

Monitoring and management for software development

White paper

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Rational software

Measurement for maturity and process improvement with IBM Rational Dashboard software.

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Overview

In recent years, measurement practices have experienced a well-deserved priority elevation. Across a wide range of industries, demand is high for more complex software and software-intensive applications to support rapidly advancing technologies. Delivering these products requires a new level of management control and monitoring designed to verify that the end product is quality software, delivered on time and within budget, that performs as it is supposed to perform. The principal mechanism for providing the information that assists managers in achieving those goals is the measurement process. As such, an organization's measurement process is now a critical asset when it comes to executing business functions.

This white paper provides an overview of the purpose, function and operation of an effective measurement process. In addition, the use of measurement within the Capability Maturity Model Integration (CMMI) is presented, highlighting how measurement supports this popular process improvement framework. Guidance for implement measurement is discussed, as well as requirements for using measurement within the CMMI, highlighting key aspects of the CMMI approach.

To help bring the information presented here into action, the use of automated measurement solutions is described using IBM® Rational® Dashboard as an example. IBM Rational Dashboard provides a number of capabilities and features designed to speed the implementation of measurement, especially for use in the CMMI and process improvement. Dashboard provides an off-the-shelf measurement solution that addresses the needs of the CMMI Measurement and Analysis (M&A) process area. Dashboard support for the CMMI falls into three essential categories:

- *A library of best-practices measurement process techniques that jump-start management and measurement deployment*
- *Automation for each and every task identified in the CMMI Measurement and Analysis process area*
- *Tailoring and configuration of every aspect of measurement, including automatically configuring data collection based on management needs*

Highlights

Across a wide range of industries, demand is high for more complex software and software-intensive applications to support rapidly advancing technologies.

CMM Integration is designed to provide guidance for improving organizations' processes and ability to manage the development, acquisition and maintenance of products or services.

The measurement guidance presented is appropriate for organizations embarking on process improvement, with or without a formal or informal CMMI assessment.

CMMI overview

The Software Engineering Institute (SEI) released the Capability Maturity Model for Software (SW-CMM) in 1990 as one of three separate Capability Maturity Models (CMMs). After its initial release, the SW-CMM was adopted successfully by many organizations. Released as a successor to the CMM, the CMM Integration (CMMI) integrates the three CMMs into a set of core process areas.

CMM Integration is designed to provide guidance for improving organizations' processes and ability to manage the development, acquisition and maintenance of products or services. It places proven approaches into a structure for appraising organizational maturity or process area capability, establishing priorities for improvement and implementing these improvements.

In CMMI models, process areas describe key aspects of such processes as configuration management, requirements management, product verification, systems integration and many others. The most widely recognized depiction of the CMMI is illustrated in figure 1.

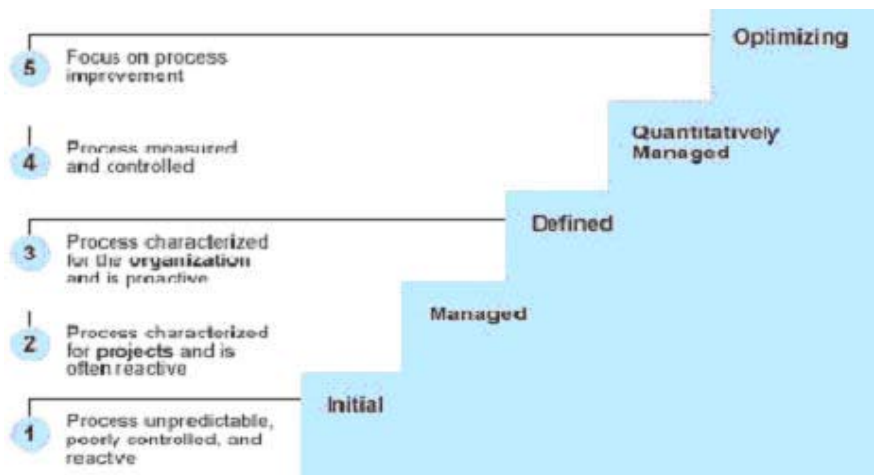


Figure 1: Five maturity levels of the CMMI

Highlights

An organization begins at Level 1, which is essentially an ad-hoc nonrepeatable set of processes or simply an organization that has not been rated. As process capability is demonstrated in specific areas, an organization is rated at one of the higher levels. The rating process is a formal activity involving assessors trained by the SEI to determine to what extent an organization has the capability they claim. Informal assessments such as those not performed by trained and certified assessors can be useful at lower-level organizations to identify gaps in software management and the engineering process.

CMMI Measurement and Analysis process area

In the CMMI, Measurement and Analysis is a process area that supports the planning and management of other process areas. Software managers use the Measurement and Analysis process to enter and establish plans, review the progress of actual performance against plan, and finally take management action to identify and resolve issues of poor process or product performance.

The measurement process is the mechanism with which managers need to manage the way that the organization requires them. Also, an organization establishes management policy that managers are expected to follow. As part of the policy, managers are required to review status information and then perform specific management tasks. The measurement process is the mechanism used by which the organization delivers the status information to managers.

Measurement and Analysis is defined and managed as a distinct process area, separate from other engineering and management processes.

Measurement is defined and managed as a distinct process area, separate from other engineering and management processes. Other management practices, as well as engineering practices, integrate into measurement. Figure 2 highlights the key tasks of the Measurement and process area.

Highlights

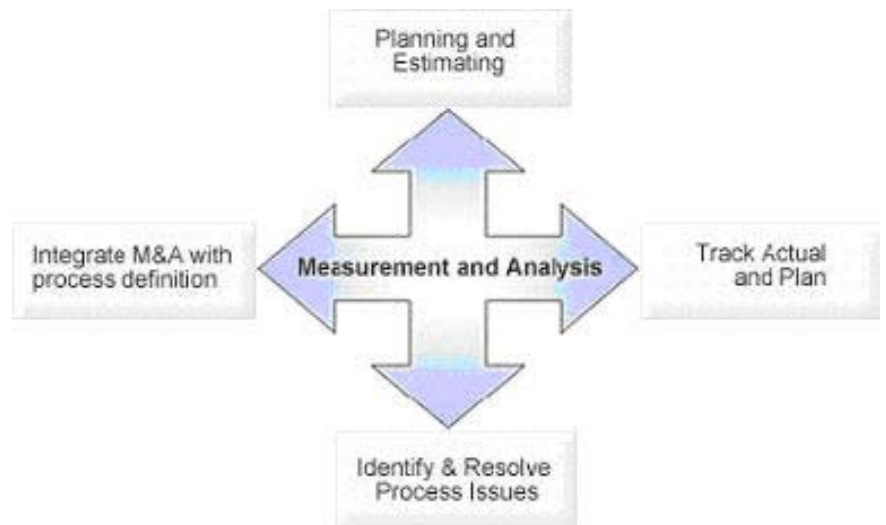


Figure 2: The measurement process supports key management practices.

While performing any of the activities within the software or systems lifecycle, the project or program manager uses the measurement process to enter and establish plans, then reviews the progress of actual performance against the plan and, finally, takes management action to identify and resolve issues of process or product performance.

Within the CMMI, the Measurement and Analysis process area also acts as a general status mechanism for other process areas, allowing managers to plan and review progress as needed.

Within the CMMI, the Measurement and Analysis process area also acts as a general status mechanism for other process areas, allowing managers to plan and review progress as needed. The high-level view of measurement within the CMMI is shown in figure 3. Notice that the information needed to manage processes, shown as “Goals and strategy” and “Process measures,” and to track the progress of goals and strategy, becomes the “requirements” of the measurement process.

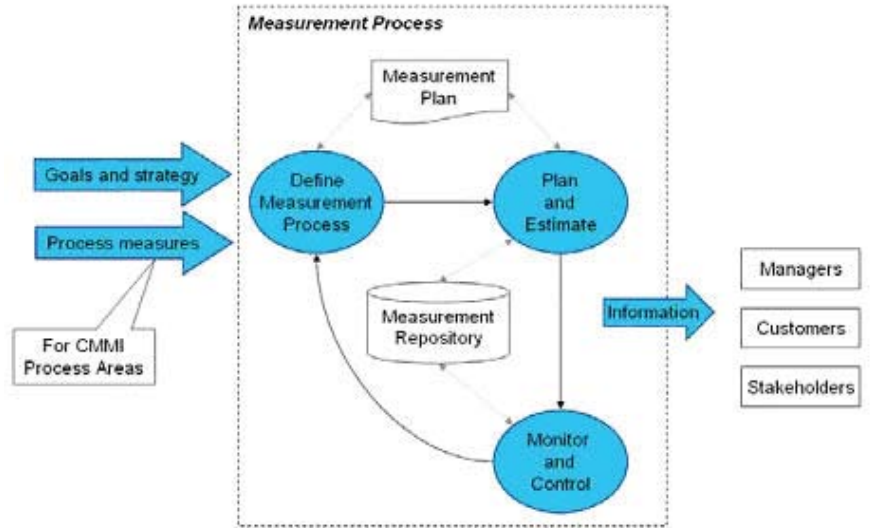


Figure 3: Overview of the measurement process

Setting up a “capable” measurement process

This section describes the measurement process capabilities needed to adequately support software, systems and other types of technical management, including satisfying guidance provided in the CMMI.

The following is the list of capabilities that your measurement process should provide:

- *Verify that business goals and processes are measured*
- *Support the tasks within the measurement process*
- *Establish a measurement approach and plan*
- *Collect and analyze data*
- *Deliver periodic measurement reports to managers and stakeholders*
- *Provide a repository and evidence of the use of measurement*
- *Provide compliance and assessment reports in parallel with status*
- *Track progress and effectiveness of process improvement*

Highlights

One of the primary purposes of measurement is to satisfy managers' information needs, helping to ensure that measurement be aligned with the business goals and needs of the organization.

The definition of an information need should contain descriptive text, references, management guidance for planning, monitoring and control, rules for determining status, as well as graphs and report formats.

The scale of the measurement process will depend on how many information needs are identified and how many managers are to become “customers” of the process. Most organizations start with a small set of information needs, typically in one or two process areas, and then expand over time. The capabilities described here should be present in any measurement approach, tool or solution, allowing your implementation to scale with your business needs.

Verify that business goals and processes are measured

One of the primary purposes of measurement is to satisfy managers' information needs. The CMMI specifically requires that measurement be aligned with the business goals and needs of the organization. Business goals can come from annual or periodic strategic planning, process improvement initiatives as well as short-term executive projects. Process measures should be extracted into information needs from the appropriate engineering and technical documents such that the measurement process is satisfying the information needs for managing those processes.

The measurement process should be able to store your organization's information needs and allow you to new projects or programs. For example, the “Software Quality” information need would be defined once and then applied consistently to several projects—enabling managers and stakeholders to share a common vocabulary and reporting format.

The definition of an information need should contain descriptive text, references, management guidance for planning, monitoring and control, rules for determining status, as well as graphs and report formats. When possible, you should avoid capturing measurement process definitions manually in cumbersome documents because the cost and time spent updating and maintaining your information needs will become unmanageable as needs evolve and the scope of your measurement process increases.

Support the tasks within the measurement process

To aid in implementation, the CMMI Measurement and Analysis process area describes a set of Measurement and Analysis practices, shown in Figure 4. These tasks specify the functions to be performed and the work products/

Highlights

artifacts to be created. However, precisely what to measure is not specified in the CMMI. Instead, each organization determines what measurements are important for managing their organizational goals, strategy and software engineering processes.

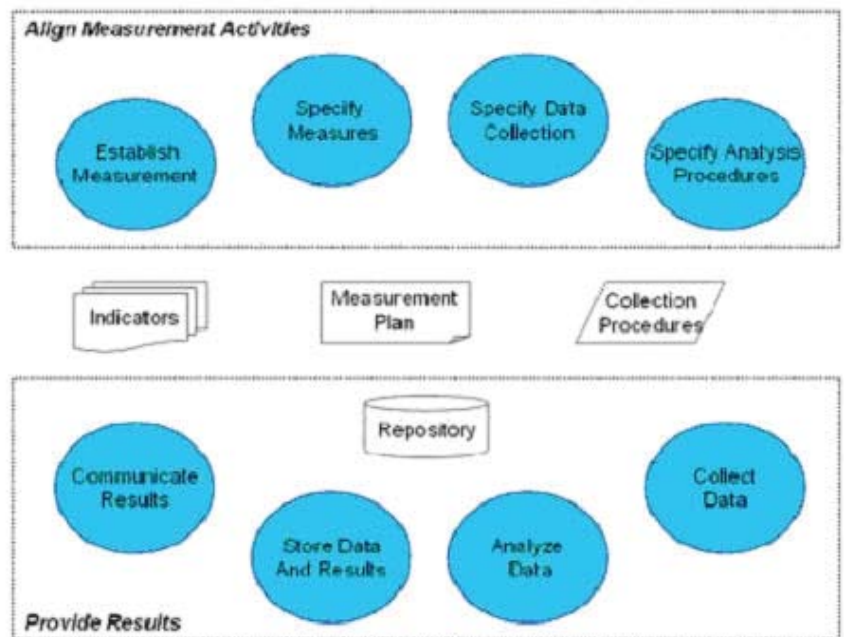


Figure 4: Measurement process tasks

Your measurement process should be able to perform these tasks.

For more details on each practice in the Measurement and Analysis process, consult Appendix A, “Task description for measurement process.”

Establish a measurement approach and plan

Before a measurement process can be started, the organization must allocate resources to establish and sustain it. These resources should be documented in the measurement plan, and would typically include:

- *Managers and their responsibilities for oversight.*
- *Budget, hours and personnel commitments.*
- *Program and project resources.*
- *Support personnel for IT, integration and deployment.*

Before a measurement process can be started, the organization must allocate resources to establish and sustain it.

Highlights

Each time resources are assigned and commitments are made to measurement, the scope of measurement should be captured in terms of the organizational units (e.g., departments, programs, projects) and specific information needs or policy to be covered by the measurement process.

You should minimize the reliance on printed or written documentation to the greatest extent possible. When your measurement plan exists solely in documentation, it becomes increasingly difficult to keep the documentation, process execution, automation and management behavior consistent.

Each time resources are assigned and commitments are made to measurement, the scope of measurement should be captured in terms of the organizational units (e.g., departments, programs, projects) and specific information needs or policy to be covered by the measurement process.

Once the set of organizational information needs have been established, it is time to create a measurement plan that contains supporting details such as the specific data to collect, collection procedures, analysis procedures and similar rules. The measurement plan may be a single measurement approach to be used across the organization, or it may contain tailoring such that different business units, types of products, projects or development models have a unique measurement approach.

Again, you should minimize the reliance on printed or written documentation to the greatest extent possible. When your measurement plan exists solely in documentation, it becomes increasingly difficult to keep the documentation, process execution, automation and management behavior consistent. As you expand your measurement process in depth (by adding information needs) or breadth (by adding organizational units), you increase the burden of maintaining a document and, at the same time, modifying your process.

Collect and analyze data

Your measurement process must collect the data that is specified in your measurement plan. Ideally, the data elements specified in the measurement plan would be collected as part of automated measurement collection. As obvious as this sounds, many organizations do not build their measurement process this way. Instead, they might collect what is easy, or use what they already have, and then modify the measurement reports accordingly. The recommended approach is to collect the data you need and no more, using automated techniques when possible.

Once data is collected, it must be analyzed before being sent to managers. Analysis includes calculating base measures from the collected data, combining base measure data to create derived measures, and assessing status by comparing measures against plan, organizational thresholds or historic data. Analysis may result in a status or indicator value that represents the

Highlights

The measurement process is usually the first time that an organization has attempted to build a consolidated picture of progress using information from disparate/disconnected sources.

“goodness” or “badness” of the current data with respect to plans. Analysis may also involve manual review of data by a subject matter expert. Analysis results are stored in a measurement repository for future review by managers and other stakeholders.

Measurement implementers should take a look at the state and technology of their IT departments before completing the measurement planning process. The measurement process is usually the first time that an organization has attempted to build a consolidated picture of progress using information from disparate/disconnected sources. There are often difficulties in obtaining data, establishing the contents and then determining how best to use it.

As part of examining your IT infrastructure, you should uncover the sources of your measurement data and also establish the mechanism, or mechanisms, that can be used to extract needed data. Such mechanisms could include Web services, an application programming interface (API), a report extract or a direct database connection. Many commercial and in-house tools are built in SQL databases—having a measurement process that can support this saves a great deal of time. In addition, data may also be provided in common file formats such as a Microsoft® Access database file, a comma separated value file or an XML file. Your measurement solution should be able to accept these file formats without requiring integration or scripting.

In designing measurement, you should recognize that your software processes and management needs will change over time. To accommodate this, the mechanism for collecting data should be practically extensible. “Practically extensible” means that you should implement a solution that provides universal integration with your data sources. You should avoid a solution that takes a point-to-point approach to integration. What you want to find is a solution that provides all required tools and technology for maintaining and extending the collection of data.

Without the automated collection of data, a measurement process will either not have the data needed to satisfy the stated information needs, or will rely on time-consuming manual methods.

Deliver periodic measurement reports to managers and stakeholders

An essential element of measurement is the actual delivery of reports to managers who need them. Once the information needs are established for

Highlights

The delivery of measurement reports allows managers to have as complete a picture of their project as practical, and to replace subjective status assessments with a quantitative, objective picture of performance.

each manager, the measurement process delivers information products (satisfying the information needs) so that managers can monitor their progress and take action when needed. The delivery of measurement reports allows managers to have as complete a picture of their project as practical, and to replace subjective status assessments (“I think we are 50 percent done!”) with a quantitative and objective picture of performance.

Your measurement solution should deliver reports in a method that requires little effort and impacts stakeholders and managers as little as practical. When there is a burden in gathering data, updating status or generating reports, managers will tend to stop using the solution. To be effective, the measurement process must deliver reports efficiently—ideally requiring less and less time on the part of managers as the measurement process matures.

While the measurement process provides updates to these reports on a periodic basis, managers should be able to use these reports anytime. For example, managers might rely on measurement reports during team meetings, reviews, program analysis, replanning discussions and for a range of other reasons. One of the beneficial aspects of measurement is that organizational information is made available to those who could benefit from it. The measurement process makes the information stored in various organizational silos available to managers for decision making.

Provide a repository and evidence of the use of measurement

Implementation of any process should lead to having evidence that the process is actually used wherever it is deployed across the organization. In performing a CMMI assessment as well as when determining internally whether your standards and policies are being followed, you need to have evidence that the process is being used. With respect to measurement, this means that there should be evidence that a measurement process is deployed, information needs have been defined, and measurement reports are being used by stakeholders.

Provide compliance and assessment reports in parallel with status

In managing a capability assessment initiative or process improvement, you should be careful to make sure your organization’s processes are the focus, not the assessment or improvement goal. For example, processes should only be modified to address CMMI if gaps are identified and the change is beneficial to the organization. Then managers and engineers should be trained on how to follow the process, and process improvement specialists should update

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the process documents. The fact that the organization is focused on a CMMI maturity level, an ISO standard or any other compliance or assessment is not useful to the rest of the organization.

With respect to measurement, this means that the measurement process may be updated by either changing existing information needs or adding new ones. You would not want to have a set of information needs for the “standard processes” and another set for “process improvement.” The measurement process delivers an integrated set of information needs, allowing managers to control the processes for which they are responsible. If some of these processes are improved, this could show up in the form of modified information needs.

In parallel with ongoing management, it is reasonable for process improvement specialists to need to understand the status and progress of only the process improvement activities, separate from the manager’s integrated set. Your measurement process should be designed to allow you to reuse one or more of the process measures to create a parallel process improvement or capability measure. Most desirably, the measurement process would allow you to organize these measures according to the framework or improvement initiative.

A measurement process should allow you to map your information needs to the CMMI, policy, model, standard or other guidance.

For example, if you were to attempt a staged CMMI for Software Level 2 initiative, then you might want a way to display your information needs in terms of the process areas required for Level 2. A measurement process should allow you to map your information needs to the CMMI, policy, model, standard or other guidance.

Track status of process improvement

There is a growing recognition that organizations should treat process improvement as a project: initiatives are committed, planned, performed and managed like any other type of product or program. Essentially, process improvement is a type of product to be managed. In this light, the measurement process, since it can measure any process, should be used to monitor the status and progress of process improvement. Managers involved in process improvement should be provided with resource commitments, status and progress related to each effort. One key aspect of measuring progress is to have a small set of indicators (between one and three) that compare current,

Highlights

improved performance, to a previous baseline. By having such a running comparison, you can develop an understanding as to how effective your process change is, and take action if needed.

One of the key things you should determine after the improvement is how much better you are, or how much more capacity has resulted. The measurement process should quantify the following information needs for executives and process improvement leads:

- *Process improvement readiness*
- *Process improvement capabilities*
- *Process improvement progress*

As an organization repeats the process improvement cycle, additional information needs could be added to focus on success factors and best practices that have been shown to lead to effective improvement.

IBM Rational Dashboard is designed to assist organizations of any size in implementing a measurement program that manages systems, software and IT developments, and it supports process evaluations such as CMMI.

Using IBM Rational Dashboard for CMMI measurement and analysis (M&A)

IBM Rational Dashboard can help organizations implement a measurement process by identifying and defining information needs. It makes possible the delivery of that information to knowledge workers—from senior executives to technical managers to developers and staff—in a way that supports decision making and improves overall program management.

IBM Rational Dashboard is designed to assist organizations of any size in implementing a measurement program that manages systems, software and IT developments, and it supports process evaluations such as CMMI. Rational Dashboard software is a highly scalable, flexible, easy-to-use solution that can help an organization:

- *Bring vital information together in digital dashboards for empowered decision making.*
- *Satisfy and sustain process maturity requirements with accurate, objective compliance information.*
- *Facilitate defining and sharing of best practices for management and measurement.*
- *Support management information needs through measurement process implementation.*

Highlights

IBM Rational Dashboard is designed to provide solutions to the primary challenges encountered when satisfying the Measurement and Analysis requirements of the CMMI.

IBM Rational Dashboard offers pre-built best practices to help shorten the time between need identification and practice implementation.

Specifically, IBM Rational Dashboard is designed to provide solutions to the primary challenges encountered when satisfying the Measurement and Analysis requirements of the CMMI by:

- *Supporting all activities identified in the Measurement and Analysis process area.*
- *Providing prebuilt best-practice information needs that jump-start CMMI Level 2 implementation.*
- *Automating all aspects of a measurement plan, from requirements, security, analysis, collection and reporting, eliminating time spent writing documentation.*
- *Allowing tailoring for organization-specific measurement or management practices.*

The remaining subsections describe how the IBM Rational Dashboard solution can help simplify and speed a measurement process implementation.

Supports all activities in the CMMI M&A process area

Rational Dashboard was specifically designed to replace the manual tasks associated with measurement. As listed in Table 1 below, there are eight activities and four primary work products identified in the CMMI M&A process area. The table describes briefly how the Rational Dashboard solution provides each required element.

Element	Type	IBM Rational Dashboard Support
Establish Measurement	Activity	The Rational Dashboard Library provides a framework for defining organizational measures and serves as a central location for defining the structure of your measurement plan. Pre-built information needs can serve as ready-to-deploy templates for your organization.
Specify Measures	Activity	The Rational Dashboard Library captures the measures needed by managers as information needs, which include graphs, series, analysis, status, formatting, and the like. Information needs commonly used by CMMI-rated organizations are shipped with the Rational Dashboard solution, ready for you to use.
Specify Data Collection	Activity	The Rational Dashboard solution provides built-in integration tools to enable you to connect to external data without writing scripts or integration code. Built-in collection technology allows you to swiftly obtain data from common data sources such as SQL databases, Microsoft Project, IBM Rational DOORS®, IBM Rational and IBM Rational Synergy.

Highlights

Status views are straightforward and available when they are needed, providing not only quick-look summary status, but also supporting analysis, details and management notes.

Element	Type	IBM Rational Dashboard Support
Specify Analysis Procedures	Activity	The Rational Dashboard Library provides tools designed to help you easily build and automate analysis within your measures—including color-coded status indicators, alarms, statistical analysis, aggregation and more. Predefined measures come with standard analysis built in. Analysis is performed automatically each time measurement data is updated.
Collect Data	Activity	The Rational Dashboard solution allows managers to get data updated, automatically, using the schedule required to meet their management responsibilities. IBM Rational Dashboard allows manual collection anytime, or batch processing to be scheduled. IBM Rational Dashboard automatically determines sources and data to collect, then updates all associated reports.
Analyze Data	Activity	The Rational Dashboard solution summarizes status and progress into effective information displays that help you quickly decipher what's going on, using clear and concise visuals that are easy to interpret. Highlighted troubled areas and direct access to supporting details help save time in determining courses of action.
Store Data and Results	Activity	The Rational Dashboard solution uses proven SQL technology to create a repository for your measurement process. This repository serves as an ongoing storage place for all your key organizational measurement data—the historical data that helps improve planning and estimating, provides proof of compliance, and contributes to lessons learned for process and performance improvements.
Communicate Results	Activity	The Rational Dashboard solution rapidly communicates measurement results via the Web to all levels of the organization that will use the information to make sound decisions. Status views are straightforward and available when they are needed, providing not only quick-look summary status, but also supporting analysis, details and management notes. The sharing of information using IBM Rational Dashboard is easy, security-rich and flexible.
Measurement Plan	Work Product	The Rational Dashboard solution provides automation for all aspects of the measurement process, essentially yielding an actionable measurement plan. IBM Rational Dashboard combines the specification of measures and procedures with integration and then graphing.
Measurement Indicators	Work Product	The Rational Dashboard Library provides the tools needed to define, apply and maintain the measurement indicators used across the organization. IBM Rational Dashboard also provides a method for combining sets of indicators into templates so that they can be applied consistently and quickly.

Element	Type	IBM Rational Dashboard Support
Measurement Repository	Work Product	The Rational Dashboard SQL database captures all the information needed for historic analysis and organizational use, as well as to provide objective evidence of use.
Procedures and Tools	Work Product	All procedures and tools needed to collect data are configured inside the IBM Rational Dashboard solution. Using built-in integrations, the software provides a consistent interface into disparate tools, and then automates the procedures for validating and gathering data.

Table 1: Measurement and Analysis process elements

Provides a set of pre-built best practices

With the Rational Dashboard solution, the time between needing a best practice and applying it is short. By simply selecting from a Library of best practices, gathered from leading software organizations, managers can deploy proven measurements/metrics in their projects. Extensive automation in the software allows managers to decide for themselves which techniques to use, without needing process improvement experts or consultants.

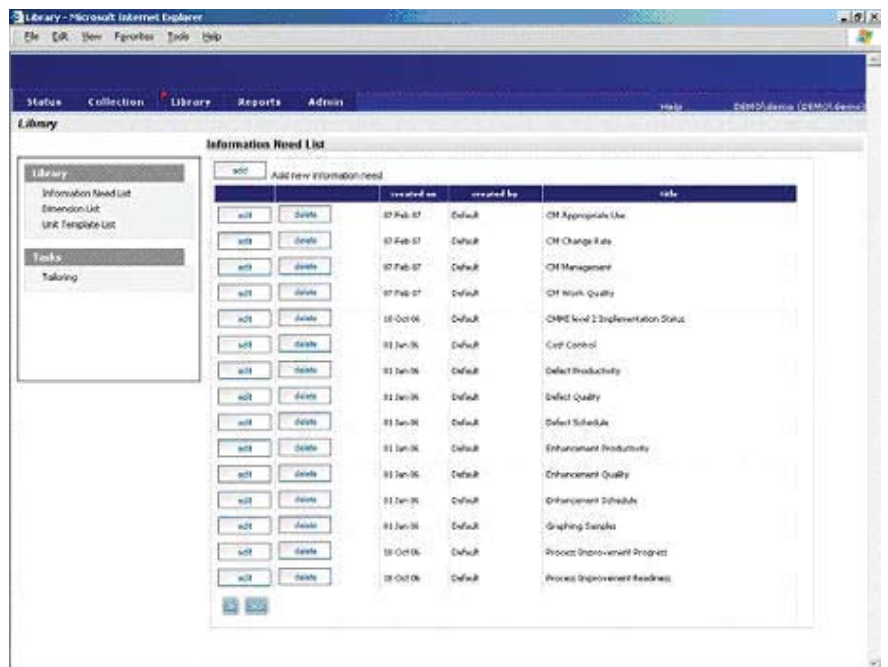


Figure 5: Library of best practices

Highlights

As an organization grows and matures, the Rational Dashboard solution can capture best practices and share them across an organization quickly and effectively.

The prebuilt Library contains information needs and management practices that have been extracted from a variety of standards, policy and guidebooks, from leading organizations such as ISO, Institute of Electrical and Electronics Engineers, Inc. (IEEE), SEI and others.

The information needs in the Library have been preassigned to CMMI Level 2 process areas. This assignment provides a starting point for establishing your organization's management and measurement processes. The assignment of information needs to process areas is contained in Appendix B.

Allows tailoring for organization-specific management practices

As an organization matures, the Rational Dashboard solution can capture best practices and share them across an organization quickly and effectively. Management techniques that save time, money or resources become competitive advantages. Methods for reducing requirements-creep or raising product quality can be captured so that the organization can address other critical strategic needs, and not relearn the lessons of past performance.

Using the built-in Library, your organization has a method to define, review, share and quickly deploy the management and measurement techniques, metrics and reports that can lead to better performance and less risk.

Eliminate time-consuming documentation and integration tasks

In a measurement process without the Rational Dashboard software, the measurement process is described in a management or measurement policy document, and then integration scripts and reports are developed based on the policy. The problem with this approach is that the policy can easily become disconnected from the integration scripts and the reports. Another problem with this approach is that updating the measurement process is time-consuming, as all three elements—the policy document, integration scripts and reporting—must be updated manually.

Contrast that manual approach with the automated approach of the Rational Dashboard solution, in which the policy document is a by-product of defining and selecting information needs within the application, and integration and reporting are automatically configured based on the selected information needs. The measurement policy is virtually always up-to-date and accurate.

Highlights

The Rational Dashboard solution presents managers with key color-coded status data, allowing them to quickly spot trouble areas in the projects and programs for which they are responsible.

Rational Dashboard technology offers proven support for high-maturity organizations.

The Rational Dashboard product provides automation for measurement policy, information needs, compliance, analysis, collection methods, reporting, users and groups, scheduling, and security and access policy. All key measurement elements are automated such that the manual and labor-intensive process of generating documents is streamlined.

Present project status using management by exception

The Rational Dashboard solution presents managers with key color-coded status data, allowing them to quickly spot trouble areas in the projects and programs for which they are responsible. The measurement process is typically used for multiple projects or programs simultaneously, delivering a set of graphs to each project manager on a periodic basis. For example, your organization may have 50 projects being measured, each with 5 information needs and 25 graphs, for a total of 1,250 graphs. To aid in finding and spotting problems quickly, IBM Rational Dashboard provides a number of management-by-exception features designed to enable managers to efficiently find trouble areas.

To simplify reviewing the performance of a single project, the application provides an array of status views, each with color-coded status linked to specific project performance. Managers can also enter their own business rules for color-coding. IBM Rational Dashboard automatically evaluates collected/analyzed data against all rules and targets. With color-coded status and alert e-mails available for requirements, software size, quality, configuration management and scheduling, managers can quickly spot troubled areas, and assess and correct issues during the project lifecycle.

Support for high-maturity organizations

High-maturity organizations, those at Levels 3 or higher in the CMMI, rely on more advanced measurement process capabilities, as compared with organizations at Levels 1 and 2. As an organization becomes more mature, its managers rely on a measurement process to provide information at a greater breadth (e.g., more process areas and work products) as well as greater depth (e.g., more detailed analysis of resources).

The Rational Dashboard solution has a history of supporting high-maturity organizations, which enables Dashboard to support the unique and more demanding needs of these organizations. High-maturity features in IBM Rational Dashboard include:

- *Tailoring for business, program, customer or other needs.*
- *Flexible analysis through extensive equations.*
- *User-configurable best practices.*
- *Stability and statistical process control.*
- *Analysis and reuse of historical data.*
- *Attribute tagging of projects by lifecycle, domain and others.*
- *Centralized administration and security controls.*

Your organization can start process improvement at Levels 1 and 2, and continue to rely on the Rational Dashboard solution as you raise your maturity to Level 5.

Data repository

IBM Rational Dashboard software captures and stores all data required for generating information needs and management reports. The application provides a data mart that captures the raw data needed to construct measurement values, as well as the historical plans and progress data contained in reports.

This data repository can be used to establish organizational capabilities by examining organizational performance in completed projects. For example, by analyzing the historical data for requirements growth in completed projects, an estimator or project manager would have a very good indication of future performance.

Technology is built in to make it easier for this type of analysis to be performed quickly and easily so that past performance data (stored in the data repository) is accessible across the organization.

The data repository can also be used to compare the current performance with previous performance. One example is a measurement report that shows current progress along with a three-month trend. Yet another example is a measurement report that compares current progress to the same period in a previous year (or quarter).

Highlights

The Rational Dashboard solution can save managers' valuable time during project startup, allowing managers to select desired information needs from a library of best practices which can be implemented within minutes.

The data repository in IBM Rational Dashboard is based on a SQL database. Because it uses common SQL technology, you may use a variety of third-party tools for reporting, specialized analysis, security, administration, backup/restore and other purposes.

Quickly initiate a new software development project

Software project startup can cripple an organization embarking on process improvement. In the first weeks or months of a new project, managers must get authorizations, establish measurement plans and policy, and set up a myriad of new tools and environments. When time runs short, the measurement process is often left undone, leaving managers to deliver critical technology without the tools they need to monitor and control their projects' success.

The Rational Dashboard solution can save managers' valuable time during project startup, automating the time-consuming and repetitive tasks of establishing an effective metrics capability. Managers can select desired information needs from a library of best practices, and see those techniques in use within minutes.

The burden lightens for IT and process specialists as managers are less reliant on them to apply best-practice measurement, metric and analysis techniques. The Rational Dashboard solution provides the technology needed to take the ideas of world-class measurement and implement them without the need for supporting personnel to become involved. From integration to analysis, and from graphing to management by exception, the solution can quickly establish the metrics that project managers need to start planning and controlling their projects.

Track compliance with standards, models and policy documents

The Rational Dashboard solution is designed to address compliance by integrating the measurement process with compliance tracking. Managers describe a compliance policy, regulation or standard with which to comply within the solution, and then assess a project's performance against it. Software projects can be easily assessed against one or more corporate policies, standards or maturity models such as the SEI's CMMI. IBM Rational Dashboard allows tailoring of key process areas, sub-processes and other sub-compliance aspects to suit a variety of compliance uses.

Highlights

Using Dashboard, managers can stay informed about the compliance of their projects by reviewing automatically generated alerts or periodically checking a set of compliance indicators available within each project

Using the Rational Dashboard solution, managers can stay informed about the compliance of their projects by reviewing automatically generated alerts or periodically checking a set of compliance indicators available within each project. Project managers review and verify their project compliance along with other project performance data—seldom being the last to see project compliance. IBM Rational Dashboard makes compliance a benefit of effective project management, not a burden.

Appendix A – Measurement task descriptions

This appendix describes each of the tasks recommended by the CMMI for a measurement process.

Establish Measurement: The organization determines the resources, people, facilities and techniques to be allocated to the measurement process. Organizational management oversight is assigned, to either a single executive or a team who is responsible for deploying, supervising and verifying measurement process implementation. The organization establishes the criteria for which business areas and business functions must use measurement as part of their management functions. This criterion includes identifying specific programs, projects and other business areas, generally called “management units.” The resources allocated to measurement and the requirements for using measurement across the organization are documented in a measurement plan.

Specify Measures: In this task, the specific measures to be used for each management unit (identified in the previous task) are identified. Measures are documented using information needs, where each information need contains one or more measures. The complete set of information needs is captured in the measurement plan, which contains high-level organizational objectives for measurement. Each information need contains guidance, reference information, measures (including plan data), stakeholders and reporting requirements that can aid the organization in achieving its goals and objectives. Additionally each information need will contain a description of how status, thresholds, targets and analysis are created.

Specify Data Collection: With a measurement plan in place and information needs defined, the organization is able to plan the physical collection of measurement data. This step identifies the sources of data for each

information need used within each managed unit. Note that while the source of data may vary from managed unit to managed unit, the information need definition does not. Specific data includes the source of data, the method for collecting it and the frequency of collection are documented in the measurement plan. Team members and other stakeholders who work with the data to be measured are trained or informed of procedures to help ensure that the correct measurement data is obtained.

Specify Analysis Procedures: The organization establishes “rules” against which the measurement data will be evaluated for gaining greater insight and spotting trouble early. Approaches include statistical analysis, mathematical manipulation of the data (summing, averaging, etc.), alarms, comparison of actual against plan, and tracking policy and regulatory compliance.

Collect Data: Actual and plan data are collected on a periodic basis for the specified measures. Data may be entered manually or collected through an automated process and is generally gathered monthly, weekly or even daily, depending on the needs of the organization.

Analyze Data: The collected data is evaluated according to the analysis procedures specified previously, after which information users review the results to assess the impact of recent changes and also to determine whether trends in data and status are significant enough to warrant further investigation. Digging deeper into the chain of data to follow problems to their root cause is a key to evaluating alternative action plans.

Store Data and Results: The collected data and resulting measures and analysis are stored in a security-enhanced, accessible place. Herein lays the ability to share the data and results across the organization and with customers, and also to use historical data as a valuable contributor to lessons learned and to future planning and estimating efforts. Stored data may also serve as documented proof of process and policy compliance.

Communicate Results: The results of having collected and analyzed measurement data (such as graphs, dashboards, alarm indicators and management notes) are shared within teams, across departments and up the corporate management chain so that each measurement stakeholder uses the information to improve decision making and control performance toward organizational goals and objectives. It is critical that the results are up-to-date, accessible and easy to interpret.

Appendix B – Information needs for CMMI Level 2

This appendix contains a matrix that maps information needs from the IBM Rational Dashboard Library to Level 2 process areas in the CMMI. Since your actual management and measurement processes are based on your engineering processes, this matrix should be tailored to add and remove information needs, and to modify the mapping so that all processes can be managed.

Mapping IBM Rational Dashboard dimensions to CMMI process areas								
Information Need	Graph Name	CMMI Dimensions						
		RM	PP	PMC	MA	PPQA	CM	SAM
Requirements Management								
Requirements Progress	Requirements Allocation	X						
	Requirements Approval Status	X						
	Requirements Growth	X	X	X				
	Requirements Object Type	X						
	User Requirements Actual Progress	X						
Requirements Stability	Requirements Change Summary	X						
	Requirements TBDs	X						
	Requirements Volatility	X	X	X				
Schedule								
Schedule Accuracy	Task Start Variance							
	Task Completion Variance		X	X				
	Task Duration Variance		X	X				
	Late Task Aging		X	X				

Mapping IBM Rational Dashboard dimensions to CMMI process areas								
Information Need	Graph Name	CMMI Dimensions						
		RM	PP	PMC	MA	PPQA	CM	SAM
Schedule Accuracy	Milestone Variance		X	X				
	Schedule Compression		X	X				
	Schedule Size		X	X				
	Task Compliance		X	X				
	Resource Loading		X	X				
	Schedule Slack		X	X				
	Task Loading		X	X				
Cost								
Cost Control	Budget at Completion		X	X				
	Cost Performance		X	X				
	Cost Variance		X	X				
Software Size/Lines of Code								
Software Size	Total Files			X		X	X	
	Total Lines			X		X	X	
	Code Growth			X		X		
	Source Line Change Summary			X				
	Source File Change Summary			X		X		
Software Configuration Management								
Configuration Management	Rework Rate						X	
	Percent Task Rework Rate vs. Tasks Completed by Release						X	

Mapping IBM Rational Dashboard dimensions to CMMI process areas								
Information Need	Graph Name	CMMI Dimensions						
		RM	PP	PMC	MA	PPQA	CM	SAM
Configuration Management	Percent Task Rework vs. Tasks Completed by Developer						X	
CM Change Rate	Component Release Activity						X	
CM Management	Task Completion						X	
	Task Average Duration from Assignment to Complete by Priority						X	
	Analysis of Tasks by Effective Duration						X	
CM Appropriate Use	Developer Workspace Last Update						X	
	Average Task Size						X	
	Task Size Cumulative						X	
	Workspace Update Aging						X	
	Percent Objects with Two or more Previous Versions							
					X			
Configuration Management	CM Change Summary					X	X	
	Change Count					X	X	
	Files by Status						X	

Mapping IBM Rational Dashboard dimensions to CMMI process areas									
Information Need	Graph Name	CMMI Dimensions							
		RM	PP	PMC	MA	PPQA	CM	SAM	
Defects									
Defect Productivity	CRs by State			X					
	Defects Close Rate			X					
	Total Allocated Defects by Severity			X					
	Percent Defects with Estimated Effort			X					
	Defect			X					
	Open vs. Closed CRs			X					
	CR Close Rate			X					
	Enhancement Productivity	Total Allocated ERs by Priority	X	X	X				
		Percent ERs with Estimated Effort	X	X	X				
Estimated Effort Per Subsystem		X	X	X					
Defect Quality	Defect Arrival Rate			X					
	New Defects			X					
	Defects by Phase Injected			X					
	Open Defect Age— Showstopper			X					
	Open Reported Defects			X					

Mapping IBM Rational Dashboard dimensions to CMMI process areas								
Information Need	Graph Name	CMMI Dimensions						
		RM	PP	PMC	MA	PPQA	CM	SAM
Defect Quality	Open Defects			X				
	Open Defect Age—Severe							
		X						
Enhancement Quality	Open ERs	X	X	X				
	Open Allocated ERs	X	X	X				
Defect Schedule	Percent Phase Remaining			X				
	Total Estimated Effort for Defects by Severity			X				
	Total Estimated Hours			X				
Enhancement Schedule	Percent Phase Remaining	X	X	X				
	Total Estimated Effort by ERs by Priority	X	X	X				
Risk								
Risk Management	Risks by Status			X				
	Risk Status		X	X				
	Risk Cost		X	X				
	Risks by Probability			X				
Software Testing								
Testing Progress	Testing Progress	X		X				
	Test Execution by Status	X		X				
Test Planning	Test Case Growth			X				



Summary

A measurement process can provide valuable guidance for improving your organization's capability to plan, monitor and control programs and projects. Software managers use the Measurement and Analysis process to enter and establish plans, to review the progress of actual performance against the plan, and finally to take management action to identify and resolve issues of poor process or product performance. The measurement process is the mechanism that the organization uses to provide information that managers need to manage the way that the organization requires them to. The CMMI contains a measurement and analysis process area that outlines key elements of a successful measurement process.

For more information

To learn more, please visit: www.ibm.com/software/rational

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