CAST
The Application Intelligence Company

# Achieving High CMMI Maturity Levels with CAST

TECHNICAL PAPER

## Introduction

As organizations continue to look for ways to increase the performance of their IT staffs, they see process improvement as a potential solution. Enhancing the process of how an individual or a team satisfies a task generally means they do it better or more efficiently. In application development, we look at this improvement in 2 ways – Quality and Productivity. If the developers can improve the quality of the work they are doing, the end result will be better all around. If at the same time, they are getting more done then the organization gets more out of its employees with improved satisfaction from the users of the technology (internal and external customers).

## What is CMMI?

For such process change, many of these organizations are selecting to follow the rules defined by the Carnegie Mellon Software Engineering Institute (SEI). Indeed, the SEI has created a process improvement approach that provides organizations with the essential elements of effective processes called the Capability Maturity Model® Integration (CMMI). To effect change in process, you needn't just implement the process, but there must be ways of measuring it and ensuring that people are following it. It is well accepted that people perform better when being monitored and measured, but it has always been difficult to do so in application development. CMMI provides the process guidance, but not the tools or ability to truly measure its success. This paper will address the joining together of CMMI with the CAST Application Intelligence Platform in conjunction with some industry processes and best practices that support the adoption of CMMI, to better manage and measure application development teams.

"Every Capability Maturity Model provides a set of publicly available criteria describing the characteristics of organizations that have successfully implemented process improvement. The purpose of CMMI is to provide guidance for improving your organization's processes and your ability to manage the development, acquisition and maintenance of products or services. CMMI places proven approaches into a structure that helps your organization appraise its organizational maturity or process area capability, establish priorities for improvements, and implement these improvements. While a new enterprise might wish to establish its processes using these concepts, the models are more commonly of interest to organizations that are seeking to improve their processes." SW-CMM (for Software Engineering) is one of the elements of the all-inclusive CMMI model, created under the leadership of Carnegie-Mellon University's Software Engineering Institute for the US Administration. It is used by key organizations such as the US Department of Defense. For detailed information about CMMI and software process improvement; feel free to check out the following link: http://www.sei.cmu.edu/cmmi/

*"Some have come to view CMM as the USDA seal of approval for software providers.[1]"*

There are five levels of maturity in the CMM for Software Engineering:

Level 1: Initial
Level 2: Managed
Level 3: Defined
Level 4: Quantitatively Managed
Level 5: Optimizing

Each maturity level stabilizes an important part of the organization's processes. Each level is composed of Key Process Areas. These Key Process Areas are groups of activities, which must be performed collectively to establish a process capability at a targeted maturity level. "When done correctly, CMM is a costly, time-consuming effort. The average time for a company to move from Level 1 to Level 5 is seven years."

CAST Application Intelligence Platform acts as an enabler of many of these Key Process Areas. CAST alone will not transform your development organization into a CMMI-certified shop, but it can certainly help you get there. You must put a process in place, document that process and teach or should we say "preach" the process. Once the process is in place and people begin to understand and follow it, you then must monitor and measure its success and that is where CAST comes in. In the following sections, we will address the different levels of CMMI and identify how CAST can help reach their success.

## How this paper is written

Many of the definitions are taken directly from papers and documentation supplied by the Software Engineering Institute and CMMI committees. These definitions are here to describe the process as defined by the SEI and are not based on opinions or process changes made by CAST.

Based on those definitions provided by the SEI, CAST has added content to describe how the use of the CAST Application Intelligence Platform can enable better success when working within the CMMI model and achieving specific level goals.

CAST does not apply directly to all key process areas; therefore you will notice some purposely-omitted ones within this document. This is done so that this paper can focus solely on those areas where CAST can help you succeed.

1 - from "Bursting the CMM Hype" - CIO.COM

# Achieving CMMI Maturity Level 1 (Initial) with CAST Application Intelligence Platform

## Level 1 definition

At maturity level 1, processes are usually ad-hoc and chaotic. The organization usually does not provide a stable environment. Success in these organizations depends on the competence and heroics of the people in the organization and not on the use of proven processes. In spite of this ad-hoc, chaotic environment, maturity level 1 organizations often produce products and services that work; however, they frequently exceed the budget and schedule of their projects. Maturity level 1 organizations are characterized by a tendency to over-commit, abandon processes in the time of crisis, and not be able to repeat their past successes.

## CAST applicability to maturity level 1

As defined, level 1 organizations have little formalized processes, but they still need to write software to develop and maintain applications. Although they have limited processes, there still is a need to manage what development teams are doing and ensure the quality of those applications which are being worked on. The CAST Application Intelligence Platform automates the collection of data and provides Application Development (AD) managers with the information they need to understand what development teams are doing and the quality of that work. Because this is automated, little process is needed and therefore can be successful even for a maturity level 1 organization.

CAST also can help organizations as they assess their status and prepare to move from maturity level 1 to maturity level 2. Since maturity level 2 organizations manage projects in a repeatable manner, CAST can help them understand the applications within their portfolio, know which ones are of highest complexity and the ones most easily maintained so that the evaluation of where and how to start managing projects can be decided based on objective data.

# Achieving CMM Level 2 (Managed) with CAST Application Intelligence Platform

## Level 2 definition

At maturity level 2, the projects of the organization have ensured that requirements are managed and that processes are planned, performed, measured, and controlled. The process discipline reflected by maturity level 2 helps ensure that existing practices are retained during times of stress. When these practices are in place, projects are performed and managed according to their documented plans. The status of the work products and the delivery of services are visible to management at defined points (for example, at major milestones and at the completion of major tasks). Commitments are established among relevant stakeholders and are revised as needed. Work products are reviewed with stakeholders and are controlled. The work products and services satisfy their specified requirements, standards, and objectives.

Maturity Level 2 – Key Process Areas are the following:

- Requirements Management
- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Measurement and Analysis
- Process and Product Quality Assurance
- Configuration Management

**CAST Application Intelligence Platform Key Benefits by selected Key Process Area**

## Project Planning

Project Planning process area includes developing the project plan, involving stakeholders appropriately, obtaining commitment to the plan, and maintaining the plan.

CAST provides insight into the structure of existing applications

As many projects do not begin with “green fields”, but with applications that already exist and require extensions and maintenance, understanding the scope of the project is key to project planning. CAST can help provide knowledge about the application itself, about how easily it can be changed, its existing quality and how easily the code can be transferred to new project team members who don’t already know its architecture. This is a key step to project planning, because without it, project managers are just guessing what the actual workload might be based solely on requirements and not what could be a complex application already in existence.

## Project Monitoring and Control

"The purpose of Project Monitoring and Control is to provide an understanding of the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan".

*CAST enables Precise Monitoring of Application Changes and provides Deep Insight over their Side Effects*

CAST's dashboard and scorecards highlight any development shortcomings regarding set targets for quantity and quality of applications. Since CAST collects metrics based on a "DNA"-level analysis, AD Management can drill down on the metrics and specific list of technical issues and exact code modules for remediation. For this, CAST software presents list of non-compliant application objects to facilitate corrective action. CAST detects changes between versions, enabling Management to monitor real progress. It also measures the quantity and quality of worked produced and estimates how much workload such changes should have amounted to, enabling Management to evaluate team performance. Such assessment is further enhanced by the possibility to benchmark applications.

CAST can also help you generate graphical views displaying all the objects making up an application and their interdependencies. Changes affecting the application's structure are displayed under the applications' eBlueprint after each analysis, enabling management to monitor progress at the most detailed level. CAST software helps evaluate the impact of these proposed code modifications on the application through automated simulations of changes and HTML reports, enabling precise evaluation of efforts to implement changes.

Finally, Project Managers know the status of your projects based on objective measurements while knowing what is really going on. CAST provides them with automated metrics so that they no longer have to rely on subjective opinions on schedules, productivity and quality. They also receive knowledge on how easy it would be to transfer the workload across team members as needed.

## Supplier Agreement Management

Once a product component is identified and the supplier who will produce it is selected, a supplier agreement is established and maintained that will be used to manage the supplier. The supplier’s progress and performance are monitored. Acceptance reviews and tests are conducted on the supplier-produced product component.

*CAST enables validation and verification of work done by suppliers*

Through analysis of the work produced by suppliers, CAST validates the quality and quantity of application code being written. CAST helps ensure that the work that is being done is well documented, follows coding and architectural standards and that what suppliers are delivering can be easily moved between suppliers or brought back in-house for maintenance, avoiding supplier lock-in.

## Measurement and Analysis

The purpose of Measurement and Analysis is to develop and sustain a measurement capability that is used to support management information needs. The initial focus for measurement activities is at the project level. However, a measurement capability may prove useful for addressing organization- and/or enterprise-wide information needs.

*CAST enables Objective, Repeatable Measurement of Applications and Development Activities*

CAST software includes an Application Development (AD) Governance Dashboard which provides a complete and current snapshot of your company's application portfolio at any given time. CAST Application Intelligence Platform relies on CAST Knowledge Base, hosted by standard RDBMS such as Oracle or IBM DB2 to manage the metadata collected and organizes the technical information into a scalable system supporting multiple applications. Large amount of historical data scattered across the enterprise can be stored, for each applications' versions, for enhanced version comparisons, detection and monitoring of changes.

## Process and Product Quality Assurance

Compliance to applicable standards and procedures must be checked objectively, which is extremely difficult and expensive for most organizations.

*CAST enables Proactive Enforcement of Code and Architecture Standards*

CAST enables organizations to enforce software engineering standards and best practices. With repeatable, proactive quality controls of all application tiers, it becomes possible to check at any moment the compliance to industry or company-specific standards, both for coding and architecture. CAST is designed to ensure the quality of applications in their entirety. Unlike typical functional and performance testing, CAST looks inside the application at the code quality level, providing real data about the applications themselves. This information is gathered automatically while development is ongoing, giving management objective status of readability, changeability, stability, testability, maintainability, performance design issues, technical inventory and application sizing and complexity based on industry standard metrics. This provides an understanding of the quality of the software being delivered and looks much deeper than just testing into what the application is expected to do. It explores the code for potential architectural, security and performance flaws that in many cases will not be seen under traditional testing, but could cause major problems once in production.

# Achieving CMM Level 3 (Defined) with CAST Application Intelligence Platform

## Level 3 definition

The software process for both management and engineering activities is documented and standardized into a standard process for the organization. All projects use an approved and tailored version of the organization's software process for developing and maintaining software.

## Maturity Level 3 – Key Process Areas are the following:

- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation
- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Integrated Project Management for IPPD
- Risk Management
- Integrated Teaming

- Integrated Supplier Management
- Decision Analysis and Resolution
- Organizational Environment for Integration

**CAST Application Intelligence Platform Key Benefits by selected Key Process Areas**

## Technical Solution

The Technical Solution process area develops technical data packages for product components that will be used by the Product Integration process area. The examination of alternative solutions, with the intent of selecting the optimal design based upon established criteria, is expected.

*CAST gathers the technical data about existing applications*

CAST is used to assess existing applications that are to be put under the process as part of being extended and maintained. To understand the technical solution, an inventory (assessment) of the technology as it exists is required to understand the architectures, complexity, reusable objects and more. CAST can automatically gather the required data about the applications, provide high level metrics and a better understanding for management and lower-level technical details for others on the development team.

## Product Integration

"A critical aspect of product integration is the management of internal and external interfaces of the products and product components to ensure compatibility among the interfaces." Integrating several applications together is indeed a challenging and costly activity. Most software development organizations that formalize the Product Integration process discover quickly that Integration Teams spend most of their time looking desperately for technical information that is very difficult to collect. Having applications communicate with one another requires: the modification of the source code, a thorough control over APIs and overall better understanding of applications technical structure.

*CAST Facilitates the Creation and Maintenance of Interfaces between Applications by Enabling a Deep Understanding of Each Application's Structure and its Interactions*

CAST provides real data gathered automatically from the applications' "DNA" across the entire code base (application and data) and not limited to a single language or technology so that in must-have situations, development teams are provided:

- Specific blueprints (roadmaps) of the applications inner workings
- Automatically-generated technical documentation
- A unified view of all interconnections and paths among applications, crossing over multiple technologies.

## Verification

"The Verification and Validation processes are similar, but they address different issues. [...] Verification ensures that you built it right (whether the work product properly reflects the specified requirements); whereas validation ensures that you built the right thing (fulfilling its intended use). "Many companies try to work around this Verification process because of the associated high implementation costs and difficulty testing the overall quality of the application itself.

*CAST enables Automated Technical Verification of Applications Compliance to Code and Architecture Standards*

CAST's architecture and coding standard rule engine proactively manages the quality, quantity, productivity and performance of applications. With CAST, software quality engineers and technology architects can efficiently and automatically audit 100% of the code to check compliance with industry and company-specific software quality rules, as many times as they want.

## Risk Management

To determine risk, you must collect work products, measures, measurement results, and improvement information derived from planning and performing the risk management process, in order to support the future use and improvement of the organization's processes and process assets. Once gathered, the objective evaluation must occur to understand adherence to the risk management process and address any noncompliance.

*CAST enables Automated Capture of Technical Metrics Essential for Risk Management*

CAST provides IT managers with the information needed to ensure that their teams are developing high quality, easy-to-maintain applications. With CAST, you can assess the risk of development as it is ongoing, understand the work that is happening and get the much needed knowledge of how flexible the application is and how well it will perform over time.

## Integrated Teaming

Information sharing between team members is often informal and incomplete. And it is even more hectic when working in a globally-distributed environment.

*CAST enables Better Teaming through Shared Understanding of Application Structures based on CAST's eBlueprints*

CAST Application Intelligence Platform helps reduce communication gaps within development teams and bring developers closer together. CAST provides group members with instant snapshots of the application, transcribing in real-time what is happening to the shared code base. It automatically populates a repository - CAST Knowledge Base - with information about the application's structure, which can be pushed to development teams as needed through a Web portal, making knowledge transfers much faster and easier: Newcomers are quickly up-to-speed and can explore the code through this intuitive interface. They can easily access the required knowledge to change existing software and make the right programming decisions.

## Integrated Supplier Management

How can you "manage selected suppliers while maintaining a cooperative project-supplier relationship?" Communications between contractor and subcontractor as well as contactor's performance are key in forging a healthy relationship with your supplier.

*CAST enables Improved Management of Outsourced Application Development - from pre-RFP Application Portfolio Evaluation to Technical Acceptance Reviews upon Delivery of Outsourced Work.*

With CAST, outsourcing can be managed like any other vendor relationship: with transparency, fact-based information and control mechanisms that are all required to build a successful value-based relationship.

At CAST, we believe in using software technology to proactively manage the relationships with sourcing partners, delivering more value while reducing risks: A new, more proactive approach providing transparency, visibility and accountability.

Once the decision has been made to outsource the application, you need to move fast to save costs and reduce risks. Your outsourcer is now in charge and is doing evolution and maintenance work on your code. How can you tell what is really going on? Is your outsourcer following your architecture and coding standards? CAST provides automated monitoring and control of the maintainability, technical quality and costs of the software delivered so that you get the visibility to audit and challenge the deliverables. You get an AD Governance dashboard showing the differences between application versions, with drill-down capabilities for controlling the performance of your outsourcer: You can substantiate your Service Level Agreements with measurable indicators by monitoring quantity and quality metrics, analyze workloads for implementing changes and get objectives measurements on your suppliers' performance. CAST also generates on-demand technical reports on the architecture and code quality of subcontracted applications. CAST offers easy project monitoring through graphical displays of the application's current structure. You can follow what is going on in the code on a regular basis and evaluate delays using

tangible data. CAST facilitates technical reviews with programmable quality diagnostic reports that help measure the conformity of the delivered application with defined standards, with information available to all parties though a Web portal. Finally with CAST, technical knowledge transfers are simplified and accelerated with automatically-generated fresh technical documentation.

## Achieving CMM Level 4 (Quantitatively Managed) with CAST Application Intelligence Platform

### Level 4 definition

At maturity level 4, an organization has achieved all the specific goals of the process areas assigned to maturity levels 2, 3, and 4 and the generic goals assigned to maturity levels 2 and 3. Sub-processes are selected that significantly contribute to overall process performance. These selected sub-processes are controlled using statistical and other quantitative techniques. Quantitative objectives for quality and process performance are established and used as criteria in managing processes. Quantitative objectives are based on the needs of the customer, end users, organization, and process implementers. Quality and process performance is understood in statistical terms and is managed throughout the life of the processes. For these processes, detailed measures of process performance are collected and statistically analyzed. Special causes of process variations are identified and, where appropriate, the sources of special causes are corrected to prevent future occurrences. Quality and process performance measures are incorporated into the organization's measurement repository to support fact-based decision-making in the future. A critical distinction between maturity level 3 and maturity level 4 is the predictability of process performance. At maturity level 4, the performance of processes is controlled using statistical and other quantitative techniques, and is quantitatively predictable. At maturity level 3, processes are only qualitatively predictable.

Based on the pure quantitative measures used in a maturity level 4 organization, CAST can play a significant role in the creation and validation at this level. Quantitative objectives can also be thought of as metrics and the only way that such metrics can be a strategic part of the process is to have a way to objectively measure them. This is where CAST provides the quantitative automated metrics capture and measurement about the quality and quantity of work happening in the application development organization. When the CAST Application Intelligence Platform is combined with other solutions like project portfolio management, software development lifecycle and software configuration management, you can receive the combined information needed to understand true project status, manage the people working within the process and ensure that the measurements can be quantified.

Maturity Level 4 – Key Process Areas are the following:

- Organizational Process Performance
- Quantitative Project Management

**CAST Application Intelligence Platform Key Benefits by Key Process Areas**

### Organizational Process Performance

The purpose of Organizational Process Performance is to establish and maintain a quantitative understanding of the performance of the organization's set of standard processes in support of quality and process-performance objectives, and to provide the process performance data, baselines, and models to quantitatively manage the organization's projects.

*CAST automatically delivers Essential Input Data to Process and Product Measurement*

Without being able to directly see what is happening in development, it becomes very difficult to measure the work product happening. CAST provides the automated discovery of the combined quality and quantity of the work being done by the development organization to objective measure the results. Capturing true quantitative measures means that management no longer needs to depend on opinions, but facts about what is happening in development. Fact-based (quantitative) metrics are what drives continued progress as organizations move up maturity levels.

## Quantitative Project Management

One essential element of quantitative management is having confidence in estimates.[...] Another essential element is understanding the nature and extent of the variation experienced in process performance, and recognizing when the project's actual performance may not be adequate to achieve the project's quality and performance objectives.

*CAST enables Automated Quantitative Measurement of Applications and Team Activities*

CAST Application Intelligence Platform automatically produces rich management information such as management metrics on quality & productivity and quality reports in an AD Governance Dashboard. The information delivered includes application functional and technical size, application complexity and development standard compliance indexes. CAST offers means to help measure software development productivity objectively: for instance, CAST can be used to compute Function Points of a software application, a key component in measuring software development productivity. These fine-grained and unified metrics are stored in CAST's Knowledge Base and permit the comparison of applications with one another and across time. In addition, CAST provides a framework to store and monitor project and process metrics coming from various sources. This directly supports the organization in the implementation of "measures and analytic techniques" as well as "the recording of statistical and quality management data". CAST Knowledge Base also serves as the collection point for related business information such as labor costs for maintaining an application, which can drive application cost calculations and team performance analysis.

# Achieving CMM Level 5 (Optimizing) with CAST Application Intelligence Platform

## Level 5 definition

At maturity level 5, an organization has achieved all the specific goals of the process areas assigned to maturity levels 2, 3, 4, and 5 and the generic goals assigned to maturity levels 2 and 3. Processes are continually improved based on a quantitative understanding of the common causes of variation inherent in processes.

Maturity level 5 focuses on continually improving process performance through incremental and innovative technological improvements. Quantitative process- improvement objectives for the organization are established, continually revised to reflect changing business objectives, and used as criteria in managing process improvement. The effects of deployed process improvements are measured and evaluated against the quantitative process -improvement objectives.

Optimizing processes that are agile and innovative depends on the participation of an empowered workforce aligned with the business values and objectives of the organization. The organization's ability to rapidly respond to changes and opportunities is enhanced by finding ways to accelerate and share learning. Improvement of the processes is inherently part of everybody's role, resulting in a cycle of continual improvement.

A critical distinction between maturity level 4 and maturity level 5 is the type of process variation addressed. At maturity level 4, processes are concerned with addressing special causes of process variation and providing statistical predictability of the results. Though processes may produce predictable results, the results may be insufficient to achieve the established objectives. At maturity level 5, processes are concerned with addressing common causes of process variation and changing the process (that is, shifting the mean of the process performance) to improve process performance (while maintaining statistical predictability) to achieve the established quantitative process improvement objectives.

Maturity Level 5 – Key Process Areas are the following:

- Organizational Innovation and Deployment
- Causal Analysis and Resolution

**CAST Application Intelligence Platform Key Benefits by Key Process Areas**

## Organizational Innovation and Deployment

The purpose of Organizational Innovation and Deployment is to select and deploy incremental and innovative improvements that measurably improve the organization's processes and technologies. The improvements support the organization's quality and process performance objectives as derived from the organization's business objectives.

*CAST enables Organization Innovation and Deployment*

As the goal of organizational innovation and deployment are to continue to grow as an organization and improve process, CAST enables the understanding of what teams are doing and the quality of that work. Because CAST provides objective information on what is happening in development and an understanding of how well the teams are working to deliver high quality applications based on the metrics captured on the work that is happening, adjustments can be made to the process and the actual work itself, continuing improvement moving forward.

## Causal Analysis and Resolution

The purpose of Causal Analysis and Resolution is to identify causes of defects and other problems and take action to prevent them from occurring in the future.

*CAST enables Identification of Defect Causes at the Applications "DNA"*

Because most defects that are difficult to identify are architectural in nature, CAST provides the insight directly into the code to identify how well architectural standards are followed and discover areas of an application that can be causing issues with quality and performance. CAST looks at the application in its entirety to understand all layers of the application functions and where issues are today or may arise in the future.

## Conclusion

CAST Application Intelligence Platform makes CMMI process improvements a reality. One of the most difficult areas in process improvement is to measure what application development teams are doing both in terms of quality and productivity (quantity). CAST automates the collection of metrics about the work that is happening in application development and provides an objective view of the work being created. Without CAST, the quality of the work being done can be interpreted as "guess work" and not fact-based measurements. To be a successful CMMI-driven organization, you need to measure the output of development. CAST provides that measurement to not only ensure that a process is being followed, but that the work being done is being done well.

**Sources:**


- "Capability Maturity Model Integration (CMMISM), Version 1.1" - Carnegie-Mellon; Software Engineering Institute - March 2002
- "Bursting the CMM Hype" - Christopher Koch - CIO.COM - March 2004




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