



CMMI® and Agile Development: A Binary Choice?

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Agenda

- Introduction
- CMMI[®] – what is it and where did it come from?
- Agile – what is it and where did it come from?
- Why the question of compatibility?
- Synergies between agile and CMMI[®]
- Real world example of these synergies
- Conclusions



- **The Capability Maturity Model Integration (CMMI®) for Development**
 - A framework for organizations to understand and make process improvements to their development processes
 - A model not a standard
 - Organization's embrace CMMI when they want to improve their processes productivity and their product quality
- **Agile development**
 - Paradigm for software development processes that are characterized by highly collaborative, cross functional teams working closely with customers to delivery regular increments of software functional capability
 - Agile practices require flexibility and rapid response to changes in requirements
 - Organization's embrace agile when they want to improve their processes productivity and their product quality
- **Why are so many convinced they can't play together?**



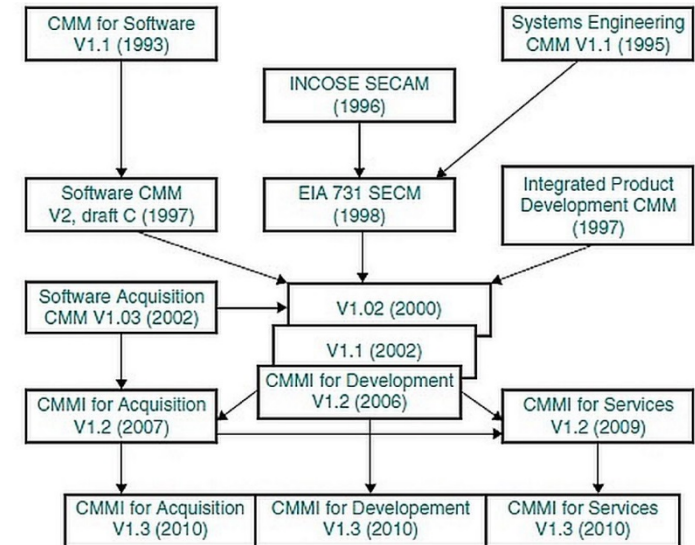
CMMI – Where did it come from?

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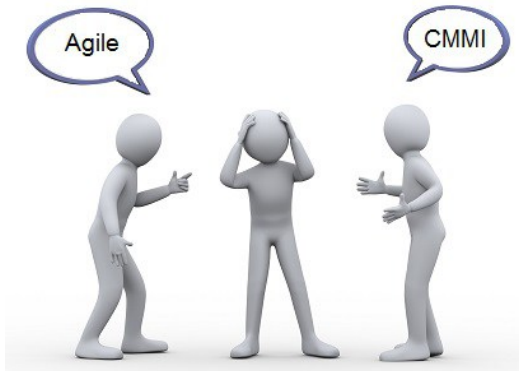
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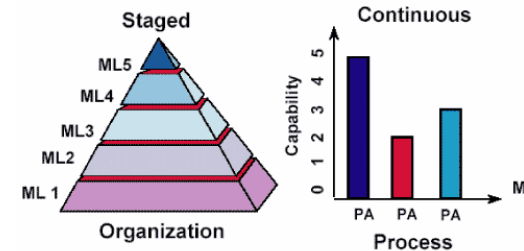
- Mid 1980's US Department of Defense (DoD) issued a Request for Proposal (RFP) to help stem the tide of failed software projects
- Carnegie Mellon University's Software Engineering Institute (SEI)(or what would become the SEI) won the award
- Watt's Humphrey introduced the first version of the Capability Maturity Model (CMM®) in 1988 and published it in his book *"Managing the Software Process"* in 1989
- CMM had many successes and many detractors
 - Many interpreted it as prescriptive and inflexible
 - Much of its own original language enforced this impression
- But contractors were required to reach certain levels to get DoD contracts – so contractors got appraised



- The SEI and the software community became smarter about process improvement over time
 - Through mentoring
 - Through appraisals
 - Through implementations in industry
- Maturity Model Integration for Development (CMMI[®]-DEV) was first introduced in 1998 (current version is 1.3 released in 2010)
 - Less prescriptive language
 - More open to projects and processes operating outside the mainstream traditional waterfall approach (though there was still ground to cover)
- Around this same time agile development was starting to get traction
 - Especially in its early days, agile seemed like an unlikely fit for application of CMMI
- But people were starting to speak of agile and CMMI – sometimes in the same sentence
 - 2005 CMMI Tech Conference added an agile and lean track
 - 2006 Software Engineering Process Group Conference (SEI run) added a similar track



- CMMI is a model not a standard
- It tells organizations what goals they must master to achieve process maturity in 22 different process areas
- There are two ways an organization might use the CMMI
 - To obtain (and possibly be appraised) at a particular maturity level – this is referred to as a staged representation
 - To obtain a process capability level for a particular process area that is critical to their business

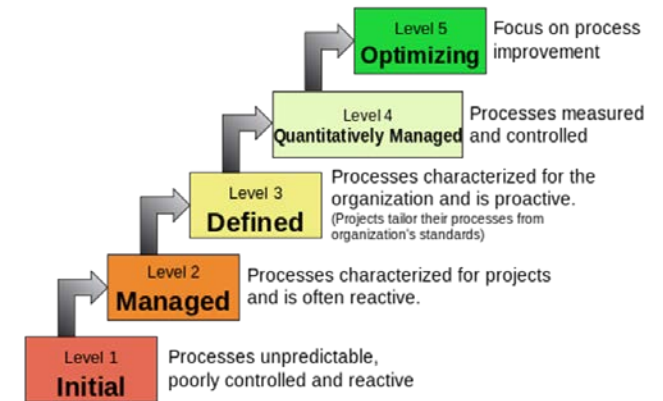


Level	Continuous Representation Capability Levels	Staged Representation Maturity Levels
Level 0	Incomplete	
Level 1	Performed	Initial
Level 2	Managed	Managed
Level 3	Defined	Defined
Level 4		Quantitatively Managed
Level 5		Optimizing

CMII – 22 Process Areas

Process Area	Category	Level
Causal Analysis and Resolution (CAR)	Support	5
Configuratio Management (CM)	Support	2
Decision Analysis and Resolution (DAR)	Support	3
Integrated Project Management (IPM)	Project Management	3
Measurement and Analysis (MA)	Support	2
Organizational Process Definition (OPD)	Process Management	3
Organizational Process Focus (OPF)	Process Management	3
Organizational Performance Management (OPM)	Process Management	5
Organizational Process Performance (OPP)	Process Management	4
Organizational Training (OT)	Process Management	3
Product Integration (PI)	Engineering	3
Project Monitoring and Control	Project Management	2
Project Planning (PP)	Project Management	2
Process and Product Quality Assurance (IPPPQA)	Support	2
Quantitative Project Management (QPM)	Project Management	4
Requirements Development (RD)	Engineering	3
Requirements Management (REQM)	Project Management	2
Risk Management (RSKM)	Project Management	3
Supplier Agreement Management (SAM)	Project Management	2
Technical Solution (TS)	Engineering	3
Validation (VAL)	Engineering	3
Verification (VER)	Engineering	3

Characteristics of the Maturity levels



Source : Sally Godfrey (2008) [What is CMMI ?](#). NASA presentation. Accessed 8 dec 2008.

- To master a specific process area, an organization must achieve both the generic goals (which apply to all process areas) and the specific goals for that process area

– Generic Goals...

- *GG1 – The specific goals of the process area are supported by the process transforming identifiable input work products into identifiable output work products*
- *GG2 – The process is institutionalized as a manage process i.e. the process is managed and performed per policy*
- *GG3 – The process is institutionalized as a defined process i.e. the process is defined at an organizational level and is used by projects tailored to the project based on organizational tailoring guidelines*

– Specific Goals... (some examples)

- ***For Configuration Management Process Area***
- *SG1 – Baselines of identified work products are established*
- *SG2 – Changes to the work products under configuration management are tracked and controlled*
- *SG3 – Integrity of baselines are established and maintained*
- ***For Measurement and Analysis Process Area***
- *SG1 – Measurement Objectives are activities are aligned with identified information needs and objectives*
- *SG2 – Measurement results which address identified information needs and objectives are provided*



- For each generic and specific goals there are a set of practices which are recommendations (not edicts) on how to achieve the goals

- **SG 2 – Measurement results which address identified information needs and objectives are provided**
 - SP 2.1 - Obtain specified measurement data
 - SP 2.2 – Analyze and interpret measurement data
 - SP 2.3 – Manage and store measurement data, measurement specifications and analysis results
 - SP 2.4 – Communicate results of measurement and analysis activities to all relevant stakeholders

- **GG1 – the specific goals of the process area are supported by the process by transforming identifiable input work products into identifiable output work products**
 - GP 1.1 – perform the specific practices of the process area to develop work products and provide services to achieve the specific goals of the process area. i.e. execute the process. – rigor and documentation of process depends on the manager and team

- **GG2 – The process is institutionalized as a managed process**
 - GP2.1 – establish and maintain an organizational process for planning and performing the process – define the organizational expectations for the process and make these expectations visible to those members of the organization who are affected
 - GP 2.2 – Establish and maintain the plan for performing the process – determine what is needed to perform the process and achieve established objectives, - establishing a plan includes documenting the plan and process description.
 - GP 2.3 – Provide adequate resources for performing the process, developing the work products and providing the services of the process – money, people, facilities, tools etc.
 -

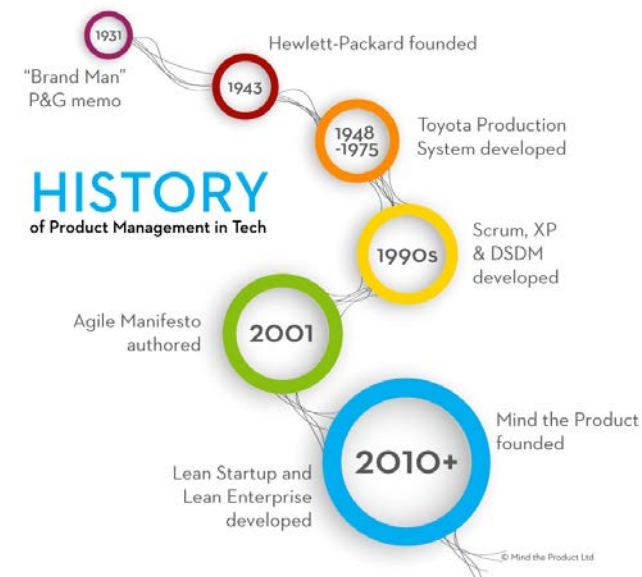
Agile – where did it come from?

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- The idea that it might be smart to build software in iterative or incremental designs did not start with the *Agile Manifesto*
 - Iterative and Incremental Design and Development(IIDD) has been around for more than 80 years
 - In 1976 Tom Gilb declared in his book “*Software Metrics*” that evolutionary development resulted in superior software
- Early software developers dealt with complexity issues associated with the process and logistics of developing software
- Technology advanced
 - Card decks and mainframes eliminated
 - Complexity moved from logistical issues to software capabilities
 - ‘Silver bullet’ type solutions were presented.... Computer Aided Software Engineering, formal methods, defined processes, CMM, many others



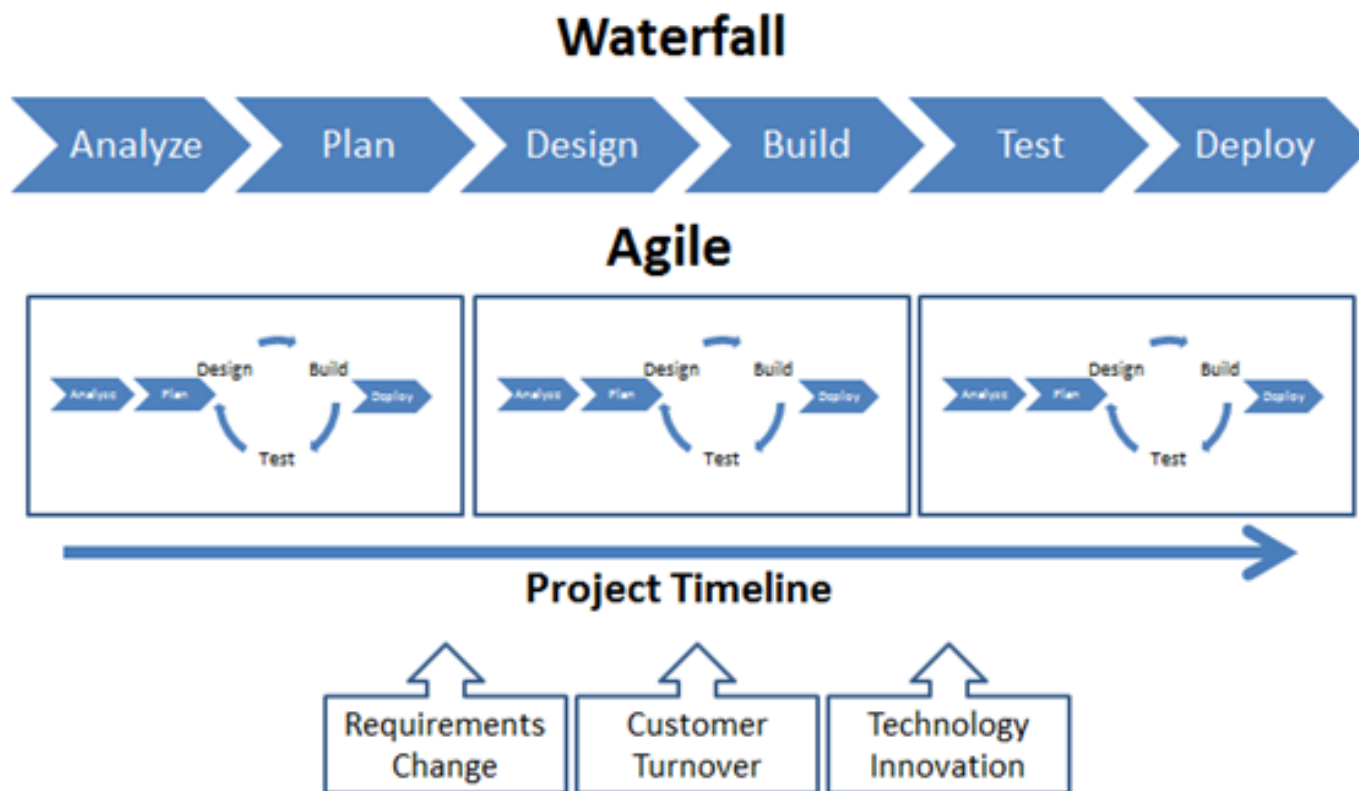
- Silver bullet solutions helped but not enough and some times by too much
- Many felt that so much focus on process was detrimental to productivity
- In 2001 a group of smart software developers introduced the Agile Manifesto



- Agile is a set of tenets; it is a philosophy
- While there are agile principles, there are no rules or standards or practices associated with the agile philosophy
- Agile development projects
 - Deliver small usable chunks of executable software in short periods of time
 - Interact with their customers and end users on a regular basis
 - Embrace flexibility and changing requirements
- Every agile team and project is (potentially) different from every other
- There are several common implementations of agile that embrace a set of specific practices... Extreme Programming (XP), Scum, Lean, Crystal, etc.



Agile – What is it?



- CMMI-Dev is a model to help organizations improve development processes towards improved project productivity and product quality
- Agile is a way of thinking to help software development teams deliver software with improved project productivity and product quality
- The goals are the same but different
 - CMMI is very top down – attempting to create institutionalization
 - Agile is more bottoms up – attempting to create great development teams who are empowered to own the development process
- Despite these differences they have not only been used successfully in the same shop – there are actual synergies when they are combined
- Caveat is... the combination needs to be well thought out by a process team and appraisers (if appraisal is a goal) that understand...
 - Agile and the way it is implemented by teams in the organization
 - CMMI and the way it is implemented by the organization

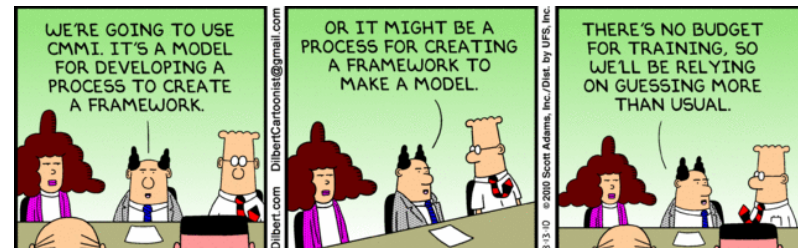
Agile & CMMI where do they run into problems?

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- There is often mistrust or outright hostility between the Agile teams and the process teams....
- “Agile is an excuse to abandon discipline and process”
 - This is not true when agile projects are done right - there is still process and discipline just not aligned to a waterfall or a “V”
 - In cases where agile is not done right this may be true and any attempt to address CMMI Level issues will likely fail
 - CMMI team may have had a bad experience with Agile
- “CMMI will burden our team with tons of unnecessary paper work and rigidity”
 - This is not necessarily true
 - This can be true if an organization interprets the generic and specific practices as edicts rather than suggestive narrative
 - Agile team may have had a bad experience with CMMI or CMM (which appeared more prescriptive and less flexible)



- CMMI can be implemented in a way that exploits existing agile practices. Four possibilities include:
 - Project Planning Goals
 - *No edict that Project Planning be done all at once... possible addition of a small amount of formality may meet PP Goals*
 - Project Management and Control Goals
 - *May be accomplished through reports at a daily standup meeting or possibly the retrospective at the end of an iteration*
 - Requirements Management Goals
 - *Most agile teams have tools in place that trace user stories and the backlog – these are in fact the requirements for the product*
 - Measurement and Analysis Goals
 - *Agile teams tend to collect lots of data with each iteration ... number of story points or user stories completed, team velocity, burn down, defects, etc. These data can be used to satisfy various measurement and analysis goals*
- Once one moves away from the prescriptive sounding practices in the CMMI and embraces the practices currently in place, one begins to see areas where the CMMI and agile work nicely together



Agile and CMMI Can Create Synergy

- CMMI is top down focused aimed at making and institutionalizing process improvements at the organizational level
- Agile is project focused aimed at improving processes at the team level
- Combining these will not be easy – especially with misconceptions, misperceptions, fiefdoms and the like
- Organizations with agile in place need to think about several things when considering CMMI
 - How many different ways do we ‘do agile’
 - Where are the synergies amongst the different agile teams and with CMMI goals
 - How do we exploit those synergies to create institutionalized processes
 - How do we create tailoring guidelines to satisfy the various agile teams
- Organizations with CMMI in place need to think about several things when considering agile
 - How rigid are the practices and processes currently in place
 - Where are their synergies between the agile practices being considered and the goals and practices currently in place
 - Where can we develop these synergies with modified processes or tailoring guidelines



Agile and CMMI – real world example

- **DTE Energy – diversified energy company**
 - Energy related businesses and services world wide
 - Various branches and divisions with different regulatory and environmental issues depending on their specific businesses and services
- **Began a process improvement initiative in the early 2000's – shooting for CMM Level 2**
- **At this time there was a small but growing group of project teams that had embraced agile practices**
- **The process team took the CMM manual and...**
 - Rather than trying to align existing organizational processes, practices and methodologies with the Key Process Areas (CMM's version of Process Areas)
 - They sat down with the CMM manual and developed plans to enforce it
- **This didn't sit well with much of the organization but especially was egregious to the agile teams**

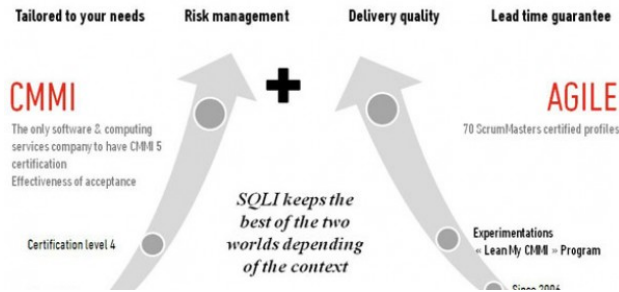


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Agile and CMMI – real world example

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- Over time as the organization expanded into more unregulated areas, the gap between the ‘agelists’ and the process group widened
- The organization took a step back and formed a Software Process Engineering Group (SEPG) bringing all the stakeholders to the table
- Once the SEPG had taken hold and started to gain acceptance with the organization as a whole, they decided to pursue CMMI Level 3
- Interestingly, the organization, through the SEPG, determined that the best approach to achieve the various process goals necessary, was to be an agile approach
- One of the SEPG findings had been – agile methodologies, proven to deliver successful software projects, also created a quicker “fail first” and “just enough” process mindset.

- CMMI assessments can apply to a subset of an organization or the entire organization.
 - “Organizational Unit” is CMMI terminology for the part of the organization the CMMI effort is targeted for
- For their first attempt at CMMI, the SEPG picked a group of projects exhibiting specific behaviors – one of which was adherence to an agile methodology
- The planning of their process improvement efforts was done in an agile fashion
 - Release 0 – project planning and timing
 - Release 1 – focus on ten Level 3 process areas, test with an informal Class B appraisal
 - Release 2 – focus on six level 2 process areas, plus priority Release 1 defects, test with an informal Class B appraisal
 - Release 3 – focus on sixteen Level 2 and Level 3 process areas, plus priority Release 2 defects, test with 2 formal Class A appraisals
- Each release was broken into iterations, with deliveries and retrospectives

- The first release went well
- The second release had an issue
 - External issues resulted in several of the projects necessary to do an assessment were cancelled or delayed
 - There were not enough projects at the right stage to make the assessment useful to the team
 - They needed to decide whether to delay the assessment or expand the breadth of projects to assess
 - They chose to extend the project set to include more traditional projects (not just agile)
 - Obviously they needed to make changes to their framework – such as an expansion of their CM framework to include traditional work products so that tailoring could account for non-agile methodologies

- **DTE Energies lessons learned from this transition**
 - Understand why you are pursuing a process improvement
 - Share your vision with the entire organization and make sure the stakeholders understand and embrace this vision
 - Based on that vision determine who is best to perform improvement initiatives
 - *Experts from the outside who will disappear after the implementation*
 - *Home grown team that will have a learning curve but will be able to go the distance over time*
 - *Some combination of the two to expedite early efforts and increase knowledge transfer*
 - Create clarity as to how you will develop, deploy, maintain and optimize process improvements



- CMMI is a model designed to help organizations achieve and institutionalize process maturity
 - It defines the goals that need to be met
 - It is neither rigid nor prescriptive as to how to meet them
- Agile is a philosophy and set of tenets to help software projects deliver better software faster.
 - Agile team determines which of the agile practices make the most sense for their team
 - There is no prescriptive set of practices or processes associated with the agile philosophy
- They can coexist peacefully. Failures are generally due to one of the following
 - CMMI implementation is an exact interpretation of the generic and specific practices guidelines from the CMMI manual
 - Agile implementation is not so much agile as it is a wild west interpretation of agile where there are lapses on planning, process, or oversight
 - Failure to adequately address potential culture issues between the process people and the agile people
 - Organizational barriers that prevent adoption of agile or CMMI
- Agile and CMMI implemented sensibly with a favorable nod to practices and intents of each other, the results can be quite successful.





- **Causal Analysis and Resolution (Level 5)**

- The purpose of CAR is to identify causes of selected outcomes and take action to improve process performance.

- **Configuration Management (Level 2)**

- The purpose of CM is to establish and maintain the integrity of work products using configuration identification, configuration control and configuration status accounting and configuration audits. Work products placed under CM include the products that are delivered to the customers, designated internal work products, acquired products, tools and other items used in creating and describing these work products. This process area applies not only to CM on projects but also to CM of organizational work products such as standards and procedures.

- **Decision Analysis and Resolution (Level 3)**

- The purpose of DAR is to analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria. While the primary application of this process area is to technical concerns, formal evaluation processes can be applied to many nontechnical issues as well – especially when a project is being planned.

- **Integrated Project Management (Level 3)**

- The purpose of IPM is to establish and manage the project and the involvement of relevant stakeholders according to an integrated and defined process that is tailored from the organization's set of standards.

- **Measurement and Analysis (Level 2)**

- The purpose of MA is to develop and sustain a measurement capability used to support management information needs.

- **Organizational Process Definition (Level 3)**

- The purpose of OPD is to establish and maintain a usable set of organizational process assets, work environment standards and rules and guidelines for teams.

- **Organizational Process Focus (Level 3)**

- The purpose of OPF is to plan, implement and deploy organizational process improvements based on a thorough understanding of current strengths and weaknesses of the organizations processes and process assets.

- **Organizational Performance Management (Level 5)**

- The purpose of OPM is to proactively manage the organizations performance to meet its business objectives. Improvement refers to all ideas that would change the organizations processes, technologies, and performance to better meet the organizations business objective and associated quality and performance objectives. This process area extends OPF practices by focusing on process improvement based on a quantitative understanding of the organization set of standard processes and technologies and their expected quality and process performance.

- **Organizational Process Performance (Level 4)**

- The purpose of OPP is to establish and maintain a quantitative understanding of the performance of selected processes in the organizations set of standard processes in support of achieving quality and process performance objectives. This process area provides performance data, baselines, and models to quantitatively manage the organization projects.

- **Organizational Training (Level 3)**

- The purpose of OT is to develop skills and knowledge of people so that they can perform their roles effectively and efficiently.

- **Product Integration (Level 3)**

- The purpose of PI is to assemble the product from the product components, ensure that the product, as integrated, behaves properly (i.e. possesses the required functionality and quality attributes) and deliver the product.

- **Project Monitoring and Control (Level 2)**

- The purpose of PMC is to provide an understanding of the projects progress so that appropriate corrective actions can be taken when the projects performance deviates significantly from the plan.

- **Project Planning**

- The purpose of PP is to establish and maintain plans that define project activities.

- **Process and Product Quality Assurance (Level 2)**

- The purpose of PPQA is to provide staff and management with objective insight into processes and associated work products. The practices in this area ensure that planned processes are implemented while the practices in the Verification process area ensure that specified requirements are satisfied.

- **Quantitative Project Management (Level 4)**

- The purpose of QPM is to quantitatively manage the project to achieve the projects' established quality and process performance objectives. This process area, unlike Project Management practices, helps to develop a quantitative understanding of the expected performance of processes or sub processes.

- **Requirements Development (Level 3)**

- The purpose of RD is to elicit, analyze, and establish customer, product and product component requirements.

- **Requirements Management (Level 2)**

- The purpose of REQM is to manage requirements of the projects products and product components and to ensure alignment between those requirements and the projects plans and work products.

Purpose of 22 Process Areas

- **Risk Management (Level 3)**

- The purpose of RISM is to identify potential problems before they occur so that risk handling activities can be planned and invoked as needed across the life of the product or project to mitigate the adverse impacts on achieving objectives.

- **Supplier Agreement Management (Level 2)**

- The purpose of SAM is to manage the acquisition of products and services from suppliers.

- **Technical Solution (Level 3)**

- The purpose of TS is to select, design, and implement solutions to requirements.

- **Validation (Level 3)**

- The purpose of VAL is to demonstrate that a product or product component fulfills its intended use when placed in its intended environment. Validation ensures that you built the right thing while verification ensures that you built it right

- **Verification (Level 3)**

- The purpose of VER is to ensure that selected work products meet their specified requirements.

Examples of Specific Practices

- **SG 1 – Baselines of identified work products are established**
- SP 1.1 – Identify configuration items, components and related work products to be placed under configuration management –
- SP 1.2 – Establish and maintain a configuration management and change management system for controlling work products - - storage media, procedures and tools for accessing the system
- SP 1.3 - Create or release baselines for internal use and for delivery to the customer
- **SG 2 – Changes to the work products under configuration management are tracked and controlled**
- SP2.1 – Track change requests for configuration items
- SP 2.2 – Control changes to configuration items
- **SG 3 – Integrity of baselines is established and maintained**
- SP 3.1 – Establish and maintain records describing configuration items
- SP 3.2 - Perform configuration audits to maintain the integrity of configuration baselines

Examples of Specific Practices

- **SG 1 – Measurement objectives and activities are aligned with identified information needs and objects**
- SP 1.1 – Establish and maintain measurement objectives from identified information needs and objectives
- SP 1.2 – Specify measures to address measurement objectives typical categories include schedule and progress, effort and cost, size and stability and quality – they can either be base or derived.
- SP 1.3 - Specify how measurement data are obtained and stored
- SP 1.4 – Specify how measurement data are analyzed and communicated
- **SG 2 – Measurement results which address identified information needs and objectives are provided**
- SP 2.1 - Obtain specified measurement data
- SP 2.2 – Analyze and interpret measurement data
- SP 2.3 – Manage and store measurement data, measurement specifications and analysis results
- SP 2.4 – Communicate results of measurement and analysis activities to all relevant stakeholders