CMMI (CAPABILITY MATURITY MODEL INTEGRATION)

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Overview

- Advantages of Managing with Processes
    - Immature Processes
    - Mature Processes
- Process Model
- Plan – Do – Check - Act
- CMMI for Process Improvement
- CMMI Constellations
- CMMI-Dev Maturity Levels
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    - Maturity Level 2: Managed
    - Maturity Level 3: Defined
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    - Maturity Level 5: Optimizing
- CMMI Process Areas
    - Project Management Related Processes
    - Engineering Related Processes
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    - Process Management Related Processes

What is a Process?

- A cluster of related practices in an area that, when implemented collectively, satisfies a set of goals considered important for making improvement in that area.

- **Process Management**: Manage the processes

- **Manage with Processes**: Management approach to manage by focusing on the processes

Advantages of Managing with Processes

- Bring a systematical approach to organization's priorities

- Improve the relationship between the functions

- Encourage customer oriented management

- Provide more effective use of resources

- Provide advantage to make decisions more quickly

- Define the responsibilities clearly

Immature Processes

- Processes are temporary and are managed on the fly by the people who perform them.

- When there is a problem, processes are not followed.

- Success depends on personal performance.

- Management has to deal with unexpected events.

- There is no time for improvement
  - The performers are always alert and reactive.

- Immature processes create heros!

Mature Processes

- Processes are defined, documented and continuously improved.

- Management and everyone else explicitly supports the processes.

- Process definitions align with the actual job descriptions.

- Success depends on the performance of the process.

- Process oriented working is supported by the management.

- Measurements of the products and processes are used for management.

Mature Processes are Institutional

- "This is the defined way of doing the job here."

- The organization creates an effective, useful and consistent structure that contains the performed processes.

- An institutional process culture is developed.
  - Management supports this culture.

- Institutional processes survive after the people who define them leave.

Advantages of Mature Processes

- Mature processes help us to understand how things are going.

- Employees improve their potentials better and they become more effective within the organization.

- Defined, measured, controlled processes are improved easily and continuously.

- The possiblity of bringing together the appropriate technology and tools is higher.

How to Use a Process Model?

- Process improvement teories are used to address the problems which are common for most organizations.

    - Define the goals and priorities of process improvement

    - Develop decisive, capable and mature processes

    - Provide guidance to improve the project and organization processes

   - Evaluate the current status of organizational practices

Importance of a Process Model

- Provides a starting point for improvement

- Uses prior experiences of the organization

- Creates an institutional language and vision

- Creates a framework to prioritize the actions

- It is a way of defining what improvement means for the organization.

Plan – Do – Check - Act

- A four-stage problem-solving model that enables organizations to continually improve processes, products or services.
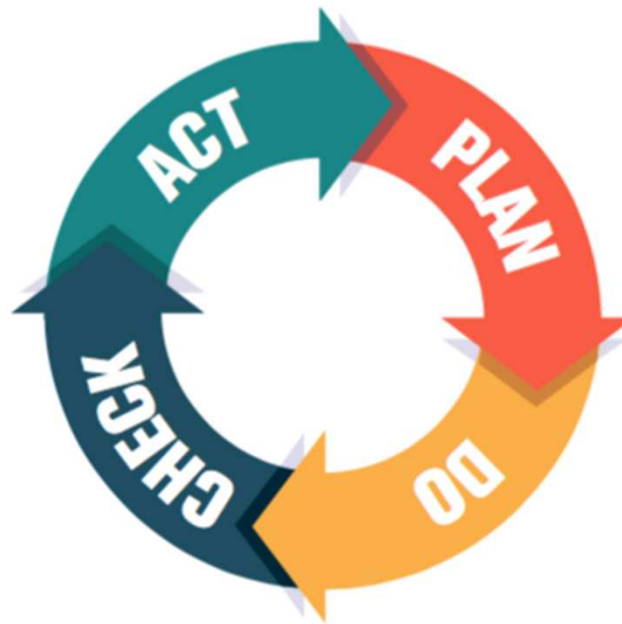
How are Processes Defined?

- Goal
- Starting activity
- Finishing activity
- Inputs
- Suppliers
- Outputs
- Customers
- Sub-processes / Detailed processes / Activities
- Owner
- Performer
- Verifier
- Performance measures and goals

Processes must be defined clearly and explicitly so that everyone involved clearly understands, consistently and continously repeats it.

Measurable

- Some measurable criteria are
  - Operation duration
  - Cost
  - Efficiency
  - Amount
  - Timing
  - Defect rates
  - Fits definition
  - Correctness
  - In time
  - Accuracy
  - Actual vs. planned

What is CMMI?

- The **Capability Maturity Model Integration**, or CMMI, is a process model that provides a clear definition of what an organization should do to promote behaviors that lead to improved performance.

  - CMMI tells what needs to be done.

  - CMMI doesn't have a definite answer for how.

  - CMMI is a guide for improvement and development.

  - CMMI is a framework model that defines the key elements for an effective software development process. CMMI sets the path from an immature process to a mature and disciplined process management.

Background

- The CMMI was developed at the Software Engineering Institute (SEI) at Carnegie Mellon University (CMU) with representation from defense, industry, government, and academia, and is now operated and maintained by the CMMI Institute, an operating unit of CMU.

- It is the successor of the popular Software CMM, or SW-CMM.

- The are multiple "flavors" of the CMMI, called "Constellations," that include CMMI for Development (CMMI-DEV), CMMI for Services (CMMI-SVC), and CMMI for Acquisition (CMMI-ACQ).

  – The three Constellations share a core set of sixteen Process Areas.

  – There is also a "People CMM," or P-CMM, that exists outside of the three CMMI Constellations.

CMMI for Process Improvement

- CMMI
  - Emphasizes the development processes to improve product development and customer services.
  - Provides a framework to organize and prioritize the process improvement activities (product, job, employee, technology)
  - Supports the coordination of multidisciplinary activities which are required to successfully deliver a product.

- The quality of a system or product depends on the quality of the process that is used to develop and maintain that product.

  – SEI

Why is Process Maturity Framework Required?

- The problems aroused by the need for capable software engineers

- High turnover of employees

- Loss of critical system information

- Increase in pays

- Increase in workload, overhead, after hours working and stress

- Increase in cost of product and maintenance

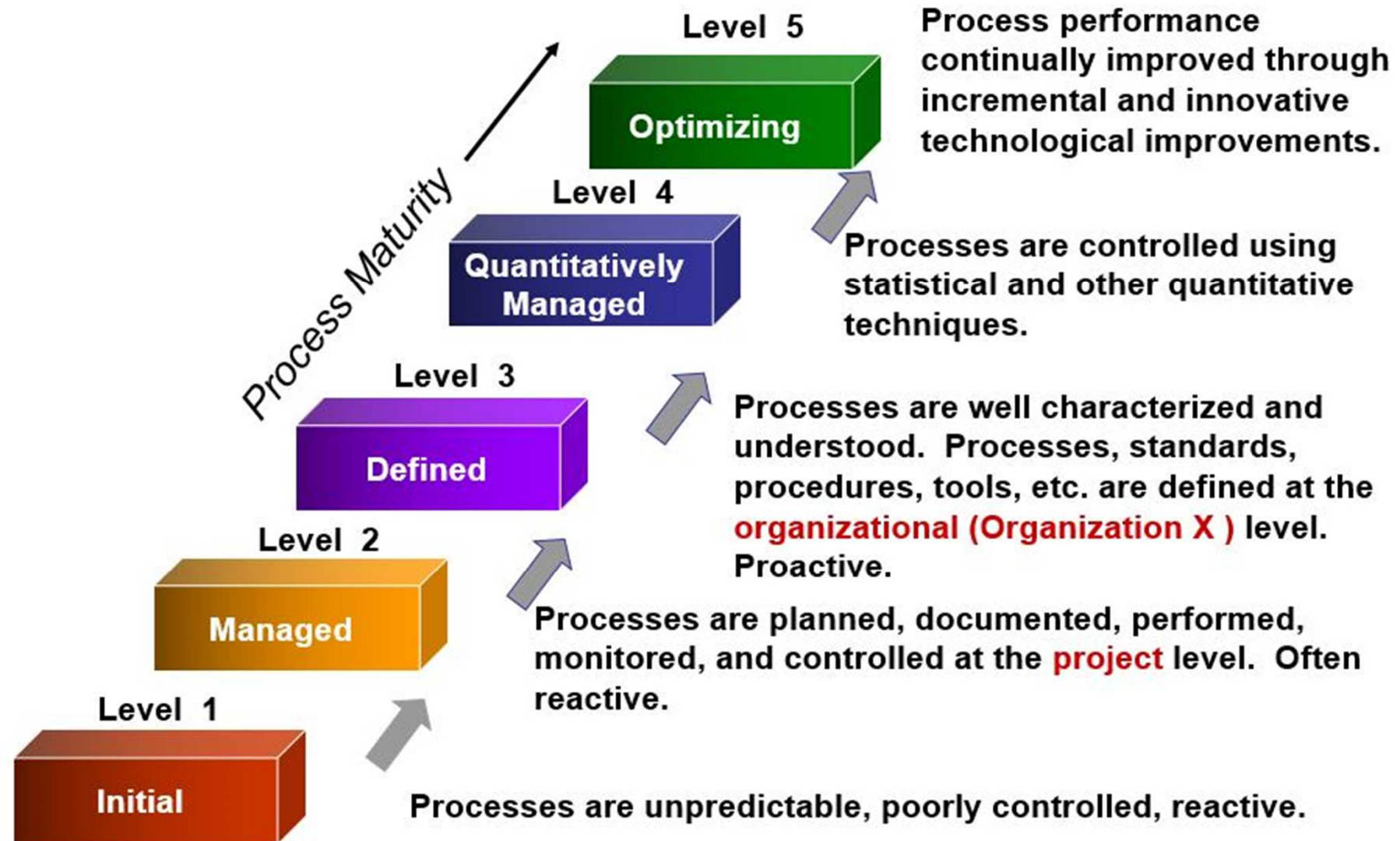- Non-finishing work

What CMMI is about?

CMMI Constellations

- The CMMI Constellation refers to the collection of CMMI Components that may combine together to form a body of knowledge that may be called a model and associated training and appraisal related artefacts and methodologies.

- A CMMI Constellation may concentrate on area of knowledge.

- CMMI, now, has got three constellations – CMMI-DEV, CMMI-SVC and CMMI-ACQ.

  - DEV stands for Development (suitable for software and systems development companies, etc.),

  - SVC stands for Services (suitable for companies delivering services like IT Services, Helpdesk services, Staff-augmentation services, etc.),

  - ACQ stands for acquisition and is for those companies interested in large scale procurements of product and product components.

- There are common elements that exist in these three constellations.

CMMI-Dev Maturity Levels

Level 5

Optimizing

Process performance continually improved through incremental and innovative technological improvements.

Level 4

Quantitatively Managed

Processes are controlled using statistical and other quantitative techniques.

Level 3

Defined

Processes are well characterized and understood. Processes, standards, procedures, tools, etc. are defined at the organizational (Organization X) level. Proactive.

Level 2

Managed

Processes are planned, documented, performed, monitored, and controlled at the project level. Often reactive.

Level 1

Initial

Processes are unpredictable, poorly controlled, reactive.

Process Maturity

Maturity Level 1: Initial

- The organization usually does not provide a stable environment to support processes.

- Success in these organizations depends on the competence and heroics of the people in the organization and not on the use of proven processes.

- At maturity level 1, processes are usually ad hoc and chaotic.

- In spite of this chaos, maturity level 1 organizations acquire products and services that work, but they frequently exceed the budget and schedule documented in their plans.

- Maturity level 1 organizations are characterized by a tendency to overcommit, abandon their processes in a time of crisis, and be unable to repeat their successes.

Maturity Level 2: Managed

- The process discipline reflected by maturity level 2 helps to ensure that existing practices are retained during times of stress.
    - When these practices are in place, projects are performed and managed according to their documented plans.
    - Projects have ensured that processes are planned and executed in accordance with policy;
    - Projects employ skilled people who have adequate resources to produce controlled outputs;
    - Projects involve relevant stakeholders;
    - Projects are monitored, controlled, and reviewed;
    - Projects are evaluated for adherence to their process descriptions.

- The status of the work products are visible to management at defined points (e.g., at major milestones , at the completion of major tasks).

- Commitments are established among relevant stakeholders and are revised as needed.

- Work products are appropriately controlled.

- The work products and services satisfy their specified process descriptions, standards, and procedures.

- **The goal is to repeat successful practices.**

Managed Level Contains

- Requirements Management (REQM) (CMMI-DEV)

- Project Planning (PP) (CMMI-DEV)

- Project Monitoring and Control (PMC) (CMMI-DEV)

- Supplier Agreement Management (SAM) (CMMI-DEV)

- Measurement and Analysis (MA) (CMMI-DEV)

- Process and Product Quality Assurance (PPQA) (CMMI-DEV)

- Configuration Management (CM) (CMMI-DEV)

Maturity Level 3: Defined

- Processes are well characterized and understood, and are described in standards, procedures, tools, and methods.

- The organization's set of standard processes is established and improved over time.
    - These are used to establish consistency across the organization.
    - Projects establish their defined processes by tailoring these according to tailoring guidelines.
    - The practices are documented.
    - Measurements related with critical practices are defined and stored in a pool for analysis.

- In many organizations when maturity level 3 is established, a common culture is developed.

Maturity Level 3: Defined

- A critical distinction between maturity levels 2 and 3 is the scope of standards, process descriptions, and procedures.
  - At maturity level 2, the standards, process descriptions, and procedures may be quite different in each specific instance of the process (e.g., on a particular project).
  - At maturity level 3, the standards, process descriptions, and procedures for a project are tailored from the organization's set of standard processes to suit a particular project or organizational unit and therefore are more consistent, except for the differences allowed by the tailoring guidelines.

- At maturity level 3, processes are typically described more rigorously than at maturity level 2.
  - A defined process clearly states the purpose, inputs, entry criteria, activities, roles, measures, verification steps, outputs, and exit criteria.
  - Processes are managed more proactively using an understanding of the interrelationships of the process activities and detailed measures of the process, its work products, and its services.

- At maturity level 3, the organization must further mature the maturity level 2 process areas.

Defined Level Contains

- Requirements Development (RD) (CMMI-DEV)

- Technical Solution (TS) (CMMI-DEV)

- Product Integration (PI) (CMMI-DEV)

- Verification (VER) (CMMI-DEV)

- Validation (VAL) (CMMI-DEV)

- Organizational Process Focus (OPF) (CMMI-DEV)

- Organizational Process Definition (OPD) (CMMI-DEV)

- Organizational Training (OT) (CMMI-DEV)

- Integrated Project Management (IPM) (CMMI-DEV)

- Risk Management (RSKM) (CMMI-DEV)

- Decision Analysis and Resolution (DAR) (CMMI-DEV)

Maturity Level 4: Quantitatively Managed

- The organization and projects establish quantitative objectives for quality and process performance and use them as criteria in managing projects.
  - Quantitative objectives are based on the needs of the customer, end users, organization, and process implementers.

- Quality and process performance is understood in statistical terms and is managed throughout the life of projects.

- Specific measures of process performance are collected and statistically analyzed.
  - This data can be used to estimate and manage future processes.
  - Process performance baselines and models can be used to help set quality and process performance objectives that help achieve business objectives.

- A critical distinction between maturity levels 3 and 4 is the predictability of process performance.
  - At maturity level 4, the performance of projects and selected subprocesses is controlled using statistical and other quantitative techniques, and predictions are based, in part, on a statistical analysis of fine-grained process data.

Quantitatively Managed Level Contains

- Organizational Process Performance (OPP) (CMMI-DEV)

- Quantitative Project Management (QPM) (CMMI-DEV)

Maturity Level 5: Optimizing

- Maturity level 5 focuses on continually improving process performance through incremental and innovative process and technological improvements.

- The organization's quality and process performance objectives are established, continually revised to reflect changing business objectives and organizational performance, and used as criteria in managing process improvement.

- Change management is a standard process throughout the organization.

- Since the organization has authorized employees to develop accountable processes, all employees are empowered to continuously improve their own work processes.

Maturity Level 5: Optimizing

- The effects of deployed process improvements are measured using statistical and other quantitative techniques and compared to quality and process performance objectives.

- The project's defined processes, the organization's set of standard processes, and supporting technology are targets of measurable improvement activities.

- A critical distinction between maturity levels 4 and 5 is the focus on managing and improving organizational performance.

  – At maturity level 4, the organization and projects focus on understanding and controlling performance at the sub-process level and using the results to manage projects.

  – At maturity level 5, the organization is concerned with overall organizational performance using data collected from multiple projects. Analysis of the data identifies shortfalls or gaps in performance. These gaps are used to drive organizational process improvement that generates measureable improvement in performance.

Optimizing Level Contains

- Organizational Performance Management (OPM) (CMMI-DEV)

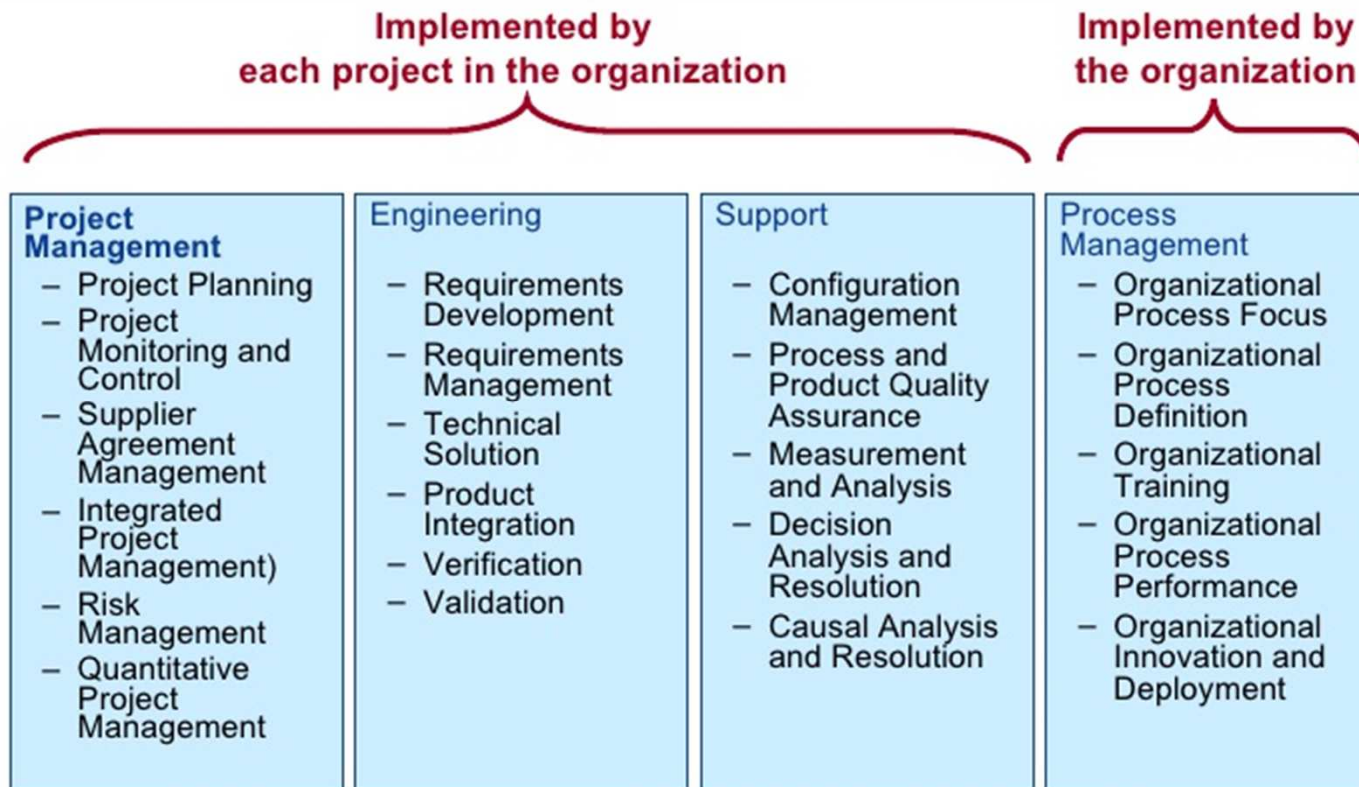- Causal Analysis and Resolution (CAR) (CMMI-DEV)

Process Areas per Maturity Level

Level			Capability	Result
5 Optimizing		**Continuous Process Improvement**	Organizational Innovation & Deployment Causal Analysis & Resolution	**Productivity & Quality**
4 Quantitatively Managed		**Quantitative Management**	Quantitative Process Management Software Quality Management	
3 Defined		**Process Standardization**	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Product Management Risk Management Integrated Teaming Integrated Supplier Management Decision Analysis & Resolution Organizational Environment for Integration	
2 Managed		**Basic Project Management**	Requirements Management Project Planning Project Monitoring & Control Supplier Agreement Management Measurement & Analysis Product & Process Quality Assurance Configuration Management	
1 Initial		**Heroic Efforts**	Design Develop Integrate Test	**Risk & Waste**

Process Areas (CMMI-DEV)

Implemented by each project in the organization

Implemented by the organization

Project Management
- Project Planning
- Project Monitoring and Control
- Supplier Agreement Management
- Integrated Project Management)
- Risk Management
- Quantitative Project Management

Engineering
- Requirements Development
- Requirements Management
- Technical Solution
- Product Integration
- Verification
- Validation

Support
- Configuration Management
- Process and Product Quality Assurance
- Measurement and Analysis
- Decision Analysis and Resolution
- Causal Analysis and Resolution

Process Management
- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment

CMMI Process Areas

- CMMI consists of 22 process areas organized in 5 levels.

- Each process area is composed of the following components

  - Required

  - Expected

  - Informative

- Successful application of each process area depends on the successful application of required and expected components.

Project Management Related Processes

- Project Planning

- Project Monitoring and Control

- Risk Management

- Integrated Project Management

- Requirements Management

- Supplier Agreement Management

Project Planning

- The purpose of Project Planning (PP) (CMMI-DEV) is to establish and maintain plans that define project activities.

- The Project Planning process area involves the following activities:
  - Developing the project plan
  - Interacting with relevant stakeholders appropriately
  - Getting commitment to the plan
  - Maintaining the plan

- PP contains the following special groups:
  - Establish Estimates: Estimates of project planning parameters are established and maintained.
  - Develop a Project Plan: A project plan is established and maintained as the basis for managing the project.
  - Obtain Commitment to the Plan: Commitments to the project plan are established and maintained.

Project Monitoring and Control

- The purpose of Project Monitoring and Control (PMC) (CMMI-DEV) is to provide an understanding of the project's progress so that appropriate corrective actions can be taken when the project's performance deviates significantly from the plan.
  - These actions may require replanning, which may include revising the original plan, establishing new agreements, or including additional mitigation activities within the current plan.

- PMC contains the following special groups:
  - Monitor the Project Against the Plan: Actual project progress and performance are monitored against the project plan.
  - Manage Corrective Action to Closure: Corrective actions are managed to closure when the project's performance or results deviate significantly from the plan.

Risk Management - 1

- The purpose of Risk Management (RSKM) (CMMI-DEV) 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 adverse impacts on achieving objectives.

- Risk management is a continuous, forward-looking process.

- Effective risk management includes early and aggressive risk identification through collaboration and the involvement of relevant stakeholders.

- Risk management should consider both internal and external, as well as both technical and non-technical, sources of cost, schedule, performance, and other risks.

- Although the primary emphasis of the Risk Management process area is on the project, these concepts can also be applied to manage organizational risks.

- Risk management can be divided into the following parts:
    - Defining a risk management strategy
    - Identifying and analyzing risks
    - Handling identified risks, including the implementation of risk mitigation plans as needed

Risk Management - 2

- In Agile environments, some risk management activities are inherently embedded in the Agile method used. (e.g., some technical risks can be addressed by encouraging experimentation.)
  - Risk Management process area encourages a more systematic approach to managing risks, both technical and non-technical.
  - Such an approach can be integrated into Agile's typical iteration and meeting rhythms; more specifically, during iteration planning, task estimating, and acceptance of tasks.

- RSKM contains the following special groups:
  - Prepare for Risk Management: Preparation for risk management is conducted.
  - Identify and Analyze Risks: Risks are identified and analyzed to determine their relative importance.
  - Mitigate Risks: Risks are handled and mitigated, where appropriate, to reduce adverse impacts on achieving objectives.

Integrated Project Management

- The purpose of Integrated Project Management (IPM) (CMMI-DEV) 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 standard processes.

- Integrated Project Management involves the following activities:
  - Establishing the project's defined process at project startup by tailoring the organization's set of standard processes
  - Managing the project using the project's defined process
  - Establishing the work environment for the project based on the organization's work environment standards
  - Establishing teams that are tasked to accomplish project objectives
  - Using and contributing to organizational process assets
  - Enabling relevant stakeholders' concerns to be identified, considered, and, when appropriate, addressed during the project
  - Ensuring that relevant stakeholders (1) perform their tasks in a coordinated and timely manner; (2) address project requirements, plans, objectives, problems, and risks; (3) fulfill their commitments; and (4) identify, track, and resolve coordination issues

- This process area also addresses the coordination of all activities associated with the project such as the following:
  - Development activities (e.g., requirements development, design, verification)
  - Service activities (e.g., delivery, help desk, operations, customer contact)
  - Acquisition activities (e.g., solicitation, agreement monitoring, transition to operations)
  - Support activities (e.g., configuration management, documentation, marketing, training)

- IPM contains the following special groups:
  - Use the Project's Defined Process: The project is conducted using a defined process tailored from the organization's set of standard processes.
  - Coordinate and Collaborate with Relevant Stakeholders: Coordination and collaboration between the project and relevant stakeholders are conducted.

Requirements Management

- The purpose of Requirements Management (REQM) (CMMI-DEV) is to manage requirements of the project's products and product components and to ensure alignment between those requirements and the project's plans and work products.

- Part of managing requirements is documenting requirements changes and their rationale and maintaining bidirectional traceability between source requirements, all product and product component requirements, and other specified work products.

- REQM contains the following special group:
  - Manage Requirements: Requirements are managed and inconsistencies with project plans and work products are identified.

Supplier Agreement Management

- The purpose of Supplier Agreement Management (SAM) (CMMI-DEV) is to manage the acquisition of products and services from suppliers that are delivered to the project's customer.

- The Supplier Agreement Management process area involves the following activities:
  - Determining the type of acquisition
  - Selecting suppliers
  - Establishing and maintaining agreements with suppliers
  - Executing supplier agreements
  - Accepting delivery of acquired products
  - Ensuring successful transition of acquired products

- SAM contains the following special groups:
  - Establish Supplier Agreements: Agreements with the suppliers are established and maintained.
  - Satisfy Supplier Agreements: Agreements with the suppliers are satisfied by both the project and the supplier.

Engineering Related Processes

- Product Integration

- Requirements Development

- Technical Solution

- Validation

- Verification

Product Integration

- The purpose of Product Integration (PI) (CMMI-DEV) 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.

- Product integration is achieved through progressive assembly of product components, in one stage or in incremental stages, according to a defined integration strategy and procedures.

- In Agile environments, product integration is a frequent, often daily, activity.

- PI contains the following special groups:
  - Prepare for Product Integration: Preparation for product integration is conducted.
  - Ensure Interface Compatibility: The product component interfaces, both internal and external, are compatible.
  - Assemble Product Components and Deliver the Product: Verified product components are assembled and the integrated, verified, and validated product is delivered.

Requirements Development

- The purpose of Requirements Development (RD) (CMMI-DEV) is to elicit, analyze, and establish customer, product, and product component requirements.

- Requirements are identified and refined throughout the phases of the product lifecycle. Design decisions, subsequent corrective actions, and feedback during each phase of the product's lifecycle are analyzed for impact on derived and allocated requirements.

- The Requirements Development process area includes three specific goals:
  - Develop Customer Requirements addresses defining a set of customer requirements to use in the development of product requirements.
  - Develop Product Requirements addresses defining a set of product or product component requirements to use in the design of products and product components.
  - Analyze and Validate Requirements addresses the analysis of customer, product, and product component requirements to define, derive, and understand the requirements.

- RD contains the following special groups:
  - Develop Customer Requirements: Stakeholder needs, expectations, constraints, and interfaces are collected and translated into customer requirements.
  - Develop Product Requirements: Customer requirements are refined and elaborated to develop product and product component requirements.
  - Analyze and Validate Requirements: The requirements are analyzed and validated.

Technical Solution

- The purpose of Technical Solution (TS) (CMMI-DEV) is to select, design, and implement solutions to requirements. Solutions, designs, and implementations encompass products, product components, and product related lifecycle processes either singly or in combination as appropriate.

- This process area focuses on the following:
  - Evaluating and selecting solutions (i.e. "design approaches," "design concepts," or "preliminary designs") that potentially satisfy an appropriate set of allocated functional and quality attribute requirements
  - Developing detailed designs for the selected solutions (contains all the information needed to manufacture, code, or otherwise implement the design as a product or product component)
  - Implementing the designs as a product or product component

- TS contains the following special groups:
  - Select Product Component Solutions: Product or product component solutions are selected from alternative solutions.
  - Develop the Design: Product or product component designs are developed.
  - Implement the Product Design: Product components, and associated support documentation are implemented from their designs.

Validation

- The purpose of Validation (VAL) (CMMI-DEV) is to demonstrate that a product or product component fulfills its intended use when placed in its intended environment.

- The validation environment should represent the intended environment for the product and product components as well as represent the intended environment suitable for validation activities with work products.
  - Whenever possible, validation should be accomplished using the product or product component operating in its intended environment.
  - The entire environment can be used or only part of it.

- VAL contains the following special groups:
  - Prepare for Validation: Preparation for validation is conducted.
  - Validate Product or Product Components: The product or product components are validated to ensure they are suitable for use in their intended operating environment.

Verification

- The purpose of Verification (VER) (CMMI-DEV) is to ensure that selected work products meet their specified requirements including customer, product, and product component requirements.

- Verification is an incremental process because it occurs throughout the development of the product, beginning with verification of requirements, progressing through the verification of evolving work products, and culminating in the verification of the completed product.

- The Verification and Validation process areas are similar, but they address different issues.
  - Validation demonstrates that the product, as provided, will fulfill its intended use, whereas verification addresses whether the work product properly reflects the specified requirements.
  - In other words, **verification ensures that "you built it right"**; whereas, **validation ensures that "you built the right thing".**

- VER contains the following special groups:
  - Prepare for Verification: Preparation for verification is conducted.
  - Perform Peer Reviews: Peer reviews are performed on selected work products.
  - Verify Selected Work Products: Selected work products are verified against their specified requirements.

Support Related Processes

- Measurement and Analysis

- Configuration Management

- Process and Product Quality Assurance

- Decision Analysis and Resolution

- Causal Analysis and Resolution

Measurement and Analysis

- The purpose of Measurement and Analysis (MA) (CMMI-DEV) is to develop and sustain a measurement capability used to support management information needs.

- The Measurement and Analysis process area involves the following activities:
  - Specifying objectives of measurement and analysis so that they are aligned with identified information needs and project, organizational, or business objectives
  - Specifying measures, analysis techniques, and mechanisms for data collection, data storage, reporting, and feedback
  - Implementing the analysis techniques and mechanisms for data collection, data reporting, and feedback
  - Providing objective results that can be used in making informed decisions and taking appropriate corrective action

- MA contains the following special groups:
  - Align Measurement and Analysis Activities: Measurement objectives and activities are aligned with identified information needs and objectives.
  - Provide Measurement Results: Measurement results, which address identified information needs and objectives, are provided.

Configuration Management

- The purpose of Configuration Management (CM) (CMMI-DEV) is to establish and maintain the integrity of work products using configuration identification, configuration control, configuration status accounting, and configuration audits.
  - The work products placed under CM include the products that are delivered to the customer, designated internal work products, acquired products, tools, and other items used in creating and describing these work products.

- The Configuration Management process area involves the following activities:
  - Identifying the configuration of selected work products that compose baselines at given points in time
  - Controlling changes to configuration items
  - Building or providing specifications to build work products from the configuration management system
  - Maintaining the integrity of baselines
  - Providing accurate status and current configuration data to developers, end users, and customers

- In Agile environments, CM is important because of the need to support frequent change, frequent builds, multiple baselines, and multiple CM supported workspaces . Agile teams may get bogged down if the organization doesn't:
  - Automate CM (e.g., build scripts, status accounting, integrity checking)
  - Implement CM as a single set of standard services.

- CM contains the following special groups:
  - Establish Baselines: Baselines of identified work products are established.
  - Track and Control Changes: Changes to the work products under configuration management are tracked and controlled.
  - Establish Integrity: Integrity of baselines is established and maintained.

Process and Product Quality Assurance

- The purpose of Process and Product Quality Assurance (PPQA) (CMMI-DEV) is to provide staff and management with objective insight into processes and associated work products.

- The Process and Product Quality Assurance process area involves the following activities:
  - Objectively evaluating performed processes and work products against applicable process descriptions, standards, and procedures
  - Identifying and documenting noncompliance issues
  - Providing feedback to project staff and managers on the results of quality assurance activities
  - Ensuring that noncompliance issues are addressed

- PPQA contains the following special groups:
  - Objectively Evaluate Processes and Work Products: Adherence of the performed process and associated work products to applicable process descriptions, standards, and procedures.
  - Provide Objective Insight: Noncompliance issues are objectively tracked and communicated, and resolution is ensured.

Decision Analysis and Resolution

- The purpose of Decision Analysis and Resolution (DAR) (CMMI-DEV) is to analyze possible decisions using a formal evaluation process that evaluates identified alternatives against established criteria.

- A formal evaluation process involves the following actions:
  - Establishing the criteria for evaluating alternatives
  - Identifying alternative solutions
  - Selecting methods for evaluating alternatives
  - Evaluating the alternative solutions using the established criteria and methods
  - Selecting recommended solutions from the alternatives based on the evaluation criteria

- DAR contains the following special group:
  - Evaluate Alternatives: Decisions are based on an evaluation of alternatives using established criteria.

Causal Analysis and Resolution

- The purpose of Causal Analysis and Resolution (CAR) (CMMI-DEV) is to identify causes of selected outcomes and take action to improve process performance.

- The Causal Analysis and Resolution process area involves the following activities:
  - Identifying and analyzing causes of selected outcomes. Taking actions to complete the following:
  - Remove causes and prevent the recurrence of those types of defects and problems in the future
  - Proactively analyze data to identify potential problems and prevent them from occurring
  - Incorporate the causes of successes into the process to improve future process performance

- Since similar outcomes may have been previously encountered in other projects or in earlier phases of the current project, CAR activities are mechanisms for communicating lessons learned among projects.

- CAR contains the following special groups:
  - Determine Causes of Defects: Root causes of selected outcomes are systematically determined.
  - Address Causes of Selected Outcomes: Root causes of selected outcomes are systematically addressed.

Process Management Related Processes

- Organizational Process Focus

- Organizational Process Definition

- Organizational Training

- Organizational Process Performances

- Organizational Performance Management (renamed from Organizational Innovation and Deployment)

Organizational Process Focus

- The purpose of Organizational Process Focus (OPF) (CMMI-DEV) is to plan, implement, and deploy organizational process improvements based on a thorough understanding of current strengths and weaknesses of the organization's processes and process assets.

- The "organization's process improvement plan" addresses appraisal planning, process action planning, pilot planning, and deployment planning.

- When the improvement is to be deployed, a deployment plan is created.

- OPF contains the following specials groups:
  – Determine Process Improvement Opportunities: Strengths, weaknesses, and improvement opportunities for the organization's processes are identified periodically and as needed.
  – Plan and Implement Process Actions: Process actions that address improvements to the organization's processes and process assets are planned and implemented.
  – Deploy Organizational Process Assets and Incorporate Experiences: Organizational process assets are deployed across the organization and process related experiences are incorporated into organizational process assets.

Organizational Process Definition

- The purpose of Organizational Process Definition (OPD) (CMMI-DEV) is to establish and maintain a usable set of organizational process assets, work environment standards, and rules and guidelines for teams.
  - Organizational process assets enable consistent process execution across the organization and provide a basis for cumulative, long-term benefits to the organization.

- The organization's "set of standard processes" is tailored by projects to create their defined processes.

- OPD contains the following special group:
  - Establish Organizational Process Assets: A set of organizational process assets is established and maintained.

Organizational Training

- The purpose of Organizational Training (OT) (CMMI-DEV) is to develop skills and knowledge of people so they can perform their roles effectively and efficiently.
  - Skills and knowledge can be technical, organizational, or contextual.

- An organizational training program involves the following activities:
  - Identifying the training needed by the organization
  - Obtaining and providing training to address those needs
  - Establishing and maintaining a training capability
  - Establishing and maintaining training records
  - Assessing training effectiveness

- OT contains the following special groups:
  - Establish an Organizational Training Capability: A training capability, which supports the roles in the organization, is established and maintained.
  - Provide Training: Training for individuals to perform their roles effectively is provided.

Organizational Process Performance

- The purpose of Organizational Process Performance (OPP) (CMMI-DEV) is to establish and maintain a quantitative understanding of the performance of selected processes in the organization's set of standard processes in support of achieving quality and process performance objectives, and to provide process performance data, baselines, and models to quantitatively manage the organization's projects.

- The Organizational Process Performance process area involves the following activities:
  - Establishing organizational quantitative quality and process performance objectives based on business objectives.
  - Selecting processes or sub-processes for process performance analyses
  - Establishing definitions of the measures to be used in process performance analyses.
  - Establishing process performance baselines and process performance models.

- OPP contains the following special group:
  - Establish Performance Baselines and Models: Baselines and models, which characterize the expected process performance of the organization's set of standard processes, are established and maintained.

Organizational Performance Management

- The purpose of Organizational Performance Management (OPM) (CMMI-DEV) is to proactively manage the organization's performance to meet its business objectives.
  - The organization analyzes product and process performance data from the projects to determine if it is capable of meeting the quality and process performance objectives.
  - The organization identifies and proactively solicits incremental and innovative improvements from within the organization and from external sources such as academia, competitive intelligence, and successful improvements implemented elsewhere.
  - This improvement cycle continually optimizes organizational processes based on quality and process performance objectives. Business objectives are periodically reviewed to ensure they are current and quality and process performance objectives are updated as appropriate.

- OPM contains the following special groups:
  - Manage Business Performance: The organization's business performance is managed using statistical and other quantitative techniques to understand process performance shortfalls, and to identify areas for process improvement.
  - Select Improvements: Improvements are proactively identified, evaluated using statistical and other quantitative techniques, and selected for deployment based on their contribution to meeting quality and process performance objectives.
  - Deploy Improvements: Measurable improvements to the organization's processes and technologies are deployed and evaluated using statistical and other quantitative techniques.

Summary

- **Manage with Processes**: Management approach to manage by focusing on the processes
  - Immature processes create heros!
  - Mature processes are institutional.
    - Processes are defined, documented and continuously improved.
    - Process definitions align with the actual job descriptions.
    - Measurements of the products and processes are used for management.
- The quality of a system or product depends on the quality of the process that is used to developed and maintain that product.
- **Plan – Do – Check – Act**
- **Capability Maturity Model Integration** (CMMI) is a process model that provides a clear definition of what an organization should do to promote behaviors that lead to improved performance.
  - CMMI doesn't have a definite answer for how.
  - Defines the key elements for an effective software development process.
  - Emphasizes the development processes to improve product development and customer services.
  - Provides a framework to organize and prioritize the process improvement activities (product, job, employee, technology)
  - Supports the coordination of multidisciplinary activities which are required to successfully deliver a product.
  - CMMI consists of 22 process areas organized in 5 levels.
- CMMI Maturity Levels:
  1. Initial
  2. Managed
  3. Defined
  4. Quantitatively Managed
  5. Optimizing
- CMMI process areas are grouped according to their relations with Project Management, Engineering, Support, Process Management

References

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