

# The Secrets of Highly Successful Measurement Programs

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## Introduction

Software measurement has become a hot topic at industry conferences, with presentations running the gamut from sophisticated statistical process control models to simplistic models of project effort tracking. In part, due to such driving factors as the Software Engineering Institute's Capability Maturity Model (CMM)<sup>1</sup>, more and more organizations are managing their application development with the help of software metrics. The most passionate supporters promote measurement as a "silver bullet" cure for all that ails the software industry, while critics refuse to even accept that benefits are possible with software measurement.

Can measurement be the system development savior of the 21<sup>st</sup> century, or is it a passing fad? The truth lies somewhere in between. While measurement has always been a part of corporate life, (can you imagine running a company without production and accounting figures?), it is only recently that measurement beyond data center operations has been even attempted. Robert Grady, author of a book outlining Hewlett Packard's successful measurement program, profiled the evolution of software metrics: "Over the years, the application of software metrics has evolved from tentative experiments to accepted best practices based on repeatable successes."<sup>2</sup> Financial and quality gains due to process improvement based on measurement are emerging, as more and more companies choose to measure and control their software processes.

There are many flavors of software metrics and with them come many reasons for measuring. The old adage: "you can't manage what you can't measure" has become the slogan for many software measurement programs -- many companies seek to increase management and control of their development and maintenance processes through measurement.

Grady identifies both tactical and strategic reasons for measurement. He states that project managers must "Define the right product, execute the project effectively, release the product at the right time.... Software metrics help to clarify those details," and later, "As more people and organizations have adopted metrics, metric usage has evolved to become a strategic advantage"<sup>3</sup> (through software process improvement). Overall, a properly planned and implemented software metrics program allows a company to identify, standardize, improve and leverage their software development best practices.

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<sup>1</sup> The Capability Maturity Model for Software V1.0 by the Software Engineering Institute of Carnegie Mellon University outlines five level of software process maturity. One of the requirements to achieve Level 3, is an auditable measurement program.

<sup>2</sup> Grady, R., "Practical Software Metrics for Project Management and Process Improvement", 1992 Prentice-Hall, Inc. page 3.

<sup>3</sup> Grady, R., "Practical Software Metrics for Project Management and Process Improvement", 1992, Prentice-Hall, Inc. page 3

Yet, despite these published successes, nearly 80% of software measurement programs fail within the first two years.<sup>4</sup> This high failure rate is consistent over the past decade, and has occurred in spite of increased industry expertise and models about how to set up software metrics. A survey of available software measurement literature reveals that there is an overwhelming focus on the *technical* aspects of measurement, but very little on the cultural or human side of metrics implementation.

These facts support the conclusion that there is more to a successful measurement program than meets the eye. The secrets of highly successful measurement programs extend well beyond the technical correctness of the chosen metrics and collecting of data. This article explores these secrets and identifies characteristics critical to measurement program success.

## Terminology

What constitutes a **software measurement program**? According to Goodman<sup>5</sup>, software measurement is:

*“The continuous application of measurement-based techniques to the software development process and its products to supply meaningful and timely management information, together with the use of those techniques to improve that process and its products.”*

For the purposes of this article, a **highly successful measurement program** is one that has survived for at least two years following implementation, having become part of the organization's way of doing business (i.e., it is an integrated part of system development).

## The Secrets of Highly Successful Measurement Programs

It may surprise you that the secrets revealed here are not tied to massive budgets and corporate wide initiatives, but instead focus on cultural and people issues surrounding measurement. They were discovered through hands-on contact and observation of client organizations in conjunction with industry published literature.

Organizations successful with measurement generally possess at least one secret, however, this is not a given. In fact, there are organizations with successful programs that have broken every rule about measurement and still survived. These organizations are anomalies and seem to survive in spite of themselves. I can provide no insight, here except to observe that for every rule, there is an exception.

### **Secret #1: Set Solid Objectives and Plans for Measurement**

The old adage, no one plans to fail; yet many fail to plan, is especially true in measurement. While few software projects would be financed without at least sketchy requirements, there are many software measurement programs funded without goals and objectives. Successful measurement programs work towards firm objectives, and measurement is an integral part of the tracking and control of specific processes.

### **How can your organization benefit?**

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<sup>4</sup> Of 610 measurement programs in place in 1998, only 140 survived the two year mark as reported in data collected by Howard Rubin in personal correspondence with the author in January 1999. Moreover, Dr. Rubin's data points since 1988 shows a consistent 78% or higher failure rate for measurement programs.

<sup>5</sup> Goodman, P. “Practical Implementation of Software Metrics”, 1993 McGraw-Hill International, Ltd., page 6

One of the best ways to target a measurement program for success is to implement it as if it were a development project: complete with requirements, design, and build phases, and including formal project management. In so doing, the software measurement program obtains the framework necessary to succeed: the overall scope must be justified, formal requirements are stated, affected processes are analyzed and designed, and metrics are chosen to support the program's needs. Victor Basili's "Goal Question Metric" approach is one that endorses a formal method for designing a metrics program. Goals form the requirements or the targets for measurement, the questions support the achievement of the goals, and the metrics provide answers to the questions.<sup>6</sup>

Companies with successful programs both took metrics seriously from the start and planned, funded and implemented measurement as a formal project, or they became serious as a result of discovering a solid combination of metrics to meet their needs.

What is common about all of the success stories, is that after surviving at least two years, all of the programs take measurement seriously: goals are set for measurement, and metrics are aligned to support key decision making.

### ***Secret #2: Make the Measurement Program Part of the Process -- Not a Management "Pet Project"***

Companies with successful measurement programs understand what measurement can and cannot do. Management relies on the measurement data to make key decisions, and data collection is an integrated part of the software development process. As such, when there is a turnover in management, the measurement program is not a peripheral pet project, prone to budget cuts.

#### ***How can your organization benefit?***

How can you accomplish this in your own organization when management views the initial measurement investment as a costly program? Target your goals, questions and metrics to support key decision making processes and maximize the usage of current data collection procedures that meet your needs. Measurement must be the means to an end -- the end being improved quality, productivity or software estimation -- not an end in itself. Measurement must support process improvement and provide a return on investment if it is to survive when times are tough.

Ask any out of work metrics practitioner what their biggest mistake was in implementing measurement, and invariably the answer will be that measurement was perceived as overhead, similar to training, and was easily cut when management needed to find "extra" budgeted dollars.

While it can take upwards of eighteen months to achieve tangible results from measurement initiatives, ensuring that there are short-term deliverables to support key decision making early will lead to success. Every company has development areas of "pain" where measurement can contribute quickly to quantify improvement potentials; these are critical opportunities where measurement can deliver value with minimal investment.

### ***Secret #3: Gain a Thorough Understanding of What Measurement is all about -- Including Benefits and Limitations***

Managers in companies with successful measurement programs understand that process improvement comes about because of corrective action, not due to the act of measurement itself. Measurement is passive and reports values of current data --

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<sup>6</sup> Basili, V. and D.M. Weiss, "A Methodology for Collecting Valid Software Engineering Data", *IEEE Transactions on Software Engineering*, Vol. SE-10, no.6 , November 1984, [page 728-738](#) | [www.qualityplustech.com](http://www.qualityplustech.com)  
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measurement is not THE corrective action. Personnel at successful companies implement corrective actions based on the measurement results, and then to go back and measure the results.

***How can your organization benefit?***

Executive management must understand that measurement is not a trivial, add-on process. Although they may be anxious for measurement results, there must be an appreciation that measurement means a cultural shift for the business -- a shift from managing by "gut feel" to managing by fact. This recognition overcomes a common cause of program failure -- unrealistic estimates of how quickly measurement results will be delivered. (I know of corporate-wide measurement programs given six months in which to deliver or die, and that included setting the goals, program design, implementation, data capture, analysis and results!)

In successful programs, metrics are used and analyzed appropriately. Measures such as function points are used as they intended -- to provide a measure of the size of the user requirements, -- not misused to evaluate individual productivity. There is no silver bullet or "Swiss army knife of metrics"; and to succeed, your organization must understand this.

***Secret #4: Focus on the Cultural Issues***

Successful measurement programs are successful because people *allow* them to succeed. In other words, by working though and with the people who are involved in measurement, companies overcame the resistance to change. By involving their staff in planning and developing the measurement program, support was gained and software measurement was given the opportunity to succeed. Cultural change affects how people view their work, how they interact with others and how they perform their work. Measurement involves all three.

***How can your organization benefit?***

People are the single largest determinant of software measurement success, and yet measurement plans often "gloss over" the cultural issues. Goodman supports this premise in the closing thoughts of his book, *Practical Implementation of Software Metrics*<sup>7</sup>: "Perhaps you have been surprised by the relatively small part that 'metrics' have to play in this work, and how much the involvement of people can affect the success or failure of such a programme."

While measurement is a part of our everyday life through sports (batting averages), finance (taxable income) and life in general (blood pressure, weight, age), it is predominantly "personal". A supportive organizational environment goes far to counter the natural defensive resistance of people to "be measured", and provides training and other opportunities for people to learn about what will be measured. Coordinators of successful measurement programs also know that new concepts are learned through frequent, short exposures to consistent information. Measurement training programs and brown-bag communication sessions are common in these organizations to enable new staff to learn about and embrace measurement.

While measurement transforms an organization's business from managing by feeling to managing by fact, its people are forced to change the way they view their work, their jobs and even themselves. It is critical for management to accept that resistance to change is human nature and should be expected and tolerated for measurement to succeed.

Landsbaum<sup>8</sup> summarized resistance to change with his insightful statement: "Everyone was totally in favor of consistency, *as long as it turned out to be the way they were already doing it.*"

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<sup>7</sup> Goodman, P. "Practical Implementation of Software Metrics", 1993, McGraw-Hill International, Ltd., page 218

<sup>8</sup>Landsbaum, J.B. and R.L. Glass, *Measuring and Motivating Maintenance Programmers*, page 3, **Englewood Cliffs, NJ**, Prentice Hall, 1992.

**Secret #5: Create a Safe Environment to Collect and Report True Data**

One of the keys to successful measurement programs is the ability to collect and accurately report true data. Equipped with an accurate picture of the development process, managers can develop corrective action that results in real process improvement. Through a relaxation or realignment of the traditional reward system, an accurate picture of the status quo could be obtained, without fear of reprisal. Data is passive, and unless people can report data without being punished for it, measurement cannot succeed. Measurement success comes from being able to accept the current situation (whether it is good news or bad), and then acting to improve on it. If people are too afraid to report the true data, measurement will only mask problems, and measurement will fail because it will not deliver as planned.

**How can your organization benefit?**

Regardless of your chosen metrics, a safe environment for collecting and reporting the data must be established; that is, the barriers to reporting true data must be removed before measurement can succeed. For example, if *perceived* on-time and on-budget projects have always been rewarded, it will be difficult to capture the actual work effort expended on a project. It will then be almost impossible to improve the estimation process without knowing how bad it was in the beginning.

This means that your corporate reward system must be realigned to incent the collection of accurate data -- no matter how bad the resulting analysis may be. In simple terms, what gets rewarded gets done, and true support for measurement will only succeed if people are not punished with the data they report. Grady<sup>9</sup> concurred in his recollections from Hewlett Packard: "Understand the data that your people take pride in reporting. Don't ever use it against them. Don't ever even hint that you might."

Provide access to the measurement data and remember that consistent definitions are critical:

- Consistent effort tracking (same resources included, same start & end points, common work categories & activities, all effort including unbilled overtime should be counted)
- The introduction of measurement implies that something requires improvement. Professionals resent implications that their work needs improvement. Providing access to data eliminates fears of measurement data misuse.
- Speculation of management motives (outsourcing, downsizing, personal measurement) is minimized if measurement information is readily accessible by the organization.
- Publishing of relevant properly correlated results to all participants and other affected parties.
- Audit and validate the correctness of the data. Garbage in will lead to garbage out no matter how good your program is.

. In the words of Grady<sup>10</sup> "you have to convince people of the importance of measurement, and you have to follow through by building an environment of trust with consistent, correct use of data".

**Secret #6: A Predisposition to Change**

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<sup>9</sup> Grady, R., "Practical Software Metrics for Project Management and Process Improvement", 1992, Prentice-Hall, Inc. page 114

<sup>10</sup> Grady, R., Practical Software Measurement for Project Management and Process Improvement, page 7, **Englewood Cliffs, NJ**, Prentice Hall, 1992.

Organizations with successful measurement programs *actively* respond to what their measurement data tells them. If the quality goes down for a product or process being measured, an investigation into the root cause is launched and appropriate remedial actions are taken. If the quality does not increase as a result of this subsequent action, further investigation is done and other changes are made. These organizations repeatedly cycle through the following steps: 1. Measure, 2. Analyze the data, 3. Make decisions based on data, 4. Implement decisive action, and back to measure. Corrective action plans are implemented to improve one or more aspects of the development life cycle until the processes affected are brought under control. In organizations with established measurement, process improvement and remedial action decisions rely on the results of the measurement data. .

***How can your organization benefit?***

If your measurement program is going to succeed there must be a commitment by management to change "something" based on what the measurement results tell them. The anonymous definition of insanity is to measure the same thing over and over and to expect different results. Without a commitment to act on the results of measurement, measurement will not succeed. A measurement program whose motto is "Measurement for measurement sake" does not deliver value to an organization, and will soon be cut off from funding.

For measurement to become an integrated and accepted part of doing business, it must provide a return on its investment. A measurement that delivers data that is never acted upon is a waste of time and money. Organizations with successful measurement programs rely on the data to make decisions to improve the product or process.

***Secret #7: A Complementary Suite of Measures***

In the same way that we rely on a dashboard of fuel and oil gauges, a speedometer, mirrors and other visual indicators (temperature and clean windshield) to operate our cars, successful measurement programs rely on a "dashboard" of complementary measures to manage the development process. Improvements shown in one gauge are checked against potential detrimental impacts shown on other gauges, to ensure that the process is still running. In these successful organizations, improved software development is the "end", while measurement is the means by which it is achieved. Complementary gauges ensure that the end is not achieved at the expense of other, equally important measures. For example, it may be detrimental to improve productivity by 60% at the expense of reducing quality and customer satisfaction by 50%.

***How can your organization benefit?***

A dashboard set of complementary metrics is essential to effectively manage the whole software development picture. Through the metrics, we can also create comparison factors to validate and substantiate the overall impact of a process improvement claim. Because software development always involves tradeoffs between a number of factors, it is critical that measurement considers several factors at once if true process improvement is to be achieved.

As such, in the planning and design phases of software measurement program, it is beneficial to select a small number of complimentary metrics to report the results of process improvement. Depending on the specific goals for your measurement program, such measures as size, effort, cost, consumed resources, quality and customer satisfaction are all potential candidates for the measurement dashboard. With a dashboard, it is easy to see visually and at a glance, what the impact of a process or product change is on its quality and productivity.

***Summary***

Software measurement is not rocket science, and yet over 80% of measurement programs implemented today will have failed by 2001. Together with a sound technical implementation approach for software measurement, organizations can increase their chances of success by following the measurement secrets presented in this article. Although the list of secrets is not

exhaustive, they do provide insights beyond many of the currently published books on the topic of software measurement. Good luck in your software measurement endeavors.

## ***About the Author***

Carol A. Dekkers is the President of Quality Plus Technologies, Inc. a management consulting firm specializing in quality initiatives, software metrics, and process improvement. She is a frequent presenter and trainer at both U.S. and international quality and measurement conferences and holds credentials as a Certified Management Consultant (CMC), a Certified Function Point Specialist (CFPS), a professional engineer (Canada) and an Information Systems Professional (ISP). She is the 1998/99 President of the International Function Point Users Group (IFPUG) Board of Directors, and is also a project editor within the ISO Functional Size Measurement working group (ISO/IEC/JTC1/SC7 WG12).