CHAPTER 3

Capability Maturity Model Integration (CMMI)

....

AeU
asiaeuniversity

LEARNING OUTCOMES

By the end of this chapter, you should be able to:

1. Describe the staged and continuous representation of the CMMI model.

2. Explain the advantages and disadvantages of each CMMI representation.

3. Describe the CMMI maturity levels and the process areas in each level.

4. Explain the purposes of CMMI appraisals and how do they fit into the software process improvement cycle.

INTRODUCTION

Organizations which are developing software processes are facing many problems regarding the need for change of existing structure. There are many issues that are raised to develop a process. To overcome the issue many models have been published – as mentioned in previous chapter, among the models or frameworks are CMMI, AMI, SPICE, Bootstrap, Trillium and ISO 9000-3. One of the best and most popular model in use is Capability Maturity Model Integration (CMMI).

Software Engineering Institute (SEI) first began the work with Capability Maturity Models (CMM), and published a book about the subject in 1995. The CMMs have meant success for many organizations; they have gained increased productivity and quality, and more accurate estimates on time and resource consumption.

The CMM was built upon the work of quality gurus such as Deming, Juran and Crosby where they were effective in transforming struggling manufacturing companies with quality problem to companies that could consistently produce high-quality products. Improvement to quality led to cost reductions and higher productivity as less time was spent in re-working defective products.

As software companies need to have quality software processes to deliver high quality software to their customers, the SEI has collected empirical data to suggest that there is a close relationship between software process maturity and the quality of the delivered software – there is a need to focus on the software process as well as on the product.

The CMM was released in 1991 and its successor, the CMMI model, was released in 2002. The CMMI is a framework to assist an organization in the implementation of best practice in software and systems engineering. It is an internationally recognized model for process improvement and is used worldwide by thousands of organizations. The focus on the CMMI is on improvements to the software process to ensure that they meet business needs more effectively.

A process is a set of practices or tasks performed to achieve a given purpose which may include tools, methods, material and people. Typically, an organization has many processes in place for doing its work. The objective of process improvement is to improve the processes in order to meet business goals more effectively.

The process is an abstraction of the way in which work is done in the organization and is seen as the glue that ties people, procedures and tools together. It may be described by a process map which details out the flow of activities and tasks. The process map includes the input of each activity and the output from each activity. Often, the output from one activity will become the input to the next activity. Sample of process map as shown in Figure 3-1.
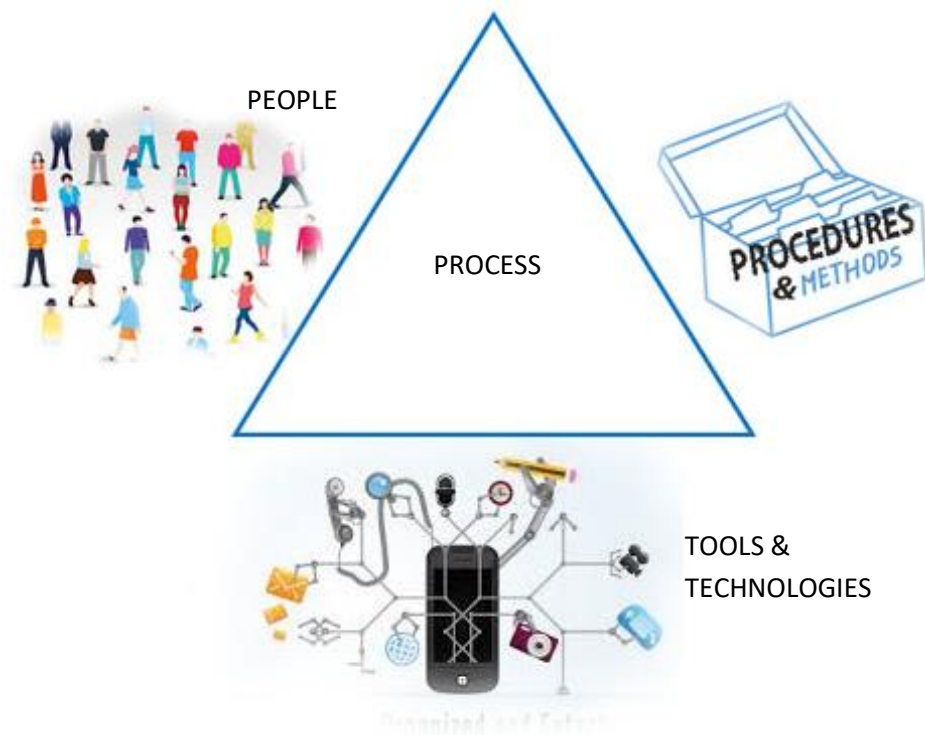
PEOPLE

PROCESS

PROCEDURES & METHODS

TOOLS & TECHNOLOGIES

Figure 3 - 1

The origin of the software process improvement field go back to Walter Shewart's work in the 1930s on statistical process control. This work was later refined by Deming and Juran. Watt Humphries began applying the ideas of Deming, Juran and Crosby to software development at IBM. His approach was published in his book

Managing the Software Process and he later moved to the SEI to work on software process maturity models with the other SEI experts.

The SEI released the CMM in the early 1990s and this process model has proved to be effective in assisting companies in improving their software engineering practices and in achieving consistent results and high-quality software.

The CMM is a process model and it defines the characteristics or best practices of good processes. It does not prescribe how the processes should be done and allows the organization the freedom to interpret the model to suit its particular context and business needs. It provides a roadmap for an organization to get from where it is today to a higher level of maturity. It also provides a place to start process improvements and a common language and shared vision.

The CMM model consists of five maturity levels with the higher maturity levels representing advanced software engineering capability. The lowest maturity level is level 1 and the highest is level 5. The SEI developed an assessment methodology to determine the maturity of software organization. Initially most organizations were assessed at level 1 maturity. Over time companies embarked on improvement initiatives and matured their software processes. Many companies are now performing at the higher maturity levels.

The Capability Maturity Model Integration (CMMI) is the successor to the older CMM, and its implementation brings best practice in software and systems engineering into the organization. The CMMI development included merging the software CMM and systems CMM and it is compatible with the ISO 15504 standard.

3.1	**CMMI Maturity Levels and Representation**

CMMI Maturity Levels

"CMMI-Capability Maturity Model Integration is a tool for implementing best practices for activities concerning products and services in organizations"

(Chrisses et al.2007 p.3-4)

The CMMI consists of five maturity levels with each maturity level (except level 1) consisting of a number of process areas. Each process area consists of a set of goals and this must be implemented by a set of related practices in order for the process area to be satisfied. The practices specify what is to be done rather than how it should be done. Processes are activities associated with carrying out certain tasks, and they need to be defined and documented.

The users of the process require appropriate training to enable them to carry out the process. Process discipline need to be enforced by the independent audits. Process performance needs to be monitored and improvements made to ineffective processes. The motivation for the implementation of the CMMI as tabulated in Table 3-2.

MOTIVATION FOR CMMI IMPLEMENTATION

1. Enhance the credibility of the company
2. Marketing benefit of CMMI maturity level
3. Implementation of best practice in software and systems engineering
4. It increases the capability and maturity of an organization
5. It increases the capability of subcontractors
6. It provides improved technical and management practices
7. It leads to higher quality of software
8. It leads to increased timelines of projects
9. It reduces the cost of maintenance and incidence of defects
10. It allows the measurement of processes and products
11. It allows projects/ products to be quantitatively managed
12. It allows innovative technologies to be rigorously evaluated to enhance process performance
13. It improve customer satisfaction
14. It changes the culture from firefighting to fire prevention
15. It leads to a culture of improvement
16. It leads to higher morale in company

Table 3 - 1

The CMMI model covers both the software engineering and systems engineering disciplines. Systems engineering is concerned with the development of systems that may not include software, whereas software engineering is concerned with the development of software systems.

The time required to implement the CMMI in an organization depends on its size and current maturity. It generally takes 1-2 years to implement maturity level 2, and further 2-3 years to implement level 3. The implementation of the CMMI needs to be balanced against the day-to-day needs of the organization in delivering products and services to its customer.

The benefits gained and the quantitative results from the implementation of the CMMI as gathered and reported by the SEI as shown in Table 3-3.

Benefit	Actual Saving
Cost	34%
Schedule	50%
Productivity	61%
Quality	48%
Customer satisfaction	14%
Return on investment	4:1

Table 3 - 2

The maturity level of an organization is a predictor of the results that will be obtained from following the software processes in the organization. The higher the maturity level of the organization, the more capable it is and the more predictable results. The current maturity level acts as the foundation for the improvement to be made in the move to the next level. Refer Figure 3-2.

The maturity levels provide a road map for improvements in the organization and it is not skipped in a staged implementation. A particular maturity level is achieved only when all process areas belonging to that maturity level (and all process areas belonging to lower maturity levels) have successfully implemented in the organization. Refer Table 3-1.
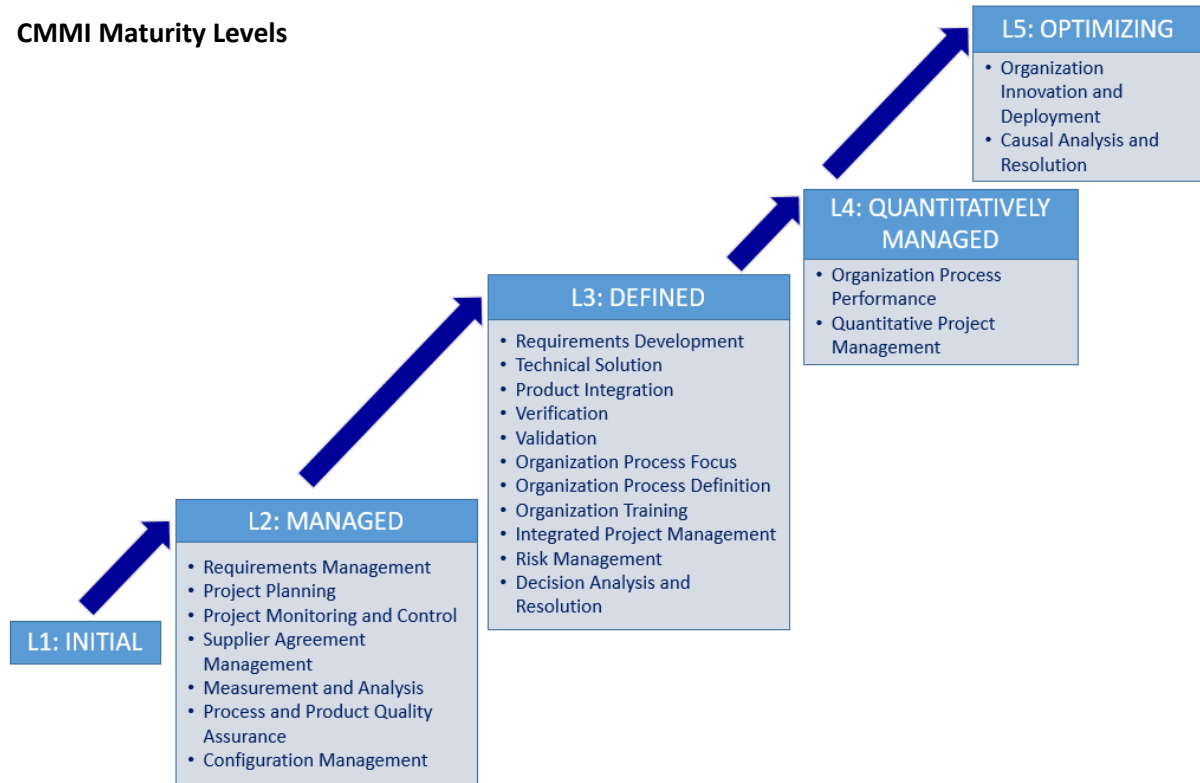
CMMI Maturity Levels

Figure 3 - 2

Maturity Level	Description
• *Initial*	At maturity level 1 processes are ad hoc or chaotic with unpredictable performance.
	Success in a level 1 is often due to the heroic of people rather than having high-quality processes in place. Level 1 organization often abandon the defined process in times of crisis and no mechanism in place to enforce the process
	A level 1 organizations are often unable to repeat previous success, since success is due to heroic efforts of its people rather than processes. They often over-commit due to lack an appropriate estimation process on which to base project commitments.
	Fire fighting is a way of life in these organizations. High-quality software might be produced but at a cost including long hours, high level of re-work, over-budget, over-schedule and unhappy customers. Projects do not perform consistently as their success is dependent on the people involved.
	Among the weaknesses in the processes:- • Poor change control • Poor estimation and project planning • Few procedures • Weak enforcement of standards.

Maturity Level	Description
2. Managed	Emphasis on maturing and management practices such as project management, requirement management and configuration management. At level 2 processes and practices based on policies are established. Projects are monitored and managed according to skills of employees, documentation, stakeholders etc. At stressful times practices are retained and no chaos is to emerge. A level 2 organization has good project management practices in place. They plan and manage new projects based on experience with similar previous projects. The process is planned, performed and controlled. A level 2 organization is disciplined in following processes and the process is enforced with independent audits. The status of the work products produced by the process is visible to management at major milestones, and changes to work products are controlled. The work products are placed under appropriate configuration management control. The requirements for a project are managed and changes to the requirements are controlled.
3. Defined	Emphasis on maturing engineering and organization practices. A maturity level 3 organization has standard processes defined that support the whole organization. These standard processes ensure consistency in the way that projects are conducted across the organization. There are guidelines defined that allow the organization process to be tailored and applied to each project. There are standards in place for design and development and procedures defined for effective risk management and decision analysis. Level 3 processes are defined more rigorously than level 2 processes, and the definition includes the purpose of the process, inputs, entry criteria, activities, roles, measures, verification steps, output and exit criteria.
4. Quantitatively Managed	Concerned with ensuring key processes are performing within strict quantitative limits and adjusting processes. A level 4 organization establishes quantitative objectives for quality and process performance and uses them as criteria in managing processes. The quantitative objectives are based on information on what customers, end users, organization and implementers need. This way quality and process performance is managed and understood in statistical terms and techniques. Processes are stable and perform within narrowly defined limits. Software process and product quality goals are set and managed. A level 4 organization has predictable process performance, with the variation in process performance identified and the causes of variation corrected.

Maturity Level	Description
5. Optimizing	Concerned with continuous process improvement that allows the organization to focus its improvement on key processes that are closely related to its business goals.
	A level 5 organization has a continuous process improvement culture in place and processes are improved based on a quantitative understanding of variation.
	Defect prevention activities are an integral part of the development life cycle. Where appropriate, new technologies are evaluated and introduced into the organization. Processes are improved incrementally or through innovative process and technology improvements.

Table 3 - 3

CMMI Representations

The CMMI is available in the staged and continuous representations. Both representations use the same process area as well as the same specific and generic goals and practices.

The stage representation as described in Figure 3-2 is the approach used in this chapter. It follows the well-known improvement roadmap from maturity level 1 improvement cycles until the organization has achieved its desired level of maturity. The stage approach is concerned with organization maturity to be made, whereas the continuous representation is concerned with individual process capability.

The continuous representation as illustrated in Figure 3-3 and it has been influenced by the ISO 15504 standard for process assessment. It is concerned with improving the capability of selected processes and gives the organization the freedom to choose the order of improvements that best meet their business needs. The continuous representation allows statements of individual process **capability** to be made. It employs six capability levels and a process is rated at a particular capability level.
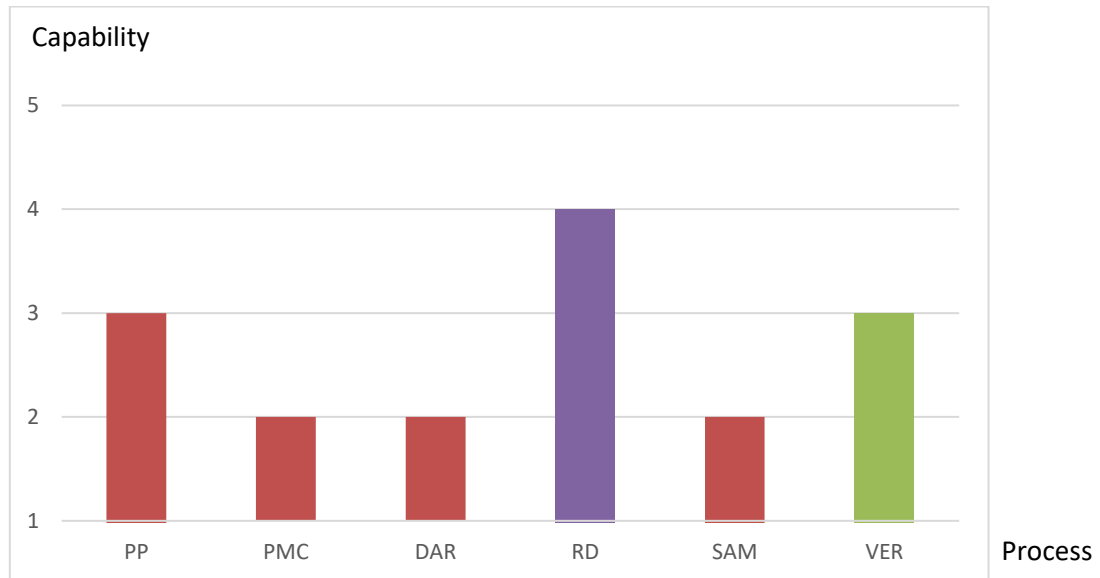
Figure 3 - 3

Each **capability** level consists of a set of specific and generic goals and practices. The capability levels provide a path for process improvement within the process area. Process improvement is achieved by the evolution of a process from its current capability level to higher capability level. Refer Table 3-4 for CMMI capability levels for continuous representation.

Capability Level	Description
Incomplete (0)	When at incomplete capability level, processes are incomplete; they are not fully performed and are missing generic goals and perhaps even some specific goals.
Performed (1)	A performed process is a process that satisfies the specific goals of the process area. The generic practice of this capability level helps institutionalizing the improvements to make sure they are followed at all times. Performance may not be stable.
Managed (2)	A process at this level has infrastructure to support the process. The infrastructure and are controlled, monitored and guided by important objectives of the organization. The process has a basic infrastructure and is planned and executed in line with organizational policy.
Defined (3)	A process at this level has a defined process, follow standards, process descriptions and procedures for the project and are tailored from the organizations set of standard processes. The processes at this level are carefully described and documented for every aspect they include.
Quantitatively Managed (4)	A process at this level is an optimizing process where the processes are controlled using quantitative techniques. From experience objectives are established and for a process, quantitative data can be analyzed to manage the process.

Capability Level	Description
Optimizing (5)	A process at this level is an optimizing process, i.e. a quantitatively managed process that is continually improved through incremental and innovative improvements.

Table 3 - 4

3.2 CATEGORIES OF CMMI PROCESSES

The process areas on the CMMI can be divided into four categories as per **Table 3-x**.

Maturity Level	Description
Process Management	The process areas in this category are concerned with activities to define, plan, implement, deploy, monitor, control, appraise, measure and improve the processes in the organization. They include:- • Organization process focus • Organization process definition • Organization training • Organization process performance • Organization innovation and deployment.
Project management	The process areas in this category are concerned with activities to create and maintain a project plan, tailoring the standard process to product the project's defined process, monitoring progress with respect to the plan, taking corrective action, the selection and management of suppliers and the management of risk. They include:- • Project planning • Project monitoring and control • Risk management • Integrated project management • Supplier agreement management • Quantitative project management
Engineering	The process area in this category are concerned with engineering activities such as determining and managing requirements, designing and developing the software, testing and maintenance of the product. They include:- • Requirements development • Requirements management • Technical solution • Product integration • Verification • Validation

Maturity Level	Description
Support	These process areas include activities that support product development and maintenance. They include:- • Configuration management • Process and product quality assurance • Measurement and analysis • Decision analysis and resolution.

Table 3 - 5

3.3 CMMI PROCESS AREAS

This section provides an overview of the process areas of the CMMI model. All maturity levels with the exception of level 1 contain several process areas. The process area are described in more detail in Table 3.6.

Maturity Level	Process Area	Description of process area
Level 2	REQM	*Requirements management* This process area is concerned with managing the requirements for the project and ensuring that the requirements, project plan (s) and work products are kept consistent.
	PP	*Project Planning* This process area is concerned with estimation for the project, developing and obtaining commitment to the project plan, and maintaining the plan
	PMC	*Project monitoring and control* This process area is concerned with monitoring progress with the project and taking corrective action when project performance deviates from the plan.
	SAM	*Supplier agreement management* This process area is concerned with the selection of suppliers, documenting the agreement/ statement of work with the supplier, and managing the supplier during the execution of the agreement.
	MA	*Measurement and analysis* This process area is concerned with the selection of suppliers, documenting the agreement/ statement of work with the supplier, and managing the supplier during the execution of the agreement.
	PPQA	*Process and product quality assurance* This process area is concerned with providing objective visibility to management on the extent of process compliance. Non-

Maturity Level	Process Area	Description of process area
		compliance issues are documented and resolved by the project team.
	CM	*Configuration management* This process area is concerned with the management of change. It involves setting up a configuration management system; identifying the items that will be subject to change control and controlling changes to them. Configuration audits are conducted.
Level 3	RD	*Requirement Development* This process area is concerned with eliciting the defining customer, product, and product-component requirements and analyzing and validating the requirements.
	TS	*Technical Solution* This process area is concerned with design, development and implementation of an appropriate solution to the customer requirements.
	PI	*Product Integration* This process area is concerned with the assembly of the product components to deliver the product, and verifying that the assembled components function correctly together.
	VER	*Verification* This process area is concerned with ensuring that selected work products satisfy their specified requirements. This is achieved by peer reviews and testing.
	VAL	*Validation* This process area is concerned with demonstrating that the product or product component is fit for purpose and satisfies its intended use
	OPF	*Organization process focus* This process area is concerned with planning and implementing process improvements based on a clear understanding of the current strengths and weakness of the organization's processes.
	OPD	*Organization process definition* This process area is concerned with creating and maintaining a usable set of organization process. This allows consistent process performance across the organization.
	OT	*Organization training* This process area is concerned with developing the skills and knowledge of people to enable them to perform their roles effectively.
	IPM	*Integrated project management* This process area is concerned with tailoring the organization set of standard processes to define the project's defined process. The project is managed according to the project's defined process.

Maturity Level	Process Area	Description of process area
	RSKM	*Risk Management* This process area is concerned with identifying risks and determining their probability of occurrence and impact should they occur. Risks are identified and managed throughout the project.
	DAR	*Decision analysis and resolution* This process area is concerned with formal decision-making. It involves identifying options, specifying evaluation criteria and method, performing the evaluation, and recommending a solution
Level 4	OPP	*Organization process performance* This process area is concerned with obtaining a quantitative understanding of the performance of selected organization processes in order to quantitatively manage projects in the organization
	QPM	*Quantitative project management* This process area is concerned with quantitatively managing the project's defined process to achieve the project's quality and performance objectives
Level 5	OID	*Organization innovation and deployment* This process area is concerned with incremental and innovative process improvements
	QPM	*Causal analysis and resolution* This process area is concerned with identifying causes of defects and taking corrective action to prevent a re-occurrence in the future.

Table 3 - 6

3.4   COMPONENTS OF CMMI PROCESS AREAS

The maturity level of an organization indicates the expected result that the project will achieve and is a predictor of future project performance. Each maturity level consists of number of process areas, and each process area consists of specific and generic goals and specific and generic practices. Each maturity level is the foundation for improvement to the next level.

The specific goals and practices are listed first and then followed by the generic goals and practices. The specific goals and practices are unique to the process area being implemented and are concerned with what needs to be done to perform the process. The specific practices are linked to a particular specific goal that when performed achieve the associated specific goal for the process area. Refer Figure 3-4.
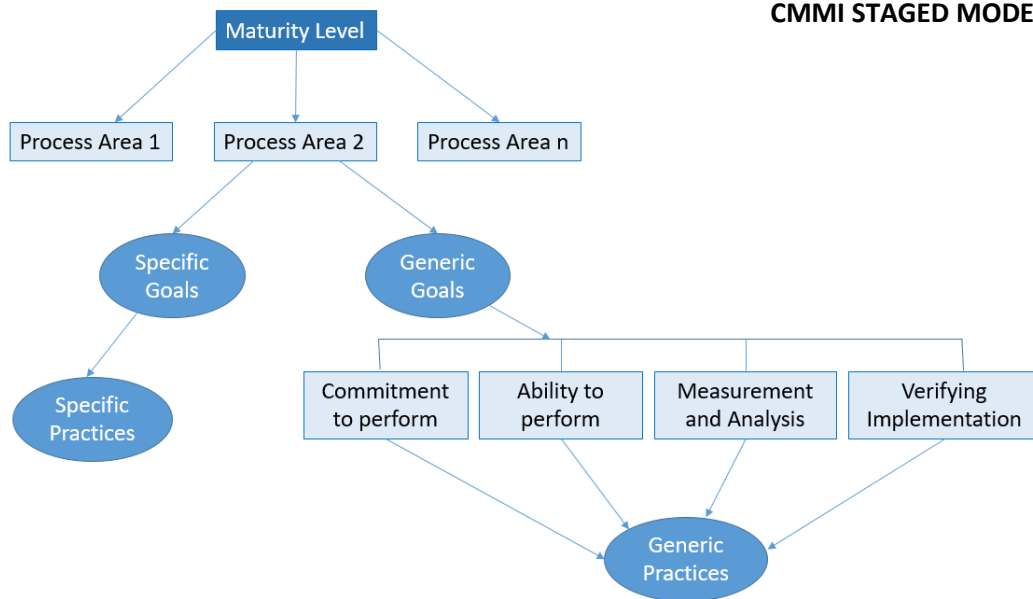
CMMI STAGED MODEL

Figure 3 - 4

The generic goals and practices are common to all process areas for that maturity level are concerned with process institutionalization at that level. Four common features organize the generic practices:-

- Commitment to perform
- Ability to perform
- Measurement and Analysis
- Verifying implementation

They describe activities that when implemented achieve the associated generic goal(s) of the process area. The commitment to perform practices relate to:-

- The creation of policies and sponsorship of process improvement
- The ability to perform practices that related to the provision of appropriate recourses and training to perform the process
- The directing implementation practices relate to activities to control and manage the process
- Verifying practices relate to activities to verify adherence to the process.

The implementation of the generic practices instutionalizes the process and makes it ingrained in the way that work is done. Institutionalization means that the process is defined, documented and understood. It helps to ensure the process is performed consistently and is more likely to be retained during times of stress. The degree of institutionalization is reflected in the extent to which the generic goals and practices are satisfied. The generic practices ensure the sustainability of the specific practices over time.

There is one specific goal associated with the requirements management process area and it has five associated specific practices as specified in Figure 3.5.
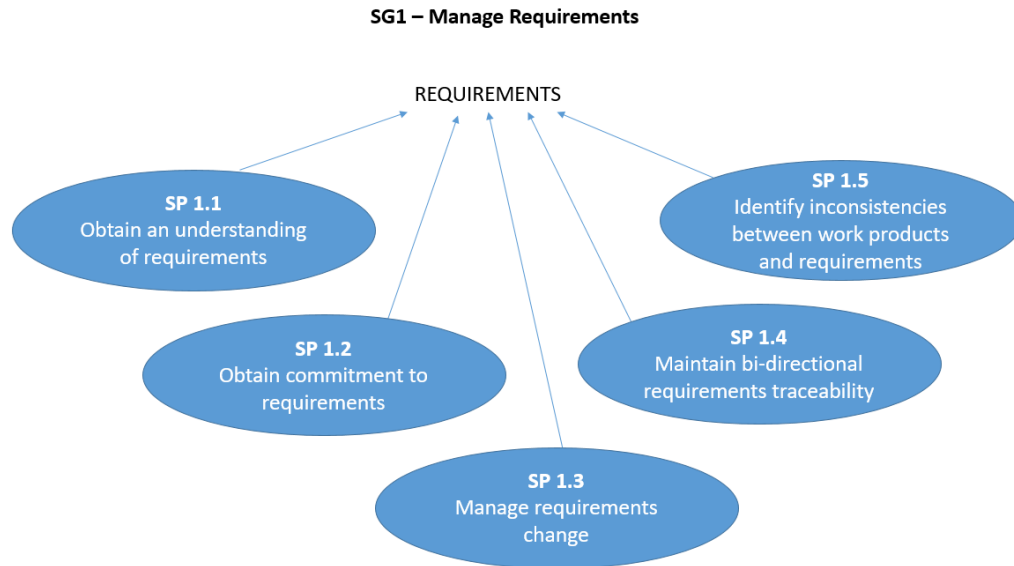

Figure 3 - 5

The components of the CMMI model are grouped into three categories: **required, expected a**nd **informative.**

Category	Description
Required	Essential in achieving goals in a particular area and includes the specific and general goals that must be implemented and institutionalized for the process area to be satisfied.
Expected	Includes the specific and generic practices that an organization will typically implement to perform the process effectively. Intended to guide individuals of groups who are implementing improvements or who are performing appraisals to determine the current maturity of the organization. They state what needs to be done rather than how it should be done. Therefore, it gives freedom on the most appropriate implementation for the organization.
Informative	Includes information to guide the implementer on how best to approach the implementation of the specific and generic goals and practices. The specific practices are concerned with process implementation of the process area and the generic practices are concerned with process institutionalization.

Table 3 - 7 CMMI model categories

Generic Goal	Generic Practice	Description of generic practice
GG 1 **Performed process**	GP 1.1	*Perform base practices* To produce the work products and services associated with the process (i.e. as specified in the specific practices)
GG 2 **Managed process**	GP2.1	*Organization policy* The organization policy is established by senior management and sets management expectations of the organization
	GP2.2	*Plan the process* Concerned with preparing a plan to perform the process. The plan will assign responsibilities and document the resources needed to perform the process as well as any training requirements. The plan/ schedule will be revised as appropriate.
	GP2.3	*Provide resources* To ensure that the resources required to perform the process as specified in the plan are available when required.
	GP2.4	*Assign responsibility* To assign responsibility for performing the process and developing the work products.
	GP2.5	*Train people* Concerned with ensuring that people receive the appropriate training to enable them to perform and support the process.
	GP2.6	*Manage configurations* Concerned with identifying the work products created by the process that will be subject to configuration management control.
	GP2.7	*Identify and involve relevant stakeholders* Concerned with ensuring that the stakeholders are identified and involved appropriately during the execution of the process.
	GP2.8	*Monitor and control the process* Concerned with monitoring process performance and taking corrective action when necessary.
	GP2.9	*Objectively evaluate adherence* Concerned with conducting audits to verify that process execution adheres to the process description.

Generic Goal	Generic Practice	Description of generic practice
	GP2.10	*Review status with higher level management* Concerned with providing higher level management with appropriate visibility into the process.
GG 3 **Defined process**	GP 3.1	*Establish a defined process* Concerned with tailoring the organization set of standard processes to produce the defined process.
	GP 3.2	*Collect improvement information* Concerned with collecting improvement information and work products to support future improvement of the process.
GG 4 **Quantitatively managed process**	GP 4.1	*Establish quantitative objectives* Concerned with agreeing quantitative objectives (e.g. quality/ performance) for the process with the stakeholders.
	GP 4.2	*Stabilize sub-process performance* Concerned with stabilizing the performance of one or more key sub-processes of the process using statistical techniques. This enables the process to achieve its objectives.
GG 5 **Optimizing process**	GP 5.1	*Ensure continuous process improvement* Concerned with systematically improving selected processes to meet quality and process performance targets.
	GP 5.2	*Correct root cause of problems* Concerned with analyzing defects encountered to correct the root cause of the problems and to prevent re-occurrence.

Table 3 - 8   CMMI generic practice

The generic goals support an evolution of process maturity and the implementation of each generic goal provides a foundation for further process improvements.

Several of the CMMI process areas support the implementation of the generic goals and practices. These process areas contain one or more specific practices that when implemented may either fully implement a generic practice or generate a work product that is used in the implementation of the generic practice. The implementation of the generic practices is supported by the process areas as specified in Table x-x.

Generic Goal	Generic Practice	Process area supporting implementation of generic practice
GG 2 **Managed process**	GP 2.2 *Plan the process*	Project planning
	GP2.5 *Train the people*	Organization planning
	GP2.6 *Manage configurations*	Project planning, configuration management
	GP2.7 *Identify/ involve relevant stakeholders*	Project planning
	GP2.8 *Monitor and control the process*	Project monitoring and control
	GP2.9 *Objectively evaluate adherence*	Process and product quality assurance
GG 3 **Defined process**	GP 3.1 *Establish defined process*	Integrated project management, organization process definition
	GP3.2 *Improvement information*	Integrated project management, organization process focus, organization process definition.
GG 4 **Quantitatively managed process**	GP 4.1 *Establish quantitative objective for process*	Quantitative project management, organization process performance
	GP4.2 *Stabilize sub-process performance*	Quantitative project management, organization process performance
GG 5 **Optimizing process**	GP 5.1 *Ensure continuous process improvement*	Organization innovation and deployment)
	GP5.2 *Correct root cause of problems*	Causal analysis and resolution).

Table 3 - 9 Implementation of generic practices

3.5   SCAMPI APPRAISALS

Many organizations that embark on a CMMI improvement initiative will arrange to have an appraisal conducted to better understand their current software process maturity.

The appraisal is an independent examination of the processes used in the organization against the CMMI standard. Its objective is to identify strengths and weaknesses in the processes and to prioritize improvements for the next improvement cycle.

The SCAMPI methodology is the appraisal methodology used with the CMMI and it comes in three distinct flavours (SCAMPI Classes A, B and C). These classes vary in:-
- Formality
- Cost
- Effort
- Timescales involved
- Rating of the process
- The reporting of results

A large organization generally has more funding available for appraisals, and it will often be interested in a formal SCAMPI Class A appraisal – allows to obtain a formal CMMI rating that may be reported back to the SEI, and it may then benchmark itself against other organization. Smaller organizations will often arrange to have a less expensive SCAMPI Class C appraisal conducted to identify strengths and weaknesses in its processes.

Appraisal allow an organization to:-

- Understand the strengths and weaknesses in its processes
- Understand its current maturity
- Prioritize improvements for the next improvement cycle
- Benchmark itself against other organizations (SCAMPI Class A)
- Relate its strengths and weaknesses to the CMMI practices.

The scope of the appraisal includes the process areas to be examined, the projects and organization unit. The scope depends on how active the organization has been in process improvement and the extent to which it has implemented software engineering best practice.

The appraisal will identify gaps in the implementation of the CMMI practices for each process area within the scope of the appraisal. The appraisal team will conduct interviews and reviews of documentation. They will determine the extent of implementation of the practices within scope.

The appraisal findings are presented and may be summarized in a written report. The findings are then used to plan and prioritize the next improvement cycle.

There are three phases in an appraisal:-

- Planning the appraisal
- Conducting the appraisal
- Reporting the results

SUMMARY

The Capabillity Maturity Model Integration is a framework to assist an organization in the implementation of best practice in software and systems engineering.

The SEI and other quanlity experts believe that there is a close relationship between the quality of the delivered software and the maturity of the processes used to create the software. The CMMI contains best practice in software and systems engineering to assist in the creation of high-quality processes.

The CMMI consists of the five maturity levels with each maturity level (except level 1) consisteing of several process areas. Each maturity level acts as a foundation for improvement for the next improvement level and each increase in maturity level of the organization represents more advanced software engineering capability. The higher the maturity level of the organization, the more capable it is, and the more predictable its results.

The SCAMPI appraisal methodology is used to determine the maturity of software organizations. This is a systematic examination of the processes used in the organization against the CMMI model. It includes interviews and reviews of documentation.

A successful SCAMPI Class A appraisal allows the organization to report its maturity rating to the SEI and to benchmark itself against other companies. Appraisals are part of the improvement cycle and improvement plans are prepared after the appraisal to address the findings and to prioritize improvements.

REFERENCES

O'Regan, G (2011).Introduction to Software Process Improvement. London, Springer.

Kenett, R., Baker, E., & Baker, E. R (2009). CMMI and process improvement for systems and software: planning, implementation and management. Taylor and Francis.