An Effective Metrics Process Model

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Here, we describe how a number of Air Force Space Command bases determine the effectiveness of metrics within their organizations. Participating in these studies were communicators from Falcon Air Force Base (AFB) (now Shreiver AFB), Colo., Peterson AFB, Colo., and Malmstrom AFB, Mont. Though limited to communications and information metrics, this process could be applied to any organization that requires decisions to be made based on facts rather than made haphazardly.

MANY ORGANIZATIONS TAKE measurements or metrics because they have the capability to measure, rather than determining why they need the information. Unfortunately, measurement for the sake of a number or statistic rarely makes a process better, faster, or cheaper. A poor measurement can hurt a process if incorrect decisions are based on the result of that measurement. People at all levels of organizations continue to take measurements hoping that they will shed light on the best way to provide a product or service. Though fraught with good intentions, these poorly contrived measurements add to the confusion of what should and should not be measured.

Metrics Process Model

Until a year ago, many of the communications and information metrics of Air Force Space Command (AFSC) were taken because they had been collected for years, and people thought those metrics must have a purpose.

At that time, many metrics were not being used to make a decision based on fact, but fulfilled a headquarters' requirement to report on information by a certain date every month. After a fairly extensive study, the AFSC Senior Communicator (SC) changed the format and collection of many of these metrics, while deleting the requirement for many that had little value.

Like many discoveries, the process for metrics collection and analysis in this directorate was the result of a change in leadership. Communications metrics at AFSC seemed to provide good information, since senior leaders did not complain about content or format of the 30 metrics collected at the headquarters level. Haphazard metrics collection continued until a number of new senior leaders asked why these metrics were being collected and if they were the right measurements for their organizations. These questions sparked a complete review of the metrics collection, analysis, and reporting process.

After completing a thorough analysis of existing approaches and an analysis of literature on this topic, we decided on a common definition and set of criteria necessary in good metrics collection, reporting, and analysis. The process derived from this research is noted in Figure 1.

Foremost in our quest for good metrics was a definition of a "good metric." Although a review of current literature on metrics indicated many definitions of this term, they could be summarized as one that helps the right level of leadership make the right decisions in a timely manner, based on fact rather than "gut feeling."

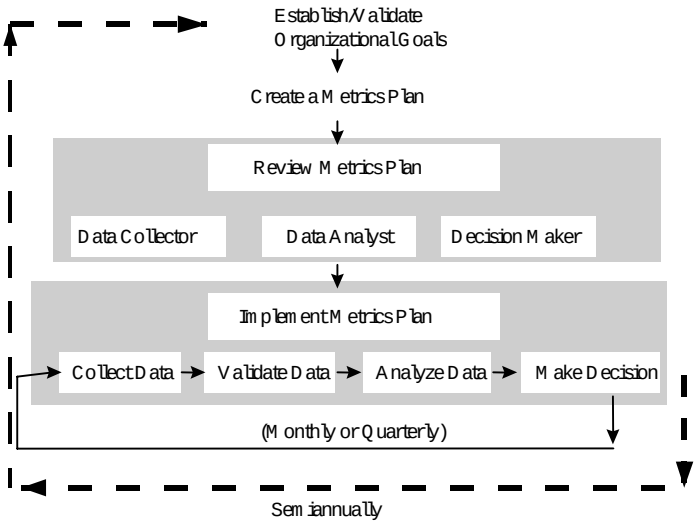


Figure 1. *Metrics process model.*

Applying the Model

Establish and Validate Organizational Goals

With that definition in mind, the majority of authors studied noted that the first step in good metrics collection is understanding the goal. Rather than ask what should be measured, ask what is important to the organization and its customers.

Many organizations have trouble with this; however, the Communications and Information Directorate at AFSC did a thorough review of its customers' requirements and understood what was important to the organization's success. The SC directorate validated its organizational goals and objectives with its customers, suppliers, and senior managers, when it published its strategic plan. Re-validated semiannually, this eight-page document outlines the direction the unit is expected to take in the next few years. Notably missing from the organization's strategic plan was a link of metrics to measure the progress of these goals.

In re-validating this strategic plan, using metrics as a tool to measure these goals, many people noted that the goals were too general because they could not be measured. These goals and objectives were revaluated, ensuring that each objective had an associated measurement to ensure progress.

Management Issues

Although these goals are important to every organization, it can be difficult to focus on defining clear, measurable goals, based on what is important to customers. Senior management can be skeptical about the value of spending time defining such goals. The Communications and Information Directorate at AFSC understood the need for such goals but proceeded cautiously, defining those goals that were most easily quantified first.

Measures of a system's up-time rates and availability were clear targets with measurable rates and long data histories. Once these goals were proven to provide useful decision points, senior leaders were willing to define other goals of interest to the organization and ultimately to the customer. Each organization must decide how many goals it needs to effectively manage its resources and meet its customers' requirements. Through trial and error, the organization found that its customer requirements could be encapsulated into about 10 measurable goals and 40 more specific subgoals called objectives. The goals provided a broad-based definition for what was important to the organization, while the objectives specified actions necessary to meet customer requirements. Each objective was written so as to be clearly measurable, and at least one associated metric was created for each objective to provide decision-making information to senior management.

Every organization will have a different approach to establishing goals based on customer requirements, but regardless of the approach, it is important that these goals are measured and quantified in terms that senior management can understand and fully support.

Create a Metrics Plan

The Communications and Information Directorate had a strong data collection program, but the analysis and use of this information was limited. Although the intent of these metrics was to measure an important or problem area, the number of metrics continued to grow, while the analysis was almost nonexistent.

A plan was created to validate the purpose of each metric. Rather than modify existing metrics, the metrics program needed an overhaul. Many of the cost, schedule, and performance metrics were relevant because they directly measured the mission. However, the metrics process to collect and analyze this information required updating. We defined an overall metrics philosophy as an adjunct to the strategic plan and noted that each new metric had to have basic information associated with it, making it useful to the right people at the right time. Figure 2 is a form we used to collect this information in a single, neat package so everyone from collectors to decision makers could understand their purpose in collecting, reporting, and making decisions based on this metric. Although simple, this broad overview causes people in the organization to think before creating or approving a metric. It also marks the conditions under which the metric will remain useful. This makes the process easier for semiannual review of the metrics, because the criteria are spelled out and metrics that have outlived their usefulness are deleted or replaced.

Metric Title	Brief Description	
Link to Goals/Objectives	Decision(s) based on analysis	Who makes decision(s)
Who collects data	How is data collected	How often is data collected
Who reports data	How and to whom is data reported	How often is data reported
Who analyzes data	How is data to be analyzed (formulas and factors)	
Lowest acceptable values	Highest acceptable numerical values	Expected values
At what point will you stop collecting this metric		

Figure 2. *Metrics collection form.*

Review Metrics Plan

In creating this metric plan, we noted that there may be other factors that we had not considered when defining each metric. To review the data objectively, we surveyed our data collectors and senior leaders to see if they understood why we collected each metric. The results were enlightening and helped to create a usable metrics program. In this survey, we asked questions about the metrics' perceived usefulness, its ability to aid in decision making, goal of the metric, tolerances set for the highest and lowest acceptable values, and timeliness of feedback based on analysis of the data. We could have interviewed people instead of taking a survey but believed anonymous answers would be more honest. We distributed one survey for each metric to each of three groups. One survey was given to data collectors and another to senior managers assigned to make decisions on each metric. The third set of surveys was distributed to the metric owners who designed the metric and are assigned to analyze the data. These surveys were used as the control group because those who designed the metric should understand why the metric is important in making decisions.

Through this survey, we obtained raw data on specific problems and accolades associated with each metric. Although we addressed specific problems, our primary reason for the analysis was to assess the overall usefulness of our metrics program. This analysis, though useful to every level, was of greater use to senior managers who make final decisions on the types of metrics to be collected in the organization.

The first trend analysis showed that one-third of the metrics were not useful in making decisions. Some had no reason for being collected; others had outlived their usefulness. Also noteworthy—few people received timely feedback from those who were assigned to analyze the data. All of these factors led to a metrics program that provided a lot of data but little useful information. Before implementing this metrics plan, many believed that their metrics were the "right" measurement.

Changes were made to existing metrics to streamline and standardize collection processes, and a number of metrics were deleted. After the new metrics passed a trial period, senior managers were confident that the new metrics provided information necessary in making decisions.

Implementing a Metrics Plan

A plan is proven only when it is implemented. Senior managers realized this, and after careful planning, proceeded to provide policy and process clarification to those collecting and analyzing data.

Policy and Process Issues

Gathering and quantifying information initially takes considerable effort but eventually becomes a regular facet of the organization. Although a metrics plan can detail how to collect data, only people can collect and analyze the right data. In gathering metric information, AFSC had to overcome many logistical concerns not only in getting the data but also in ensuring that the data was consistent among the nine communications agencies for which this organization compiled information. They began by clearly defining the requirements in a policy letter signed by the SC. Information to be collected and suspend dates for collection were defined in this policy, which each of the nine communications organizations were required to follow.

Once this policy was signed, the task of ensuring consistent, measurable data had just begun. Though the organization felt that its policy and direction was clear, it took three months for all data collection agents to consistently collect the information requested. After a series of clarifications and minor changes in the collection process, a consistent process to collect metric data was defined and published. Although different for each organization, it can be assumed that even with the best intentions, consistent data collection is an iterative process requiring modifications until all data collectors use the same processes and methods. Although automation can help in this consistency, it is ultimately up to the people who define the metrics to clearly articulate the process for data collection.

Metric Utilization by Management

Even if a metrics plan were perfectly implemented, it still would be incomplete unless the correct level of management makes decisions based on the metrics. It has been well-documented that management buy-in and commitment are necessary before a metrics process can work.

AFSC ensured that its senior management understood the implications of the metric analysis through monthly metric meetings with senior managers, midlevel managers, and people who collect and analyze the data. This type of high visibility is crucial for a successful metrics program. Without definite due-dates and justification for information collection and analysis, senior managers likely would not make metrics a priority. Everyone who collects, analyzes, or makes decisions based on metrics data must be aware of the process, due-dates, and most important, that the metrics are being used to make corporate decisions. When all parties involved understand the importance of these metrics, they are likely to make an effort to collect accurate data, analyze it, and ensure reporting is done quickly to aid in the decision-making process.

Reviews

To be effective, even the most perfect plan needs consistent review. The first review of the metrics plan for this organization shook up the way we used metrics to make decisions.

After the initial review, there was a large turnover in senior leaders, changing some of the primary goals and focuses of the organization. There was another review at the semiannual point, and although the changes were much more subtle, metrics were again changed to reflect the criteria needed for solid decision making within the organization. This continues to be an iterative process, and the senior leadership of the AFSC SC's office is committed to continuing this process.

From Model to Reality

Although there were a number of positive examples using this metric plan, the metrics depicting network status had particularly good results. The SC was measuring up-time rates on servers, and although senior management realized that these servers were a key to our success and mission accomplishment, they did not have well-defined goals.

In starting this project, no one knew exactly why such metrics as "up-time rate of servers," "numbers of computers in an organization," and "number of megabytes of data processed" were collected. These measurements were discarded because they were only one-dimensional, leaving the data analyzer and decision maker with such questions as "Is that a good up-time rate?" and "Is that a lot of data being processed?"

The right measurements soon became apparent in the goal-definition stage. Originally, goals were stated solely in terms of up-time rate and easily measured quantities—not because these were the best metrics, but because they were the easiest to collect. Many metrics originally were turned down because they were not easily placed in a bar or Gantt chart. It soon became apparent that by defining the goal, the metric becomes obvious, rather than defining an easy metric and trying to make a goal based on it.

After much deliberation, the goal became "reduce operations and maintenance costs by 20 percent while maintaining equal or better service to the customer."

With this clear, measurable goal in mind, metrics were created that measured total system cost, cost per capita, and cost per megabyte of data. Cost was defined in terms of dollars and manpower required. The purpose of this goal was clear, and the decisions associated with these measurements were no longer nebulous. These costs could be compared to in-house and contract labor costs. This organization found that the most useful metrics were those that compared two or more quantities rather than solely reporting finite measurements. When these metrics were compared with the up-time rates, some excellent savings opportunities were discovered.

By asking why the metric is important to you, is everyone consistently measuring the same type of data, and how will decisions be made based on the data, collection data became clear, concise, and consistently repeatable. Decisions could effectively be made from the compiled information.

A number of important decisions were made based on the new metrics. For example, in looking at network status and up-time rates on servers, it was determined that a 100 percent up-time rate was not cost effective, based on the analysis of the cost of up-time vs. network availability and efficiency.

Also by comparing costs per capita with costs per megabyte, many decisions were made to consolidate information processing operations, again saving maintenance man-hours and server costs. By following this systematic process, the organization was able to define clear, measurable goals and obtain information crucial to the decision-making process.

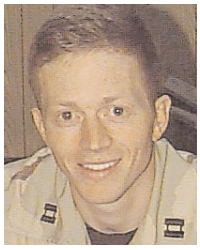
Conclusions

Many people may look at this model or method and note its simplicity. Throughout the literature analyzed, however, authors note the difficulty of creating metrics that are easy to understand yet help the right level of management make timely decisions based on fact. Many times, the difficulty is that we continually ask how to measure a process rather than determining what decisions need to be made.

If organizational goals are written clearly and are measurable, creating a metrics program becomes simple. A successful metrics program ensures that data is collected and analyzed consistently, and most important, this program ensures that the right people are making timely decisions based on fact. All that remains is a semiannual review to ensure that you stay on track with the decisions your organization is making based on these metrics.

We encourage you to take this analytical view of your metrics, thinking not of individual measurements but of a system that helps you make good organizational or corporate decisions. This process has been proven throughout the available literature and in practice. Most organizations could benefit from implementing a structured metrics program. ◆

About the Authors



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Measures and Metrics Web Sites

www.sei.cmu.edu/sema/welcome.html

This is the home of the Software Engineering Measurement and Analysis team of the Software Engineering Institute (SEI). The focus is on software measurement and empirical research that accelerates the identification and adoption of improvement to software engineering practices.
The site contains valuable information about SEI's technical reports, guidebooks, and training regarding software measurement.

www.psmsc.com

The PSMSC site is the home of the Practical Software Measurement Support Center. This site includes information about the PSMC. A section is devoted to current issues and news. It also includes a complete copy of *A Guide to Objective Program Insight*, one of PSMC's valuable products.

www.stsc.hill.af.mil/Metrics/index.html

The Software Technology Support Center's metrics page is dedicated to help organizations improve their metrics programs as it relates to software process improvement. Topics such as Practical Software Measure and Evaluating Measurement Capablilty are available. A great list of recommended readings also can be found.

www.ifpug.org/home/docs/otherpages.html

This is the home of the International Function Point Users' Group. It contains valuable links to useful function point-related tools as well as more than two dozen links to metrics-related sites.