Moving from ISO9000 to the Higher Levels of the Capability Maturity Model (CMM)

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Abstract. There are a large number of software organizations that have been certified under ISO9000. Many of these now want to move to the Capability Maturity Model (CMM). This article discusses the possible gaps in the processes of an ISO organization with respect to the CMM, and how an organization can move from ISO to higher levels of the CMM. It is based on our experience of successfully transitioning from ISO to level 4 of the CMM in less than one year.

Introduction

There are a large number of software developing organizations in the world that are ISO9001 certified. Many of these are now considering adopting the SEI's Capability Maturity Model (CMM) [Hum88,Pau93a], which provides a basis for process management and improvement [Hum89]. In this transition from ISO9001 to CMM, processes have to be enhanced to suit the CMM (while preserving ISO9001). In this article we discuss the typical enhancements that might be needed by an ISO organization when moving to higher levels of maturity in the CMM framework, based on our own experience in successfully transitioning from ISO to level 4 of the CMM. Though this work has origins in our experience of successfully implementing CMM Level 4, for the sake of generality, the discussion in this article focuses on the general issue of an ISO organization transitioning to higher levels of CMM.

ISO 9001 is a standard that has 20 clauses, which are meant for service organizations [ISO87]. This standard has been interpreted for a software organization in ISO 9000-3 [ISO91], and further guidelines and elaboration has been given in TickIT guidelines [ISO92]. ISO certification process is binary – an organization is either ISO certified or it is not. If an organization is ISO certified, then its processes must satisfy the 20 clauses. CMM, on the other hand, gives a framework for process improvement. It categorizes software processes in five levels of maturity – starting from initial (level 1) to optimizing (level 5). A software organization can be at any of these levels. Another key difference between ISO and CMM is that ISO is quite general and is written from customer and external auditor's perspective. On the other hand, CMM is software specific, which provides a road map for internal process improvement. Another key difference is that ISO has been specified as a set of clauses that have to be implemented, while the CMM specifies characteristics of the processes of an organization at different levels of maturity.

Comparisons have been done between the ISO9001 model and the CMM [Bam93,Pau93b]. However, these tend to be comparison between the models and tend to be clause-by-clause or KPA-by-KPA (key practice area) analysis. These studies, though useful, provide little guidance to an organization in moving from ISO9001 to CMM, which has to focus on the implementation of these models. For an organization, what is needed is not what clauses satisfy which practices, but what are the likely "gaps" in the processes of the organization with respect to the CMM. In other words, an organization that wants to move from ISO to CMM can really benefit if it can easily find what is missing in its processes with respect to CMM.

One of the difficulties in discussing implementations is how to go define an implementation for a model as a model renders itself to many possible implementations. However, though it is possible that a model may be implemented in various ways, it is also true that there are some properties that all implementations are likely to

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have. In this report we attempt to compare the processes of a "typical" ISO9001 software organization and compare it with processes required in a software organization at CMM level 2, 3 or 4. The result of this is the set of gaps that are likely to exist in the processes of an organization that has an ISO compliant quality system. Hence, it will be very helpful to an ISO organization in its journey towards the CMM model.

In our study, we will consider a "typical ISO company" and then for each KPA identify what gaps the organization may have with respect to that KPA. As we are considering "typical ISO organization", we have to make some judgments about processes of an ISO company. Though it is possible to do so at a higher level, we cannot make claims at a very detailed activity level. Hence, the study will focus on major process gaps. For both the CMM and ISO, we will consider the "minimal" implementation, that is, an organization that is implementing what is necessarily required from the model. For ISO, we have also used the TICKIT guidelines, as they are the most applicable to software organizations, and are used during ISO certification of software companies.

Processes in an ISO9001 Organization

ISO 9001 is specified as a set of 20 clauses, with interpretations given for software in ISO 9000-3 and TickIT. There are different ways these clauses can be implemented by an organization. So, before we can find gaps with respect to CMM, first we have to consider what processes and structures are likely to exist in a "typical" ISO certified software organization. These can then use to identify potential gaps with respect to the different levels of CMM. In this section we identify the processes and structures that are likely to result by implementing the clauses of ISO. Hence, we discuss the major sections or sub-sections in ISO9000-3 standards that are relevant for comparison with CMM.

Management Responsibility (4.1)
The clauses in these will ensure that there is a management representative who has authority to implement ISO and report results to senior management. Generally, the head of the group responsible for processes will play this function. Also, senior management has to periodically review the quality system and its implementation in the organization. Hence, an implementation of this will generally ensure that there is a process group in the organization and a mechanism for senior management to review the activities of this group.

Quality System (4.2)
The clauses in this ensure that the main elements of the management and development processes are documented in a quality system (QS). As the organization has to ensure that the processes listed in the QS are implemented, implementation of this also ensures that there are some methods in place for training/orientation on the QS and for disseminating the QS to the people implementing it.

Internal Audits (4.3)
Internal audits have to be conducted by people independent of the people performing the tasks. Implementation of this ensures that an organized independent auditing mechanism is in place in the organization that checks the implementation in projects of processes defined in the QS, and ensures that deviations are corrected.

Corrective Action (4.4)
This requires that causes of non-compliances are analyzed and the actions taken to correct them and prevent them from occurring in future. Implementation of this ensures that there are mechanisms to report shortcomings in the QS, correcting the shortcomings, and disseminating the changes in the QS.

Document Control (6.2)
Implementation of this ensures that all documents are reviewed and approved by authorized personnel prior to issue, appropriate documents are available to people who need them, and changes to documents are identified and reviewed and approved by original approver.

Quality Records (6.3)
Implementation of this ensures that "foot-prints" are left for all activities done, so someone can review the performance of the activities objectively. In particular, the implementation ensures records for the execution of quality tasks are maintained (i.e. performance of the activity, defects found, tracking of defects, etc.).

Contract Review (5.2)
Ensures that a formal, documented, contract is established between the supplier and the customer which clearly defines the scope, commitments, etc. and that the contract is reviewed and approved (like any other document).

Requirements Specification (5.3)
Ensures that all functional and non-functional requirements should be documented (and subject to document and configuration control), and that the document is approved by the customer. The implementation of this clause is likely to lead to some template or checklist for requirement specification.

Development Planning (5.4)
Ensures that a development plan for the project is developed and documented (and therefore reviewed and approved), which includes statement of objectives, organization of project resources with roles and responsibilities, development phases in the project, development schedule identifying tasks to be performed and resources and time required for them, etc.. Implementation of this clause will ensure that the processes are such that

- The development is broken in some phases (minimal is design, implementation, and testing).
- For each phase, formal inputs and outputs are defined, implying that the work products for the project are defined and documented.
- Outputs of each phase are verified/reviewed and approved.
- Development methods and tools that are to be used are specified
- Progress reviews are planned (and later executed, with records left).
- Schedule for the various tasks
- Risks for the project are documented.
- How the project is to be monitored, that is, status reporting in the project.
- Interfaces with other groups (within the organization and outside), and escalation mechanisms.

Implementation of this is likely to result in some template for project plan. However, detailed methods or guidelines for different aspects of planning, like estimation, risk management, may not be in place.

Quality Planning (5.5)
Ensures that quality objectives, in measurable terms when possible, and input and output criteria for each phase are specified. Furthermore, the types of testing and verification activities that are planned are specified. Again, implementing this may result in a generic template, but methods for setting quality objectives are not likely to be in place.

Design and Implementation (5.6)
Ensures that some design rules are there that are used to create a design document (which has to be reviewed and approved). Use of design methodologies and past experience is encouraged. In implementation, coding standards are expected. Implementation of this essentially will make sure that designs are created, documented, and reviewed/approved. Some standards are also likely to be in place.

Testing and Validation (5.6)
Requires that testing is planned and test plans are created (and reviewed and approved), test results are recorded and all problems found are recorded (and later resolved). Again, implementation of this ensures that test plans are created, all defects are logged and tracked, and records of testing are maintained.

Configuration Management (6.1)
Requires that a configuration management plan for a project is made which identifies the configuration items and tools and methods to be used for SCM. Proper versioning is done and changes to configuration items are reviewed and controlled. Some configuration status reports for items and change requests are needed. Implementation of this will generally result in some template for CM, basic CM procedures, proper versioning and change control.

Measurement (6.4)
Requires that metrics are reported and used to manage a project. Though no metrics are proposed, it does require that defects and customer complaints are logged and analyzed as metrics. A lot of suggestions are made about how to use metrics. Consequently, implementation of this may differ widely. Implementing this clause ensures that defects found by customers and customer complaints are being logged. This will require that defects are being monitored. As timeliness is generally of importance to customers, the schedule of activities is

also likely to be monitored. However, effort may not be monitored and process measurements (like quality and productivity) may not be in place.

Training (6.9)
Requires that training needs are identified, training plan is done (reviewed and approved), and training records are kept. Implementation of this ensures that there is some training unit/group that identifies training needs, plans training, and delivers training. However, there are few constraints on the contents of the training program.

In summary, some of the practices/structures that an ISO company is likely to have are:

- Some quality system (QS) manuals or documents describing the various practices in the organization.
- A group within the organization, like a quality group or department. Such a group is likely to be doing process activities and hence can play the role of SEPG.
- An internal audit program, which requires that different aspects of implementation of the quality system of the organization are audited by some people who are independent from the ones doing the implementation.
- Some procedures to identify reasons for non-compliances, and for changing the processes, and disseminating the changes.
- A senior management review of activities of the quality group.
- Documentation policies and guidelines which require that all identified work products are documented. In other words, project plan, schedule, requirements, test plans, etc. are likely to be documented.
- Documentation control procedures that ensure that proper versioning is maintained, the documents are reviewed and approved, and that impact of change of a document is understood and made on other documents as well.
- An overall development life cycle specifying the major phases including requirements, design, coding, testing, and installation. Documentation procedures require that outputs of these are documented, approved, and reviewed.
- Project planning policies requiring that a proper project plan be developed which contains the estimates etc. before the development begins. As part of the planning, quality plan also needs to be done.
- Configuration management policies and practices.
- Some training program with records of training being maintained.
- Some metrics program. In particular, reporting of defects, and their tracking to closure.
- Quality record keeping, which ensure that all quality activities are planned and their outcome is recorded.

Different organizations will go to different depths in these areas in their ISO implementation and the details of the actual implementation will, obviously, determine the actual gaps for an organization with respect to CMM. For example, an ISO organization may have a detailed measurement program for measuring effort, schedule, etc., while another organization might just be tracking schedule and defects. Similarly, a process definition may contain fair amount of detail, or it may just enumerate the basic stages in the process.

Gap Analysis

The main difficulty in doing this type of study is how to define or characterize processes of a “typical” ISO or a “typical” CMM level i organization? For doing a practical study, we will make some assumptions. First, though ISO 9001 also looks at general running of the organization and the support services within the organization, we will focus attention to the software processes. Secondly, though there are many things stated and implied in the ISO/TickIT standards, we will go by what is “generally” practiced, “generally audited”, and “generally expected” from a “typical” ISO organization. For example, the TickIT guidelines do have some statements referring to improvements of the organization over time. However, they are not stated precisely and, in practice, are not compulsorily required for an ISO 9000 certification (though may be checked in an audit of a “mature” ISO organization). Thirdly, in CMM, though there are many key practices in CMM under each KPA, many of them are categorized under “commitment to perform”, “ability to perform”, “measurements” and “verification”. These key practices focus on policies, authorizations, review etc. In our study, we will focus mainly on key practices that are grouped under “activities performed”. Where necessary, we will include other key practices also.

In the CMM, for each KPA there are certain goals that must be satisfied by the processes of the organization. Then, there are key practices for each KPA (which are grouped in five groups). These key practices, if implemented, will satisfy the goals. The methodology we use is as follows. We start with the KPA coverage reference sheets provided by SEI, that are used during a CMM assessment. These sheets, for each KPA, give the different goals, and what activities should be performed to satisfy the activities for a goal, and what artifacts/documents are expected for that goal. These, are our basis for gap analysis. For each goal, we see if ISO/TickIT is likely to satisfy the goal. If not, we list what is likely to be missing in the ISO company as a possible gap. Later, we will compile all these gaps.

Level 2 KPAs

KPA: Requirements Management. There are two goals of this KPA. The first goal focuses on requirements being documented and controlled, and the second focuses on maintaining of consistency of other documents (eg. Plans, designs, etc.) with software requirements. Clauses 5.3.1 of ISO 9000-3 and 4.4.2 of TickIT require that requirements are precisely stated. And the general ISO requirement of document control requires that this document is controlled, authorized, and approved. Hence goal 1 is likely to be satisfied by an ISO organization. The section 5.3.2 (4.4.2 of TickIT) require that a change control mechanism for requirement exists, that considers the impact of the change on the project (document control procedures will require that a change request document is reviewed and change is authorized). Any reasonable implementation of this clause will require that on requirement changes, design and other work products are also appropriately changed. Hence, an ISO company is likely to satisfy goal 2 also.

So, there are not likely to be any gaps in an ISO organization with respect to this KPA.

KPA: Software Project Planning. There are three goals of this KPA. Goal 1 requires that estimates are documented, and activities supporting that require that estimates for size, effort, schedule, and critical resources are derived using a *documented procedure.* In general, ISO does not require effort estimates (though they are implied as part of the plan), and the focus is generally on activities and schedule. Plus, ISO does not require any procedure for estimation. Hence, **a likely gap** could be that a consistent estimation procedure may not exist in an ISO company.

The goal 2 requires that project activities are planned and documented. The activities require that the plan is controlled and managed, and identifies risks also. Clauses 5.4.1, and 5.4.2 cover these, along with TickIT guidelines requiring risk identification during planning. Goal 3 requires that affected groups and individuals agree to their commitments and its activities require that the commitments are reviewed by senior management. Senior management review is satisfied by ISO, as plan documents and commitments have to be authorized. But, ISO does not require any particular group or person to do the estimation. However, in practice, it will be satisfied, as the project leader is likely to do the estimation in an implementation of ISO. Hence, there are no further gaps for this KPA.

Project Tracking and Oversight. There are three goals in this KPA. Goal 1 requires that actual performance is tracked against the plans. Activities require that effort, cost, schedule, and risks are tracked, and actual measurement data is recorded, and formal reviews are held at milestones. ISO does require that planned activities be executed (and leave a record of execution), it does not explicitly require effort to be tracked. An ISO company may track only the schedule of activities. Hence, **a likely gap** is that an ISO company is not analyzing actual effort expended on a project and comparing it with plans.

Goal 2 requires that corrective actions are taken when actual performance deviates from planned. In an ISO company, a corrective action is required for “non compliances” found in a project. However, these usually focus on activities not done, improper control, etc. Generally, an ISO company may not perform any corrective action based on actual performance. Hence, a continuation of the gap mentioned above is that an ISO company might not be having any procedures for corrective action based on analysis of planned vs. actual of effort, schedule, etc.

Goal 3 requires that changes to plans and commitments are agreed and reviewed. An ISO company will satisfy this by approval requirements for its general plan, and changes to plan.

Software Subcontract Management. This comes under the more general heading of *purchasing* in ISO. Goal 1 requires that a qualified subcontractor is selected. It is satisfied by TickIT guidelines. Goal 2 requires that there is an agreement with the subcontractor. This is also satisfied by TickIT guidelines. Goal 3 says that there is a regular communication with the subcontractor. This is not required by ISO, and hence can be **a gap** in an ISO organization. Goal 4 requires that the performance of the subcontractor is tracked against its commitments. This is only partially satisfied by TickIT, and can also be **a gap.**

Software Quality Assurance. ISO also focuses on software quality planning and execution. Hence, all the four goals of this KPA are likely to be satisfied by an ISO company. One possible gap could be that ISO does not require that an independent SQA group exist, though it requires an independent internal auditing group. This may be a gap, though it can be argued that an independent auditing group is sufficient to provide the independence that is being desired by CMM.

Software Configuration Management. The four goals of this KPA require that the CM activities are planned, what is put under CM is planned and these items are controlled, changes to the items are controlled, and affected groups know the status of the different items. SCM is a support process in ISO and there are specifications for this. As SCM practices can vary from simple to very elaborate, it is not easy to evaluate an SCM practice. However, most likely the ISO practices, coupled with the general requirements of approval, reviews, and document control, all these goals are likely to be satisfied by an ISO company. A possible gap could be that the configuration management audits are not being performed. However, the internal audit mechanism may be looking at configuration management, thereby somewhat removing this possible gap.

Level 3 KPAs

Organization Process Focus. There are three goals in this KPA. Goal 1 states that software process activities are coordinated across the organization. The activities require that a group exists for this coordination, a process database is there, tools and processes in limited use are evaluated for possible use in the rest of the organization (i.e. learning), and training is provided. In an ISO company, a group is likely to exist which coordinates all process related activities. However, this group may not be trying to identify good practices and tools and may not actively plan to disseminate these. This is **a possible gap.**

Goal 2 requires that the process is assessed periodically and action plans developed based on the report. This is likely to be satisfied in an ISO company as an internal audit group is required to audit periodically and all "non compliances" have to be closed. Some of the non compliances may require processes to be changed (while others might just relate to deployment of processes on projects). However, internal audits may not suffice as proces assessment and some process assessment and planning activity might be needed. This is a **likely gap.**

Goal 3 requires that organization level process development and improvement activities are planned. ISO has very limited focus on process management. Hence, this goal is not likely to be satisfied, and this is **a likely gap.**

Organization Process Definition. This has two goals. Goal 1 requires that a standard process for the organization is developed. The activities require that process is developed according to a documented procedure, and is documented using some standards, and guidelines and criteria for tailoring of the process for projects exist. Most of these **are gaps.** Goal 2 requires that information about process use is collected. Activities require that a process database be established, and a library of process related assets be maintained. These **are also likely gaps.** In other words, an ISO organization may not have procedures for process development, it is not likely to have tailoring guidelines, and it is not likely to have any process database and process assets. Requirement of tailoring guidelines also require that the processes are defined with reasonable details so that tailoring guidelines may be built. Detailed process specification is also not explicitly required by ISO, and hence this might also be a gap.

Training Program. The goal 1 requires that training activities are planned. This is likely to be satisfied by an ISO organization. Goal 2 is that training is provided. The activities for this require that procedures for conducting training are needed and standards for courses are needed. This is **a likely gap.** Goal 3 requires that individuals receive training, and an activity requires that there should be a waiver procedure for required training. This waiver procedure may not be there in an ISO company and is **a likely gap.**

Integrated Software Management. Goal 1 requires that the process being used on the project is a tailored version of the organization process. Tailoring is not an issue with ISO, and this is **almost a definite gap.** Goal 2 states that project is planned and managed according to the project's process. The activities require that lessons are learned from projects and documented, a documented procedure for risk management exists, projects effort and critical resources are managed, thresholds for deviation from planned are established for effort, schedule, critical resources, and reviews of the project are periodically done. Though the goal can be argued as being implied by ISO guidelines, most of the activities are not likely to be performed in an ISO company. And hence, **constitute likely gaps.** In other words, the gaps here are lack of lessons learned mechanism, proper guidelines for risk management, managing of effort, schedule, and critical resources, and thresholds for performance variation for taking action.

Software Product Engineering. The first goal is that software engineering tasks are defined and performed consistently. Most of the activities under this are likely to be satisfied by an ISO company. However, **a minor gap** could be that CMM requires that rationale for tool selection is documented, which may not be done by an ISO company. Goal 2 requires that consistency is maintained across different work products. This is likely to be satisfied by an ISO company.

Intergroup Coordination. This is not a clear issue in ISO, and is not an issue with most software only organizations. However, for software only organizations, it might mean that intergroup issues between the project team and other groups is not hurting the project. As ISO covers the organization (which CMM does not), intergroup issues are likely to be covered by ISO.

Peer Reviews. ISO does not require group reviews. It only requires that all documents are reviewed. Hence, this KPA is not likely to be satisfied by an ISO company, and the **entire KPA can be considered as a gap.**

Level 4 KPAs

Quantitative Process Management. This KPA requires that goals for the performance of the process on a project are established, based on the past performance of the process, and measurements are taken along the process execution and data used to quantitatively control the project. As data collection, its analysis, etc. are not covered in detail in ISO, much of this KPA will constitute a gap. Specifically, the **possible gaps** are: (1) Methods for quantitatively managing a project, including making plans, collecting data and analyzing them, and taking corrective actions where necessary. (2) The process capability of the process in quantitative terms (and then use of this capability to set goals for the projects).

Software Quality Management. This KPA requires that quantitative quality goals are set for the software products, plans are made to achieve the goals, and that the actual progress is monitored and corrections made, if needed, to ensure that goals are met. Though ISO requires a quality plan to be made and some quality objectives to be set, and even suggests that goals be measurable wherever possible, it does not require measurable goals and measurable progress. Hence, many of the activities under this KPA will constitute Specifically, the **possible gaps** are: quality capability of the process, documented method for setting quantitative quality goals and developing quality plan, method for quantitative monitoring of progress in achieving quality goals and taking actions based on this analysis.

Summary of Gaps

Based on the analysis in the previous section, now we can summarize the gaps that are likely to exist in an ISO company with respect to level 2 and 3 and 4 of the CMM. First, we summarize the gaps for each KPA. Then, we will list the major gaps that are likely to exist, for which major actions might be required.

	KPA	**Probable Gaps**
	LEVEL 2 KPAs	
1	Requirements Management	None
2	Project Planning	• Documented procedure for estimation
3	Project Tracking and oversight	• Tracking of effort and comparing with estimated effort.

		• Taking of corrective actions based on actual data on effort (and schedule).
4.	Software subcontract management	• Regular communication with the subcontractor
5	Software Quality Assurance	None
6	Software Configuration management	None
	LEVEL 3 KPAs	
7	Organization Process Focus	• Method to identify and disseminate usage of new tools and processes that are already being used in some parts of the organization. • Plan for software process development and improvement activities
8	Organization Process Definition	• Documented procedure for developing and maintaining a process. • Tailoring guidelines • Process definition with sufficient details. • Organization software process database • Library of process assets
9	Training Program	• Procedure for conducting training • Course material preparation standards • Waiver procedure
10	Integrated Software Management	• Tailoring guidelines • Learning technical and management lessons • Guidelines/procedure for risk management • Tracking of effort, critical resources, etc. • Thresholds for variation of actual performance on a project as compared to planned for taking action
11.	Software Product Engineering	• Rationale for tool selection • Defect data analysis
12	Intergroup coordination	• None
13	Peer Reviews	• All activities and goals of this KPA
	LEVEL 4 KPAs	•
14	Quantitative Process Management	• Methods for quantitatively managing a project, including making plans, collecting data and analyzing them, and taking corrective actions when necessary. • Process capability in quantitative terms (and this capability used in project planning and execution)
15	Software Quality Management	• Methods for setting quantitative quality goals for a project, methods for quantitatively monitoring the progress and taking corrective actions when necessary. • Quality capability of the process known in quantitative terms.

Where to Go From Here

The gaps given above are the gaps that are most likely to occur in the processes of an ISO organization with respect to various levels of the CMM. For a particular ISO organization, the exact nature of the gaps will, obviously, differ depending on how mature their ISO implementation is and what kind of processes have been put in place. Hence, for an ISO organization, desiring to move to higher levels of the CMM, the first thing it has to do is to identify the actual gaps that exist for that organization, using the general approach followed above. The chances are that the gaps in the organization will be a subset of the gaps given above. At Infosys, the gaps we found were indeed a subset of the gaps given above.

Once the gaps are known, then action plan is to be prepared for plugging the gaps. The gap plugging exercise has two major components – defining what needs to be done for plugging the gaps (i.e. procedures), and then deploying the procedures that are defined on projects. As is the case with any process, identifying the

procedures is a conceptual activity which requires good understanding of the current processes and objectives of the organization, so that meaningful procedures can be devised. However, deployment is the hard part. For the purposes of planning and execution, we can classify the gaps into three categories – *process issues* are those that relate to change in process definition (and implementation), *structural or management issues* are those that deal with management structures needed for plugging the gaps, and *process data related issues* deal with usage of process data. The different gaps under these categories are given below.

Process Issues
Estimation procedure
Process for process development and maintenance
Life cycle process with sufficient details
Tailoring guidelines for processes
Procedure for conducting training
Course material preparation standards
Risk management guidelines/process
Peer review process
Guidelines for quantitatively managing a project
Guidelines for setting quality goals

Structural/Management/Policy Issues
Collecting lessons learned from projects and disseminating them or making them available
Identify and disseminate usage of new tools and processes that are being used in parts of the organization
Collecting process assets and making them available for other projects
Data collection from projects (on effort, schedule, defects, and size)
Communication channels and structures with the subcontractors
Waiver policies for training
Project tracking and taking corrective actions based on actual performance of the project and set thresholds
Plan for software process development and improvement
Policies for peer review (and data collection for reviews)

Process Data
Process database – which will probably have summary data from completed projects.
Process capability – understanding the process capability in quantitative terms
Quantitative analysis of performance of processes on a project
Using this data properly in project planning

The process issues will require that first the processes are defined. One method for process definition is the time tested method of having working groups or task forces. For structural/managerial issues, the procedure is usually not the hard part. Structures are needed in the organization to support these activities. For example, for lessons learned, some methods might be needed to identify "good practices" and then some methods will be needed to disseminate these. Similarly, data collection in projects is a management issues – how to ensure that good data is collected from projects. Some of the structural issues can also be considered as process issues, like project tracking using project performance, but we feel it is more of a management issue, that is, the problem is finding effective means of getting this activity done. Data analysis issues are usually outside the regular project cycle, hence have been grouped separately. Management structures and procedures will have to be defined for these.

Once the processes are defined, mechanism identified, data analysis procedures defined, their piloting and deployment can begin. The mechanism for deploying a process should be defined in the process management process. For example, the process may be to first try a new process on a pilot project, followed by fine tuning of the process, and then the final deployment. The process management process will define the process for deployment (and in the process also fill one gap). However, it should be understood that deployment structures and resources will be required for any deployment. Unless, properly trained resources do not actively take up the task of deployment, the deployment is likely to be a very hard task.

There are two approaches possible for overall deployment from the point of view of the CMM assessment. The first is to fully deploy the new processes and structures in the organization and then go for an assessment. The other is to go for a limited deployment in some parts of the organization and then go for an assessment. The full

deployment is done later after the assessment. The advantage of the latter approach is that it is quicker and provides validation of the processes before the big task of organization wide deployment is taken. From the CMM point of view, both approaches are acceptable. The purpose of the assessment is to prove that the organization has the capability of executing projects at a certain level by examining a reasonable number of projects and people. The capability can be proved by a limited deployment. Also, being at CMM level I does not mean that all projects of an organization are following procedures of level I – there could be projects which for customer or business reasons might be following processes that are lower than level I.

Which level should an ISO organization shoot for, if it adopts the CMM framework. Though many might say that level 3 is the natural choice, we feel that the right "target" is level 4. Reaching level 3 from ISO provides limited visible benefits and the basic process-based approach remains by-and-large unaltered. Level 4 has only two more KPAs and with a little extra effort, should be achievable for an ISO organization. A big advantage of going for level 4 is that it brings about a change in the way the projects and processes are managed – it makes everything data oriented. This provides a quantitative shift and provides the organization a quantitative visibility into its processes.

The second major question for an ISO organization is in how many rounds should the gaps be implemented. Again, the traditional wisdom is that changes should be done slowly and incrementally. We feel that the "big-bang" approach may be well suited, if the gaps are not too wide. In this, all the identified gaps are "filled" together, resulting in a set of processes that are level 4 compliant. These processes then have to be implemented. A key success factor for this approach is that the whole initiative for reaching certain level has to be treated and managed like a project, which is sponsored and monitored by the senior management of the company. At Infosys we followed this approach very successfully. Aspects of managing this project are described in a different report [Jal98].

Time required to move to level 3 for an ISO organization will, vary depending on the severity of gaps, the commitment of the organization in achieving higher maturity levels, and how well is the process improvement initiative managed. If an organization had some measurement system in place and the processes defined in its ISO certified quality system were reasonably detailed, and there is enough motivation to take all the gaps together, in parallel, then in about 1 year the organization can move to level 3. In this much time, it can have all the processes defined, with at least a limited deployment (on new projects) to prove the capability. In our organization, as we already had a good data collection and analysis program, and our quality system was process oriented with most of the elements of CMM in it, we were able to move to level 4 within one year.

Summary

There are a vast number of software organizations that have been certified under ISO9001 which now want to move to the Capability Maturity Model (CMM). This article, based on our experience of successfully transitioning from ISO to Level 4 of the CMM, discusses the possible gaps the processes of an ISO organization might have with respect to different levels of the CMM, and how an organization can move from ISO to higher levels of the CMM.

For finding the gaps we have considered a "general" ISO organization. The exact nature of the gaps, obviously, will depend on the exact nature of the processes of the organization. However, we believe that the gaps given in this article are the most likely gaps and the actual set of gaps will be a subset of these. Hence, the set of gaps given above can act as a useful guide or checklist for an organization planning to move to higher levels of CMM. The method we have used in this article can be used by an organization to do a detailed gap analysis.

We have then discussed briefly what to do after the gaps are identified and the different ways in which an organization can go about preparing for an assessment. We suggest that an ISO organization should shoot for level 4 of the CMM. We also suggest that the big-bang approach can be followed for reaching level 4, provided the initiative of achieving high maturity level is managed like a well-controlled project. We also propose that a limited deployment, followed by an assessment and then organization wide deployment might be a more sensible way of proceeding.

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