

# Choosing a CMMI Model Representation

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*What is a CMMI model representation? The answer requires an explanation of the structure of CMMI models. The basic building blocks in every CMMI model are called process areas. A process area does not describe how an effective process is executed (e.g., entrance and exit criteria, roles of participants, resources). It describes what those using an effective process do (practices) and why they do those things (goals).*

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In a Capability Maturity Model®, process areas can be organized into one of two representations, a continuous representation or a staged representation. For example, the Electronic Industries Association's Interim Standard 731, Systems Engineering Capability Model (SECM) is a model with a continuous representation. The Software Engineering Institute's Capability Maturity Model for Software (SW-CMM®) is a model with a staged representation.

To illustrate why an organization might choose one representation over the other, imagine two companies, Foo Toys and Widget Toys. Both companies manufacture software-intensive toys and, until now, have not pursued process improvement.

The Foo Toys management wants to improve how the company handles risks and integrates product components. Management is happy with how the company's other processes are operating and decides to focus on those two process areas only. Foo Toys' management chooses the continuous representation. Using that representation, Foo Toys will concentrate on only those process areas that relate to risk management and the integration of components. When Foo Toys achieves both the specific goals for a process area and the general goals associated with all levels equal to or less than a particular capability level, it achieves the capability level for that process area. (Goal achievement is determined by a review of the practices associated with the goal.) If Foo Toys successfully achieves the specific goals for product integration and all the capability Level 2 and 3 goals, it could be said that Foo Toys is Level 3 in product integration.

The management of Widget Toys, however, wants to improve the company's overall development capability and sees many areas requiring attention. Recognizing the many interdependencies across process areas, Widget Toys' management chooses the staged representation. Using that representation, Widget Toys will concentrate on the process areas at maturity Level 2, thus establishing its project management processes. When Widget Toys performs the practices in these process areas successfully, it also achieves the corresponding goals. When Widget Toys achieves all of the goals of a process area, the process area is satisfied. For Widget Toys to successfully achieve a maturity level, it must satisfy all of the process areas through that level. If Widget Toys satisfies all of the process areas through maturity Level 2, it could be said that Widget Toys is maturity Level 2.

By design, the granular information contained in the two CMMI model representations is virtually identical. However, each of the representations provides benefits that will be valued differently by organizations.

In CMMI models, process areas describe key aspects of such processes as configuration management, requirements management, product verification, systems integration, and many others. Let us examine the two representations in more detail.

## Continuous Representation

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. 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, Foo Toys must satisfy the specific goals and Level 2 practices for that process area as well as the Level 2 generic goals for that same process area.

## Staged Representation

In the staged representation, the summary components are maturity levels. Within each maturity level there are process areas that contain goals, common features, and practices. For Widget Toys, the practices serve as guides on what to implement to achieve the goals of the process area.

In a staged representation of a CMMI model, practices are categorized into common features:

1. *Commitment to perform* includes practices that ensure that the process is established and will endure. It typically involves establishing organizational policies and leadership.
2. *Ability to perform* includes practices that establish the necessary conditions for implementing the process completely. It typically involves plans, resources, organizational structures, and training.
3. *Activities performed* includes practices that directly implement a process. These practices distinguish a process area from others.
4. *Directing implementation* includes practices that monitor and control the performance of the process. These typically involve placing designated work products of the process under configuration management, monitoring and controlling the performance of the process against the plan, and taking corrective action.
5. *Verifying implementation* includes practices that ensure compliance with the requirements of the process area. These typically involve reviews and audits.

## Capability Levels vs. Maturity Levels

The continuous representation consists of capability levels, while the staged representation consists of maturity levels. The main difference between these two types of levels is the representation they belong to and how they are applied:

- *Capability levels*, which belong to a continuous representation, apply to an organization's process-improvement achievement in individual process areas. There are six capability levels, numbered 0 through 5.
- *Maturity levels*, which belong to a staged representation, apply to an organization's overall process-improvement achievement using the model. There are five maturity levels, numbered 1 through 5. Each maturity level comprises a set of goals that, when satisfied, improve processes. Maturity levels are measured by the achievement of the goals that apply to a set of process areas.

Level	Continuous Representation: Capability Levels	Staged Representation: Maturity Levels
Level 0	Not Performed	N/A
Level 1	Performed	Performed
Level 2	Managed	Managed
Level 3	Defined	Defined
Level 4	Quantitatively Managed	Quantitatively Managed
Level 5	Optimizing	Optimizing

Table 1. *Capability Levels and Maturity Levels*

When Widget Toys uses the staged representation, it will evaluate its progress using the same basis as all other organizations that use the same model with the staged representation. Although Widget Toys can pursue process improvement at any pace it wishes, the basis for evaluating its progress will be exactly the same.

Using the staged representation, Widget Toys can identify the maturity levels through which it can evolve to establish a culture of engineering excellence. Each maturity level forms a necessary foundation on which to build the next level.

Using the continuous representation, Foo Toys can produce a capability level profile (i.e., a list of process areas and their corresponding capability levels). Types of capability level profiles include the following:

- An *achievement profile* represents the current achieved capability level in selected process areas at Foo Toys.
- A *target profile* represents the capability levels that Foo Toys wishes to achieve.

Maintaining capability level profiles throughout the process-improvement life cycle enables the engineering process group at Foo Toys to demonstrate its progress to management as well as guide its process-improvement activities.

A target profile can reflect the unique needs of the organization (called *target staging*) or it can reflect the levels used by the staged representation (called *equivalent staging*). Equivalent staging permits benchmarking of progress among projects, organizations, and other enterprises.

## Selecting a Representation

When making the decision about which architectural representation to use for process improvement, Foo Toys and Widget Toys would consider the comparative advantages of each approach as represented in Table 2:

Continuous Representation	Staged Representation
Grants explicit freedom to select the order of improvement that best meets the organization's business objectives and mitigates the organization's areas of risk.	Introduces a sequence of improvements, beginning with basic management practices and progressing through a predefined and proven path of successive levels, each serving as a foundation for the next.
Enables increased visibility into the capability achieved within each individual process area.	Visibility is primarily at the maturity level with limited visibility at the process area level.
Allows the generic practices from higher capability levels to be more evenly and completely applied to all of the process areas.	Generic practices are grouped as institutionalization common features that are applied to all process areas at all maturity levels.
Because capability levels are measured by process area, comparisons across and among organizations can only be made on a process area by process area basis.	Permits easy comparison across and among organizations because process improvement results are summarized as a single maturity-level number.
Reflects a newer approach that does not yet have the data to demonstrate its ties to return on investment.	Builds on a relatively long history of use that includes case studies and data that demonstrate proven return on investment.
Affords an easy comparison of process improvement to ISO 15504 because the organization of process areas is derived from 15504.	Allows comparison to 15504, but the organization of process areas does not correspond to the organization used in 15504

Table 2. *Advantages of Using Each Model Representation*

Foo Toys chose the continuous representation because it wanted to focus improvement efforts in two predefined areas.

Widget Toys chose the staged representation because it wanted a clear path to process improvement that provides an easy comparison to competitors that use the same model. Regardless of which representation you choose for your organization, the CMMI model you choose will help you improve your development processes. In essence, both representations were designed for equivalent use in process improvement and assessments. *ss*

### About the Author

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