



Does Capability Mature?

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1 A quick overview

1.1 Summary

Many articles have been written about the CMMI®, mostly saying that this is the best thing since sliced bread or complaining that it is a bureaucratic nightmare. I would like to briefly talk about it, what it is, what it is not, how to use it, the benefits you can get from it, the issues you can get from it and whether it applies to your environment or not...

I am not trying to sell a product, but I need to point out that I am a “visiting scientist” with the Software Engineering Institute, who is the custodian of the model. As such, I naturally have a stake in persuading people that the model is a good thing, but I do wish to try to avoid the sales pitch in this article and focus on the benefits and risks of the model, as a general introduction.

1.2 What to read

If you have no idea what CMMI is about, have heard the acronym and no little else, turn to section 2: “What is the CMMI”.

If you know what it is in general but would like to have a better understanding of the contents, turn to section 3: “The structure of the model”.

If you are interested in knowing why you should implement this model or not, turn to section 4: “What are the benefits?”

If you are trying to decide whether this is a valid approach for your organization, turn to section 5: “Will it work for me?”

2 What is the CMMI?

2.1 The CMMI as a measurement tool



The first idea behind the Capability Maturity Models was certainly to be able to measure the ability of a potential supplier to deliver the work that they promised. This was the question asked by the US Department of Defense, first consumer of software in the world, when they created the Software Engineering Institute. The answer was a model that allowed measuring the maturity of an organization's capability.

In this context, capability refers to the capability of the proposer to deliver what they promise. The word Maturity refers to self-knowledge. A mature person is someone who knows what (s)he is capable of doing or not doing. Mature people understand personal limits and use their skills most efficiently while avoiding most of the embarrassment of

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starting something that they cannot finish¹. Maturity in the context of the Capability Maturity Models means the same thing: we are measuring whether an organization knows its own possibilities and limits well enough to make a reasonable proposal, or whether they have just promised something in order to get the contract and will then try to negotiate their way out of schedule slippages and invoicing the additional budget required to complete the work.

The original concept was to measure the knowledge of the organization by seeing how well the processes, or work practices, are implemented: does the organization have processes that protect the customer from the mistakes or lack of experience of a given individual? In order to do this, the processes were defined in terms of their product or output and grouped into five levels of maturity, which are briefly defined here.

2.1.1 Maturity Level 1: the Initial level

Every organization that manages to produce some software is rated at least at maturity level 1.

2.1.2 Maturity Level 2: the Managed level

Originally name the "Repeatable" level. At this level, every project is visibly being managed to a reasonable level. This means that they are doing a reasonable job at analysing and managing changes to requirements, the project work is estimated based on the requirements, planned and progress monitored. Risks are identified, configuration management is in place.

At this level, we find mainly "discovery" processes: processes aimed at understanding what we do, what we need to do, what we should be doing, how we are doing... This is the preliminary step in establishing processes, where the organization seeks to identify what works and what does not work.

2.1.3 Maturity level 3: the Defined Level

Growing from the previous level, the organization now understands what they need to do and how it should be implemented. Therefore, we find that best practices are being shared, lessons learnt across projects and teams and interaction is being managed. By having a clear understanding of the successful and less successful approaches to given activities, the organization demonstrates a clear understanding of the capabilities and limits of the organization and develops repeatedly improved quality through common approaches.

The sharing of best practices and lessons learnt is key in this area, were the processes are standardized at the organization level. Projects can then select the most appropriate approach to their issues and problems.

2.1.4 Maturity Level 4: the Quantitatively Managed level

Originally named the "Managed" level, this is the level where the organization starts to understand statistically the impact of the processes: if I perform a full Fagan inspection rather than a "buddy check", I understand how much this will cost in time and effort, but how many more defects can I expect to find and what is the impact this would have on my testing. By using this understanding of the return on investment of the processes, the organization can learn to use the most efficient approach to achieve the quantified improvement objectives. Organizations at this level seek to identify and remove as

¹ Mature wines are supposed to taste better, mature cheeses smell more – but we are not talking about these types of maturity, here

rapidly as possible exceptional causes of variation to the process, project or product quality.

2.1.5 Maturity Level 5: the Optimizing level

This is the highest level of the model, and therefore the only one with a name in the present continuous form. At this level, the members of the organization are taking their detailed understanding of the processes being used and their impact and using this information to implement major changes to the organizational approach. This is the level when innovative technology and new approaches can be completely understood and the consequences analysed before the decision is made. At this level, the organization will consider how to identify and remove the common causes of variation.

2.2 The CMMI as a tool for improvement

Once the principle of having different levels of maturity was understood, there was only one-step to consider how improvements can be planned and implemented strategically. As the model describes the effects and products of the processes in a simple, prioritized manner, it makes sense that an organization looking at improving the manner in which to improve would understand that the products defined at the lower maturity levels need to be completed first.

2.3 The CMMI as a standard

The original Capability Maturity Model (the Software CMM) was so successful, that many other standards were developed along similar lines. These standards and approaches had a lot in common and usually had some advantage of the others. They included products such as EIA 731, ISO 15504, People CMM, Systems CMM, IPD CMM, SA CMM, Systems Security CMM and many more.

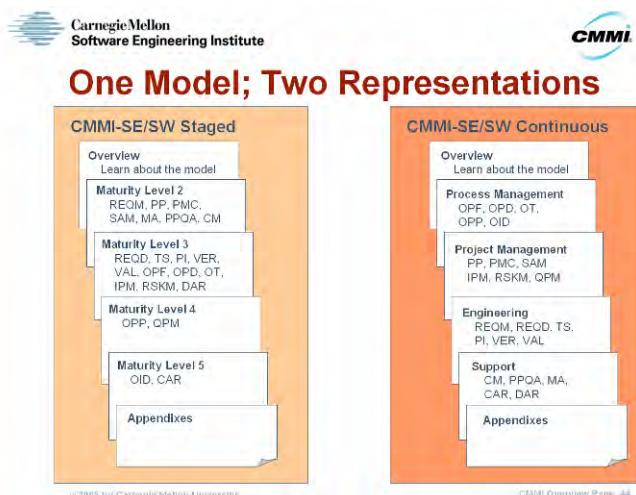
The Software Engineering Institute was then called upon to try to consolidate the various models and standards into a single approach, using the best practices of each and replacing the weaknesses in each one. This was the basis for the CMM Integration or CMMI, which is now the main process quality standard in the world.

3 The structure of the model

The model is structured in such a way that it can be used in a number of different manners.

3.1 Model representations

The model's contents are structured in two complementary manners. It can be used according to the traditional ("staged") representation or a "continuous" representation.



3.1.1 The Staged representation

Based on the original concept of the software CMM, this representation allows organizations to measure themselves and compare themselves to others. The idea behind this is that at each maturity level, a number of process areas have been implemented to a documented level of satisfaction.

Based on the experience of the authors of the model, the levels are defined as being the things that need to be implemented in order to have a satisfactory level of quality at each maturity level. For instance, the first things that the organization should consider getting in order include understanding and managing requirements and change requests, estimating and planning projects, monitoring the progress of the project, keeping the various work products synchronized throughout the lifecycle. These activities are supported by basic measurements and analysis (demonstrating their alignment to the business objectives) and quality assurance.

3.1.1.1 Measurement based on the staged representation

The staged representation measures the organization. It focuses on whether a process or practice is implemented and carried out systematically throughout the organization. The objective is to ensure that the organization will do the right thing, even under pressure.

3.1.1.2 Improvement based on the staged representation

Understanding the elementary logic of those process areas defined at each maturity level allows organizations to determine easily what should be the next improvement to implement. It allows the basics to be put into practice first, and then build on those according to a proven strategy

3.1.2 The Continuous representation

This approach recommends the organization perform an analysis of their objectives and determine which processes most directly influence the quality of their products and services and start improving those.

3.1.2.1 Measurement based on the continuous representation

Using this representation, the organization is not measured as such, instead each process area is measured based on its own merits. Based on the importance for your customers, you can determine through this methodology that you have planning and testing at level 4, while configuration management and peer reviews are level 2.

With a good understanding of the needs of your customers or the services you need to deliver, this can be very valuable information.

3.1.2.2 Improvement based on the continuous representation

Improvements here are basically considering how a specific process should it be implemented: are your reviews planned and monitored, are they performed according to a documented procedure, do they follow a standard approach that allows the comparison of the results between teams, do you have historical data on the expected number of defects identified...

The biggest challenge with the continuous representation is differentiating the areas that need to be prioritized in order to ensure progress from those that are symptoms of something else.

The advantage of this approach is to bring to consideration what should or could be done in order to improve the efficiency of something that is particularly important to your customer.

3.2 Modelled disciplines

Many of the issues that are included in the model are common to different businesses and industries; others are specific to particular disciplines (such as the creation of

software). The model considers different disciplines, which can be considered in combination or separately.

3.2.1 Software engineering

The traditional subject for the Software Engineering Institute is naturally software engineering and this is a prime concern for the model and for the developers. As we move ahead in the twenty-first century, we find that more and more software is critical to the development and maintenance of products. Software and software-rich products remain the number one focus of the product.

3.2.2 Systems engineering

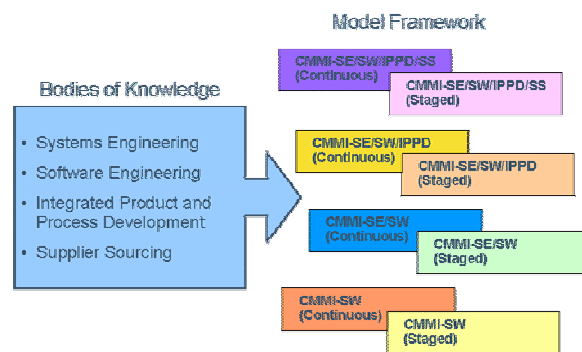
More and more organizations, particularly in the Western world, are considering their business to be systems and integration rather than development. Through this expansion of the model, the CMMI is now being used by people who have absolutely no software in their products as well as companies that are combining software, hardware and engineering aspects.

3.2.3 Supplier sourcing

This discipline is concerned with the selection and collaboration with suppliers. Few (if any) organizations today can claim to build completely the product they sell to their customers. The supplier sourcing discipline focuses on ensuring that the components they have purchased and integrated into their product are developed with the same level of concern for quality and reliability as the rest of the product. This also means ensuring that the supplier will deliver on time, as requested.

3.2.4 Integrated process and product development

This discipline concerns the organizational mode of the teams performing the work. The objective is to set up a basic organization that allows semi-independent and self-regulating teams to be able to work within the context of the organization as a whole. The area focuses on setting up the environment that allows team members to make decisions within the context and constraints of their roles.



3.3 Themes of the CMMI

A number of themes are found throughout the model.

3.3.1 Institutionalization

One of the strengths of the model is the focus on what is called the “institutionalization” of the processes. This refers to the fact that the process is part of the organization’s way of life. This is not questioned: this how we do things. The institutionalization factor is related to a number of aspects of the implementation, related to management’s commitment to the process (as defined in an organizational policy), training, planning, monitoring, measurement, reporting, etc.

3.3.2 Measurement

Measurements form a key component of the improvement process. Measurements are implemented from the beginning and lead towards the statistical control of the

processes. Measurements focus primarily on the business objectives. The basic objectives are established, from a business goal point of view and from an improvement point of view. The measurements regard the aspects of the quality of the process (e.g. how much effort, what are the benefits...), the quality of the projects (e.g. delivery on time, satisfaction of the stakeholders...) and the quality of the products (e.g. number of defects, response time...)

3.3.3 Communication

Communication is critical throughout the approach. This includes communication with the management and team members, between teams and groups. Most important, the communication with the customers and suppliers are stressed in many areas.

3.3.4 Action, not words

One of the big differences between the CMMI and other models is that CMMI is interested in results and actions: progress reporting is only important to the extent that it generates an appropriate reaction when deviations are incurred.

4 What are the benefits?

4.1 Demonstrations of success

There are many published success stories of CMMI implementation. They generally all present the same flaw: they come from small divisions of very large companies². In addition, we are clearly lacking data of what it means to make little steps. What is the benefit of moving from maturity level 1 to maturity level 2? There is a simple reason for the absence of data at this level: low maturity organizations do not measure their cost of quality; if you do not have measurements of what it was like before, how can you measure the change?

In my personal opinion, the data published on the success of CMMI falls into two categories: generalized, anonymous data and incidental data from a particular context.

The generalized data will state that a company (anonymous) has measured a return on investment of 880% for the CMMI based process improvement. There is no information as to how this was measured, what were the other improvement or change activities that were running at the same time, from where to where did they go, how long did it take, what was the actual cost of process improvement, what was included, what was not included...

The incidental data are available from a number of organizations. They show a reduction in rework, or the increase in productivity.

Both these groups of data present serious problems. Statistics based on hidden data are not trustworthy as far as I am concerned. Incidental data do not mean the same solution will work for me.

However, I have so far seen no data from an organization demonstrating that they implemented the CMMI recommendations and the cost was greater than the return on investment. Moreover, as the CMMI insists that from the beginning you need to start measuring the cost and the value, the data should exist if the approach does fail.

² Naturally, many of these large companies will tell you the data come from the corporation without mentioning that this is success was only seen in one or two engineering departments.

On the other hand, many organizations out there have tried to implement the approach and failed. They cannot demonstrate the model is wrong, only that it did not work for them or that their method of implementation was not successful.

4.2 Successful usage of the model

Many companies throughout the world have successfully implemented the CMMI and used it as guide for their process improvement efforts. One of the key factors that they have in common is that they have focused primarily on doing what is right for the company rather than doing what the model recommends.

By understanding their organization's quality needs, they have sought to use the model as a guide, often in parallel to other approaches that offered different aspects of quality improvement, such as ISO 9000, ITIL, Six Sigma or Prince2. The combination of approaches allows them to determine what is the most successful and useful section and aspect of each one of these models and techniques. The resulting approach allows them to better understand and implement activities that will focus on their customers' needs.

These organizations have sometimes published results, in particular metrics demonstrating the improved schedule respect, the reduction in rework, the lower number of defects injected into the product, the increased customer satisfaction and the increased satisfaction of the engineers in the organization. One of the side effects of having what corresponded to higher maturity as defined by the CMMI was a significant reduction of staff turnover, as people were more satisfied in their work.

I have personally witnessed the same results in organizations throughout the world, having personally worked with organizations in Ireland, UK, Belgium, France, Germany, Poland... all the way to China. I have seen the same effects in organizations of several hundred and even thousand engineers and organizations with barely a dozen engineers and even one that had four engineers. This can be done, because the model does not require you to do anything or document anything. It asks to see evidence that basic engineering activities have been done. In addition, it asks that these activities be performed in accordance with the business needs and objectives.

The point of using the model correctly is a learning process. As people are using the model, it becomes evident that they start to understand why they should be doing certain things rather than others. As they look at what the model is requesting and start comparing that to the contents of their project documentation, they start to understand why they should be doing things and get a real understanding of the benefits the manners in which things are to be implemented in order to secure the quality of the work being completed.

4.3 Failed usage of the model

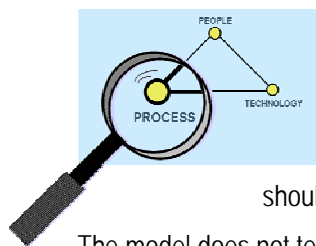
Unfortunately, many have tried the CMMI and failed hopelessly. This is frequently because they have not had the correct level of understanding before starting.

The CMMI authors expect organizations to understand some key concepts and apply the processes rationally in order to achieve their business goals. One of the requirements of the model is that there is a company policy stating that an activity is important to the company. My understanding of the word "policy" is that the voice of management can be found in the document and it explains what is important to the company. Unfortunately, many organizations have presented to me a document, which they call policy, written by the process engineers, and containing more or less direct quotes from the model. These documents do not have the authority of a policy and demonstrate that the organization is mostly interested in satisfying the appraiser coming to assess them against the model. The purpose of a policy is the expression of

the commitment of management to a practice or approach that they see as beneficial to the organization, to the employees, to the customers, to the shareholders and fitting into the corporate vision and mission statements. This means that management will not be able to start requesting engineers or project managers to start disregarding some aspects of the processes and practices when they wish to bypass the system. The purpose is to ensure that the practice continues rather than being implemented once. This is useful. Doing what the model asks because the model says so is not a useful activity: either it will result in bureaucracy or the approach will be abandoned after a few weeks.

Using the model as a bureaucratic approach to a lot of documentation is, unfortunately, a common feature. This results in a feeling that the model is not useful and is not appropriate for organizations "like ours".

5 Will it work for me?



No. That is the simple answer. The model will not work for you. Only your team members work for you.

The model does not provide a lesson in engineering.

The model does not provide you with the processes you should implement.

The model does not tell you what you need to do next.

The model does not contain any of the answers you need.

However, the model does contain the questions you need to ask yourself. The basic concept of the model is that it lists examples of the types of results one should be able to find in order to see if an activity has been done. It bases itself on the simple premise that if you can find no trace or evidence that something has been done, you can assume that it has not been done. If it has been done and left no trace, no one will remember what the results were. If you had a meeting and no minutes were made, no one will remember what decisions and action points were discussed or agreed. If you have reviewed the customer requirements and have no trace of changes or questions, you probably did not review them properly or you will not remember or agree on how the differences have been resolved.

By reading and understanding the model, you may be prompted to think of some activities you forgot. If you understand how these activities fit into your business objectives. If you understand the benefit your organization would get from being able to produce the type of things that the model mentions, you have benefited. If you think you have a better solution than what the model suggests, consider very carefully how you would demonstrate to an investor that your solution is better. If you remain convinced, the model will have made you think a little further, which is again a benefit for you.

Most important, when applying the model is always to be reasonable and apply common sense. The model requires that every project be planned. This seems like a logical request at first. As you consider what a project is, you may start to have doubts. You may come to realize that you have projects that last two days, using one person – do you really want a project plan for this? Consider the options and I believe you will conclude that yes, you do want to plan your two day work. If you present me with a twenty-page plan that took a week to write, you have wasted your time – your project plan for this kind of a project might one or two pages. On the other hand, if you have a project that is going to last five years and use 300 engineers, I would not expect you to have a project that is only twenty pages long and was written in a week...

The CMMI is a model. It is a snapshot of the world, an ideal world that is relatively static. When you understand it, it is a very useful model, because it contains an extraordinary

wealth of information, which is applicable to different levels and sizes of organizations. If you apply it without thinking of your business or your customers, if you do things because the model says you should do it without understanding, I guarantee that you will find yourself in the midst of a large bureaucracy, and any bureaucracy is there to be bypassed by the more imaginative people. This means you will have wasted your time.

6 Conclusion

“Every man is given the key to heaven; the same key will open the doors of hell”

If it is used to forward your business, the CMMI is a powerful tool that can help you improve significantly. If it is used to get a rating for advertising purposes or do it because someone talked you into “doing CMMI”, you will create a nightmare bureaucracy.

The purpose of CMMI is to facilitate process improvement. Improvement means making your ways better, not throwing them out and replacing them with some theoretical set of practices and templates. Do not buy processes: improve those that work for you. Do not invent new ways, you are already doing great things within your organization, what you need to do is learn from your failures, so that you can repeat your successes. The CMMI will point out some of the things you should consider.

For more information, see <http://www.sei.cmu.edu/cmmi>. Author can be contacted at Peter@qpit.ltd.uk