Capability Maturity Model Integration CMMI

Shahid Mahmood

Virtual University of Pakistan

Domez Colony Kundian , District Mianwali.

ms140400344@vu.edu.pk

Abstract—CMMI has started to play a key role in software development organizations worldwide. To meet the increasingly and competing demand of software many organization has adopted the CMMI level instead of simple CMM level. CMMI model is more comprehensive and rigid than the CMM model, as it covers 23 key process areas versus CMM's 18 key process areas. In addition, CMMI has 460 practices versus CMM's 316. Still the number of process can be very overwhelming and it opens up the question how to best implement them. In order to stage the process improvement effort , CMMI offers five maturity levels that can only be reached one after the other ,The capability maturity model (CMM) approach to Software engineering process improvement is the most governing paradigm of organizational change that software organizations implement. It is proved that some organizations have accomplished their various goals with the help of CMMI. The vast majority have failed. The quality of a product is largely determined by the quality of the process that is used to develop and maintain it. Behavioral changes are needed at management and staff levels such as increased personal accountability, tighter links between product management; development SCN etc. The Capability Maturity Model Integration (CMMI SM) project has involved a large number of people from different organizations throughout the world. These organizations were using a CMM or multiple CMMs and were interested in the benefits of developing an integration framework to aid in enterprise-wide process improvement. Although these models have proven useful to many organizations, the use of multiple models has been problematic. Many organizations would like to focus their improvement efforts across the disciplines within their organizations. However, the differences among these discipline-specific models, including their architecture, content, and approach, have limited these organizations' ability to focus their improvements successfully. Further, applying multiple models that are not integrated within and across an organization becomes more costly in terms of training, appraisals, and improvement activities. A set of integrated models that successfully addresses multiple disciplines and has integrated training and appraisal support solves these problems.

Keywords—Key process area; Capability level; Maturity level; Staged; Continuous; SMI; ESI;

I. INTRODUCTION

During the last decade, Software engineering process has emerged as dominant approach for improving quality and productivity in software development organization. In fact the CMMI project was formed to build an initial set of integrated models, improve best practices from source models based on lesson learned, establish a framework to enable integration of future models, create an associated set lf appraisal and training products. In nutshell a CMMI model provides a structured view of process improvement across an organization. Furthermore CMMI can help us in integrate traditionally separate organizations, set process improve goals, priorities, provide guidance for quality processes, provide a yardstick for appraising current practices. CMMI provides a way to focus and manage hardware and software development from product inception through deployment and maintenance.

Actually CMMI is a good place to start to build a software engineering processes in an organization's standard business practices. CMMI express process improvement experience and lessons learned form broader industry and also includes a wealth of processes and best practices for system engineering , software engineering and learning , all in a single unified frame work. CMMI is a process –improvement model that provides a set of Best practices that address productivity, performance, Costs, and Stockholder satisfaction. However it is not a set of "Bolt- on Processes" That Last only as long as the well is Squeaking. On the other hand CMMI provides a consistent , enduring framework that holds new ideas and creativity. CMMI also Facilitates Enterprise-Wide Process Improvement, Unlike Single-Discipline Models. It is proven industry framework to improve product quality and development efficiency for both hardware and software. Capability maturity model integration is sponsored by US Department of Defense in cooperation with Carnegie Mellon University and the Software Engineering Institute (ESI). Many companies have been involved in CMMI definition. In the paper we will demonstrate the representations of the CMMI model , both Staged and continuous. CMMI, staged , uses 5 levels to describe the maturity of the organization, same as predecessor CMM.

II. IMPORTANT DEFINITIONS

Some important definitions related to the paper are given below.

A. Process:
A process area in CMMI model consists of activities that are implemented in that CMMI model. These activates can be mapped to one or more practices in a CMMI process areas to allow a process to be useful for process improvement and appraisal.

B. Process Area:
The latest version of Capability Maturity Model Integration (CMMI)--CMMI for Development, Version 1.3—contains 22 Process Areas that describe the aspects of product development that are to be covered by organizational processes.

C. Managed process: A managed process is process that is planned and executed in accordance with company standards; employs skilled people having adequate resources to produce controlled output. It has relevant stake holders. This process is monitored a reviews by mangers. Process is evaluated for adherence to its process description.

D. Defined Process: A process is said to be defined process it is managed process such that tailored to meet the organizations. Set of standers process according to the organizations tailoring guidelines has a maintained process description and contribute work products, measure, and other process improvement information to the organizational process assists.

III. KEY PROCESS AREAS:

A. Immature Versus Mature Software Organizations

To set the sensible goals for the software engineering processes it is needed to understand the difference between immature and mature software organizations comprehensively. In an immature software organization, software processes are generally improvised by practitioners and their management during the course of the project. Even if a software process has been specified, it is not rigorously followed or enforced. The immature software organization is reactionary, and managers are usually focused on solving immediate crises (better known as fire fighting).

Software organization possesses an organization-wide ability for managing software development and maintenance processes. The software development process is provided to both existing staff and new employs. The processes mandated are usable and consistent with the way the work actually gets done. These defined processes are updated when necessary, and improvements are developed through controlled pilot-tests and/ or cost benefit analyses. A matured organization has clear roles and responsibilities within the defined process and also clear though out the project and across the whole organization.

In a mature organization, managers of the organization monitor the quality of the software products and the process that produced them. This kind of organizations has their clear and firm objective, qualitative basis for judging product quality and analyzing problems with the product and process. These organizations have their predefined schedules and budgets based on the result of historical record and quality of the product they had developed in the past. In general matured organizations follow a disciplined process consistently because all f the participants understand the value of doing so. And the necessary infrastructure exists to support the process. schedules and budgets are routinely exceeded because they are not based on realistic estimates. When hard deadlines are imposed, product functionality and quality are often compromised to meet the schedule.

Immature organization, have no clear objective basis for judging product quality or for solving product or process problems. That's why product quality in these organizations is unpredictable.

In contrast of immature software organization, a mature so

IV. SOURCES OF THE CMMI

The software Engineering Institute (SEI) developed an initial version of a maturity model and maturity questionnaire at the request of the government and with the assistance of the MITRE Corporation. During the whole process of development of maturity model and questionnaire, the SEI has paid attention to advice from practitioners who are involved in developing and improving software process. In fact we want to provide a mature model that has the following characteristics.

- It is based on actual practices

- It reflects the best of the state to the practice;

- It reflects the need of individuals performing software process improvement, software process assessments or software capability evaluations;

- It uses the documentation;

- This model is publicly available.

V. STRUCTURE OF THE CMMI

The capability maturity model CMM is composed of five maturity levels. With the exception of Level 1, each maturity levels composed of several key process areas. Each key process area is organized into five sections called common features. Each specific goal applies activities, so called "specific practices "that help to achieve these specific goals. Generic goals are common between all the set of process areas.
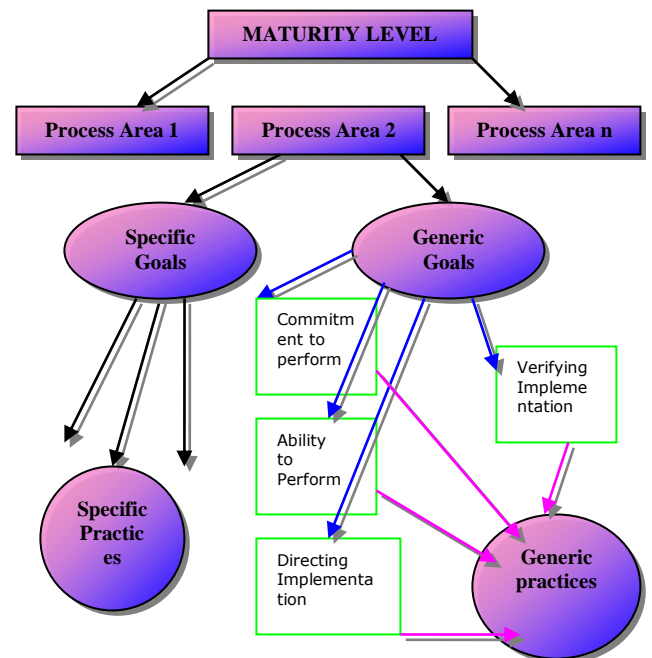

Fig. 1. CMMI STAGED Structure

We can use the capability maturity model integration to provide a framework for integration of process improvement for multiple process areas. The key process areas for the CMMI are system engineering, Software supplier sourcing, engineering, and development; and integrated product and process development. Different versions of CMMI model are publicly available, depending on how many of these areas are applicable to an organization. Each version of CMMI model provides two different improvement models. These are continuous model and the staged model.

VI. STAGED MODEL

To reflect maturity in process across various process areas, organizations are likely to choose the staged model. In staged model to measure the maturity level of an organization we have defined different maturity levels from one to five as follows.

- Initial
- Managed
- Defined
- Quantitively managed
- Optimizing

Basic structure of the staged model is shown in figure below. Each maturity level is defined on pervious maturity level by defining the predefining a set of key process area to reach to next level. Each key process area may consist on the different set of specific and generic goals. Each key process area consist on a specific goals related to it . Each specific goal applies activates so called "specific activities ". That helps to achieve these goals. In general all generic goals are common between all key process areas (To develop a project plan is a specific goal within the project planning process Area). To achieve a specific goal we use the generic practices that help to achieve the generic goal.

VII. CMMI STAGED REPRESENTATION - 5 MATURITY LEVELS

Maturity levels provide a recommended order for software process improvement. Maturity levels organise the process areas (at each maturity level we have predefined set of process areas). Each maturity level maintain organization's processes to improve the performance quantitively .
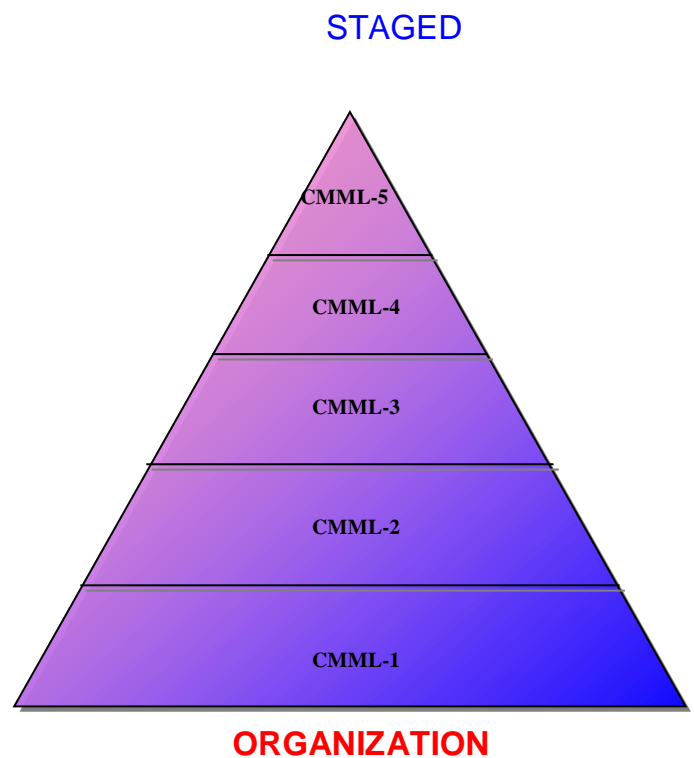
STAGED

Fig. 2. CMMI Staged Model

The maturity levels are measured by the achievement of the specific and generic goals that apply to each predefined set of key process areas.

VIII. CMMI STAGED REPRESENTATION - 5 MATURITY LEVELS

These five maturity levels define an original scale for measuring the maturity of an organization's software process and for evaluating its software process capability. Each maturity level indicates the level of process capability. Levels of capability maturity models, one though five are decomposed into 22 key process areas (KPAs), called common features.

In the staged representation performance of process improves continually through incremental and innovative technological improvements. Key process area are controlled though statistical and other quantitative techniques.
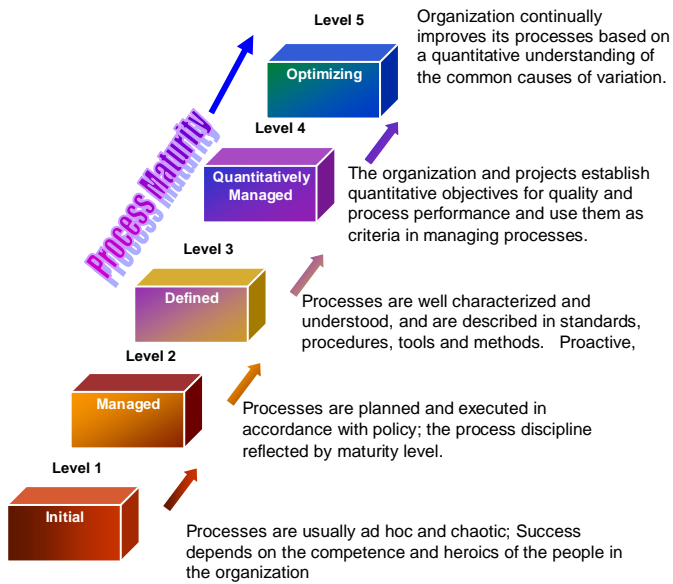
Fig. 3. CMMI Staged Representation - 5 Maturity Levels

It to be noted that maturity levels 2 through 5 has the same names as capability levels 2 through 5. This was decided already because the concepts of maturity levels and capability levels are essential to each other. Maturity levels are used to characterize organizational improvement relative to a set of process areas, and capability levels characterize organizational improvement relative to an individual process area.

A. Level -1 : Initial

At maturity level 1, Processes are ad hoc and chaotic. Organization is unable to provide the stable environment. . Success of the organization depends on the competence a heroic actions and not on the previously proved process. In the maturity level 1 we are able to provide the products that work. But in the preparation we exceed the limit of Budget an time. In Maturity level-1 originations are characterized by over commit and d these organizations are unable to repeat their success. Abandon processes in the time of crises.

B. Level 2 – Managed

In the maturity level we accomplish all the requirement s of the initial level. In other words we have confirmed that processes are planned , performed , measured and controlled

In the 2nd level we ensure that our current practices are being performed , as per routine . when these practices are in place, it means that our project process are managed and performed according to the documents . At this level our project requirement processes , and services are managed according to the documents planned . Furthermore management can define

the check points to endure that the services, products and processes are proceeding according to the documents planned .

Stockholders can define some rules among themselves and can revise these rules as necessary. Furthermore stockholders can check or review these rules products , services and documents planned.

C. Level -3 Defined

As mentioned earlier for the managed maturity level -2 , all pervious requirements are established according to the rules of pervious maturity levels . Processes at maturity levels 3 are well characterized and understood, are defined in procedures, tools and standers.

Basic difference between maturity level 2 and maturity level 3 is the scope of standards process descriptions and procedures. However at maturity level 2 the standards , process descriptions and procedures are quite different for any organization, in each instance of the processes. At maturity level 3 processes, procedures and processes descriptions are defined using the organization's set of standards processes to meet the particular needs of the particular organization. At maturity level 3, to define the standard process we can use the process standards of maturity level 2 and maturity level 1. Furthermore we can endure that specific goal of maturity level 1,2 and 3 has accomplished, while the general goal of maturity level 2 has fulfilled. At This maturity level while defining standards , procedure, process descriptions we use the organization's standard processes in a way that they suit to a particular project or organization. A critical difference between the maturity level 2 and maturity level 3 is that process are defined in more details and rigorously then the maturity level 2 furthermore process are defined managed proactively using the understanding the interrelationship between process , its work products and its services. A defined process clearly defined the purpose , input entry criteria activities , rules , measures , rectification steps, outputs and exit criteria.

D. Level -4 :Quantitativly Managed

At the maturity level -4 an organization have achieved all the specific goals assigned to maturity levels 2,3,4, and generic goals assigned to key process areas of maturity level 2, and maturity level 3.

At maturity level 4 sub-processes are selected such that significantly contribute to the performance of the organization and these process are controlled using the statistical and other quantitatively defined measures. Quantitative objective for the quality an process performances are established and are used to manages the processes. Quantitative objective for an organizations are established according to the needs of the customer, end users, organization and process implementation. Process quality and performance are understood in terms of statistics across all organization and whole life of processes . For these process we statistically measure the process performance, control , analyze them according to predefined statistical

measures. Special cases of process procedure deviations are identified and where it is appropriate we prevent these causes to deviate the process in future.

To make the proper decision we incorporate the quality and process performance measures into the measuring repository of the organization. The critical difference between the maturity level 3 and maturity level 4, is that in level 3 we only predict the process on quantitively measure where's in maturity level 4 we quantitively measure the performance of process and then these measures are used to statistically predict the performance of process in the future.

In simple words at maturity level 4 , we control the process's performance on some statistical measures and we make process performance predictions based on statistical measures , that we have calculated earlier.

E.   Level 5 :Optimizing

At maturity level 5 an organization have achieved all the specific goals of level 2,3,4 and 5, it also achieved the generic goals of maturity level 2 an d3
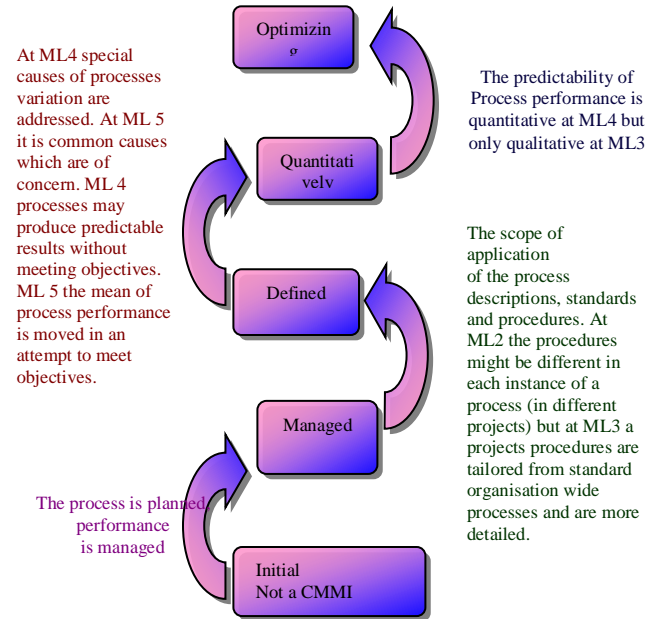
Process are continuously improved by quantitively understanding the inherent common causes of variations in the process.

In the OPTIMZING level 5 we continuously improve the process performance , through both incremental and innovative technical ideas. In this level we Quantitively define the objective for continuous improvement of the organization. Quantitative process improvement objective are continuously revised to reflect the changes in the business objectives an used as criteria in managing the process improvement . The effect of process improvement applied are quantitively measured and evaluated against the Quantitative process improvement objectives. In the activities of measurable activities we target both the defined processes and organizations set of standard process. Optimizing processes at level 5 , that are agile an innovative are dependent on the empowered workforce, aligned with business values an d objectives of an organization. The organization ability to respond rapidly to changes and enhancement is accelerated through finding the ways to accelerate and share learning . in fact improvement is the property of every body inherently that results in continuous cycle of improvement.

Critical difference between maturity level 4 and maturity level 5 is the type of process variation addressed. At maturity level 4 , we concerned with the special causes of variation in processes and predicting statistically final results of the processes improvement . At level 4 we can achieve the predicted goals , however these results may not match to the quantitively defined objective.

At maturity level 5 , our objective is to find the common causes of process variation and changing the process quantitively improve the process performance , to achieve the predefined quantitively process improvement objective.

Distinctions

At ML4 special causes of processes variation are addressed. At ML 5 it is common causes which are of concern. ML 4 processes may produce predictable results without meeting objectives. ML 5 the mean of process performance is moved in an attempt to meet objectives.

The predictability of Process performance is quantitative at ML4 but only qualitative at ML3

The scope of application of the process descriptions, standards and procedures. At ML2 the procedures might be different in each instance of a process (in different projects) but at ML3 a projects procedures are tailored from standard organisation wide processes and are more detailed.

The process is planned performance is managed

IX.   MATURITY LEVELS AND PROCESS AREAS:

Below is given a list of all the corresponding process areas defined for a software engineering organization. However these process areas may be different for different organization.

Detail of process areas require quite length documentation, which is beyond the scope of this paper. Therefore we are giving only names of the key process areas.

Level	Focus	Key Process Area	Result
5 Optimizing	Continuous Process Improvement	• Organizational Innovation and Deployment • Causal Analysis and Resolution	Highest Quality / Lowest Risk
4 Quantitatively Managed	Quantitatively Managed	• Organizational Process Performance • Quantitative Project Management	Highest Quality / Lowest Risk

Level	Focus	Process Areas	Quality/Risk
3 Defined	Process Standardization	• Requirements Development • Technical Solution • Product Integration • Verification • Validation • Organizational Process Focus • Organizational Process Definition • Organizational Training • Integrated Project Mgmt (with IPPD extras) • Risk Management • Decision Analysis and Resolution • Integrated Teaming (IPPD only) • Org. Environment for Integration (IPPD only) • Integrated Supplier Management (SS only)	Medium Quality / Medium Risk
2 Managed	Basic Project Management	• Requirements Management • Project Planning • Project Monitoring and Control • Supplier Agreement Management • Measurement and Analysis • Process and Product Quality Assurance • Configuration Management	Low Quality / High Risk

1 Initial	Process is informal and Adhoc		Lowest Quality / Highest Risk

X. CMMI CONTINUOUS STRUCTURE:

In the continuous representation of a CMMI model, the summary components are process areas. Within each process area there are specific goals that are implemented by specific practices. The order in which Process Areas are addressed can follow a recommended staging.

A process area contains specific practices to achieve the purpose of the process area. Generic practices are grouped in Capability Levels. Generic practices are added to the specific practices of each process area to attain a capability level for the process area.

Also contained in the continuous representation of a CMMI model are generic goals that are implemented by generic practices.

Specific goals and practices are unique to individual process areas, whereas generic goals and practices apply to multiple process areas. Each practice belongs to only one capability level. To satisfy capability level 2 for a process area, Following picture illustrate CMMI Continuous Model Structure.
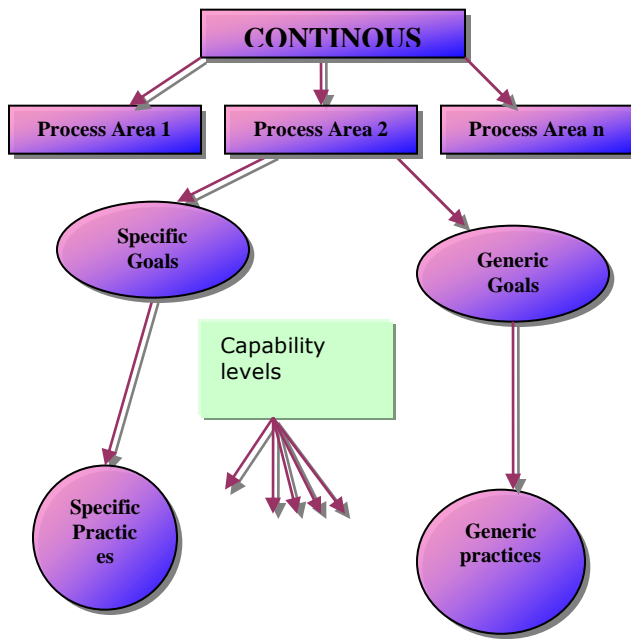
Fig. 4. CMMI continuous structure

XI. CAPABILITY LEVELS (CMMI MODEL)

CAPABILITY LEVEL 0: Incomplete
CAPABILITY LEVEL 1: Performed
CAPABILITY LEVEL 2: Managed
CAPABILITY LEVEL 3: Defined
CAPABILITY LEVEL 4: Quantitatively Managed
CAPABILITY LEVEL 5: Optimizing

These levels belong to a continuous representation of Capability maturity model integration (CMMI) that can be applied to an organization's process improvement achievement in individual key process areas. These levels are a means for incrementally improving the processes corresponding to a given process area. There are six capability levels. Numbered zero to five.

To achieve mature software, a maturity level provides us an evolutionary base for development. Each maturity level provides a proper layer for key process improvement. With respect to CMMI, stage model has five maturity levels as follows.
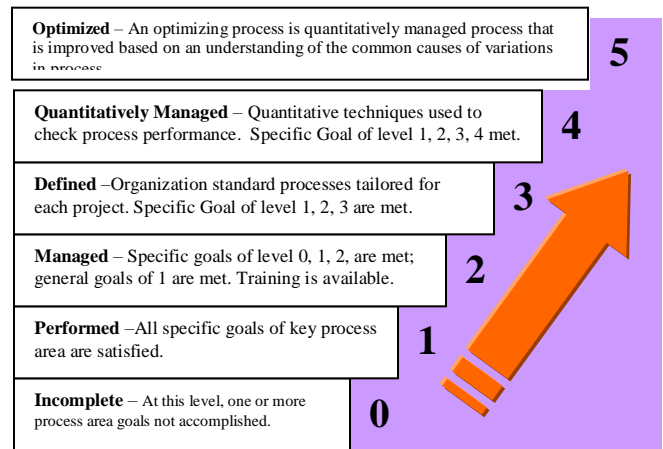

Fig. 5. CMMI Capability Levels in Continous Representaion Model

A. Capability Level 01: Incompelete

An *incomplete process* is a process that either is not performed or is partially performed. One or more of the specific goals of the process area are not satisfied and no generic goals exist for this level since there is no reason to institutionalize a partially performed process.

B. Capability Level 1: Performed

It is also termed as a "performed process". A performed process is a process that satisfies the specific goals of a process area. It supports and enables the work needed to produce identified output work products using identified input work products.

Difference between an incomplete and performed process is that performed process satisfies all of the specific goals of the process area. The performed process supports and enables achievement of specific goals of the process area by transforming identifiable input work product to produce identifiable output work product. It is an ad-hoc process model that is not repeatable

C. Capability Level 2: Managed

The 2nd level of capability maturity model integrated also called a "managed Process". A managed process varies from project to project. However this process model is repeatable. A managed process have all the characteristics of performed process including some additional characteristics, such as, it is planned and executed in accordance with policy , employs are skilled people having adequate resources to produce controlled outputs involves relevant stack holders ; is monitored reviews and controlled and it is evaluated for adherence to it process description.

Difference between the managed process and performed process is the extent to which these processes are used. A managed process is planned and their performances are managed against the plan. In the managed process model we take the correctness action when the actual results and performance deviate from the planned results. It is helpful in achieving the objectives of the plane and it is institutionalized for consistent performance.

To institutionalize the managed process model we doe the following things.

- Adhere to organizational policies.

- Follow strictly the established plan and process descriptions.

- Provide the required resources (Funds. Trained people and required tools.)

- Assign responsibility and authority for performing the process

- Review the activities, status and results of the process with higher level management and taking corrective action.

- Identify and involve relevant stockholder

- Train the people to perform and support the process

- Evaluate the objective of process, its work products and its services for adhering to the process descriptions standards and procedures, and addressing noncompliance.

D. *Compatibility Level 3 Defined*

This is also characterized as " defined process " , which is managed process and tailored according to the organization's set of standards process according to the organization's tailoring guidelines , measures, and contributes work products and other process–implement information to the organizational process asserts.

Compatibility Level 4: Quantitatively In Managed Level

The main purpose of the quantitively managed level is to achieve the project's established quality and process-performance objectives. Process measurements; adapt to problems to reduce variance; predictable performance. To effectively address the specific practices in this process area, the organization already establishes s set of standard processes and related organizational process assets , such as the measurement repository and the process asset library, for use by each project in establishing its defines process. The project defined processes a set of sub-processes that form an integrated and coherent life cycle for project. It is established, in part, through selecting and tailoring processes from the set of standard processes.

At this level the organization and projects establish quantitively objectives for quality and process performance and use them as criteria in managing projects. Quantitative basically depends on the need 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 projects.

E. *Compatibility Level 5: Optimizing*

At maturity level 5, an organization continually improves its processes based on a quantitative understanding of its business objectives and performance needs. The organization uses a quantitative approach to understand the variation inherent in the process and the causes of process outcomes. The purpose of this optimizing level 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.

Maturity level 5 focuses on continually improving process performance through incremental and innovative process and technological improvements. The organization's quality and process performance objectives are established, continually revised to reflect changing business objectives and organizational performance, and used as criteria in managing process improvement.

The Organizational Innovation and Deployment process area enables the selection and deployment of improvements that can enhance the organization's ability to meet its quality and process-performance objectives. The term "improvement," as used in this process area, refers to all ideas (proven and unproven) that would change the processes and technologies to better meet the quality and process-performance objectives. The effects of deployed process improvements are measured using statistical and other quantitative techniques and compared to quality and process performance objectives. The project's defined processes, the organization's set of standard processes, and supporting technology are targets of measurable improvement activities.

XII. ORGANIZATION OF PROCESS AREAS IN CONTINUOUS REPRESENTATION:

Category	Process Area
Project Management	- Project Planning - Project Monitoring and Control - Supplier Agreement Management - Integrated Project Management(IPPD) - Integrated Supplier Management (SS) - Integrated Teaming (IPPD) - Risk Management Quantitative Project Management
Support	- Configuration Management - Process and Product Quality Assurance - Measurement and Analysis Causal Analysis and Resolution - Decision Analysis and Resolution

	• Organizational Environment for Integration (IPPD)
Engineering	• Requirements Management • Requirements Development • Technical Solution • Product Integration • Verification • Validation
Process Management	• Organizational Process Focus • Organizational Process Definition • Organizational Training • Organizational Process Performance • Organizational Innovation and Deployment

Process Area	Abbr	ML	CL1	CL2	CL3	CL4	CL5
Project Planning	PP	ML 2	green	green	blue		
Process & Product Quality Assurance	PPQA	ML 2	green	green	blue		
Supplier Agreement Manager	SAM	ML 2	green	green	blue		
Configuration Manager	CM	ML 2	green	green	blue		
Decision Analysis & Resolution	DAR	ML 3	blue	blue	blue		
Product Integration	PI	ML 3	blue	blue	blue		
Requirements Development	RD	ML 3	blue	blue	blue		
Technical Solution	TS	ML 3	blue	blue	blue		
Validation	VAL	ML 3	blue	blue	blue		
Verification	VER	ML 3	blue	blue	blue		
Organisational Process Focus	OPF	ML 3	blue	blue	blue		
Integrated project management	IPM	ML 3	blue	blue	blue		
Organizational training	OT	ML 3	blue	blue	blue		
Risk Management	RSKM	ML 3	blue	blue	blue		
Organisational Process Performance	OPP	ML 4	orange	orange	orange		
Quantitative Project Management QPM	QPM	ML 4	orange	orange	orange		
Organizational Performance Man	OPM	ML 5	dark red	dark red	dark red		
Causal Analysis and Resolution	CAR	ML 5	dark red	dark red	dark red		

XIII. EQUIVALENT STAGING

Equivalent staging allows a CMMI maturity level in the staged representation to be compared from the designated capability of process areas in the continuous representation.

TABLE I.   EQUIVALENT STAGING

			CL 1	CL 2	CL 3	CL 4	CL 5
Requirements Management	REQM	ML 2	green	green	blue		
Measurement & Analysis	MA	ML 2	green	green	blue		
Project Monitoring and Control	PMC	ML 2	green	green	blue		
Project Monitoring and Control	PMC	ML 2	green	green	blue		

A. Explanation of the Diagram

The colored areas in the Capability level CL columns representing the target profiles that are equivalent to maturity levels ML in the staged representation.

- To equalize the capability level to maturity level 2 in a staged representation, the key process areas to the left of green sector must have satisfied capability levels 1 and 2 in the CMMI continuous representation.

- To match the capability level to maturity level 3 in a staged representation, the process areas to the left of green and blue sector should be satisfied CMMI capability levels 1,2 and 3 in the continuous representation .
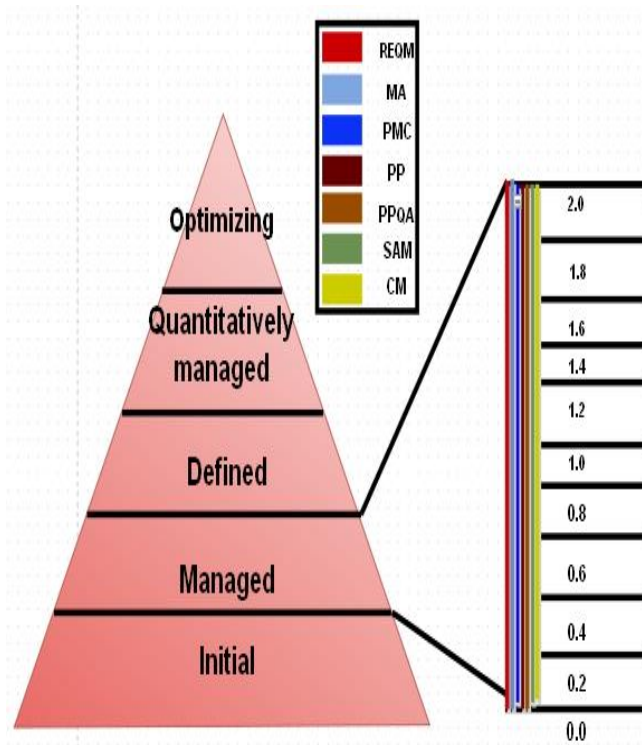
XIV. COMPARING THE CMMI MATURITY LEVEL 2

Fig. 6. Maturity Level 2 Equivalence

A. Explanation of the diagram

The colored areas in the Capability Level columns indicate desired profiles that are equivalent to maturity levels in the CMMI staged representation .

- To be equivalent to maturity level 4 in a staged representation, the key process areas to the left of green, blue and orange sector must have satisfied capability levels 1, 2, and 3 in the continuous representation.

- To be equivalent to maturity level 5 in a CMMI staged representation, all of the key process areas must have satisfied capability levels 1, 2 and 3 in the CMMI's Continuous representation.

XV. COMPARISON OF CAPABILITY AND MATURITY LEVELS

TABLE II.   COMPARISON OF CAPABILITY AND MATURITY LEVELS

Level	Continuous Representation Capability Levels	Staged Representation Maturity Levels
Level 0	Incomplete	
Level 1	Performed	Initial
Level 2	Managed	Managed

Level 3	defined	Defined
Level 4	Quantitatively Managed	Quantitatively Managed
Level 5	Optimizing	Optimizing

XVI. COMPARISONS BETWEEN STAGED AND CONTINOUS MODLES

TABLE III.   COMPARISONS BETWEEN STAGED AND CONTINOUS MODLES

Continuous Representation	Staged Representation
Process areas are organized by process area categories.	Process areas are organized by maturity level.
Improvement is measured using capability levels. Capability levels: - Measure maturity of a particular process across an organization. - Range from 0 through 5.	Improvement is measured using maturity levels. Maturity levels - measure maturity of a set of processes across an organization - Range from 1 through 5.
There are two types of specific practices: base and advanced. All specific practices appear in the continuous representation.	There is only one type of specific practice. The concepts of base and advanced practices are not used. All specific practices appear in the staged representation except when a related base-advanced pair of practices appears in the continuous representation, in which case only the advanced practice appears in the staged representation.
Capability levels are used to organize the generic practices.	Common features are used to organize generic practices.
All generic practices are included in each process area.	Only the level 2 and level 3 generic practices are included.
Equivalent staging allows determination of a maturity level from an organization's achievement profile.	There is no need for an equivalence mechanism back to the continuous representation because each organization can choose what to improve

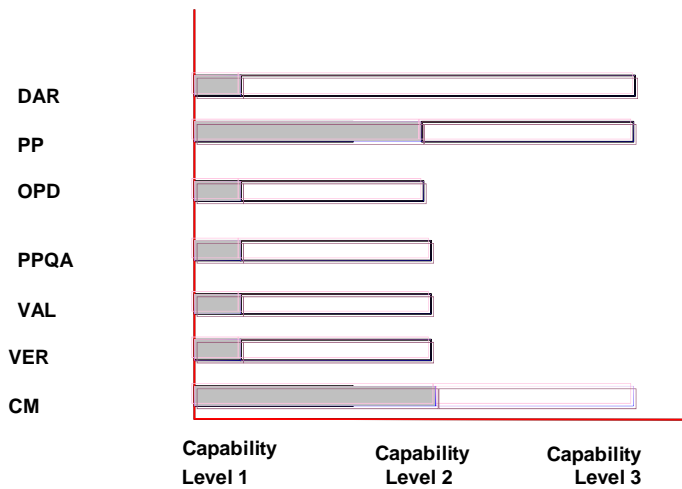|		and how much to improve it using the staged representation.

XVII. Target & Achievement Profiles

Fig. 7. Target & Achievement Profiles

OPP	Organizational Process Performance	Process Management	4
OT	Organizational Training	Process Management	3
PMC	Project Monitoring and Control	Project Management	2

XVIII. Capability Maturity Model Integration (CMMI) Core Process Areas

Abbreviation	Name	Area	Maturity Level
CAR	Causal Analysis and Resolution	Support	5
CM	Configuration Management	Support	2
DAR	Decision Analysis and Resolution	Support	3
IPM	Integrated Project Management	Project Management	3
MA	Measurement and Analysis	Support	2
OPD	Organizational Process Definition	Process Management	3
OPF	Organizational Process Focus	Process Management	3
OPM	Organizational Performance Management	Process Management	5

Conclusion

Efficiently and effectively improve and assess multiple disciplines across their organization. CMMI team is working to assure the CMMI Product Suite addresses needs of software and systems engineering communities of practice

Two representations of the CMMI model have been developed: continuous and staged. With each new release of the model, the difference between these two has decreased till the point that it is not easy to identify the difference between these two representations. It is needed to the model users to which version of the model form the CMMI product Suite they will use. Organizations using CMMI must be able to

- Measurement and Analysis & Data management at Level 2
- Risk Management & Decision Analysis and Resolution at Level 3
- Expansion of Software Product Engineering
- Configuration Management for all Process Areas

Use of an integrated model to guide enterprise process improvement promises to be one of the more sustainable & profitable initiatives that any organization might pursue

Reference

[1]   http://www.software-quality-assurance.org/index.htm   tabulated   and annotated list of CMMI for software, organized by process area and activity
[2]   http://www.sei.cmu.edu/cmmi/ CMMI Web site
[3]   CMMI for Development, Version 1.2 (free PDF at SEI) http://www.sei.cmu.edu/publications/documents/06.reports/06tr008.html
[4]   Process Area (CMMI) at Wikipedia.org Overview of process areas and activities
[5]   Major changes in CMMI Version 1.3
[6]   CMMI V1.3: Agile
[7]   CMMI V1.3, High Maturity Practices Clarified
[8]   Deploying the CMMI V1.3
[9]   CMMI Overview. Software Engineering Institute. Accessed 16 February 2011.

[10] Overview of the CMMI Version 1.3 Process Areas

[11] "Standard CMMI Appraisal Method for Process Improvement (SCAMPISM) A, Version 1.2: Method Definition Document". *CMU/SEI-2006-HB-002*. Software Engineering Institute. 2006. Retrieved 23 September 2006.

[12] ^a ^b ^c ^d Sally Godfrey (2008) What is CMMI ?. NASA presentation. Accessed 8 dec 2008.

[13] CMMI Process and Measurements Roadmaps

[14] CMMI Product and Product Integration Roadmaps

[15] CMMI Project Roadmap

[16] CMMI Roadmaps