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Achieving CMMI Compliance

Jack Low, VP of Emerging Technologies

I-Logix

Abstract

Implementing and maintaining a CMMI compliant organization is key to the success of delivering on time and quality products. Using CMMI provides the organization a framework for developing and maintaining good practices throughout the development and delivery of the product. The 5 levels of CMMI give organizations a roadmap and set of progressive goals to manage and improve their processes over time via the Process Areas. The benefits are clear, an ROI of 5:1. The challenge is in implementation. The need for an infrastructure to support and maintain this effort is key.

This paper will describe how iNotion, a Product Life Cycle Management Portal from I-Logix specifically supports CMMI. Using iNotion to assist organizations in the implementation and ongoing support of CMMI provides real value in both time and money. iNotion's suite of services provides organizations with the key infrastructure and functionality to quickly and easily develop and maintain their CMMI objectives. It can assist and help manage all 4 of the Integrated Process Areas for Levels 2 and 3 of the Process Areas, and provide a foundation for Levels 4 and 5.

- **Process Management**
- **Engineering**
- **Project Management**
- **Support**

The following table summarizes the Maturity Levels and Process Areas and iNotion's services that support or enable these process areas:

CMMI	iNotion Services
Level 2 - Managed	
Support Process Area	
Configuration Management	• **Task Management** • **SCM Client**
Product & Process Quality Assurance	• **Product Library** • **Task Management** • **Inspections Services** • **Subscription/Notification**
Measurement & Analysis	• **Task Management**

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Project Management Process Areas	
Supplier Agreement Management	• **Product Library** • **Task Management** • **Inspections Services** • **Subscription/Notification**
Project Monitoring and Control	• **Task Management** • **Project Management** • **Subscription/Notification**
Project Planning	• **Project Management**
Engineering Process Areas	
Requirements Management	• **Product Library** • **Change Control Board** • **Subscription/Notification**

Level 3 - Defined

Engineering Process Areas	
Verification	• **Inspections Services** • **Product Library** • **Task Management** • **Subscription/Notification**
Product Integration	• **Task Management** • **Project Management** • **Product Library**
Validation	• **Task Management**
Technical Solution	• **Product Library**
Requirements Development	• **Task Management** • **Product Library** • **Inspection Services** • **Change Control Board**
Process Management	
Organization Process Focus	• **Task Management** • **Product Library** • **Inspection Services** • **Change Control Board** • **Subscription/Notification**
Organizational Process Definition	• **Task Management** • **Product Library** • **Inspection Services** • **Change Control Board** • **Subscription/Notification**

Organizational Training	• **Task Management** • **Product Library** • **Subscription/Notification**
Project Management	
Integrated Project Management	• **Task Management** • **Product Library** • **Change Control Board** • **Subscription/Notification** • **Project Management**
Risk Management	• **Task Management** • **Inspection Services** • **Project Management**
Integrated Teaming	• **All**
Integrated Supplier Management	• **All**
Support	
Decision Analysis and Resolution	• **Task Management** • **Product Library** • **Project Management** • **Subscription/Notification**
Organizational Environment for Integration	• **All**
Level 4 – Quantitatively Managed	
Process Management	
Organizational Process Performance	• **Task Management** • **Metrics**
Project Management	
Quantitative Project Management	• **Task Management** • **Project Management** • **Metrics**
Level 5 - Optimizing	
Process Management	
Organizational Innovation and Deployment	• **Task Management** • **Inspections** • **Metrics**
Support	
Casual Analysis and resolution	• **Task Management** • **Metrics** • **Subscription/Notification**

Table 1 iNotion functional mapping to CMMI PA's

As shown in Table 1, iNotion's built in applications and services provide solutions to assist companies either attempting to become CMMI compliant, or those trying to provide a better infrastructure to maintain compliance.

Using iNotion as the base infrastructure, organizations are able to achieve Levels 2 and 3 in a shorter time frame with greater efficiency. Once this is achieved, iNotion's ability to monitor and report on all aspects of the process enables organizations to accelerate their advancement to Levels 4 and 5. All this means an organization will begin to reap the benefits of CMMI sooner, thereby providing a measurable and significant return on their investment, and ensuring the product is delivered on time, with the correct resources, and far fewer defects.

CMMI overview

CMMI, *Capability Maturity Model Integration*, provides guidance for improving your organization's processes and your ability to manage the development, acquisition, and maintenance of products or services.

It represents an evolved set of guidelines that were initially established by the Software Engineering Institute (SEI)[1] in response to a request from the US Air Force to create an improved method of selecting software vendors. As use of the Capability Maturity Model® for Software (CMM®) expanded in the last decade, organizations began to realize the benefits in terms of productivity, quality, and competitiveness. Organizations utilizing the CMM are able to reap significant cost benefits in a few short years.

Yearly Cost of improvement	$245,000
Years engaged in improvement	3.5
Yearly cost per SW Engineer	$1375
Productivity gain per year	35%
Yearly reduction in Time to Market	19%
Yearly reduction in post-release Defects	39%
Business Return per dollar invested	$5

Table 2- Median Results from and SEI study of 13 software organizations[2]

These benefits are clearly demonstrated in Table 2 above. Although this chart refers to CMM, the ROI of 5:1 makes a compelling if not overwhelming business case to proceed with implementation of CMMI as soon as is possible. It is reasonable to expect that CMMI will yield even higher benefits than CMM as the scope is expanded.

As many organizations move towards CMMI and begin to implement these practices, they will discover that the benefits from a cost perspective and the improved quality of their products will compound over time. In addition these benefits are long lasting and once an organization reaches level 5, that the improvements are self sustaining, and become a natural part of the character and environment of the people.

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[1] The SEI is a federally funded research and development center sponsored by the U.S. Department of Defense through the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. http://www.sei.cmu.edu

[2] Humphrey, W.S., "Three Dimensions of Process Improvement Part I: Process Maturity", *Crosstalk*, CTSC, Hill Air Force Base, Utah, February 1998, pp 5-6

Maturity Model

Organization planning to implement a CMMI model must make certain decisions at the outset. In particular, whether to implement a continuous or staged representation, and which model to implement; Systems Engineering, Software Engineering, or Integrated Product and Process Development.

In general, organizations that are migrating from CMM will select the staged representation. This enables them to quickly migrate from CMM. In addition, it allows an organization to implement CMMI in an ordered way, ensuring compliance at each of the levels before. The model the organization will select will depend upon the scope of the deployment, and needs of the organization. The IPPD (Integrated Product and Process Development) model is the broadest in scope and covers the other two models.

The basic premise of the Maturity Model is to provide a structured and organized way to increase the quality and efficiency of an organization. There are five levels of maturity in the CMMI approach. They are:

1. Initial
2. Managed
3. Defined
4. Quantitatively Managed
5. Optimizing

Each of the levels, starting at level 1, represents an increased degree of maturity and discipline in the processes. At level 1, organizations are usually run in an ad hoc and chaotic manner. There are no real defined processes, and products are produced by heroism and excessive effort by the people involved.

Level 2 (Managed) is where CMMI really begins. The key elements of level 2 are as follows.

- All projects of the organization have ensured that requirements are managed and that processes are planned, performed, measured, and controlled and the processes, products, and services are managed.
- The status of the products and the delivery of services are available to management at specified points in the schedule.
- Commitments are defined among the stakeholders and are modified as needed.
- Products are reviewed with stakeholders and are configuration controlled. The products and services meet their specified requirements, standards, and objectives

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Organizations can use a variety of automated tools to address each of these elements, or they can manage them manually. In the end, the key is that the organization actually addresses these in a consistent and controlled fashion.

As organizations develop their processes in level 2, they are in fact creating a foundation and framework for the entire company. It is imperative that level 2 is properly and consistently implemented and defined in order to progress the level 3.

Level 3 (Defined) is where organizations essentially institutionalize the defined processes in Level 2. By institutionalizing, they ensure consistency across the organization. This creates the opportunity for the organization to improve and refine the process over time. Projects can define their own processes by customizing the organization's set of standard processes according to the established guidelines. These guidelines ensure that the intent and goal of the processes are maintained, while permitting flexibility at the project level. This is also the key distinction between level 2 and level 3. At level 2, the goals are met by implementing specific processes at a project level. Level 3 takes the best of breed of these processes and institutionalizes them across the organization.

This allows projects to customize the process for their particular needs, but ensures consistency in objectives and metrics across the organization.

Another critical difference is that at maturity level 3, processes are described in more detail than at maturity level 2. At level 3, processes are managed more aggressively using defining the process activities and detailed measures of the process, its products, and its services.

Level 4, (Quantitatively Managed) is where quantitative objectives for quality and process performance are defined and used as a measurement in managing processes. Quantitative objectives are based on the needs of the customer, end users, organization, and process implementers. Quality and process performances are measured in statistical terms and are managed throughout the life of the processes.

Specific measures of process performance are collected and analyzed. Special causes of process deviation are identified and, where appropriate, the sources of special causes are corrected to prevent future occurrences.

By capturing and maintaining these specific measures of process performance, an organization will be able to use this data in the future to make adjustments and or corrections in the process.

The main difference between level 3 and level 4 is that in level 3, processes are only qualitatively measured, whereby in level 4 they are quantitatively measurable.

Level 5, **(Optimizing)** is where 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 deviation in the processes.

The focus is on continually improving process performance through both 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.

A critical distinction between maturity level 4 and maturity level 5 is the type of process deviation addressed. At maturity level 4, processes are concerned with addressing special causes of process deviation and the statistical predictability of the results, i.e. knowing how well they work. While processes may produce predictable results, the results may be inadequate compared to the established objectives. At maturity level 5, processes are concerned with addressing common causes of process deviation and changing it to improve process performance to achieve the established quantitative process-improvement objectives, i.e. making the processes better in order to meet or exceed the objectives.

The ultimate goal is to achieve level 5 for all organizations, as it becomes a self sustaining activity, providing for growth, adjustments, and adaptation in the way the organization and people behave. By achieving this goal, organizations have a complete understanding of how they operate, quantitatively, and can then evolve their operations with measurable results.

Process Areas

To achieve CMMI level 5 benefits, an organization should address four key process area categories. They are as follows:

- **Process Management**
- **Project Management**
- **Support**
- **Engineering**

These process area categories are then broken down into basic and advanced process areas for each. What is important to note is that each of these categories and their subsequent areas interact with each other. They often provide the catalyst, or information input needed by another area in order to operate successfully. Organizations will need to implement the basic process areas first, and then as they progress, implement the advanced process areas as well.

Process Management

The key goal of the Process management process area is to ensure an organization defines a set of standard processes, trains personnel on the processes, and establishes a baseline of performance to measure the process execution. From there it enables an organization to extend their understanding of the behaviors, to modify or adjust the process, and then finally have a means by which they can quantitatively measure. In effect, this process area derives the best practices from the experiences of maturity level 2, and then sets the organization's standard processes.

The basic process management areas are centered on defining, educating, and keeping the organization focused on the processes to be used throughout the life cycle of the product. The following are the basic process management areas, and their respective maturity level.

- **Organizational Process Focus (*Maturity Level 3*)**
- **Organizational Process Definition (*Maturity Level 3*)**
- **Organizational Training (*Maturity Level 3*)**

Organizational Process Focus process area assists the organization to plan and deploy process improvement based on knowing the current strengths and weaknesses of the organization's processes and process assets. Opportunities for improvements to the processes are obtained through various means. These include process-improvement proposals, measurement of the processes, lessons learned, and results of appraisal and product evaluation activities.

Organizational Process Definition process area establishes and maintains the set of standard processes and other information based on the process needs and objectives of the organization. These other information includes descriptions of processes and process elements, descriptions of life-cycle models, process tailoring guidelines, process-related documentation, and data. Projects can then customize the standard processes to create their project specific defined processes. Experiences and work products from performing these defined processes, including measurement data, process descriptions, process artifacts, and lessons learned, are used to improve or sharpen the set of standard processes.

Organizational Training process area defines the training needs of the organization as well as the tactical training needs that are common across projects and support groups. In particular, training develops the skills required to perform the organization's set of standard processes. The main components of training include a managed training-development program, documented plans, knowledgeable personnel, and measuring the effectiveness of the training program.

The advanced process management areas provide the organization with the capability to meet its quantitative objectives for quality and process performance. It is imperative that organizations first meet the basic process management areas at their respective maturity levels before engaging in the advanced. The advanced are predicated on having the information and capabilities of the basic in place in order to succeed. The following are the advanced process management areas, and their respective maturity levels.

- **Organizational Process Performance (*Maturity Level 4*)**
- **Organizational Innovation and Deployment (*Maturity Level 5*)**

Organizational Process Performance process area focuses on quantifiable objectives for quality and process performance based on the organization's business objectives. This enables organizations to provide projects and support groups with common measures, performance baselines, and performance models. This enables quantitative project management and statistical management of critical sub processes for both projects and support groups. The organization analyzes the performance data collected from these defined processes to develop a quantitative understanding of product quality, service quality, and process performance of the set of standard processes.

Organizational Innovation and Deployment process area is focused on defining how an organization will select and then implement improvements to the process. It is important to define how innovation will be identified, and that the organization has a formal method to decide upon and then improve which ideas to implement. The criteria for implementation must be based on a quantitative measurement of the benefits and costs from deploying these ideas.

Project Management

The Project Management process areas cover all project management activities related to planning, monitoring, and controlling the project. They are focused on ensuring an organization properly plans for, and then executes the plan, along with monitoring. This includes coordination and management of all resources used in the project, whether it is information, internal personnel or suppliers.

The basic project management process areas focus on the basic activities related to defining and adhering to the project plan. It also focuses on defining and maintaining commitments, monitoring progress of the project against the plan and taking corrective action if needed, and finally managing supplier agreements when relevant. The basic project management areas and their respective maturity levels are as follows:

- **Project Planning (*Maturity Level 2*)**
- **Project Monitoring and Control (*Maturity Level 2*)**
- **Supplier Agreement Management (*Maturity Level 2*)**

Project Planning process area includes creating the project plan, involving stakeholders, get commitments to the plan, and maintaining the plan. When using an IPPD approach, stakeholders are not just the technical experts for product and process development, but also the business and marketing implications of the product and process development. This is critical because many facets of the project extend well beyond simply the development of the product. The plan must be comprehensive with regards to technical and business related issues or activities.

Project Monitoring and Control process area focuses on monitoring activities and when needed, taking corrective action. The project plan defines the level of project monitoring, the frequency of reviews, and the measures used. Progress is primarily determined by comparing progress to the plan. If actual progress deviates from the expected progress, all corrective actions are taken as needed. This may include re-planning.

Supplier Agreement Management process area addresses the need of the project to identify, contract, and then monitor and measure the performance of a supplier. Once an outsourced component is identified and the supplier who will deliver it is selected, an 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

The advanced project management process areas address activities such as defining a defined process that is customized from the set of standard processes, coordinating and

collaborating with relevant stakeholders (including suppliers), risk management, forming and sustaining integrated teams, and managing the project's defined process. The advanced process areas and their respective maturity level are as follows:

- **Integrated Project Management (*Maturity Level 3*)**
- **Risk Management (*Maturity Level 3*)**
- **Integrated Teaming (*Maturity Level 3*)**
- **Integrated Supplier Management (*Maturity Level 3*)**
- **Quantitative Project Management (*Maturity Level 4*)**

Integrated Project Management process area defines and maintains the defined processes that are customized from the set of standard processes. The project is managed using the project's defined process. The project uses and contributes to the organization's process information. The project ensures that the relevant stakeholders coordinate their efforts on time through stakeholder involvement; the identification, negotiation, and tracking of critical dependencies; and the resolution of coordination issues within the project with the stakeholders.

The Integrated Project Management for IPPD process area creates a shared vision for the project. This shared vision should align both horizontally and vertically with both the organization's and integrated team's shared visions, created in the Organizational Environment for Integration and Integrated Teaming process areas, respectively. These shared visions collectively support the coordination and collaboration among stakeholders. Finally, the Integrated Project Management for IPPD process area implements an integrated team structure to perform the work of the project in developing a product. This team structure is based on the breakdown of the product itself, much like a work breakdown structure. This activity is performed in conjunction with the Integrated Teaming process area.

Risk Management process area takes a continuous, forward-looking approach to managing risks with activities that include identification of risk parameters, assessments, and handling. It extends from the basic project management area for risk management.

Integrated Teaming process area provides for the creation and maintenance of each integrated team. Part of maintaining the team is developing the integrated team's shared vision, which must align with the project's and organization's shared visions. The teams can and are interdisciplinary, including technical, quality, and business members of the organization. The Integrated Teaming process area interacts with other Project Management processes by supplying team commitments, work plans, and other information that forms the basis for managing the project and supporting risk management.

Integrated Supplier Management process area proactively identifies sources of components that may be used to satisfy project requirements and monitors selected supplier work and processes. It covers selecting, evaluating, monitoring, the providers. The Integrated Supplier Management process area works closely with the Supplier Agreement Management process area during the supplier selection process. Integrated Supplier Management also shares monitoring information with the Engineering and Support process areas in the form of technical solution, product integration, and validation data as well as process and product quality assurance and configuration management data.

Quantitative Project Management process area uses quantitative and statistical techniques to monitor process performance and product quality. Quality and process-performance goals for the project are based on established organization objectives. All processes defined must have a measurable performance that can be monitored and adjusted based on deviations to the process. Through this process area, organizations can begin to build the information needed to execute improvement and innovation at level 5.

Support

Support process areas cover the activities that support product development and maintenance. In general, the Support process areas focus on project level processes, and may or may not address processes that apply more generally to the organization.

The basic support process areas focus on the support functions that are used by all process areas. All Support process areas rely on the other process areas for inputs, the basic Support process areas provide support functions that are covered by generic practices. The following are the basic support processes and their maturity level.

- **Configuration Management (*Maturity Level 2*)**

- **Process and Product Quality Assurance (*Maturity Level 2*)**

- **Measurement and Analysis (*Maturity Level 2*)**

Configuration Management process area defines and maintains the integrity of work artifacts using configuration identification, control, status accounting, and audits. The work artifacts placed under configuration management include the products that are delivered to the customer, designated internal work artifacts, acquired products, tools, and other items that are used in creating and describing these products. Examples of work artifacts that may be placed under configuration management include plans, process descriptions, requirements, design data, drawings, product specifications, code, compilers, product data files, and product

technical publications. They should be accessible to all the members of the team as needed.

Process and Product Quality Assurance process area requires specific practices for objectively evaluating executed processes, work artifacts, and services against the defined process descriptions, standards, and procedures and ensures that any issues arising from these reviews are addressed. Process and Product Quality Assurance supports the delivery of high-quality products and services by providing the project staff and all levels of managers with appropriate visibility into, and feedback on, the processes and associated work artifacts throughout the life cycle of the project.

Measurement and Analysis process area requires specific practices that guide projects and organizations in aligning measurement needs and objectives with a measurement approach that will provide objective results. These results can be used in making informed decisions and taking appropriate corrective actions

The advanced Support process areas provide the projects and organization with an advanced support capability. Each of the process areas relies on information and inputs from the other process areas in order to succeed. The advanced support processes and their respective maturity levels are as follows:

- **Organizational Environment for Integration (*Maturity Level 3*)**
- **Decision Analysis and Resolution (*Maturity Level 3*)**
- **Causal Analysis and Resolution (*Maturity Level 5*)**

Organizational Environment for Integration process area establishes the approach and environment for the implementation of IPPD. The environment is created by obtaining, adapting, or developing processes that fosters productive integrated team behavior as well as stakeholder communication and collaboration. This creates the organization's shared vision, and manages people to ensure collaborative behavior.

Decision Analysis and Resolution process area supports all the process areas by providing a formal evaluation process so that alternatives are compared and the best practices are selected to accomplish the goals of the process areas.

Causal Analysis and Resolution process area is where the project strives to understand the common causes of variation/deviation in processes and their performance and remove them from the project's processes. It also provides knowledge to continually improve the organization's processes. Both the defined processes and the set of standard processes are targets of these improvement activities. Organizations implementing this process area have fulfilled all of the underlying process areas, enabling a self-sustaining improvement cycle on both project specific and organizational wide processes.

Engineering

The Engineering process areas integrate software engineering and systems engineering processes into a product-oriented process improvement scenario. Improving development processes focuses on key business objectives, rather than specific disciplines. The Engineering process areas apply to the development of any product or service in the engineering development domain including software products, hardware products, services, or processes.

Although CMMI does not refer to any of the engineering processes as basic vs. advanced, there is still a need to build these processes incrementally upon each other. The primary or basic engineering process and its respective maturity level is listed below.

- **Requirements Development (*Maturity Level 2*)**

    The Requirements Development process area identifies customer needs and translates these needs into product requirements. The requirements are then analyzed to produce a high-level conceptual solution. They are then allocated to a set of product-component requirements. Additional requirements that help define the product are identified and allocated to product components. This set of product and product-component requirements describes the product's performance, design features, verification requirements, etc. in terms the developer understands and uses.

    The Requirements Development process area supplies requirements to the Technical Solution process area, where the requirements are converted into the product architecture, product-component design, and the product component itself (e.g., coding, fabrication). Requirements are also supplied to the Product Integration process area, where product components are combined and interfaces are ensured to meet the interface requirements supplied by Requirements Development.

The second level of engineering process areas feed off of the requirements development, or extend it, as in requirements management. They are focused on the actual processes and tools used for developing the product. These second level process areas and their respective maturity levels are listed below:

- **Requirements Management (*Maturity Level 3*)**
- **Technical Solution (*Maturity Level 3*)**
- **Product Integration (*Maturity Level 3*)**
- **Verification (*Maturity Level 3*)**
- **Validation (*Maturity Level 3*)**

Requirements Management process area focuses on the maintenance of the requirements. It defines how to obtain and control requirement changes and ensure that other relevant information is kept in sync. It provides traceability of requirements from customer to product and from product to product component. It also ensures that changes to requirements are reflected in project plans, activities, and work products. The changes may impact all the other Engineering process areas. Therefore, requirements management is a dynamic sequence of events. Establishment and maintenance of the Requirements Management process area is fundamental to a controlled and disciplined engineering design process.

Technical Solution process area is intended to provide 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 best design based upon identified criteria, is required. These criteria may vary across products. It is dependant upon on product type, operational environment, performance needs, support needs, and cost or delivery schedules. The task of selecting the final solution makes use of the specific practices in the Decision Analysis and Resolution process area.

Product Integration process area defines the expected specific practices associated with generating the best possible integration sequence, integrating product components and delivering the product to the customer.

Product Integration uses the specific practices of both Verification and Validation in implementing the product integration process. Verification verifies the interfaces and requirements between product components before product integration. During product integration in the operational environment, the specific practices of the Validation process area are used.

Verification process area ensures that all the work artifacts meet the specified requirements. Verification is generally an incremental process, starting with product-component verification and usually concluding with verification of fully assembled products. Verification also addresses peer reviews that are a proven method for removing defects early and provide valuable insight into the work products and product components being developed and maintained.

Validation process area validates products against the customer's needs. Validation may be performed either operationally or in a simulated operational environment. Coordination with the customer on the validation requirements is critical. The scope of the Validation process area includes validation of products, product components, selected intermediate work products, and processes. The process may be iterative as changes are introduced. Issues discovered during validation are usually resolved in the Requirements Development or Technical Solution process areas.

Summary of CMMI

As companies strive to attain greater levels of efficiency and quality within their operations and products, a formal approach to managing all aspects of a products lifecycle becomes essential. CMMI's rigorous approach to defining the essential process areas, and their interrelationship or dependencies on each others provides a framework for companies to establish and define their processes and practices at both the organizational level, as well as the project level. It also provides a way to measure respective companies on the maturity of their processes via audits and certifications.

Companies wanting to implement this framework will have to make a significant commitment to the environment, tools and infrastructure. Proper deployment and a strong infrastructure to support CMMI are essential in attaining successful implementation in both a reasonable time frame, and cost.

CMMI Infrastructure Needs

While it possible to implement CMMI without an underlying infrastructure, it is far more difficult. Organizations need a way to manage the information, define and execute the general and specific processes, and provide a robust platform for the collaboration and communication elements essential to CMMI. Each of the process areas listed above have critical needs for information management, process management, and

collaboration. Without a common infrastructure across the organization, it would become onerous for organizations to fully implement a CMMI program.
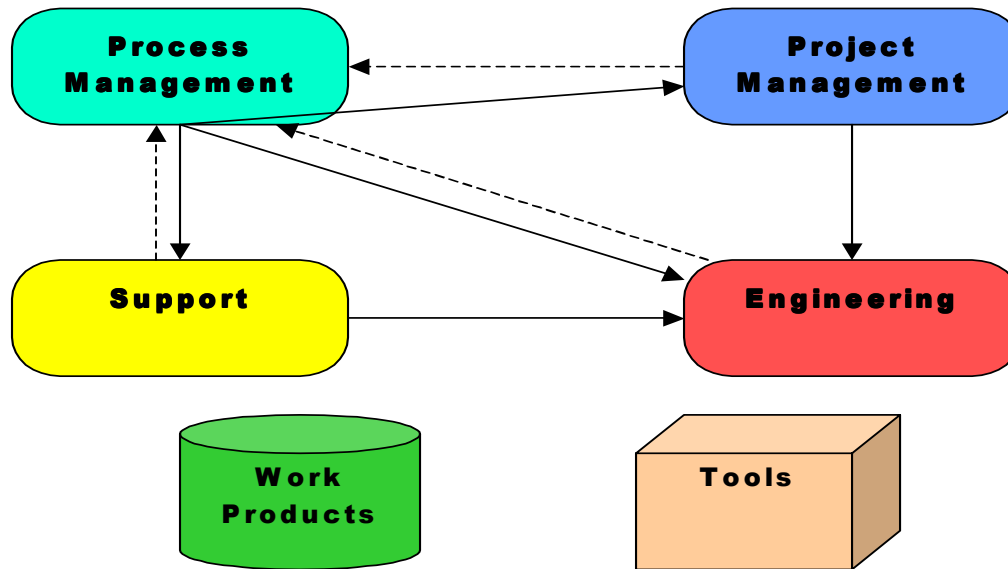

Figure 1 CMMI process areas and their interaction

Just a few of the challenges to organizations in implementing CMMI are

- Publish the generic practices developed, then to review all of the specific derived practices at each project
- Measure and incorporate best practices or lessons learned from the specific practices back into the generic practices
- Manage the information generated at both the generic level and the specific project level
- Foster collaboration between the entire integrated team
- Publish the information to all members of the team, including suppliers
- Integrate the various tool sets used at the generic and specific level to ensure adequate information flow
- Coordinate and share and get commitment to the establishment of a project plan
- Monitor all aspects of the project plan to ensure reactive adjustments to change
- Keeping everyone in the integrated team aware of all aspects of change
- Providing a way for members of the distributed integrated team to perform and document peer reviews

It should be apparent that without at least a basic infrastructure to support these and the other needs of CMMI, successful deployment is at serious risk. When looking at infrastructures, organizations should ensure that they have at least a basic set of services built in to facilitate deployment of CMMI.

- Work Product Artifact Configuration Management (not source code)
- Defect Management
- Project Management
- Project Planning

In addition, the ideal infrastructure would provide additional services helpful if not necessary to an organization implementing CMMI. They would be services or capabilities such as

- Workflow (Process) templates
- Subscription Services to work products
- Comprehensive and dynamic reporting capabilities
- Integration to other tools e.g. configuration management for source code, requirements management, and other authoring tools.
- Peer Review Support
- Collaboration Services
- Decision and commitment logging
- Internet accessible

While there are many products that can service some of these critical areas, and even fewer that can fulfill the ideal domains, there is a product available today that is flexible enough to conform to your specific needs, and at the same time provide the robust set of services, and infrastructure to assist you to achieve Level 3 Maturity of CMMI.

This product is called iNotion from I-Logix.

iNotion

iNotion is an out-of-the-box deployable, highly productive, Product Lifecycle Management (PLM) portal. iNotion tightly couples marketing, product development, quality assurance, your suppliers and, if desired, the customer as well. It simplifies and expedites the management of people, the tasks assigned to them, and the artifacts they produce by providing a scalable, configurable, real-time, integrated, product lifecycle solution. iNotion accomplishes this by providing instant, controlled, web-based access between a wide array of development artifacts and product management services from any location at any time.

iNotion uniquely provides a web based infrastructure that includes and links project management, task management, inspections, document management, defect management and component management with subscription and notification services. As a result, you can subscribe to any product information of interest and iNotion will automatically notify you via email as that information changes. Furthermore, because subscription and notification services are integrated with the tasks, people, and the artifacts that are produced, you can efficiently manage change and the overall product lifecycle efficiently with timely and accurate information.
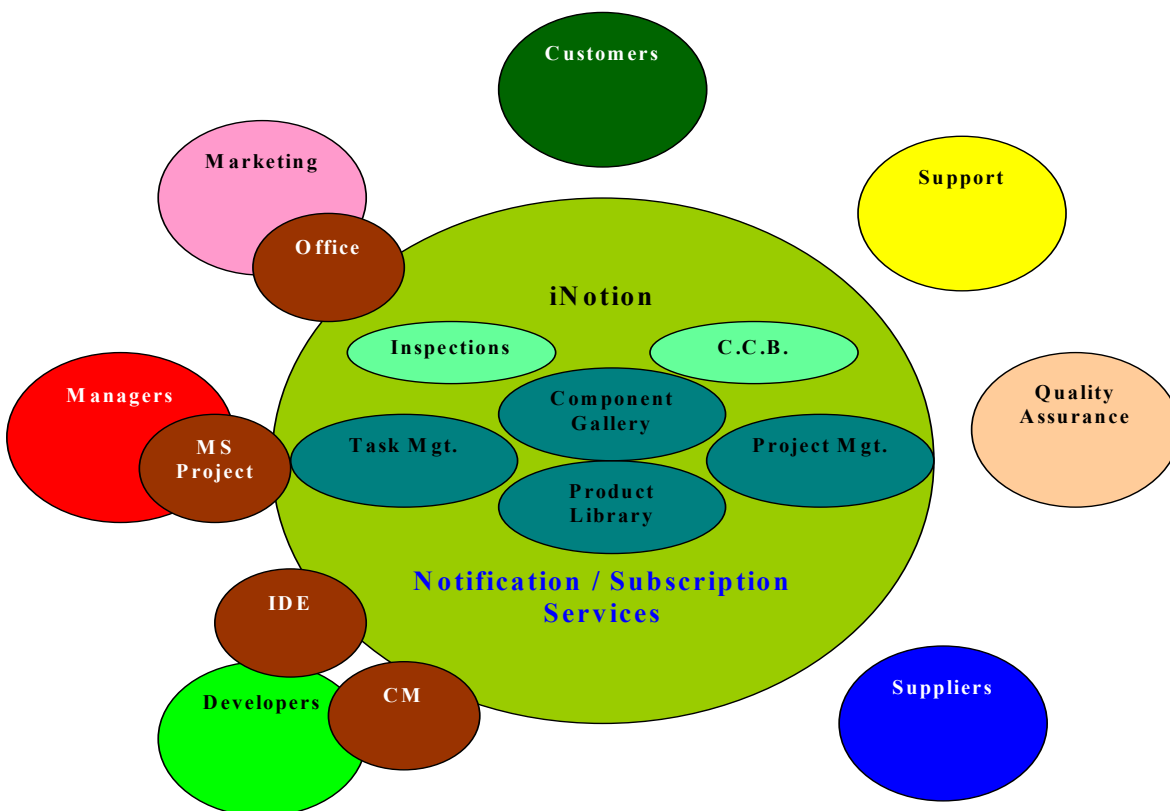
Figure 2 iNotion and the players in CMMI product lifecycles

iNotion's extensible architecture provides seamless integration with incumbent point tools and enhances their value and effectiveness. For example, modeling, metrics collection, data analysis, configuration management, and requirements management capabilities can be simply plugged into the infrastructure through the API and this information can then be shared and viewed in a 360° basis simply through an Internet browser.

With iNotion, the information is always accurate. The links between the activities are dynamic and the connectivity to the information is always available.

iNotion capitalizes on the presence of many existing tools, fills the void for many others that are missing and uniquely provides the right information to the right people at the right time, from anywhere in the world through one common Internet browser user interface.

Product Management Services

Product Library

Product Library Management

iNotion Product Library Management offers comprehensive services for archival, search and retrieval of development artifacts and information across multiple products and multiple projects. Development artifacts in iNotion can be of any digital file type, from Word .doc files to DLL's, to images, to executables, to audio files etc. With Product Library Management, you can submit development artifacts to the iNotion library, control access privileges, search the library, monitor and receive notifications of changes, manage versions and provide cross-links between the artifacts enabling dependency linking and navigation.

iNotion provides an audit trail for all changes to the product library, which is critical to meeting regulatory requirements. You are able to easily track who changed what information, and when. You are also free to roll back to any version of an artifact that is stored in the product library. Equally important, cross-links between development artifacts, the people assigned to them, and the tasks make navigation to the right information very easy and fast. iNotion doesn't replace your CM tool; it complements it, by providing more flexible access to all of the information not just the source code. iNotion provides the right data to the right people at the right time.

iNotion Product Library Management also offers a powerful yet easy to use search and query facility. With this capability, you can quickly develop, save, and reuse sophisticated product library queries. You can search for information efficiently by simply loading a query and activating the search engine. The iNotion query engine rapidly retrieves all information pertaining to the query. Furthermore, iNotion allows you to develop your own queries using standard SQL statements thus extending the flexibility of the iNotion search facility.

Using iNotion will enhance your ability to configuration manage all of the non-source code

Task Management

iNotion Task Management enables you to create and assign tasks to product team members. Tasks, including defects, enhancements, and general project tasks may have classification, priorities, due dates, and assignments. With iNotion, you can update the status of tasks and oversee the advancement of the tasks throughout the product lifecycle process, and for the entire team. Moreover, relevant artifacts can be easily linked to tasks enabling easy reference, navigation, and future tracking of assignments to completion.

A core capability of the iNotion Task Management System is the workflow engine. Project Managers can define the approved process that team members need to follow for a particular project. This workflow can then be monitored and controlled through iNotion. As an integral part of the notification service, managers can maintain constant awareness of the activities and progress of tasks throughout their team as they receive automatic updates to workflow progression. In addition role based notification allows you to make sure the right people are informed of the task and can make the timely decisions that are so critical in product development and support.

The iNotion Task Management System can also be tightly linked to Microsoft Project data. In fact, you can plan your project with Microsoft Project and those tasks in the Work Breakdown Structure (WBS) can be automatically loaded and linked in iNotion. Then, as work continues, task updates in iNotion are automatically reflected in the Microsoft Project database, resulting in time saved and accurate status reporting.

iNotion's Task Management System includes a robust reporting mechanism so you can generate both predefined and user-defined reports that document the status of the team against the tasks to which they have been assigned. Reports can include all information stored within iNotion such as task identification and description, estimate to completion, time spent on a task, the status of a task, the people assigned to a task, and disposition history which details the task progress throughout the lifecycle. The

TMS reporting mechanism is both flexible and simple to use to ensure that you can easily retrieve the information you need to accurately report the status of your product.

Workflow management combined with the audit trail and history produced by iNotion are both extremely valuable to product development environments that adhere to regulatory process control. iNotion keeps the entire team up to date in terms of the tasks that are being performed and the progress made against those tasks.

Project Management

iNotion's Project Management enables real-time project management for the first time through tight integration with Microsoft Project. This capability links tasks in iNotion with specific elements of the Microsoft project plan so you can, on a timely basis determine your progress on each of the tasks as spelled out in a Work Breakdown Structure created in Microsoft Project. This greatly simplifies the design review process and saves countless hours chasing information needed to update the status of the project plan because it is now linked to the plan and thus readily available. For the first time it becomes possible to keep the project plan up to date with the actual progress of the work. Project Management also includes the ability to receive and produce weekly reports, task priorities, and project plan estimations.

iNotion also provides a set of services allowing for prioritization, estimation of task effort, and weekly reporting of all team members. iNotion gives those in charge of the project a clear and concise view of all aspects of product development planning.

Component Management

iNotion Component Gallery provides product team members the ability to create, submit, catalog, and easily find and reuse product components through an integrated Component Gallery. This intrinsic iNotion capability makes component-based development now possible because it provides a means for actually managing components, the main obstacle to most failed attempts at component-based development.

The iNotion Component Gallery gives you the ability to catalogue components based on classifications. In addition, through iNotion it is possible to download components, gather metrics on a component, view the history, and log defects and enhancements

against components through the integrated set of system services. With the iNotion Component Gallery, reuse of product components becomes a reality.

iNotion provides full lifecycle support services for components because Component Management is fully integrated with other product management services within iNotion such as product library, task, and project management, greatly simplifying component usage and maintenance.

Inspections — *Inspection Management*

Inspection Management allows product team members to capture the decision-making process and enable multiple team member reviews for any product development artifact, online. Through iNotion Inspection Management, you can schedule reviews for the product team members, and assign roles to the team members such as Moderator, Author, Inspector, and Reviser. Reviews of the artifact can then take place within a scheduled period with comments captured in iNotion.

Inspections with audit trail and history are critical to processes that must adhere to regulatory requirements. iNotion supports such environments by capturing the artifacts, the inspection schedule, and the results of the inspections into a complete history file. This file also contains an audit trail and the roles played by each of the product team members.

C.C.B. — *Change Control Board*

The Change Control Board, or CCB in iNotion enables all managers in the cross-functional product team to schedule, tally and record decisions pertaining to any aspect of the product development project. Whether the issue is in what release of the product to resolve certain issues, to what new features are to be included, to sign off on new processes or procedures, the CCB provides the infrastructure and framework to schedule, and record the decisions. Through the powerful iNotion linkage, you can relate documents, incidents or even free form questions to the voting. It also provides notification services to ensure all parties are informed of the vote and the actual agenda.

Notification / Subscription Services — *Subscription and Notification*

Subscription and Notification is a unique and extremely powerful product management service that is integrated with all iNotion

modules. With Subscription and Notification, you are automatically notified of any update to any task, query, or artifact to which you have subscribed. Subscriptions can be established by either you or your project managers. This greatly simplifies the task of the Project Manager who typically has to track things manually and notify the interested parties individually. iNotion also allows you to identify your own specific criteria for notification ensuring you can monitor and track the right information relative to your product. Subscription and Notification saves significant time by automating the monitoring and notification processes. No longer will you have to manually monitor the subject matters of interest. iNotion will do that for you and notify you of any change that affects that particular piece of information.

Security

iNotion provides a highly configurable and secure infrastructure for control and access. Users of iNotion who have administrator privileges are able to configure product environments where individual users and groups are provided various levels of access privileges. Users are authenticated using their login access rights. Data transmission is secure with 128bit encryption. The combination of configurable access privileges, user authentication and secure transmission ensure the right information is provided only to the right people at the right time.

3rd Party Integration

iNotion's product management services are easily extensible with the iNotion 3rd Party Plug-In Application Programming Interface (API). This API allows you to leverage your existing investments in COTS or homegrown products, and stay within the iNotion infrastructure. iNotion enables the plug-in of virtually any type of tool into the infrastructure, such as requirements traceability, testing, metrics collection, CRM, PDM, defect/enhancement tracking, modeling tools, IDE's, and configuration management products that support the Microsoft Source Code Control Interface (MSSCCI).

For example, iNotion allows you to work within your IDE but check development artifacts in and out of your CM repository through iNotion, without leaving the IDE. This provides seamless operation of development tasks while capturing the history through iNotion and while at the same time linking those artifacts to the tasks that are managed in iNotion. This extensibility mechanism gives you the flexibility to construct the optimal product lifecycle management infrastructure, consisting of both intrinsic iNotion services and 3rd party products.

iNotion fully integrates into the Office tool suite (Word, Excel, PowerPoint), so that you can view, edit and store Office documents directly into iNotion from these authoring tools. In addition, iNotion tightly integrates with MS Project.

Summary: iNotion and CMMI

iNotion can clearly support out of the box many of the process areas covered by CMMI. This includes all of the basic needs of an infrastructure like Work Product Artifact Configuration Management, Defect Management, Project Management, and Project Planning

iNotion can support many of the other services that are clearly desirable such as workflow (Process) templates, subscription Services to work products, comprehensive and dynamic reporting capabilities, integration to other tools e.g. configuration management for source code, requirements management, and other authoring tools, peer review support, collaboration services, decision and commitment logging, and Internet accessible.

While no software can guarantee compliance with CMMI at any level, iNotion can provide the key infrastructure necessary to assist the organization to define, implement, and increase their compliance. iNotion is flexible enough to accommodate your specific needs and environment for CMMI.

Using iNotion to assist organizations in the implementation and ongoing support of CMMI provides real value in both time and money. iNotion's suite of services provides organizations with the key infrastructure and functionality to quickly and easily develop and maintain their CMMI objectives. It can assist and help manage all 4 of the Process Areas for Levels 2 and 3 of the Process Areas, and provide a foundation for Levels 4 and 5 Process as well.

I-Logix

I-Logix Inc.
3 Riverside Drive
Andover, MA 01810
Tel: 978-682-2100
Toll Free: 888 8ILOGIX
Fax: 978-682-5995
E-mail: info@ilogix.com
http://www.ilogix.com

European Headquarters
I-Logix UK Ltd.
1 Cornbrash Park
Bumpers Way
Chippenham
Wiltshire SN14 6RA
England
Tel: +44 1249 467-600
Fax: +44 1249 467-610
E-mail: info_euro@ilogix.com