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Road Map to CMM Implementation
Netsol’s Experience

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ROAD MAP TO CMM IMPLEMENTATION
NETSOL’S EXPERIENCE

by

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Every organization is a network of processes, like business development, production, quality assurance, human resources, finance, etc. These processes work together to process input to the organization and transform it into products & services for their customers. Management premise is that the quality of a software system is highly influenced by the quality of the process used to develop and maintain it. This premise implies focus on process as well as product. The paper discusses the implementation aspects of Software Capability Maturity Model that provides a software process maturity framework helping a software organization to improve its process for quality & productivity gains.

According to the software process management guru, Watts Humphrey, “The Actual Process is what you do, with all its omission, mistakes, and oversights. The Official Process is what books say you are supposed to do”. That means a software organization must focus on two basic principles. Firstly, to develop reliable, efficient and pragmatic Official processes those are consistent with the current practices in the organization. Secondly, to ensure that company culture allows these processes to be diffused in organizational practices. That is how an organization can reduce the differences in Official & Actual Processes.

Many software companies fail in process improvement efforts as they try to force the Official Process in such a way that the Official Process go unused and remains in company archives and the Actual Process has no relation with the Official Process.

I have been working on Software CMM for last few years and helped my organization to prepare for CMM based assessments. I have been conducting workshops on CMM nationwide as well. This paper describes different aspects related to CMM implementation, based on my knowledge gained through official training on CMM & CMM-based Assessments and the feedback from my colleagues & participants of workshops, and my personal experience.

The major portion of this paper explains the steps those I took to make NetSol first company in Pakistan to be assessed at CMM Level 2. This will give you an opportunity to have access to first hand knowledge of CMM Implementation in a software organization in Pakistan.
PROCESS, CAPABILITY & MATURITY:

Before we talk about Capability Maturity Model (CMM), a process maturity framework, it would be better if we review the concepts related to process, capability & maturity. This would help us to better understand concepts of CMM itself.

A process is a sequence of steps performed for a given purpose. And a “Software Process” can be defined as a set of activities, methods, practices and transformations that people employ to develop and maintain software and the associated products e.g. Project plan and design documents etc. “Software Process Capability” describes the range of expected results that can be achieved by following a software process. The software process capability of an organization provides one mean of predicting the most likely outcomes to be expected from the next software project the organization undertakes. And “Software Process Maturity” is the extent to which a specific process is exactly defined, managed, measured, controlled and effective. Maturity implies a potential for growth in capability and indicates both the richness of an organization’s software process and the consistency with which it is applied in projects throughout the organization.

PROCESS IN ORGANIZATIONAL CONTEXT:

The Software Process Framework (SPF) separates information within a CMM maturity level into an organizational structure for software process documentation called the operational framework. The operational framework contains the following process information types:

POLICY:
The "laws" or "regulations" that govern or constrain operations.

STANDARDS:
The "operational definition" or “acceptance criteria” for final & interim products.

PROCESS:
Describe “what happens” within the organization to build products that conforms to the standards in accordance with the policies of organization.

PROCEDURES:
Describes "how-to" or step-by-step instructions that implement the process

TRAINING:
Knowledge/skills required to use a procedure.

TOOLS:
Automated support needed to implement the procedures
SOFTWARE CAPABILITY MATURITY MODEL® (CMM®):

Software Capability Maturity Model was developed by Software Engineering Institute (SEI), Carnegie Mellon University, USA. Throughout the development of this model, the SEI has paid attention to advice from practitioners who are involved in developing and improving software processes. Their objective has been to provide a model that:

- Based on actual practices
- Reflects the best of the state of the practice
- Reflects the needs of individuals performing software process improvement, software process assessments, or software capability evaluations;
- Documented
- Publicly available.

The Capability Maturity Model for Software (SW-CMM) is a framework that describes the key elements of an effective software process. The CMM describes an evolutionary improvement path from an ad hoc, immature process to a mature, disciplined process.

The CMM covers practices for planning, engineering, and managing software development and maintenance. When followed, these key practices improve the ability of organizations to meet goals for cost, schedule, functionality, and product quality.

The CMM establishes a yardstick against which it is possible to judge, in a repeatable way, the maturity of an organization's software process and compare it to the state of the practice of the industry. The CMM can also be used by an organization to plan improvements to its software process.

STRUCTURE OF CMM®:

CMM® is organized into five maturity levels. A Maturity Level is a well-defined evolutionary plateau towards achieving a mature software process. The five maturity levels provide the top-level structure of the CMM.

Except for level 1, each maturity level is decomposed into several key process areas that indicate where an organization should focus to improve its software process. Key Process Areas (KPA) identifies the issues that must be addressed to achieve maturity level.

The practices that describe the KPAs are organized by Common Features. The common features are attributes that indicate whether the implementation and institutionalization of a KPA are effective, repeatable, and lasting. Each KPA is described in terms of key practices. The Key Practices describe the activities and infrastructure that contribute most to the effective implementation and institutionalization of the key process area.
What Does A Maturity Level Mean?

1) **Initial**: The software process is characterized as ad hoc, and occasionally even chaotic. Few processes are defined, and success depends on individual effort and heroics. At Level 1, visibility into the project's processes is limited.

2) **Repeatable**: At Level 2, the customer requirements and work products are controlled, and basic project management processes are established to track cost, schedule, and functionality. These management controls allow visibility into the project on defined occasions.

3) **Defined**: The software process for both management and engineering activities is documented, standardized, and integrated into a standard software process for the organization. All projects use an approved, tailored version of the organization's standard software process for developing and maintaining software.

4) **Managed**: Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.

5) **Optimising**: Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies. At this level, new and improved ways of building the software are continually tried, in a controlled manner, to improve productivity and quality.

**BENEFITS:**

Software industry today continues to be faced with rapidly changing, advancing technologies, mature users, and increased demands for quicker turnaround. Managers today are challenged with many additional dynamics. How can companies effectively compete in the industry, maintain customer satisfaction, build software on time, in budget and of high quality? Is software process improvement worth the investment? The Software Engineering
Institute’s (SEI) Capability Maturity Model (CMM®) has been embraced by the software industry as a model of excellence that minimizes project risks and improves quality and productivity. Some other benefits of CMM are as follows:

1. A framework for improvement
2. To forge a shared vision
3. Establishes a common language for talking about the software process
4. Supports measurement of the software process by providing a framework for performing reliable and consistent appraisals
5. A “Common Sense Engineering” approach to software process improvement.
6. A conceptual structure for improving the management and development of software products in a disciplined and consistent way
7. Identifies practices for a mature software process and provides examples of the state-of-the-practice
8. Tool to help software organizations improve their software processes

The benefits of implementing CMM® in organization and moving up through the levels of the CMM® are substantial as illustrated below:

<table>
<thead>
<tr>
<th>Category</th>
<th>Range</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return on Investment (ROI)</td>
<td>4.0 - 8.8</td>
<td>5.0</td>
</tr>
<tr>
<td>Productivity gain per year</td>
<td>9% - 67%</td>
<td>35%</td>
</tr>
<tr>
<td>Reduction in time to market</td>
<td>15% - 23%</td>
<td>19%</td>
</tr>
<tr>
<td>Pre-test defect detection gain per year</td>
<td>6% - 25%</td>
<td>22%</td>
</tr>
<tr>
<td>Yearly reduction in post-release defects</td>
<td>10% - 94%</td>
<td>39%</td>
</tr>
</tbody>
</table>

Table 1: Benefits of CMM

Some specific industry examples of benefits are: Schlumberger, product planning slippage-1990 it was 50% in 1992 reduced to 5%; Raytheon, for every $1.00 invested they showed a $7.80 avoidance of rework costs; Texas Instruments, Reduced find-fix time for defects from 8 hours each to 11 minutes.

CMM - WORLD-WIDE SCENARIO:

WORLDWIDE TRENDS OF IT COMPANIES

Worldwide trends of IT companies in relation to CMM adoption can be expressed through some facts and figures as described below. This data represents distribution of 1756 organizations assessed or reassessed since 1987 through June 2002, from different perspectives. Source of this information is …

<table>
<thead>
<tr>
<th>Organization Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial/In- house</td>
<td>70.5 %</td>
</tr>
<tr>
<td>Department of Defense/Federal Contractor</td>
<td>24.9 %</td>
</tr>
<tr>
<td>Military/Federal</td>
<td>4.6 %</td>
</tr>
</tbody>
</table>

Table 2: Distribution w.r.t. type of organization
Figure 2: Distribution w.r.t. Organization Size (1094 org. reporting size data)

<table>
<thead>
<tr>
<th>Organization Size</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-100 employees</td>
<td>48 %</td>
</tr>
<tr>
<td>101-200 employees</td>
<td>23.5 %</td>
</tr>
<tr>
<td>201-2000+ employees</td>
<td>28.5 %</td>
</tr>
</tbody>
</table>

Table 3: Distribution w.r.t. size of organization
CMM Level | Percentage
--- | ---
Optimizing (Level 5) | 6.8 %
Managed (Level 4) | 7.3 %
Defined (Level 3) | 23.4 %
Repeatable (Level 2) | 43.2 %
Initial (Level 1) | 19.3 %

**Table 4** Organization Maturity Profile (August 2002)

**Figure 3** USA and Offshore comparison (since 1998 for 1124 organizations)

<table>
<thead>
<tr>
<th>Country</th>
<th>Country</th>
<th>Country</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>Venezuela</td>
<td>Republic of Korea</td>
<td>Singapore</td>
</tr>
<tr>
<td>Australia</td>
<td>Finland</td>
<td>Malaysia</td>
<td>South Africa</td>
</tr>
<tr>
<td>Austria</td>
<td>France</td>
<td>Mexico</td>
<td>Spain</td>
</tr>
<tr>
<td>Barbados</td>
<td>Germany</td>
<td>Netherlands</td>
<td>Sweden</td>
</tr>
<tr>
<td>Belgium</td>
<td>Greece</td>
<td>New Zealand</td>
<td>Switzerland</td>
</tr>
<tr>
<td>Brazil</td>
<td>Hong Kong</td>
<td>Pakistan</td>
<td>Taiwan</td>
</tr>
<tr>
<td>Canada</td>
<td>Hungary</td>
<td>Philippines</td>
<td>Thailand</td>
</tr>
<tr>
<td>Chile</td>
<td>India</td>
<td>Poland</td>
<td>Turkey</td>
</tr>
<tr>
<td>China</td>
<td>Ireland</td>
<td>Portugal</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>Colombia</td>
<td>Israel</td>
<td>Puerto Rico</td>
<td>United States</td>
</tr>
<tr>
<td>Denmark</td>
<td>Italy</td>
<td>Russia</td>
<td>Uruguay</td>
</tr>
<tr>
<td>Egypt</td>
<td>Japan</td>
<td>Saudi Arabia</td>
<td>Vietnam</td>
</tr>
</tbody>
</table>

**Table 5** Countries where assessment has been made

Good to see that now Pakistan name is there because of NetSol. This information is taken from SEI website, and the same depicts that there is an increasing trend of CMM adoption world-wide.
WORLDWIDE TRENDS OF IT CLIENTS

Over last two decade IT clients have changed a lot as compared to early days. Now the clients are more aware of Software Engineering & Management processes and their importance & impacts. Now the clients know how strong engineering & management processes of their software vendor support high quality product to be delivered on time & within budget.

They have also experienced high maturity organization and on average found better results as compared with the low maturity organization. They understand the value of CMM maturity levels worldwide. Many of the clients now set CMM Level 3 or higher as a prerequisite to bid for a project. In other words CMM Maturity level is being used a yardstick to compare the software organizations.

OPPORTUNITIES FOR PAKISTAN IT INDUSTRY

Following is a subset of high maturity organization, that includes:

- 73 Level 4 organizations
- 69 Level 5 organizations

It is interesting to note that 84 of the high maturity organizations assessed are outside the United States. As you can see in the table below, the high maturity organizations are concentrated in USA & India. There are very few high maturity organizations in other parts of the world. But you must acknowledge that this is one of the reasons why India is leader in IT sector worldwide.

In my opinion, this is an opportunity for us at national level to develop high maturity software organizations and become the competitor in the first place. As it is the only way to survive in future.

<table>
<thead>
<tr>
<th>Country</th>
<th>Level 4 Organizations</th>
<th>Level 5 Organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>China</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>France</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>28</td>
<td>46</td>
</tr>
<tr>
<td>Ireland</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Israel</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Russia</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Singapore</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>39</td>
<td>19</td>
</tr>
</tbody>
</table>

Table 6: High Maturity Organizations

CMM – THE CHALLENGE:

GENERAL PROFILE OF PAKISTAN IT COMPANIES

With the recent recession in American economy in general and IT sector in particular, some Pakistani software companies are badly hit. Before the recession some well-known Pakistani companies had ambitions to achieve CMM Level-3 by year 2002. The
recession has made them reconsider their priorities. In some cases this has pushed the targeted CMM assessment time to year 2003-04; while in other cases the CMM assessment has cancelled.

Beside all these facts, NetSol has set an example for IT sector in Pakistan. NetSol became first company to call for a formal CBA-IPI (CMM-based Appraisal for Internal Process Improvement) in March 2002. As a result of this CBA-IPI NetSol has successfully been assessed at Maturity Level 2. This is just a beginning of a journey towards a higher maturity organization in Pakistan. There are other organizations those are willing to preparing for higher maturity levels.

OTHER SIDE OF CMM

CMM is not a silver bullet and does not address all of the issues that are important for successful projects. For example, the CMM does not currently address expertise in particular application domains, advocate specific software technologies, or suggest how to select, hire motivate and retain competent people. Although these issues are crucial to a project’s success, they are not part of SW-CMM.

It takes long-term commitment from the management to allocate & provide resources towards the effort against CMM implementation in an organization. These resources are in terms of effort, time, funds & tools. CMM implementation requires these resources for process development & improvement, implementation, & assessment activities.

CMM implementation does require huge investment. There are costs associated with full-time & part-time resources working for CMM. In addition, there are costs associated with external consultancy & assessment services.

Software CMM is a better choice for a software organization seeking international business. As CMM is being used a

Why CMM?

1. Entire organization focus on continuous process improvement
2. Proactive identification of weaknesses and rectifying them
3. Focus on preventing occurrences of defects
4. Cost/ time savings for all project and process related activities

CMM - MEETING THE CHALLENGE:

I would say that we could surely meet this challenge of implementing CMM in IT industry of Pakistan. But to do so we need to organize ourselves at both national & organization levels. We need to make efforts in creating awareness & infrastructure at national level, as well as build the organizational culture that supports quality improvement. There are a few factors that can play a crucial role in the success of CMM initiative in Pakistan.

First & foremost important factor is the Government support. Government can support CMM initiative both financially and by developing infrastructure that is required for this initiative. Second factor is the awareness of Software Process Improvement (SPI). We need to create awareness for SPI at national level. SPI is inevitable for an organization that wants to succeed in the industry & have long term plans to remain in the business. We must take
certain actions at national level that will increase the interest towards SPI at all levels in the organization, from Top Management to the Junior Developers, from Development Team to other teams in the organization e.g. SQA.

Third factor is that we need to develop resources for SPI, like Process Engineers, SPI Consultants, and Lead Assessors. This can only be done through providing training opportunities & giving exposure to SPI related activities. Either these training are hard to find, or these are too costly if acquired outside Pakistan. And the last factor is sharing of our experiences. This is a common practice in leading IT countries. Examples of these knowledge-sharing forums are SPINs (Software Process Improvement Networks) a group that is created at regional level to share the experience voluntarily; & SEPG Conferences that are being organized around the globe to share the experience at international level. These conferences are big source of information for the attendees as well as others to learn from the best practices experienced by different people internationally.

Looking at the other side what we need to do at organization level. I will be discussing a “Road Map to CMM Implementation”, as we followed in NetSol and is typical for an organization.

**ROAD MAP TO CMM:**

*Understand Need & Value of CMM*

Before an organization takes a decision against CMM Implementation, two fundamental questions must be answered to support management decision. First, Why do software process improvement? That means what would be the impact on the bottom line? or would it provide the company a competitive advantage? And secondly, Will the CMM help the organization improve? And what about other approaches?

For most of the organizations Project Management issues have been the major reasons for failure. For example;

- “Project management issue emerge as the main reasons for runaway projects.” (KPMG)
- “The most software productivity and quality improvements today are management … driven.” (SRI International)
- “What we have found is that most projects fail because of people and project management concerns….” (R. Thomsett)

Software process improvement should be done to help the business-not for its own sake. Because if it is not linked with the business objectives, management will lose interest in the long run, or in case of problems faced during implementation. We must understand that improvement is a long-term, & strategic effort. We need to plan to achieve expected impact on bottom line, and we should measure our progress against these plans.

CMM-based SPI has been broadly adopted throughout the world. CMM can help management to meet its business objectives for the following reasons;

- CMM addresses management processes, CMM-based software process improvement (SPI) can guide organizations to significant improvements in performance
- CMM implementation can impact the organization with increasing
  - Visibility into organization performance
  - Predictability of results
  - Staff morale
  - Product performance
  - Ability to manage complexity
  - Visibility of business value

*Initiate Process Improvement*
There are certain pre-requisite before going through SPI efforts. First, we need to identify the business drivers behind SPI, e.g. customer, market, competitor, common issues in projects, etc. Second, it is important to gain senior management support towards this initiative, as it is very important to sustain SPI efforts in an organization. Third, there should be a clear agenda behind SPI, it should be purely for improved performance & business. Fourt, it should be ensured that SPI purpose is to improve Process & not the People. Lastly, you must set realistic expectation as far as time lines or impact is concerned. And above all ensure that your plans are agreed upon by all the participants, e.g. management, SEPG, project managers.

We must consider the principles of Process Improvement to ensure success, they are:

- Improvement direction must start at the top
- Fix the process not the people
- Everyone must be involved in the improvement process
- Effective improvement requires knowledge of current practices
- Improvement is continuous
- Improvement requires investment
- Use external help to reduce risk

There are different areas to focus on during SPI efforts. People & Culture: because people need a reason to change. Communication: change without communication is driving without roads. Management Commitment: to ensure organizational support, resource availability, and time allocation. Planning: A good plan means you are half way done. Tools & Processes: tools & processes help you ensure consistency & completeness, and support smooth implementation.

**PLANNING PROCESS IMPROVEMENT**

Planning is most important factor to ensure successful execution of any project. An SPI Project cannot be successfully executed unless real problems have not been identified. When these will be eliminated or addressed properly will ensure the strong relationship with business. For this reason, SPI objectives should be tied up with over all business objectives of the organization.

As discussed earlier, with strong management commitment, allocation & availability of resource can be ensured. One has to ensure that resources are available in terms of time, effort, & fund as required against the plan.

While planning for training, development of processes, implementation or assessment it must be ensured that timelines are selected carefully. And you must come up with a credible plan after careful considerations & estimation. Plan must also provide the right direction & focus for SPI activities. It has to been ensured that certain measurements are in place to track effective progress against the plan. The input to a successful SPI Plan are

- A documented diagnosis and recommendations
- Fundamental Plans
  - Business plans
  - Organizational improvement plan
BUILD INFRASTRUCTURE

For effective execution of SPI Plan in an organization an infrastructure needs to be developed for ensuring organization wide support. Following are examples of certain group that may exist in an organization to execute & support SPI activities according to an SPI plan.

- Management Steering Group (MSG): A group representing top management. They are responsible for setting up strategic objectives for the people involved in SPI. At NetSol the MSG comprises of President/CEO, Director IT/Operations, Project Manager SPI, & One Senior Project Manager.

- Dedicated Quality Engineering Function: A group or department that is responsible to provide support in developing and maintaining of organization standard software process in compliance with international standards, like CMM

- CMM Implementation Group (CIG) (or SEPG): A group of comprising of Project Managers responsible for developing/improving, reviewing, & approving standard software process for implementation in all projects across the organization. They take assignments for certain improvement area and through a Process Action Team (PAT) ensure that improvement is made into the process as appropriate. And in addition they have to ensure that all projects follow standard processes in the organization and resolve any issues that may arise.

- Process Action Teams (PATs): A group of people, that is lead by a CIG Member, to develop/improve the software processes, they are advised by Quality Engineering function & CIG on different issues during the development of processes.

- Project Coordinators: A person from development team (software engineering Team) who ensures that his/her project follows all standard processes of organization as applicable. And also to ensure coordination among different groups related to a project, e.g. SQA, Technical Communication, QE, etc.

DEVELOP IMPROVEMENT ASSETS & CULTURE THAT SUPPORTS

As an output of activities performed collectively by all SPI participants becomes available, in the form of policies, process guides, templates, forms, etc. A repository of process related documents should exist and must be accessible to all practitioners. This database is used for understanding of standard processes and is used as a reference while executing development projects.

In addition efforts should be made to develop a supportive culture for SPI in the organization while developing improvement assets as well as at the time of their implementation. More is the participation & clear communication more becomes an organizational culture that supports and sustains SPI efforts. Suggestions should be highly encouraged as a feedback from practitioners of the software processes. This feedback could be in relation to standard software processes, their contents, and problems & improvement areas associated with these.

PREPARE FOR APPRAISAL

This section provides information about CMM based appraisal in general. That would help to understand what different activities are performed, how these are performed, and who are the people involved in the assessment.
As a first step we must understand that, business needs drive the requirements for process improvement and assessment. Business goals for process improvement are usually related to, reducing costs, improving quality, decreasing time to market, etc. Fundamental assumption, behind these goals, is that cost, quality, & schedule are largely determined by the development process used by the organization.

There are different methods available for assessment against CMM. They are, Interim Profile (IP), Software Capability Evaluation (SCE), & CBA-IPI (CMM Based Appraisal for Internal Process Improvement). Following are the goals for CBA-IPI.

- Provide an accurate picture of existing software processes relative to reference model, like SW-CMM
- Provides a baseline of organization’s capability
- Provides strengths & weaknesses relative to the CMM
- Provides findings to guide planning future process improvement activities
- Support, enable, and encourage an organization’s commitment to software process improvement

There is a standard framework designed by SEI for CMM-based Assessments, known as CMM-based Appraisal Framework or CAF. All assessment methods mentioned above follow the same framework with some alterations. In brief a CMM Based assessment follows a few major steps that are discussed as follows.

- Plan & Prepare: This phase comprises of on-site as well off-site activities. Those include training, briefing, questionnaire, document review, etc.
- Conduct Assessment: This stage is carried out on-site, with the assistance of local Assessment Team Members (ATMs) trained by the SEI authorized Lead Assessor. They perform assessment activities lead by the Lead Assessor, by conducting interviews, document reviews, and consolidation of the data collected.
- Report Results: Final stage of an assessment is to compile the report based on the finding as per data collected during assessment & findings are based on consensus & consolidation. First the draft finding is reported to Assessment Participants & then after necessary adjustment final findings are reported.

During the assessment different people in the organizations are responsible for playing different roles to ensure a successful assessment. Brief description of each is given below.

- Sponsor: CEO or the Top Management that is inviting the Lead Assessor for the Assessment. Sponsor is responsible for communicating business goals for the organization, must demonstrate full commitment against SPI & assessment activities, by providing adequate funds & resources required. Sponsor is also responsible for defining the scope of assessment as well.
- Lead Assessor: Lead assessor should be qualified & authorized by SEI to conduct the assessment. He is responsible for planning, organizing, & managing the whole assessment activity, off-site as well as on-site. He may also be responsible for training the Assessment team Members.
- SEPG: SEPG (QE & CIG at NetSol) provide assistance to both the Sponsor & Lead Assessor, e.g. the site coordinator and librarian, etc.
- Assessment Team Members: They must meet selection criteria; they should be opinion leaders in their organizations. They are required to be formally trained to assist Lead Assessor during assessment.
Assessment Participants: Project Managers, Team Leads, Designers, Analysts, QA, SCM, & SEPG people are being interviewed for assessed projects & non-assessed projects. They are required to be participate as per schedule & provide any documented that has been requested by the assessment team. 

Data for the assessment is collected through different data sources during the assessment; following is a brief about these. Document Review is one of the important activities during the assessment to verify the observation made. Document review is conducted for Process Documentation as well as Project Related documents like, plans, Design documents, etc. And these documents are reviewed both at organization & project levels. Maturity Questionnaire is also used as a data source, but its importance is limited just to identify anomalies, & areas for immediate investigation. Interviews is another important source of data during the assessment, coupled with document review it provides sufficient visibility to the practices followed in the organization. Data is also being collected during the assessment through presentations made by assessment participants, and during draft finding presentation to the participants.

Data collected, information seen and heard during the assessment through different sources, is consolidated by the assessment team into observation that team determines with consensus are accurate, corroborated by at least two independent sources, and are validated as consistent with each other. Sufficient data must be collected for each key practice to cover the CMM scope, the organization scope, and the software life cycle.

Once data is collected and consolidated in terms of observation & findings, Rating is done for each goal of each Key Process Area (KPA) within assessment scope. If all goals are satisfied, the KPA is “satisfied”. If one goal is unsatisfied, the KPA may be rated “partially satisfied” however, this is unsatisfied to maturity rating. If all KPAs within a maturity level are satisfied and all KPA satisfied within each maturity level below it, then a maturity level rating is “achieved”. That means to be assessed at Level 3, an organization must satisfy all the goals of all the KPAs for Level 3 as well as all goals of KPAs for Level 2.

A CMM based assessment is a rigorous activity that provides the visibility of actual process being used in the organization. And this is done by carefully interviewing the practitioners at different levels & functions. And it judges the overall performance of the organization across the projects.

COMMON MISTAKES:

Most of the organization those start software process improvement activities using CMM, fall face down when they make some of the mistakes in common as mentioned below.

- There is no link between business objectives & and improvement initiative. Because of this the top management may not continue to support in case of any crisis or serious problem faced.
- Thinking that ISO 9001 certification or like make an organization equivalent to CMM Level 3 organization. Definitely there are some similarities but not such that they are equivalent.
- Doing less or no measurement to know what effort has been made and what benefits have been earned. Some kind of measurement helps organization to realize the impact of SPI activities in an organization.
There is a lack of change agent in the organization. Change is not easy at all, but it is possible if you have an effective change agent in the organization, like a senior manager or a group of people that advocate and support the change towards improvement.

All the people in the company at different levels of the organization must be clearly communicated about the objectives of SPI activities, effort & progress made, while ensuring their participation in SPI activities.

Starting SPI activities, just to win a contract, or fulfill the contract requirement.

Thinking that we are so mature that we need no improvement.

**CRITICAL SUCCESS FACTORS:**

To be successful in SPI initiative in the organizations, one must observe following critical success factors.

- Understand the context first, know about the culture & history of organization with regard to SPI. Know why projects are painful, what are the major issues faced by the organization.
- To ensure that funds & resources are allocated & available as required, it is very essential to establish Senior Management Commitment for SPI.
- Quantify Business Goals, and link them with SPI objectives, and ensure that progress against these is measured.
- Identify and select process improvement approach that best suits your organization, for example, PDCA, IDEAL, etc.
- A plan made for SPI activities i.e. process development & improvement, training, assessment and other related activities should be agreed by all participants across the organization.
- Perform a gap analysis to know where you are, and the plan for improvement activities accordingly.
- Manage expectation by effective communication across the organization at different levels.
- Track the progress made against SPI activities as per plan, and resolve issues faced in an effective manner.
- Apply certain measurement to know the progress made against the objectives.
- Use external help from CMM consultants to reduce the risk.
- Plan for Internal assessment prior to external.

**FIRST-EVER CBA-IPI IN PAKISTAN:**

In 3rd quarter of 2001, Netsol tried to contact different SEI Authorised Lead Assessors to come and perform a Pre-Assessment for Netsol. But due to sad incidence of September 11, no one was willing to come to Pakistan; afterwards there was Pak-India tension, which caused another delay in this activity. But NetSol didn't wait for anything and carried their efforts for SPI activities. Finally we contacted Mr. Raney Wong, SEI authorized Lead Assessor, working with Xerox Software Singapore Centre, we were fortunate to know that he was willing to travel into Pakistan. As we have already implemented CMM Level 2 process & started implementing Level 3 Processes, NetSol CEO Salim Ghauri took the initiative to call for an official CBA-IPI (CMM Based Appraisal for Internal Process Improvement) instead of a Pre-Assessment. Official CBA-IPI, is a detailed study of processes, practices, people & project artefacts to investigate the strengths & weaknesses against SW-CMM. And assess the organization at certain Maturity level.
As a result first ever CBA-IPI in Pakistan started on March 1, 2002, with training of Assessment Team Members (ATMs) to participate in the assessment under the supervision of the Lead Assessor. First three days were used for Assessment Training, and evenings were used to go through process documentation and artefacts produced by the project to be assessed during this assessment. During the assessment 4 projects were assessed, about 50 people were interviewed, and lots of documents were reviewed. During the assessment the ATMs along with Lead Assessor worked 16 Hrs on average for 8 days & nights.

It was the glorious morning of Friday 8th March 2002, which brought a message for whole Pakistani IT industry. NetSol was assessed at CMM-Level 2. Surely all the praise to Allah Almighty who showed us this day and people who were looking forward to NetSol, hoping that NetSol will bring Pakistan among very few countries that have reported successful CBA-IPI, were having smiles on their faces. Surely it was a success of the whole Pakistan. But it is just the beginning; we have to go a long way through CMM Level 5. As we have launched Level 3 processes a month earlier than the assessment we had gaps for Level 3 but most of them were because newly developed process need time to be institutionalized across the organization. We at NetSol are striving for the best, and we plan to call for another CBA-IPI when we are prepared for Level 4, and Insha Allah we will be able to call for 2nd CBA-IPI within a year.
AUTHOR’S SYNOPSIS:

Muhammad Furqan Khan is an MBA (PU). He is currently working as Manager Quality Engineering with NetSol Technologies (Pvt.) Ltd. He has over ten years of experience in Software Quality Management, Software Process Improvement, Software Development, and Assessments against ISO 9001 & Software CMM®.

Major Achievement

2002: First-ever CMM Level 2 Software Organization in Pakistan

Participated in First CBA-IPI in Pakistan held at NetSol Pakistan, prepared the organization for this SEI (USA) official-CMM based Assessment, to have the company assessed at CMM® Level 2. Worked as Site Coordinator for this CBA-IPI & also participated as an Assessment Team Member (ATM). Last one & a half year efforts at NetSol resulted in Achieving CMM Level 2, for the first time in Pakistan. And all these SPI efforts were carried out and managed by me without help from any external CMM® Consultant.

1998: First-ever ISO 9001 Software Organization in Pakistan

In a record time established & implemented a complete Quality Management System satisfying ISO 9001 Requirements, which was recommended for Certification after successful Initial Audit by Third Party Auditors. Certificate was awarded to company as First Software House to be certified against ISO 9001 in Pakistan. All this effort completed without help from any external Consultant.

Workshops & Presentations

Mr. Khan has conducted various workshops & seminars at prestigious academic institutions of Pakistan namely, Lahore University of Management Sciences (LUMS), National University of Science and Technology (NUST); APIIT, GIK Institute Engineering Sciences & Technology on the following subjects:

- Introduction to CMM
- Road Map to CMM
- Process Definition Approaches
- Process Assessment Approaches
- SPI using ISO 9001, TickIT & CMM
- Quality Initiative in a Software Organization
- Software Metrics & Measurements

He was a Faculty Member for “Software Engineering Workshop III” (Jan 6-11, 2001); Organized by “Dr. A. Q. Khan Research Laboratories”. He is also Visiting Faculty Member for Pakistan Institute of Quality Control.
REFERENCES: