Process Recognition and Assessment Programs

There are a number of process recognition and assessment programs. The commonly known programs are ISO 9001:2008 Quality Management System and Capability Maturity Model Integration®. Others include Lean Six Sigma, Exemplary Facilities Program, Malcolm Baldridge National Quality Program, In-Plant Quality Evaluation (IQUE): DLAM8200.5, Software Quality Assurance, DLAH 8250.2, Integrated Contractor Assessment Program (ICAP), AFCMDR 178-4, and Contractor Performance Certification Program (CP)2.

Lean Six Sigma (LSS)

Lean manufacturing focuses on speed by reducing and eliminating non-value added processes and activities. Six Sigma focuses on quality by reducing defects and variations in products.

This business improvement methodology combines the best aspects from Lean Manufacturing and Six Sigma to create Lean Six Sigma (LSS).

LSS has two methodologies depending on whether you are focusing on existing business processes or new products/processes. The methodologies are:

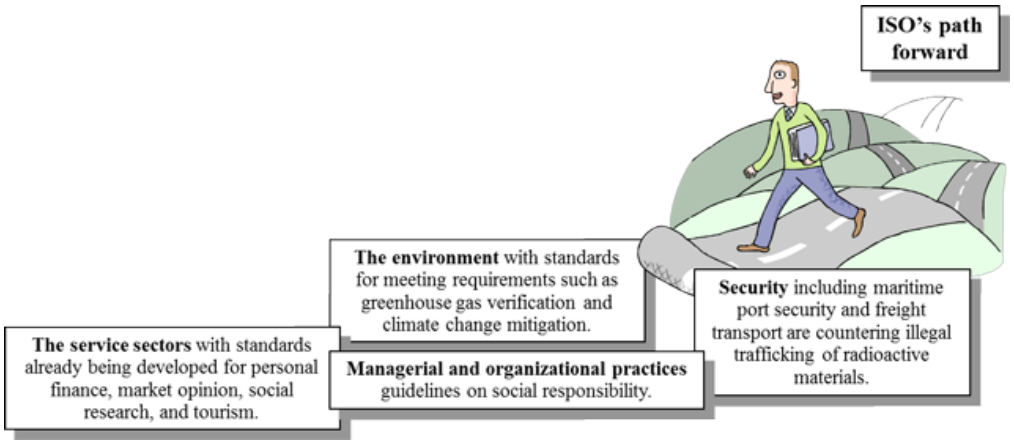
1. Define - Measure - Analyze - Improve - Control (DMAIC) which solves problems and eliminates wastes in existing business processes
2. Define - Measure - Analyze - Design - Verify (DMADV) which predicts, defect-free performance designs for new products or processes

The LSS Steps are to:

1. Identify the processes most important to delivering customer value
2. Map these processes using value stream mapping - a technique to analyze and design the flow of materials and information to bring a product or service to a customer
3. Identify bottlenecks and constraints in the value stream
4. Apply variation reduction through DMAIC/DMADV to standardize the relevant process steps
5. Continue monitoring, controlling and refining

International Organization of Standards (ISO)

ISO is a non-governmental organization (NGO) created on February 23, 1947 and the world's leading developer of International Standards. Its standards specify the requirements for state-of-the-art products, services, processes, materials, and systems and for good conformity assessment, managerial and organizational practice. ISO standards are designed to be implemented worldwide. ISO has a current portfolio of over 18,500 International Standards, of which about 1,100 are new ISO standards published each year. Currently 248 countries participate and over 50,000 experts contribute annually to the work of the organization which is published in English and French. The ISO mission is to define standards telling organizations what to do but not how to do it. The standards are general and not specific to any particular domain, life cycle process model, or product.



ISO 9000 Series

ISO Technical Committee (TC) 176 published ISO 9000 Series in 1987. It was primarily concerned with **quality and process management**. This means what the organization does to fulfill customer's quality requirements, and applicable regulatory requirements, while aiming to enhance customer satisfaction and achieve continual improvement of its performance in pursuit of these objectives. The ISO 9000 series is a five part international standard to ensure quality management and quality assurance. The set of five (5) documents are: ISO 9000, ISO 9001, ISO 9002, ISO 9003, and ISO 9004, where ISO 9000 and 9004 are guidelines and the inner three are models. ISO 9001 deals specifically with software and the current version of this standard is ISO 9001-2008. The ISO 9000 Series is scheduled for revision, as are most ISO standards, every five years. The objective is Total Quality Improvement, laying the foundation for world class quality.

ISO 9000-1 Guidelines for Selection and Use
ISO 9000-2 Guidelines for Selection and Use - Hardware
ISO 9000-3 Guidelines for Selection and Use - **Software**

ISO 9001 Model for Quality Assurance in: Design/development, production, installation, and servicing

ISO 9002 Model for Quality Assurance in: Production and installation

ISO 9003 Model for Quality Assurance in: Final inspection and test

ISO 9004 Guidelines

International acceptance evolved over time. The European Community adopted ISO 9000 as its preferred quality standard. Initially this included Belgium, Denmark, France, Germany, Great Britain, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain. Later the European Free Trade Association countries (Norway, Sweden, Finland, all other European countries) adopted ISO 9000. Then the

European Community set a policy that anything bought or sold in the European Community must be ISO 9000 compliant as of January 1993. This helped ensure a quality standard and Australia, Japan, and other Pacific Rim countries, South America, and Africa adopted ISO 9000. The United States was late to adopt the standard, because at that time in the early 1990s, the Software Engineering Institute's Capability Maturity Model® (CMM®) was more prevalent and the Department of Defense (DoD) contractors were not historically seeking out global markets. Over the following 10 years, significant changes occurred. Today United States based software companies are rapidly engaging in assuring quality and certifying to ISO 9001.

The benefits of ISO 9000 certification include:

1. Greater focus on the needs of the customer
2. Customers know the company is quality oriented
3. Company culture changes from the emphasis on error detection to a focus on error prevention
4. Employees have better knowledge of their jobs and quality systems
5. The number of audits is reduced since there is evidence of quality emphasis
6. Increased competitive edge
7. Enhanced marketability

A quality management system (QMS) is the organizational structure, procedures, processes, and resources needed to implement quality management. To apply and maintain a QMS following ISO 9001:2008, you are required to:

1. Fully engage top management to:
    a. Define why you want to implement ISO 9001. Identify the goals you want to achieve. Typical goals may be become more efficient and profitable, produce products and services that consistently meet customer requirements, achieve customer satisfaction, increase or maintain market share, improve communications and morale in the organization, reduce costs and liabilities, or increase confidence in the production system.
    b. Define your mission, vision, and values in your organization.
    c. Define your organization's stakeholders including customers, suppliers.
    d. stockholders, employees, end users, shareholders, and society. Identify what others expect of you.
    e. Define your quality policy.
    f. Define and align organizational objectives and related product/service quality objectives.
2. Identify key processes and the interactions needed to meet quality objectives. Obtain information about the ISO 9000 family.
3. Implement and manage the QMS and its processes using process management. Apply the ISO 900 family of standards in your management system. Obtain guidance on specific topics within the quality management system.
4. Build your ISO 9001-based QMS
    a. Identify ISO 9001 requirements
    b. Map these requirements with your implemented QMS, where applicable
    c. Make a gap analysis: identify where in your existing system the requirements are fulfilled, and where they are not
    d. Include in your QMS processes the activities, procedures and controls needed.
5. Implement the system, train company staff and verify effective operation of your processes
6. Manage your QMS
    a. Focus on customer satisfaction
    b. Monitor and measure the operation of your QMS
    c. Strive for continual improvement
    d. Consider implementing business excellence models in the company operations.
7. If necessary, seek third party certification/registration of the QMS or alternatively, issue a self-declaration of conformity techniques. Continue to improve your business.

Preparing for an ISO audit follows four basic steps:

1. Phase 1 - Preparation for the Audit
    - Establish a steering committee
    - Complete the questionnaire/application
    - Perform a pre-audit
2. Phase 2 - Review of Quality Documents
    - Circulate quality manual and procedures for review and update
    - Train employees in new procedures being developed
3. Phase 3 - Planning & Conducting the Audit
    - Prepare for the audit
    - Perform the audit
    - Report on the audit
4. Phase 4 - Conduct Follow-up Activities

ISO certification requires time and effort to fulfill the requirements and when the organization becomes ISO certified, it gets an ISO certificate.

Software Engineering Institute (SEI)

The SEI is a federally funded research and development center (FFRDC) sponsored by the DoD through the Defense Advanced Research Projects Agency (DARPA). The DoD established the SEI to advance the practice of software engineering because software has become an increasingly critical component of U.S. Defense Systems and the demand for quality software produced within budget and schedule constraints exceeds its supply. The SEI contract was competitively awarded to Carnegie Mellon University (CMU) in December 1984. University of Maryland was another offeror. Currently the SEI is staffed by approximately 250 technical and support personnel from industry, academia, and government.

The SEI mission is to provide leadership in advancing the state-of-the-art practice of software engineering, improve the quality of systems that depend on software, and promote the evolution of software engineering from an "ad hoc, labor-intensive activity" to a discipline that is well managed and supported by technology.

The SEI has four focus areas:

1. **Software Process Improvements** to make lasting improvements in the software engineering practice;
2. **Real-Time Distributed Systems** to ensure that quantitative methods are employed to evaluate software designs, upgrades, and trade-offs;
3. **Risk Management** to develop and institutionalize software risk management; and

4. **Software Engineering Techniques** to codify an accepted best practice for engineering software and standards to support the practice.

History of the Capability Maturity Model

In the late 1980s it was believed that software engineers and managers knew their problems in great detail but typically disagreed on which improvements were most important. Therefore an organized and prioritized strategy for improving was necessary to achieve consensus on which improvements to undertake first. The philosophy was to improve the software process with many small, evolutionary steps rather than revolutionary innovations. This strategy, an evolutionary path to increase software process maturity in stages and improvements at each stage, provides the foundation for improvement at the next stage. This principle of staged improvement originated in the 1920s with Walter Shewhart in statistical quality control. W. Edwards Deming and Joseph Juran, the "Kings of Quality," developed it further. By focusing on a limited set of activities and working aggressively to achieve them, an organization can steadily improve its processes.

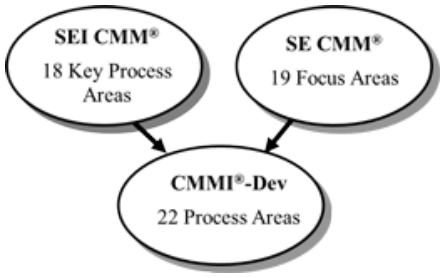
Achieving higher levels of software process maturity requires a long term commitment over many years. In the 1990s, a decade-long process improvement program was foreign to most U.S. aerospace-oriented industries, but not so to other industries, such as the automotive industry.

The CMM® model was descriptive, normative, and abstract, but not prescriptive. It **described** key essential attributes expected to characterize an organization at a particular maturity level. It detailed practices characterizing the **normal** types of behavior expected in an organization performing large scale, government contracts. It was sufficiently **abstract** that it does not unduly constrain how the software process was implemented by an organization yet it **did not prescribe** or specify how to improve the software.

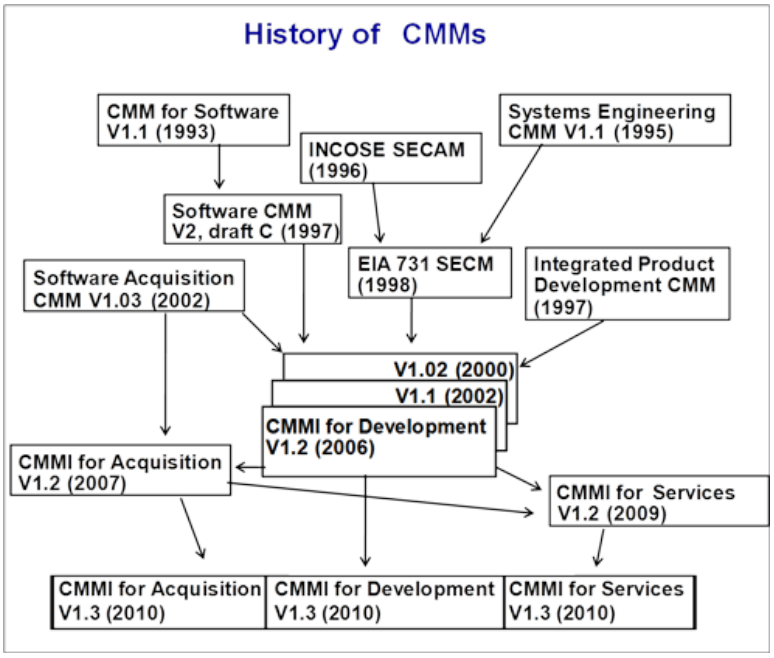
Watts Humphrey, a legend in software process improvement from the SEI, published the first version of the Capability Maturity Model® (CMM®) in 1988; the next version titled *Capability Maturity Model for Software, Version 1.1, Technical Report CMU/SEI-93-TR-024 ESC-TR-93-177* was released in February 1993. The original questionnaire, intended to provide a simple tool for identifying areas of improvement, was too often regarded as a "model" and its later version 1.1 provided more effective guidance for establishing process improvement programs. The CMM® continued to develop based on the original maturity framework and questionnaire, incorporating feedback from appraisals and evaluations in industry and government, and continued to emphasize the key process areas for levels 2 and 3. Since few organizations were assessed at levels 4 and 5, less was known about the characteristics of such organizations.

In the early 2000s, the CMM® evolved into the Capability Maturity Model Integration® for Development (CMMI®-DEV) which included the systems engineering perspective. The SEI team along with personnel from government and industry developed the CMMI® versions 1.1 which was first released in 2001, followed by version 1.2 in 2006. The current version, CMMI®-DEV Technical Report CMU/SEI-2010-TR-033 ESC-TR-2010-033, was released in November 2010. Appraisals using this integrated version began

in 2002. The CMMI®-DEV now replaces the earlier CMM® and the Systems Engineering CMM® (SE-CMM®) both of which were retired in June 2007.



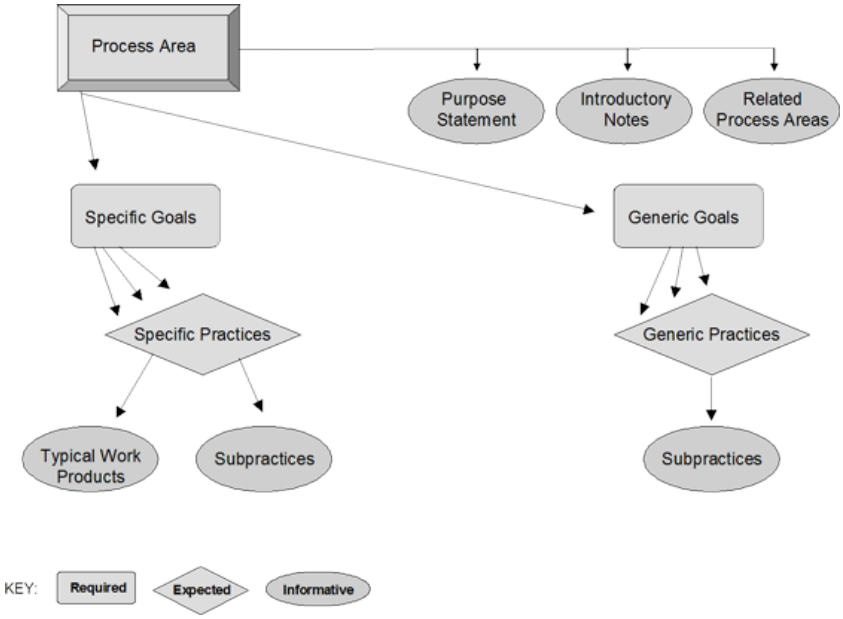
Several other CMMIs have evolved including the CMMI® for Acquisition and the CMMI® for Services; these three are called the CMMI® constellation. The SEI defines the CMMI® Framework as the basic structure that organizes CMMI® components and combines them into CMMI® constellations and models; and a constellation as a collection of CMMI® components that are used to construct models, training materials, and appraisal related documents for an area of interest, e.g., development, acquisition, services. The history of the CMMs is shown in this table.



CMMI ®

The CMMIs are a collection of best practices to help organizations improve their processes and a set of guidelines for developing better products and services.

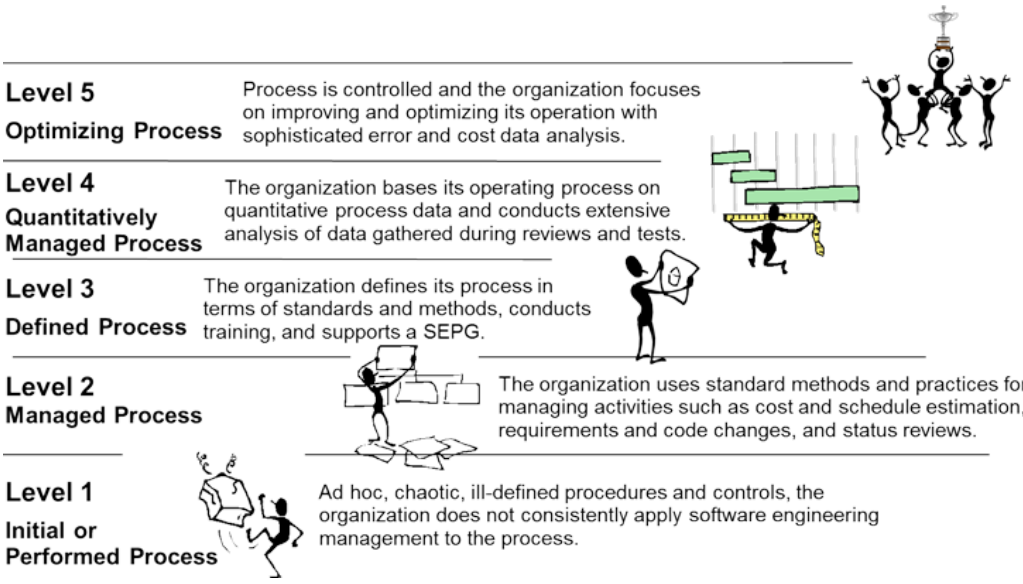
It should be noted that all the CMMI® process areas follow a similar pattern. Each process area has a purpose statement, introductory notes, and a relationship to other process areas. Each process area has specific goals, which in turn have specific practices. The specific practices can be typical work products or can lead to sub-practices. The generic goals consist of generic practices and sub-practices. Each process area is made up of required, expected, and informative parts as shown in the figure.



The CMMI® supports two improvement paths which are associated with the two types of levels: maturity levels (the staged representation) or capability levels (the continuous representation.) The maturity level (or staged representation) empowers the organization to incrementally improve groups of process areas selected by the organization. Using the capability level or continuous representation, the organization incrementally addresses every process area in successive sets.

Level	Continuous Representation Capability Levels	Staged Representation Maturity Levels
Level 0	Incomplete	(Not Applicable)
Level 1	Performed	Initial
Level 2	Managed	Managed
Level 3	Defined	Defined
Level 4	(Not Applicable)	Quantitatively Managed
Level 5	(Not Applicable)	Optimizing

The levels are defined as shown in the figure.

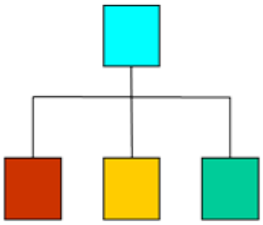


For the continuous representation, organizations incrementally improve in each of the process areas. Once an organization attains Level 3 in the continuous representation, it continues to improve by focusing on further improving its processes. In the staged representation, organizations improve in selected groupings. To be successfully appraised Level 2, the Level 2 process areas must be implemented. To be successfully appraised at Level 3 compliance, the Level 2 and Level 3 process areas must be implemented. For Level 4, Levels 2, 3, and 4 process areas must be implemented; and for Level 5, all process areas must be implemented.

CMMI® for Development (CMMI®-DEV)

The CMMI®-DEV, which combines software and systems engineering models into one framework, integrates several source models, eliminates inconsistencies, and reduces duplication. The International Council of Systems Engineering (INCOSE) approved the CMMI®-DEV. The practices for CMMI®-DEV levels 4 and 5 are being refined as the SEI works closely with organizations striving to understand and achieve these maturity levels. The CMMI®-DEV is now the industry standard. The SEI is also working with ISO to ensure consistency with international standards. Even though the original intent was to improve processes for large companies, projects, and organizations, many of the companies being appraised have fewer than 100 people. The SEI and its partners may produce tailored versions of the CMMI® for small projects, companies, or organizations.

Small Company



Small Organization

Small Project

An example of demonstrated evidence at each maturity level is shown in this table.

Level 1	• Programmers do what they individually think is best and hope their work comes together at the end of the project. • Cost, schedule, and quality are generally unpredictable and out of control. • The organization operates without formal planning or programming practices. • Projects are plagued by poor change control. • Tools aren't integrated into the process. • Senior management doesn't understand programming problems or issues.
Level 2	• Programmers have enough experience developing certain kinds of systems that they appear to use a process. • The corporate process consists of its accumulated wisdom and is informal. • This organization can succeed when developing systems similar to those developed in the past. • This organization falters when faced with new tools, methods, applications, and organizational changes. • Turnover of personnel results in loss of process.
Level 3	• At this level, corporate process is written down in a set of standards. • The process is repeatable and does not depend on individuals for preservation. • It has not been measured or compared with other processes. • The process has been formalized but is by no means optimized.
Level 4	• The standard process is measured and hard data is collected to assess its effectiveness. • Hard data is used to measure the quality of the software products. • Hard data can be used to judge the merits of competing processes.
Level 5	• In the lower levels of process maturity, an organization focuses on repeatability and measurements primarily to improve product quality, e.g., measure the number of defects per 1K LOC to know how good the code is. • At the optimizing level, the organization focuses on repeatability and measurement to improve its development process. • This organization can vary its process, measure results, and establish the variation as a new standard when the process provides improvement. • Tools are in place to automate measurement.

As you can see at Level 1, the software organization is based on heroics and what the programmer thinks is best. As you move to Level 5, you can see that processes are in place to ensure processes are repeatable, managed, measured, and optimized.

CMMI®-DEV has 22 process areas where 16 are core process areas common to all CMMI® models, 1 is a shared process area with CMMI®-Services, and 5 are development-specific process areas. The CMMI® for Development is divided into four process area categories: Project Management, Engineering, Process Management, and Support, each with subordinate process areas as shown in the table.

Project Management Process Areas	Process Management Process Areas
Integrated Project Management (IPM)*	Organizational Process Definition (OPD)*
Project Monitoring and Control (PMC)*	Organizational Process Focus (OPF)*
Project Planning (PP)*	Organizational Performance Management (OPM)*
Quantitative Project Management (QPM)*	Organizational Process Performance (OPP)*
Requirements Management (REQM)*	Organizational Training (OT)*
Risk Management (RSKM)*	**Support Process Areas**
Supplier Agreement Management (SAM)**	Causal Analysis and Resolution (CAR)*
Engineering Process Areas	Configuration Management (CM)*
Product Integration (PI)***	Decision Analysis and Resolution (DAR)*
Requirements Development (RD)***	Measurement and Analysis (MA)*
Technical Solution (TS)***	Process and Product Quality Assurance (PPQA)*
Validation (VAL)***	*Core Process Area, **Shared Process Area with CMMI-Ser, ***Development-Specific Process Area
Verification (VER)***	

Key:
Level 2 – Yellow
Level 3 – Green
Level 4 – Blue
Level 5 - Purple

The staged representation Level 2 processes are shown in yellow; the Level 3 processes are shown in green; the Level 4 processes are shown in blue; and the Level 5 processes are shown in purple.

Organizations improve by following the SEI recommended CMMI® implementation steps:

1. Secure Sponsorship and Funding
2. Take Core Training
3. Prepare Your Organization for Change
4. Form a Process Group
5. Know Where You Are
6. Know Where You Are Going
7. Communicate and Coordinate
8. Track Your Progress

For an organization to be successfully appraised, it undergoes an assessment using Standard CMMI® Appraisal Method for Process Improvement℠ (SCAMPI℠) which is designed to provide benchmark quality ratings relative to Capability Maturity Model Integration (CMMI®) models. There are three SCAMPI℠ classes: Class A, B, and C. SCAMPI℠ A is the most formal, requires SEI-authorized Lead Appraisers, and uses the SCAMPI℠ A Method Definition Document (MDD) to conduct the appraisals.

Typically an organization begins with a less formal internal process review or SCAMPI℠ C, which requires selecting an assessment team of about eight people. Usually four people are from another

department or even from outside the organization that have been trained and know what to do. It is especially important that the leader is trained as well as the rest of the team prior to the SCAMPI℠ C appraisal. The assessment team has mix of talents including experienced software engineering professionals, but no managers or supervisors.

Preparations for a SCAMPI℠ C begin months before the assessment. To get started, managers and their team determine the projects that will be assessed, select and notify the participants who will be involved, prepare the schedule, and reserve meeting rooms.

When the assessment occurs, typically there is a review of three or four key projects. The assessment team collects responses to the questionnaire and performs in-depth discussions with project managers and practitioners. The team completes an extensive review of documented evidence and ensures the correlations between the interview responses and the documentation. This also creates synergy among the assessment team who collectively analyzes the data, reviews findings with project personnel, applies the CMMI®, and then as a team reaches consensus on the CMMI® maturity level. The team observes strict confidentiality and only releases the composite results to management. At this point senior management is briefed and a focus on action begins. The assessment is a catalyst for change. Here is the schedule for a typical two week SCAMPI℠ appraisal, the culmination of the months of preparation.

Assessment Schedule (PDF attached to the same item as this PDF in Blackboard)

It is important to observe that advanced planning and coordination expedites the process. Preparation for an assessment must begin months earlier. Establishing the organizational evidence library can require more than two staff months of effort. As shown in this example, a large part of the organization is involved in the assessment overview on the first Wednesday morning, and in the assessment findings which are presented on last Friday morning to "educate" the organization. Senior corporate personnel are actively involved in the assessment overview, assessment findings presentation, and executive debrief.

A typical interview session has predefined scripts that are used for each interview based on the CMMI®. Opening and closing questions are standard for each interview and directed to all participants. In general, the interviewer role rotates among assessment team members who come from other sites. The interviewer does not take notes, while the other team assessors take extensive notes. The local site team members do not conduct interviews; they take notes and ask questions. As an example, questions from the Organizational Process Focus (OPF) Process Area include:

OPEN	What are your responsibilities on the project?
OPEN	What parts of your process do you think work well?
OPEN	What part of your process does not work as well and what would you do about it?
OPF GP 2.4	What is the evidence showing a management steering committee for process improvement? What is the evidence showing a process group that facilitates and manages the process improvement activities?
OPF SP 1.1	What are the policies, standards, and business objectives that are applicable to the organization's processes?
OPF SP 2.1	What are the strategies, approaches, and actions to address identified process improvements?
OPF SP 3.2	What projects in the organization are starting up?
CLOSE	Is there anything else about your process that you would like to mention?

GP: Generic Practice
SP: Specific Practice
OPF: Organizational Process Focus

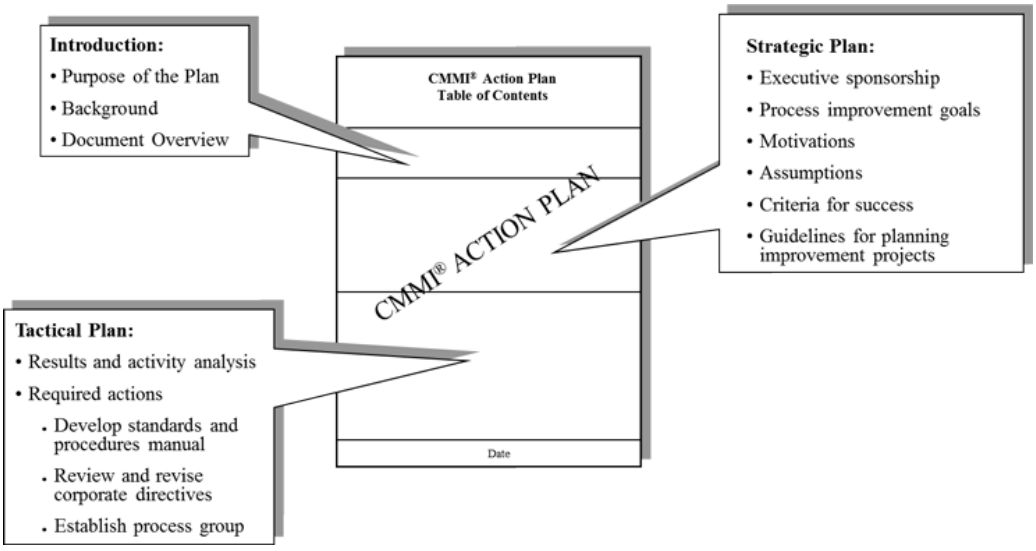
Following the assessment, the organization must decide where to go from here. Typically the Software Engineering Process Group (SEPG) develops an action plan defining the plan to move to the next level. The software manager, chief engineer, and corporate president must continue to endorse this activity by allocating several months to develop the plan and approximately one year to implement the plan.

To implement the Action Plan, it is important to remember the principles of process change:

1. Major changes must start at the top
2. Fix the process, not the people
3. Understand the current process first
4. Change is continuous
5. Improvement requires investment
6. Retaining improvement requires periodic reinforcement

The Action Plan should have three parts as shown:

1. Introduction which gives the purpose, background, and document overview
2. Strategic Plan which discusses the executive sponsorship, process improvement goals, motivations, assumptions, criteria for success, and guidelines for planning improvement projects
3. Tactical Plan which includes the results and activity analysis, and required actions such as developing the standards and procedures manual, reviewing and revising corporate directives, and establishing a process group or Software Engineering Process Group (SEPG)



Today, many organizations from numerous domains are appraised using CMMI®. The list of believers is made up of companies and government agencies, U.S. corporations and foreign entities, defense contractors and commercial organizations, and small and large companies covering virtually all business areas. Refer to the latest Software Engineering Institute CMMI® reports: http://cmmiinstitute.com/wp-content/uploads/2014/05/Maturity-Profile-Ending-March-2014.pdf and http://cmmiinstitute.com/assets/presentations/2013SepCMMI.pdf

One example is the process improvement plan that Motorola put in place in the early 1990s. This historic example shows how process improvement initiatives can advance an organization. John Major, Senior Vice President and Director of Standards and Software Development at Motorola, delivered the keynote address during the 6th National SEPG Meeting in Dallas, TX, April 25–28, 1994. He stated that Motorola had 10,000 software engineers across 70 groups. Motorola had a successful Six Sigma hardware initiative which achieved less than three defects per 1,000,000 parts and now he wanted to apply this initiative to software. Motorola won the Malcolm Baldridge award, placed a heavy emphasis on metrics through its Management and Improvement by Measurement, and required mandatory training of 40 hours per year for each software engineer at Motorola University. Motorola had 120 trained CMM® appraisers and conducted over 40 appraisals. The majority of its software organizations were at Level 2 or above, and it expected 75% of its software organizations to be at Level 3 by 1995, which it accomplished. More impressive, in 1991, it established Motorola India with10 employees and by the time of this briefing in 1994, it had 150 employees and 25 projects. Motorola India was Motorola's first organization to be rated CMM® Level 5 and one of five Level 5 organizations across the entire industry.

The current CMMI® which includes both software and systems engineering continues to increase its number of believers. The Maturity Profile Reports describes CMMI® adoption trends since 2007 using the Standard CMMI® Appraisal Method for Process Improvement (SCAMPI℠) V1.2/V1.3 Class A appraisals reflect:

- 84 countries across six continents with the majority in Asia and North America
- 74% were non-USA organizations
- Greater than 7,800 SCAMPI℠ A appraisals were reported to the SEI
- 2013 contains the highest number of SCAMPI A appraisals for any year reported so far
- Majority of organizations are rated Level 2 or 3

As you can see from the linked files, the vast majority of organizations are commercial/ development for sale to organizations consumers.

The number of countries where appraisals have been performed and reported continues to increase. China, United States, and India have the greatest number of appraisal reports, and China and United States represent more than 80% of the total number of appraisals; however, 84 countries have had SCAMPI A Appraisals delivered, so much of the world is represented.. More than 80% of appraised organizational units have 200 or fewer employees and the percentage is increasing steadily.

The evidence of success for using the CMMI® is remarkable.

The SEI stated in its Performance Results of CMMI®-Based Process Improvement report with case study analyses that "Better quality may not always be free, but it can occur with better project performance as a result of disciplined process improvement." The representative sample of companies who provided detailed performance improvement results for this case study analysis were 3H Technology, ABB, Hitachi Software Engineering, Motorola Global Software Group (GSG) China Center, Motorola Global Software Group (GSG) India Center, Motorola Global Software Group (GSG) Russia Center, Raytheon Network Centric Systems North Texas, TrialStat Corporation, Tufts Health Plan, and Warner Robins Air Logistics Center. The performance improvements over time are shown in this table.

Performance Improvements over Time by Category

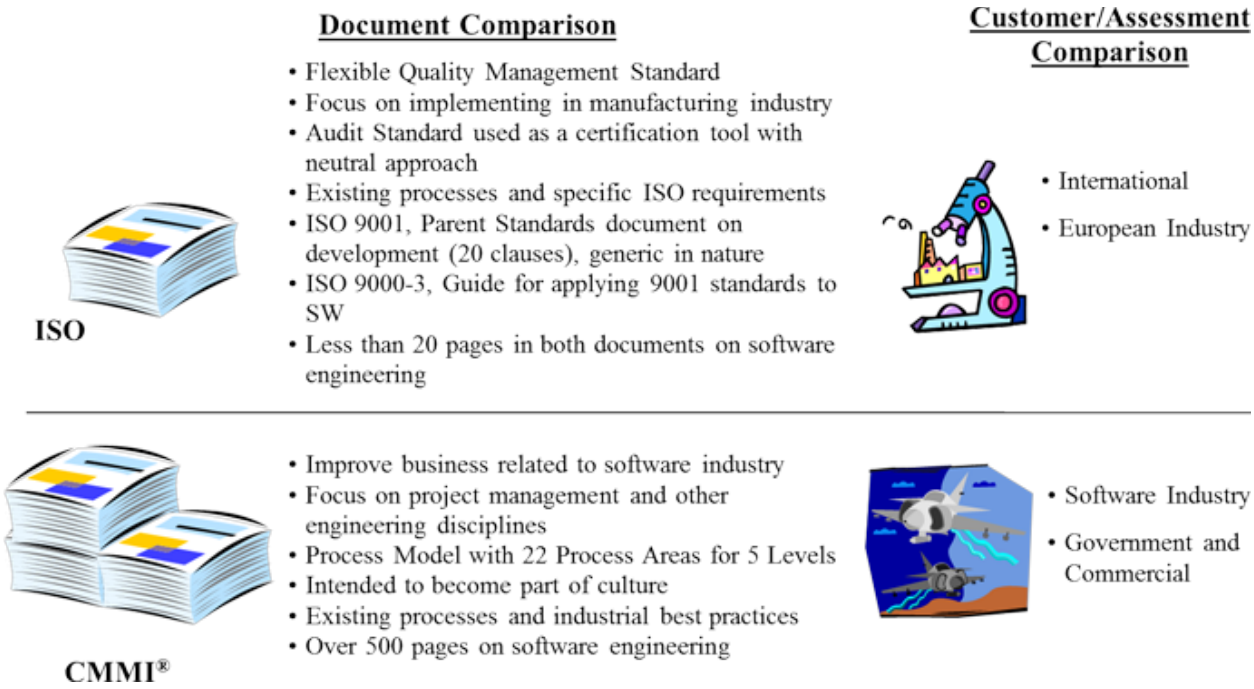
Performance Category	Median Improvement	Number of Data Points	Lowest Improvement	Highest Improvement
Cost	34%	29	3%	87%
Schedule	50%	22	2%	95%
Productivity	61%	20	11%	329%
Quality	48%	34	2%	132%
Customer Satisfaction	14%	7	−4%	55%
Return on Investment	4.0 : 1	22	1.7 : 1	27.7 : 5

Comparing ISO 9001:2008 and the CMMI®-DEV

Many organizations believe that being certified as ISO 9001, an audit standard, is the same as being CMMI® appraised, a process model with a set of best practices. While the two organizations, ISO and SEI, work together to ensure consistency between ISO 9001 and CMMI®, fundamentally they are different but share many of the same philosophies and common understandings.

ISO certification is used across any domain and does not specifically relate to engineering and project management like the CMMI®. The ISO certification is either pass or fail, i.e., you receive the certificate or you don't; there are no levels of improvement. The CMMI® has five levels of process maturity and can be implemented with one of two models: staged and continuous. ISO certification is not as rigorous as CMMI® maturity with its 22 process areas. In fact, Mark Paulk from the SEI did a study that showed that ISO and CMM® processes are highly correlated, but there are differences in the level of abstraction in the two documents. Most people agree that if an organization is appraised at CMMI® Level 3, then it can likely easily be ISO certified and conversely if it is ISO certified, it is likely to be at least at CMMI® Level 2; however Mark Paulk and Richard Desjardins, another software process expert, know of CMMI® Level 1 organizations that are ISO certified. Shahanali and his team wrote a paper, ISO 9000 vs. CMMI: A comparison! that compared ISO and CMMI®. He wrote that CMMI® is an "approach for process improvement which provides organizations, essential element of effective processes to improve their performance... focusing on system engineering and software engineering."

CMMI®, first released in 2000 based on the CMM®, is used to determine the level of maturity of software intensive systems. ISO is part of a quality management standard. The primary differences between the two models are conceptual, scope, approach, and implementation.



CMMI® for Acquisition (CMMI®-ACQ)

CMMI® for Acquisition (CMMI®-ACQ) Version 1.3 was released in November 2010. It was designed for use by those who acquire, procure, or otherwise select and purchase products and services for business purposes. Acquisition includes government acquisition, supply chain management, supplier management, procurement, and outsourcing. This process model focuses on acquirer processes, integrates bodies of knowledge essential for successful acquisitions, and provides an opportunity for acquisition organizations to:

- Avoid or eliminate barriers and problems in the acquisition process through improved operational efficiencies
- Initiate and manage a process for acquiring products and services, including solicitations, supplier sourcing, supplier agreement development and award, and supplier capability management
- Use a common language for both acquirers and suppliers, so that quality solutions are delivered more quickly and at a lower cost with the most appropriate technology

It has 22 process areas that are in four process area categories. **Project Management** process areas contain activities related to managing the project through defining, planning, deploying, implementing, monitoring, controlling, and integrating. All but two of these process areas are core process areas. **Acquisition Engineering** process areas contain required acquisition-related practices and practices that address acquirer activities related to establishing, executing, and transitioning an acquisition project. **Process Management** process areas contain cross-project organizational activities including appraising, measuring, and improving processes; and practices that provide the acquiring organization with a capability to develop and deploy processes and supporting assets and to document and share best practices and learning across the organization. **Support** process areas cover activities that support acquisition and address processes that are used in the context of performing other processes. These processes may address more general processes that apply to the organization.

Notice that the high maturity processes (Level 4 and 5 processes) describe:

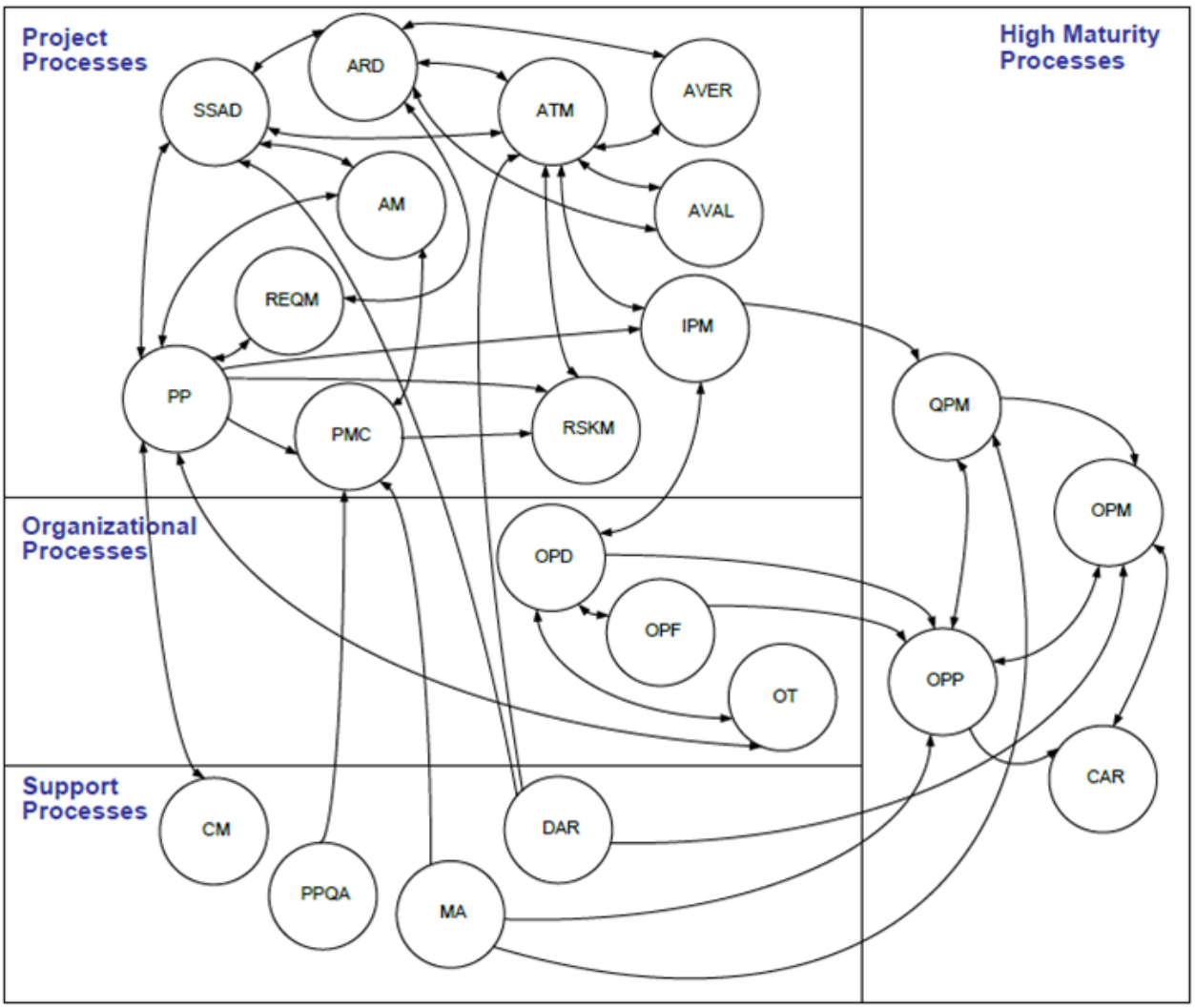
- Practices that further align process management, project, and support processes with the business objectives
- Practices at both the organizational and project level for establishing objectives for quality and process performance to monitor variation in the organization's and projects' processes, evaluate the impacts of proposed changes to those processes, and systematically deploy processes across the organization
- Mature measurement and analysis processes

The CMMI®-ACQ process areas and the staged levels are shown in this chart.

Project Management Process Areas	Process Management Areas
Agreement Management (AM)**	Organizational Process Defintion (OPD)*
Integrated Project Management (IPM)*	Organizational Process Focus (OPF)*
Project Monitoring and Control (PMC)*	Organizational Performance Management (OPM)*
Project Planning (PP)*	Organizational Process Performance (OPP)*
Quantitative Project Management (QPM)*	Organizational Training (OT)*
Requirements Management (REQM)*	Support Process Areas
Risk Management (RSKM)*	Causal Analysis and Resolution (CAR)*
Solicitation and Supplier Agreement Development (SSAD)**	Configuration Management (CM)*
Acquisition Engineering Process Areas	Decision Analysis and Resolution (DAR)*
Acquisition Requirements Development (ARD)**	Measurement and Analysis (MA)*
Acquisition Technical Management (ATM)**	Process and Product Quality Assurance (PPQA)*
Acquisition Verification (AVER)**	
Acquisition Validation (AVAL)**	* Core Process Area, **Acquisition-Specific Process Area

Key:
Level 2 – Yellow
Level 3 – Green
Level 4 – Blue
Level 5 – Purple

The key relationships among the CMMI®-ACQ process areas are shown in this graphic. The Project Processes include both the Project Management and Acquisition Engineering process areas, and the High Maturity processes are the Level 4 and 5 process areas.



CMMI® for Services (CMMI®-SVC)

CMMI® for Services (CMMI®-SVC) Version 1.3 was also released in November 2010. The service industry is a significant driver for worldwide economic growth. This process model provides guidance on developing and improving mature service practices to improve service provider performance and customer satisfaction. Specifically, it covers the activities required to manage, establish, and deliver services. It has 24 process areas where 16 are core process areas common to all CMMI® models, 1 is a shared process area with CMMI®-DEV, and 7 are service-specific process areas with 1 addition. Additions are clearly marked model components that contain information of interest to particular users; in this model the additional process area is Service System Development (SSD). The core process areas of Work Planning, Work Monitoring and Control, Integrated Work Management, and Quantitative Work Management have different titles in the CMMI®-SVC as compared to CMMI®-DEV and CMMI®-ACQ which are titled Project Planning, Project Monitoring and Control, Integrated Project Management, and Quantitative Project Management. Despite the terminology differences, the material is considered to be the same core process area in all three CMMI® constellations.

Category	Process Area	Maturity Level
Process Management	Organizational Process Definition (OPD)* Organizational Process Focus (OPF)* Organizational Performance Management (OPM)* Organizational Process Performance (OPP)* Organizational Training (OT)*	3 3 5 4 3
Project and Work Management	Capacity and Availability Management (CAM)*** Integrated Work Management (IWM)* Quantitative Work Management (QWM)* Requirements Management (REQM)* Risk Management (RSKM)* Supplier Agreement Management (SAM)** Service Continuity (SCON)*** Work Monitoring and Control (WMC)* Work Planning (WP)*	3 3 4 2 3 2 3 2 2
Service Establishment and Delivery	Incident Resolution and Prevention (IRP)*** Service Delivery (SD)*** Service System Development (SSD)**** Service System Transition (SST)*** Strategic Service Management (STSM)***	3 2 3 3 3
Support	Causal Analysis and Resolution (CAR)* Configuration Management (CM)* Decision Analysis and Resolution (DAR)* Measurement and Analysis (MA)* Process and Product Quality Assurance (PPQA)*	5 2 3 2 2

***Core Process Area, **Shared Process Area with CMMI-Dev, ***Service-Specific Process Area, ****Service Specific Process Area Addition**