byproduct of normal activity; encourage automatic transfers from other systems such as finance and payroll. The measurement process may start with basic, commercially available applications: database, spreadsheet, word processing, and presentation graphics. More advanced tools can be added later.

It should not be very difficult or expensive to provide basic measurement data. The unavailability of data may indicate a low level of maturity in the project engineering process.

It is often possible to integrate the data collection and analysis tools with other tools of the software and systems engineering environments. Data collection can also be integrated with other activities, minimizing the amount of "new data" needed to support measurement.

Use the Results of the Measurement Process to Make Decisions

Select measures that help derive management information early. Information must be obtained early enough to allow managers to take the actions necessary to reduce risks or correct problems. Do not wait to make management decisions until the measurement process provides a complete set of perfect data. Management information should be derived from a minimal amount of data, complemented by real-time events and qualitative insight.

Make measurement data and information available to everyone in the organization. Provide participants with the training, tools, and access to the basic data that will help them derive the information they need to support their work. A key to success in an acquisition or outsourcing scenario is to establish an effective interface between both the acquirer's and supplier's analysts. The acquirer and supplier offer different perspectives on

project performance. Good communication improves understanding on both sides and leads to a win-win situation.

Measurement should be an integral part of the project and the organization; it should support the existing technical and management processes. Measurement should not be treated as an "add on" but as a part of the organization's normal business process. Develop standard indicators and report formats that are tied directly to critical objectives and issues. Standard indicators and reports will become a common "language" for communicating status and pointing out anomalies. Managers must be willing to listen to "bad news" reported by the measurement process and to react in a constructive manner.

Use measurement data and derived information to report project status proactively. Do not try to influence or skew measurement results. Understand how results were achieved, what they mean for project issues, and what actions are feasible. The benefits of measurement derive form its use. Don't ignore the information it provides.

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