Introduction to The Capability Maturity Model Integration®

SES CMMI® Training Series
June, 2009

Software Engineering SERVICES

Agenda

- What is CMM®/CMMI®?
- Process Maturity
- CMM® vs. CMMI®
- CMMI® Basics
- Process Maturity and SES Personnel
- Implementing Process Improvement

Software Engineering SERVICES

Agenda

→What is CMM®/CMMI®?

- Process Maturity
- CMM® vs. CMMI®
- CMMI® Basics
- Process Maturity and SES Personnel
- Implementing Process Improvement

Software Engineering SERVICES

Birth of the Capability Maturity Models (CMM®)

- Capability Maturity Models (CMM®)
  - Software/system process framework
  - common-sense proven software/system practices
- CMM® based on:
  - Process management concepts of well-known guru's like Crosby, Deming, Juran,...
  - over 30 years of similar/commonly known software problems
  - improvements to CMM® have been made continually via:
    - knowledge acquired from software process assessments
    - extensive feedback from industry and government
- CMM® Main Objective:
  - help organizations achieve sufficient maturity to manage technology introduction

Software Engineering SERVICES

Software Engineering Institute (SEI™) Establishment

- Software Engineering Institute (SEI™) established in 1984
  - by federal government at Carnegie Mellon University in Pittsburgh, PA
  - to address software engineering unpredictability and high failure rate
- SEI Mission
  - To provide leadership in advancing the state of the practice of software engineering to improve the quality of systems that depend on software
  - Reason for establishment
    - Software engineering community lacked a shared view of the state of practice or agreement about what constitutes good practice
    - Development activity and resulting products were unpredictable
    - Success or failure was ***totally dependent on the staff assigned***

"One way to measure the capability of a software organization is to observe what it does in a crisis. That is when good practices are important..." Watts Humphrey

Software Engineering SERVICES

Agenda

- What is CMM®/CMMI®?
- →Process Maturity
- CMM® vs. CMMI®
- CMMI® Basics
- Process Maturity and SES Personnel
- Implementing Process Improvement

Software Engineering SERVICES

Process Maturity

- What is Process?
  - Various Familiar Definitions
    - Webster's definition (as related to software): "1. A systematic series of actions directed to some end."
    - IEEE definition: "a sequence of steps performed for a given purpose."
    - SEI definition (93-TR-24), p. 3: "…set of activities, methods, practices, and transformations that people use to develop and maintain software and the associated products."
  - Processes:
    - enables engineers to do their job much more effectively.
    - allows engineers to concentrate on resolving the technical issues.
    - gives engineers the tools they need to benefit from the lessons learned by others.

Software Engineering SERVICES

Process Maturity

- What is Process Maturity?
  - puts the focus on process as well as product
  - consistent method for getting work done
  - gives managers & engineers defined, documented, continuously improving processes:
    - well understood
    - well used
    - living
  - visibly supported by management and all staff
  - well-controlled with audits to ensure proper use and enforcement
  - measurements manage products & processes

Software Engineering SERVICES

Process Maturity

- Why is Process Maturity Important?
  - Immature organizations rely on their current practitioners
  - About 85% of the problems are caused by the system, not the people
  - Most organizations are constantly fighting fires
    - project staff are constantly reacting with no time for improvements
    - firefighters eventually get burned out
    - even though the ember may get rekindled later, they are working in a reactive mode as opposed to the more successful proactive mode

Software Engineering SERVICES

"If builders built like programmers program, a woodpecker could destroy civilization!"
Gerald Weinberg

Process Maturity & CMM®

- Why use the CMM®?
  - "Just a good way to do business"
  - Common-sense practices proven successful
  - Good foundation for improvements
  - Great tool for maturing organizations & projects
  - Allows freedom to develop & improve over time
  - Unique processes to meet organizations unique needs
  - Builds culture based on proven common practices

Software Engineering SERVICES

Process Maturity

- Benefits of Process Maturity
  - People develop more fully to their potential and are more effective within the organization
  - There is a much greater likelihood of developing successful products on time and budget
  - There is an increased likelihood of successful introduction of new technology, techniques, & tools
  - Due to defining, measuring, and controlling of processes, improvements are more successful and more likely to be sustained over time

Software Engineering SERVICES

Process Maturity

- Barriers to Process Maturity
  - Organizational politics
  - Overly ambitious
  - Major reorganizations
  - Previous failures
  - Hinders ‘real work’ attitude
  - Executive turnover
  - Paperwork approvals
  - Declined market
  - Turf guarding

at

Software Engineering SERVICES

Process Maturity

- Enhancers for Process Maturity
  - Executive emphasis and monitoring
  - Assigned responsibility
  - Respected Process Group
  - Involvement of technical staff in process improvement
  - Adequate resources
  - Clear goals established

Software Engineering SERVICES

Agenda

- What is CMM®/CMMI®?
- Process Maturity
- →CMMI® vs. CMM®
- CMMI® Basics
- Process Maturity and SES Personnel
- Implementing Process Improvement

Software Engineering SERVICES

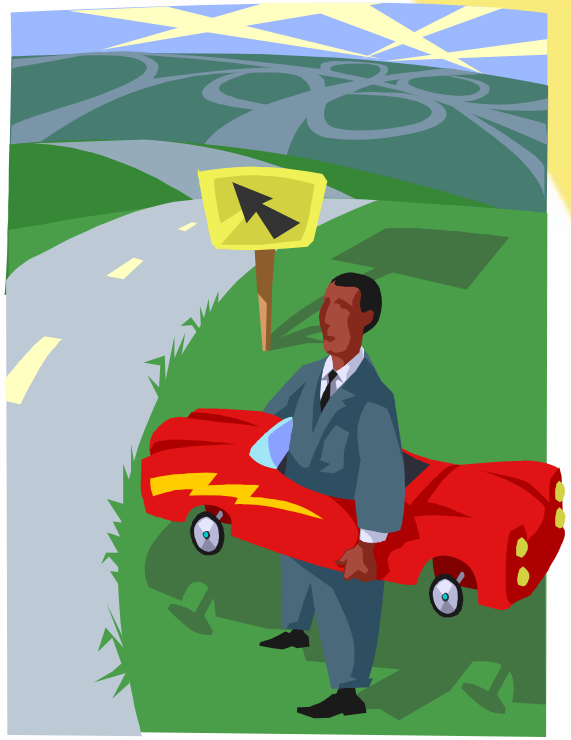
CMMI® vs. CMM®

- SEI℠ established in 1984
- CMM® published in 1991
- CMMI® published in 2000
  - merged several models into a coherent model
  - collaborative effort between the SEI, government, and industry representatives
  - main objective: develop an integrated model that is consistent with as many other well-known models as possible

Software Engineering SERVICES

CMMI® vs. CMM®

- Why CMMI®?
  - Explosion of CMMs® and CMM®-like models
  - Multiple models within an organization
  - Multiple assessments
  - Multiple training
  - Multiple expenses
  - Multiple concepts
  - Differing terminology



Software Engineering SERVICES

Agenda

- What is CMM®/CMMI®?
- Process Maturity
- CMM® vs. CMMI®
- →CMMI® Basics
- Process Maturity and SES Personnel
- Implementing Process Improvement

Software Engineering SERVICES

CMMI Basics

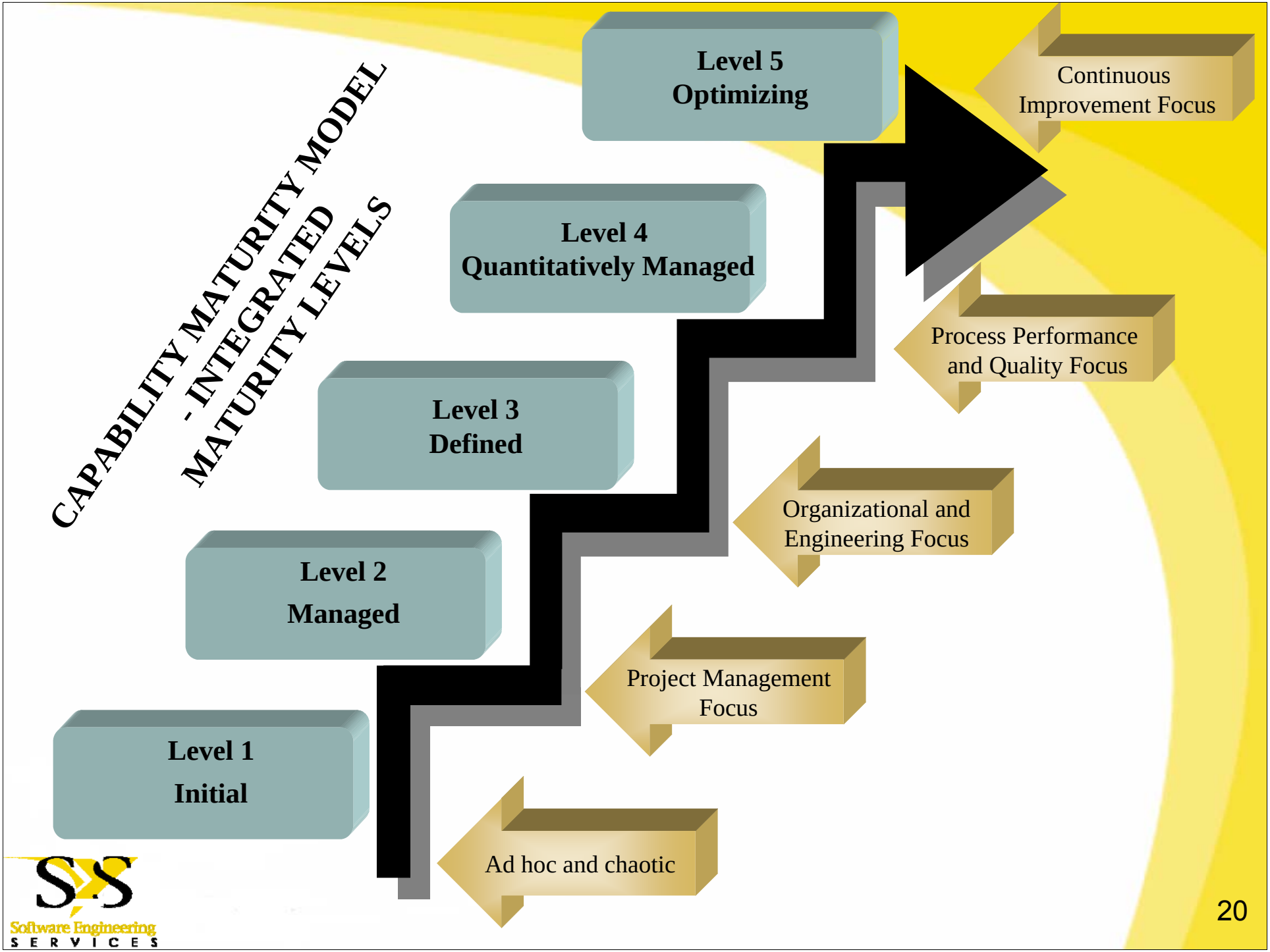
- Three Constellations
  - CMMI-DEV
  - CMMI-AQC released in Nov 2007
  - CMMI-SVC released in Feb 2009
- All three constellations have:
  - 6 capability levels and 5 maturity levels that share the same names
  - 16 core process areas
  - additional unique process areas

Software Engineering SERVICES

CMMI Basics

- Maturity Levels
  - Well-defined evolutionary plateaus on the path toward becoming a mature software organization.
    - Each level is a layer in the foundation
    - 5 maturity levels:
      - Initial, Managed, Defined, Quantitatively Managed, Optimizing
    - Maturity levels are composed of Process Areas (PAs)

Software Engineering SERVICES



Software Engineering
SERVICES

Maturity Model Based on Kim Caputo's CMM® Level Definitions

Optimizing (5) "insight"

Organization is analogous to the weather satellite missile guidance system. Because laser bomb missiles can experience problems in bad weather, an advanced system uses up-to-date data from a weather satellite to guide missiles to their target

Managed (4) "foresight"

Organization is analogous to the capability of the laser bomb missile. The laser pinpoints the desired target, and the missile is activated to hit the target with pinpoint accuracy. Level 4 organizations can use what it sees from its current perspective to predict what to expect in the future, then take appropriate action to target the desired result. Essentially, they know what to do with information they've observed. This takes more than good eyesight it takes **foresight**.

Defined (3) "good eyesight"

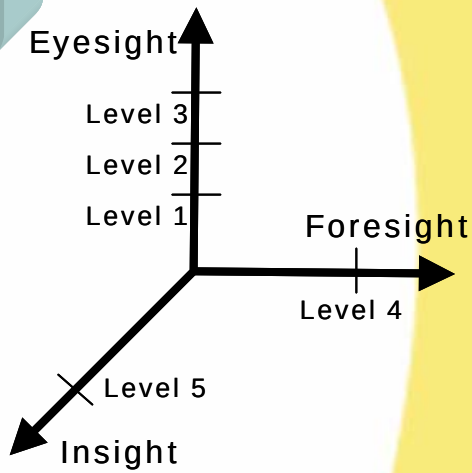
Organizations have 20/20 vision with an increased field of vision. With their peripheral vision, they can see the whole picture and can select and deploy the appropriate skills and resources to solve problems. This is equivalent to the defense term "total battlespace awareness": they know where the friendlies are, distinguish friend from foe, and coordinate to support friendlies and eliminate foes using the most appropriate force to do the job.

Repeatable (2) "lights are on"

Organizations have improved vision. Basically, "the lights are on," and they can see what they are doing. However, they tend to suffer from another problem: tunnel vision.

Initial (1) "in the dark"

Organizations suffer from poor eyesight. Basically, they are doing projects "in the dark"



Software Engineering SERVICES

CMMI-DEV, V1.2

Maturity Level	Focus	Process Areas
5 Optimizing	**Continuous Improvement**	Organizational Innovation and Deployment Causal Analysis and Resolution
4 Quantitatively Managed	**Process Performance and Quality**	Organizational Process Performance Quantitative Project Management
3 Defined	**Organizational and Engineering Processes**	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution
2 Managed	**Project Management**	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
1 Initial	**Ad hoc and chaotic**	

Software Engineering SERVICES

CMMI-SVC, V1.2

Maturity Level	Focus	Process Areas
5 Optimizing	**Continuous Improvement**	Organizational Innovation and Deployment Causal Analysis and Resolution
4 Quantitatively Managed	**Process Performance and Quality**	Organizational Process Performance Quantitative Project Management
3 Defined	**Organizational and Service Establishment & Delivery**	**Capacity and Availability Management** **Service Continuity** **Incident Resolution and Prevention** **Service System Transition** **Strategic Service Management** ***Service System Development*** Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Risk Management Decision Analysis and Resolution
2 Managed	**Project Management**	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management **Service Delivery**
1 Initial	**Ad hoc and chaotic**	

Software Engineering SERVICES

CMMI® Basics

- Some important clarifications:
  - Practices describe **what** is to be done, but should NEVER be interpreted as mandating **how**
  - Subpractices, typical products, practice notes, references, elaborations, amplifications are for informative purposes only

Software Engineering SERVICES

Agenda

- What is CMM®/CMMI®?
- Process Maturity
- CMM® vs. CMMI®
- CMMI® Basics
- →Process Maturity and SES Personnel
- Implementing Process Improvement

Software Engineering SERVICES

Process Maturity and SES Personnel

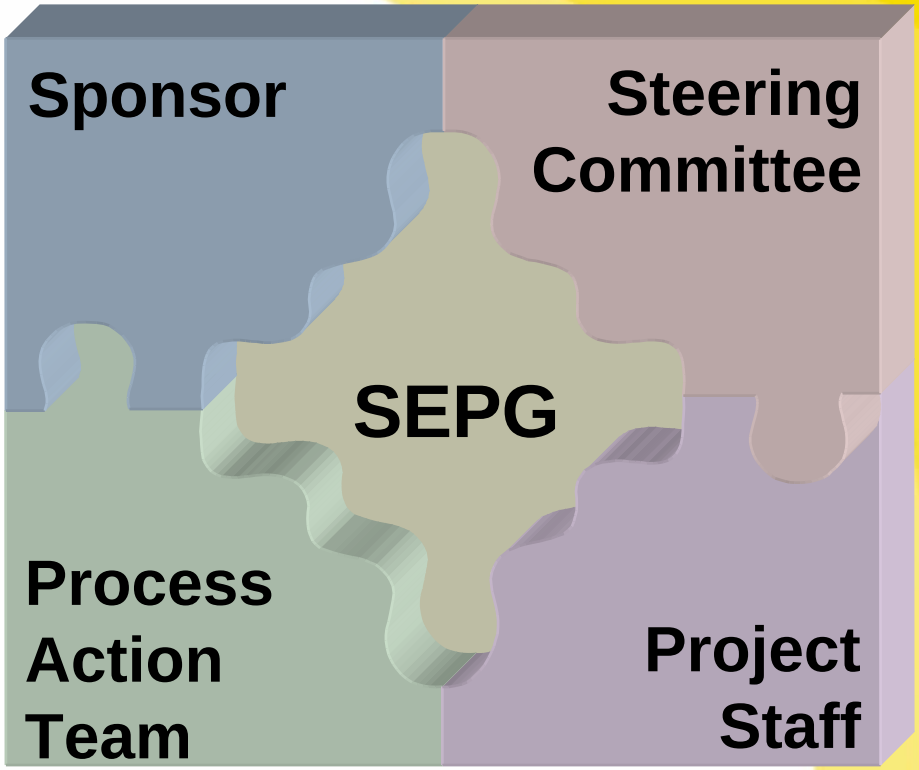
SEPG: Focal point for process improvement efforts.

Sponsor: Executive/senior managers that set the direction for continuing process improvement.

Steering Committee: Small management group that establishes and monitors the SEPG and their activities.

Process Action Team: Groups or teams of appropriately skilled staff to tackle specific issues/process improvement tasks.

Project Staff: Staff making teams that implement projects.



Software Engineering SERVICES

"If we don't change our direction we will end up where we're headed"

Process Maturity and SES Personnel

SES uses a Process Management Group (PMG) as their SEPG. This name was adopted to emphasize that software is not our only focus.

The PMG is chartered to maintain processes for each process area of the CMMI®, to train CMMI® subjects, and to assist project personnel in adopting and tailoring processes for use on their projects.

The PMG is SES's focal point for process improvement.

Software Engineering SERVICES

"If we don't change our direction we will end up where we're headed"

Process Maturity and SES Personnel

- PMG Role and Responsibilities
  - Establish process standards
  - Develop improvement plans
  - Form Process Action Teams
  - Launch improvement activities
  - Manage all the improvement projects
  - Work with projects on project processes and tailoring activities
  - Report progress and issues to steering group
  - Maintain process databases
  - Serve as the focal point for technology transition
  - Provide project consultation
  - Make periodic assessments and status reports for senior management
  - Provide process training organization and projects

Software Engineering SERVICES

Process Maturity and SES Personnel

- SES Process Group Meetings
  - Meetings are held monthly, for about 1 hour
  - Everyone participates - interactive, not presentation
    - Some initial training
  - Process Action Teams will be established as needed
  - Actions will be assigned and tracked
  - Typical agendas
    - Scheduling, planning, & statusing
    - Training
    - Measurement reporting
    - Special topics
    - Action item review

Software Engineering SERVICES

Agenda

- What is CMM®/CMMI®?
- Process Maturity
- CMM® vs. CMMI®
- CMMI® Basics
- Process Maturity and SES Personnel

→Implementing Process Improvement

Software Engineering SERVICES

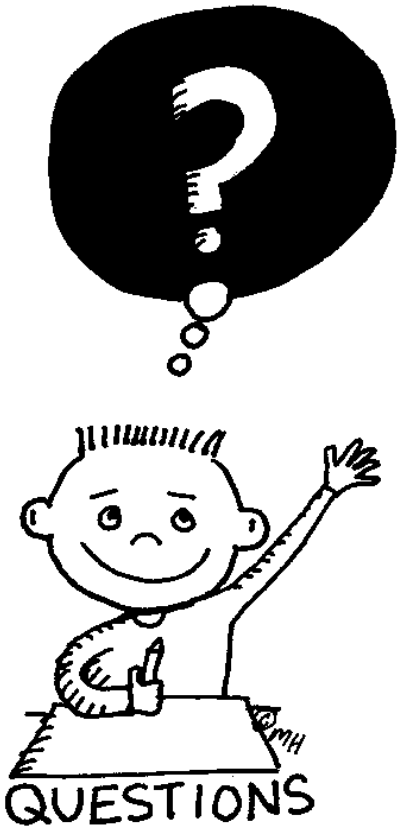
Implementing Process Improvement

- Software Process Improvement is a Project!
  - organized and managed
  - managed schedule with clear milestones and deliverables
  - resources must be allocated (people, computers, etc.)
  - ongoing reviews, planning, etc
  - clear expectations from management
  - publicly supported and recognized by executive management
  - supported and recognized by staff

"I hear and I forget, I see and I remember, I do and I learn."
Confucius, Chinese philosopher, 500BC

Software Engineering SERVICES

Summary and Q&A



Software Engineering
SERVICES

CMMI vs. CMM

- SEI Defined Benefits from CMMI:
  - Efficient, effective assessment and improvement across multiple process disciplines in an organization
  - Reduced training and assessment costs
  - A common, integrated vision of improvement for all elements of an organization
  - A means of representing new discipline-specific information in a standard, proven process improvement context
- Other Benefits
  - Some companies experiences, up to Level 4, were rolled into CMMI which was not available for SW-CMM
  - Inputs from the reader and user community were incorporated

Software Engineering SERVICES

CMMI Basics

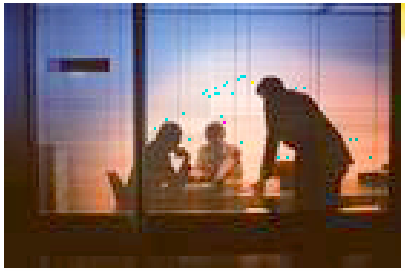
- What the CMMI does NOT cover
  - All software/system process and quality improvement issues
  - Some issues are addressed only indirectly or by implication, including:
    - specific tools, methods, and techniques
    - concurrent engineering and teamwork
    - system engineering, marketing, etc.
    - human resources
    - organizational behavior

Software Engineering SERVICES

CMMI Basics

- Level 1 Initial Features
  - Processes ad hoc and chaotic
  - Unstable organizational environment
  - Project success is based on hero and competence of staff
  - Even though products work most of the time, projects exceed budget and schedule
  - Processes abandoned during crisis
  - Over commitment of resources

Software Engineering SERVICES



CMMI Basics

- Level 2 Managed Features
  - Requirements are managed
  - Processes planned, performed, measured, and controlled
  - Processes implemented even during times of crisis
  - Projects managed according to documented plans
  - Products and services are visible to management via statusing
  - Work products reviewed with stakeholders and they satisfy established requirements, standards and objectives

Software Engineering SERVICES

CMMI Basics

- Level 3 Defined Features
  - Processes well-characterized and understood
  - Processes established and improved over time
  - Processes consistent throughout the organization
  - Organizational processes tailored by projects based on established organizational tailoring criteria
    - Important distinction between Level 2 and 3
  - Processes more detailed and followed rigorously
  - Processes proactively managed by organization

Software Engineering SERVICES

CMMI Basics

- Level 4 Quantitatively Managed Features
  - Statistical and quantitative processes used to control selected subprocesses
  - Quality and process performance criteria established and used to manage processes
  - Process variations identified and sources corrected
  - Quality and performance measures incorporated into organizational measurement repository
  - Key is predictability

Software Engineering SERVICES

CMMI Basics

- Level 5 Optimizing Features
  - Processes continually improved based on quantitative measures and understanding of causes of variation
  - Focus on incremental and innovative technological improvements
  - Process improvement objectives established for organization
  - Business objectives continuously revised to reflect changes
  - Common causes of variations is key as opposed to concentration on special causes

Software Engineering SERVICES

The People Side of CMM

SEI Definition of the SEPG:

"The software engineering process group is the focal point for process improvement. Composed of line practitioners who have varied skills, the group is at the center of the collaborative effort of everyone in the organization who is involved with software engineering process improvement. Group size is usually equal to 1-3% of the development staff. Because the process group is small, it relies upon outside support, in particular, the support of a steering committee and technical working group."

Software Engineering SERVICES

The People Side of CMM

- Common Problems Establishing Process Groups
  - Too large teams
    - Too many cooks spoil the meal
    - Team must be small enough to make decisions and act upon them
  - Lack of some Full-Time Process Professionals
    - Need dedicated team focused on accomplishing the process improvement goals
    - Team of part-time workers can become large and unwieldy hence lacking focus on what needs to be accomplished
    - Some part-time members balanced against at least one full-time member of the Process Group
    - Sends a very loud signal to the organization, the improvement project is not “real work”

Software Engineering SERVICES

Anyone can hold the helm when the sea is calm.

The People Side of CMM

- Process Groups Common Problems
  - Anyone who wants to be on the team can
    - Select the right people for the Process Team
    - Just because process improvement means that everyone is involved it does **not** mean that everyone should be part of the improvement team
    - Team should not be run as a democracy
  - Lack of empowerment
    - Must be empowered with the authority to make the appropriate changes
  - Entire process team must be synergistic
  - PMG must work closely with programs rather than "throwing things over the fence"
  - PMG MUST be proactive

Software Engineering SERVICES

"Make a decision! Make a decision! People are dying all around you!"
Christopher P. Higgins (based on his Army experience),
Bank of America National Manager Currency Services

The People Side of CMM

- Selecting the right people
  - The skill of the members of the various infrastructure roles is critical
    - One bad apple can spoil the batch
    - People are key the success of the improvement effort
    - The Process Group team members often makes the difference between whether the improvements are actually undertaken with the benefits realized or the effort is wasted.

"WHEN PEOPLE are highly motivated, it's easy to accomplish the impossible. And when they're not, it's impossible to accomplish the easy."

-- BOB COLLINGS

Software Engineering SERVICES

Makeup of a Successful Process Group Member

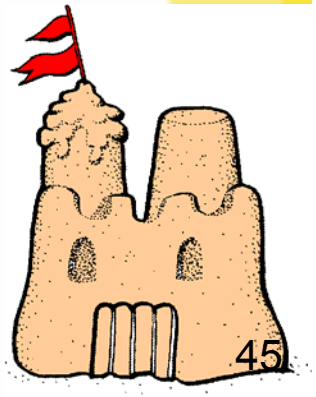
- Software/Systems Engineering Background
- Confident without huge ego
- Proactive and willing to take reasonable chances when necessary
- Organized/Ability to organize without over-organizing (avoid bureaucracy)
- Visible, respected member of the organization
- Easy-going but not too easy-going that things don't get done
- Ability to communicate at all levels from managers to practitioners
- Ability to interpret explanations made by both management and practitioners
- Non-argumentative
- Detail oriented
- Good listener, open to others opinion
- Strong without being overbearing
- Willing to bend when necessary and knowing when it's necessary
- Totally committed to process improvement and the organization
- Immense drive/motivation and ability to drive others
- Ability to work in stressful situations
- Able to withstand criticism from all levels (both internal and external to the organization)
- Ability to keep a proper perspective (don't get angry)
- Focused
- Adaptable - "roll with the punches"
- Never lose sight of goals
- Creditability with senior management and even more important practitioners
- Ability to maintain confidentiality
- Ability to lead as well as follow (recognize when each is appropriate)
- Ability to become an "expert" in many different areas not normally field of expertise - may have to be self-taught

Software Engineering SERVICES

"I want to build sand castles and leave. I don't want to be there when it needs to be painted. I want to hand it over and go on to the next one."

Sherry Higgins ,

Top Gun at Lucent Technologies



Software Engineering SERVICES

Implementing Process Improvement

- Plan-Do-Study-Act (PDSA) Cycle
  - W. Edwards Deming introduced the concept in Japan subsequently it was called the Deming cycle.
    - Mechanism for perpetual change
    - Also called Shewhart Cycle for Learning and Improvement
  - Four-step quality improvement process
    - ***Plan*** - a plan to effect improvement is developed.
    - ***Do*** - the plan is carried out, preferably on a small scale.
    - ***Check*** - the effects of the plan are observed.
    - ***Act*** - results are studied to determine what was learned and what can be predicted.

Software Engineering SERVICES

Deming Cycle

Act

- three options:
  - adopt the change
  - abandon the change
  - modify your prediction or rerun the cycle with different variables (environment, materials, people, rules)

Plan

- study the process
- recognize the opportunity
- define the opportunity
- gap between the customer needs and the process performance
- define the theory on how to realize the opportunity
- statement of theory, an idea
- plan for a test, comparison, or experiment
- choice between several suggestions
- predict the outcome -- form an hypothesis

Check [Study]

- observe the test results
- use statistical methods where possible
- do they correspond with the hopes and expectations
- how does it affect your ability to predict tomorrow's results?

Do

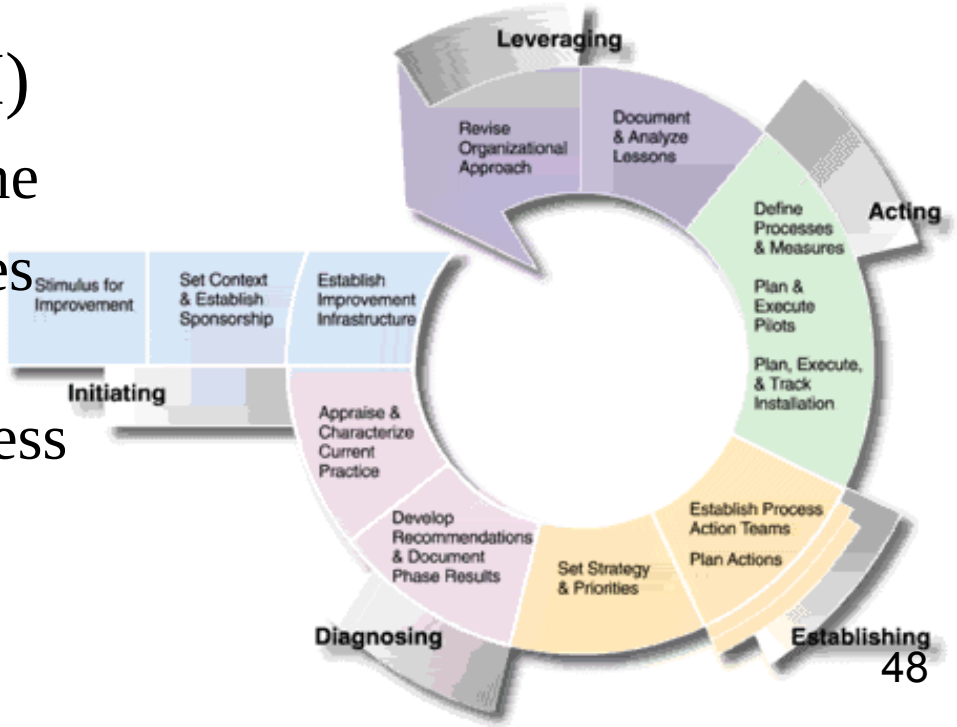
- test the theory to achieve the opportunity (carry out the test, comparison, or experiment)
  - preferably on a small scale
  - according to the plan
- test on customers to
  - increase satisfaction by educating them
  - improve your understanding of customer expectations

Implementing Process Improvement

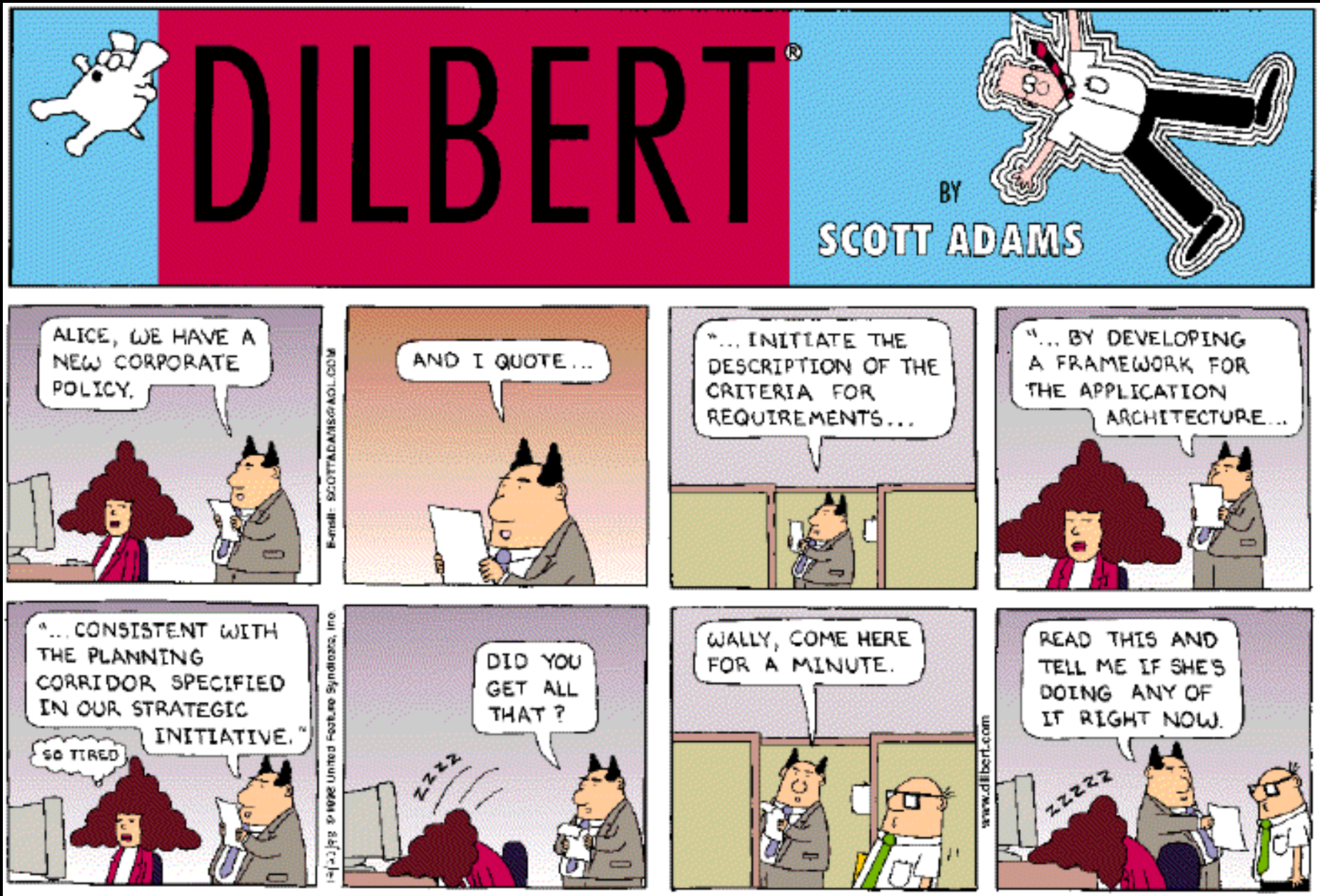
IDEAL(SM) Model is an adaptation of the Deming Cycle

Created by Software Engineering Institute (SEI)

- Model has evolved over time
- Outlines five different stages in the iterative improvement process
- Provides roadmap for Process Improvement



Software Engineering SERVICES



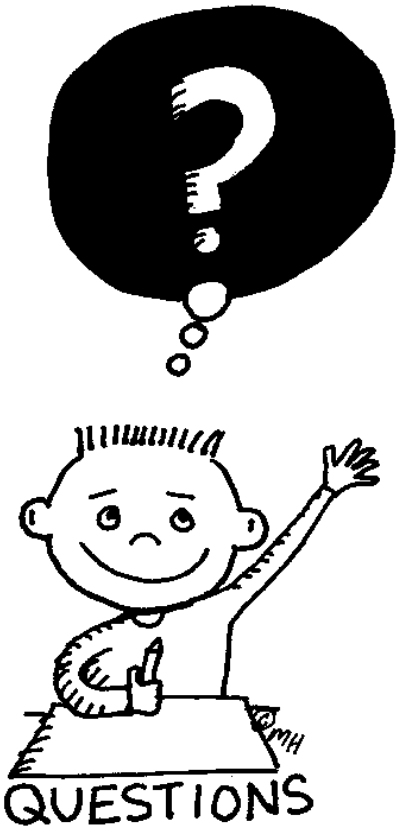
Capability Im-Maturity Model (CIMM)

Level Characteristic	Description
0. Negligent Indifference	Failure to allow successful development process to succeed. All problems are perceived to be technical problems. Managerial and quality assurance activities are deemed to be overhead and superfluous to the task of software development process. Reliance on silver pellets.
-1. Obstructive Counter Productive	Counterproductive processes are imposed. Processes are rigidly defined and adherence to the form is stressed. Ritualistic ceremonies abound. Collective management precludes assigning responsibility. Status quo
-2. Contemptuous Arrogance	Disregard for good software engineering institutionalized. Complete schism between software development activities and software process improvement activities. Complete lack of a training program.
-3. Undermining Sabotage	Total neglect of own charter, conscious discrediting of peer organizations software process improvement efforts. Rewarding failure and poor performance.

Crosstalk Journal, Nov. '96, "The Capability Im-Maturity Model (CIMM)" by Capt. Tom Schorsch, *U.S. Air Force*

Software Engineering SERVICES

Q& A?



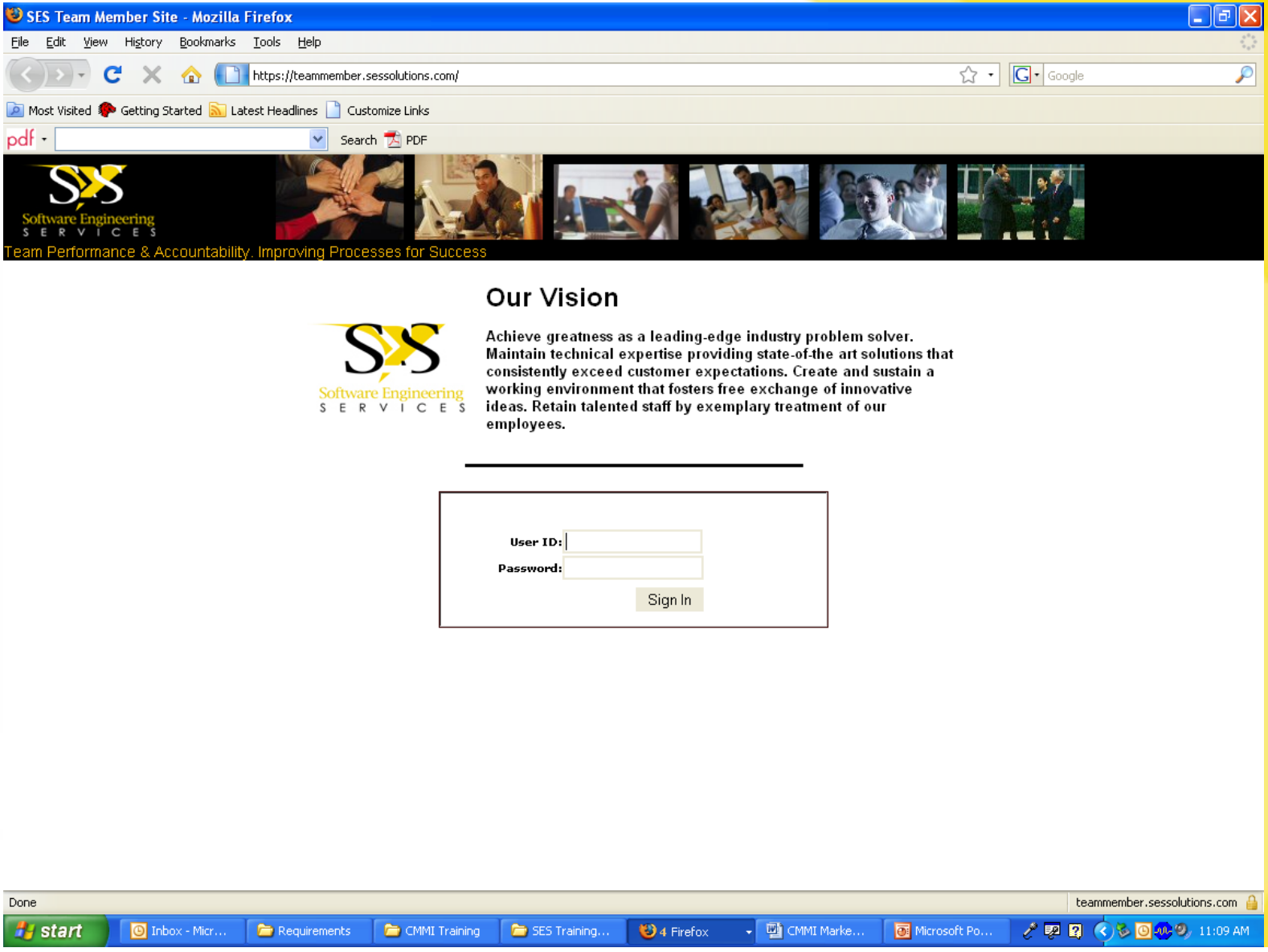
Software Engineering
SERVICES

Remember Quiz

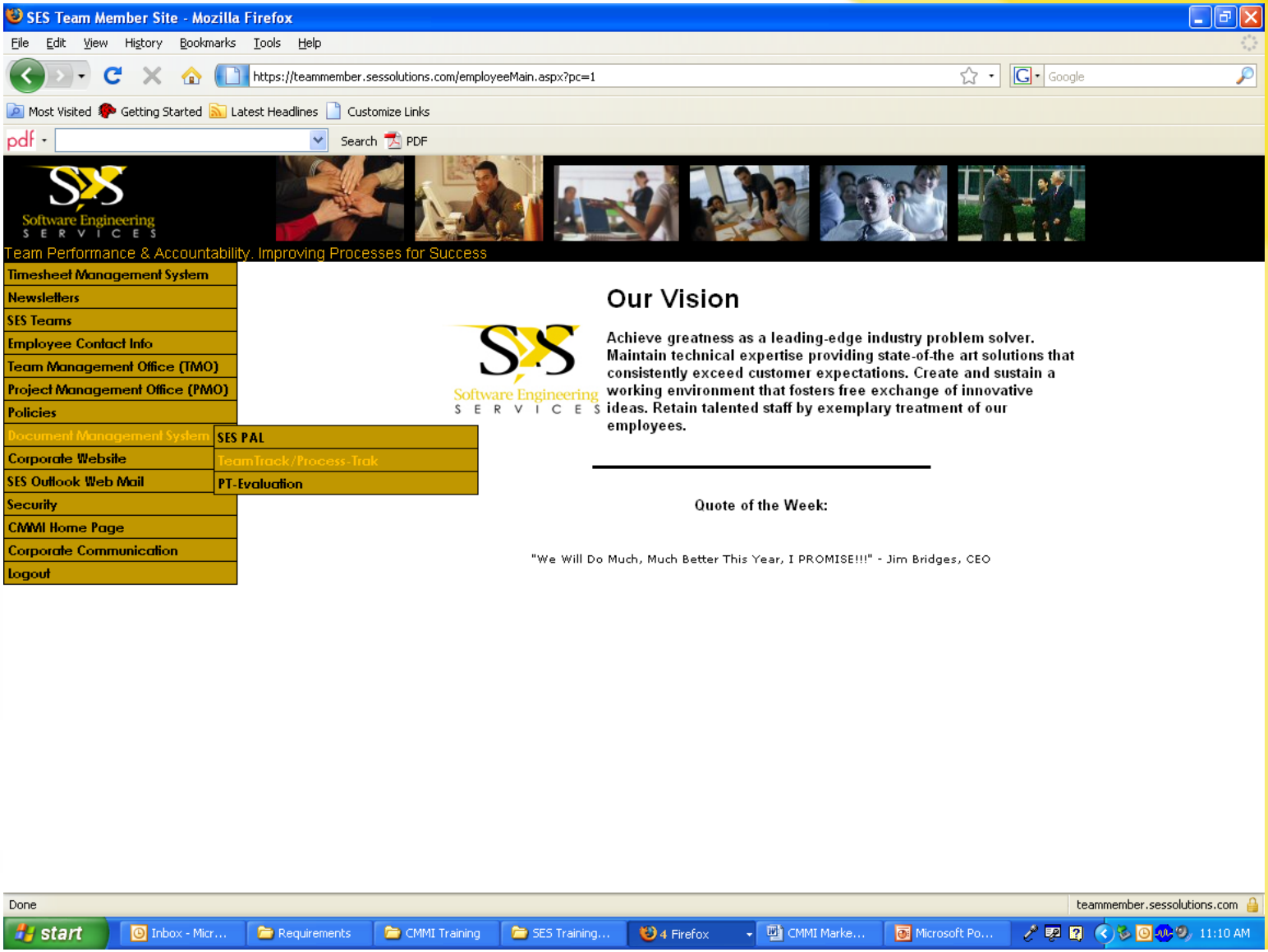
- Reminder that you have to take the quiz within two weeks after you attend the training
- To access the quiz, follow the steps on next few slides

Software Engineering SERVICES

Log in to team member website

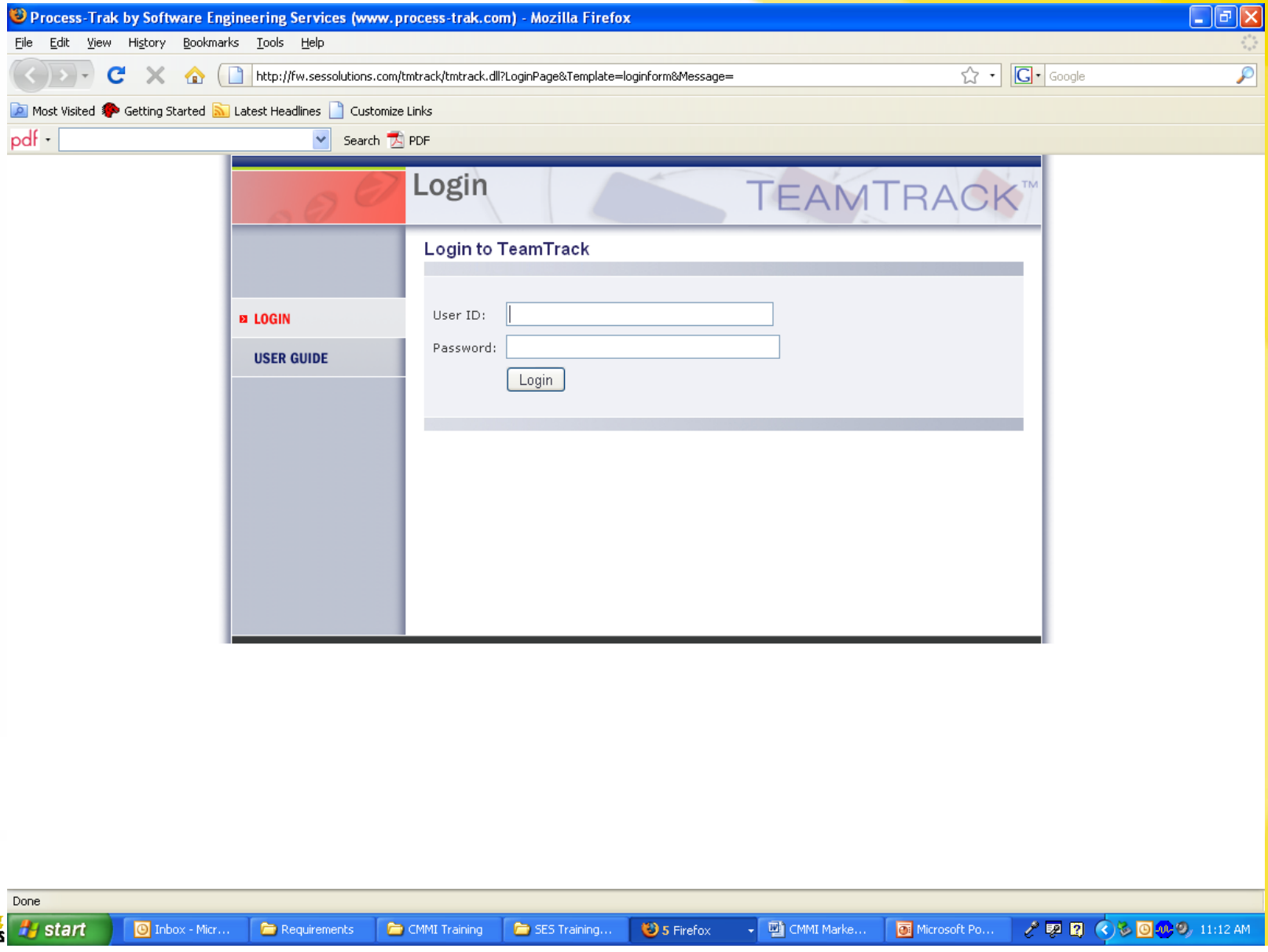


Click-> Document Management System-> TeamTrack /Process-Trak



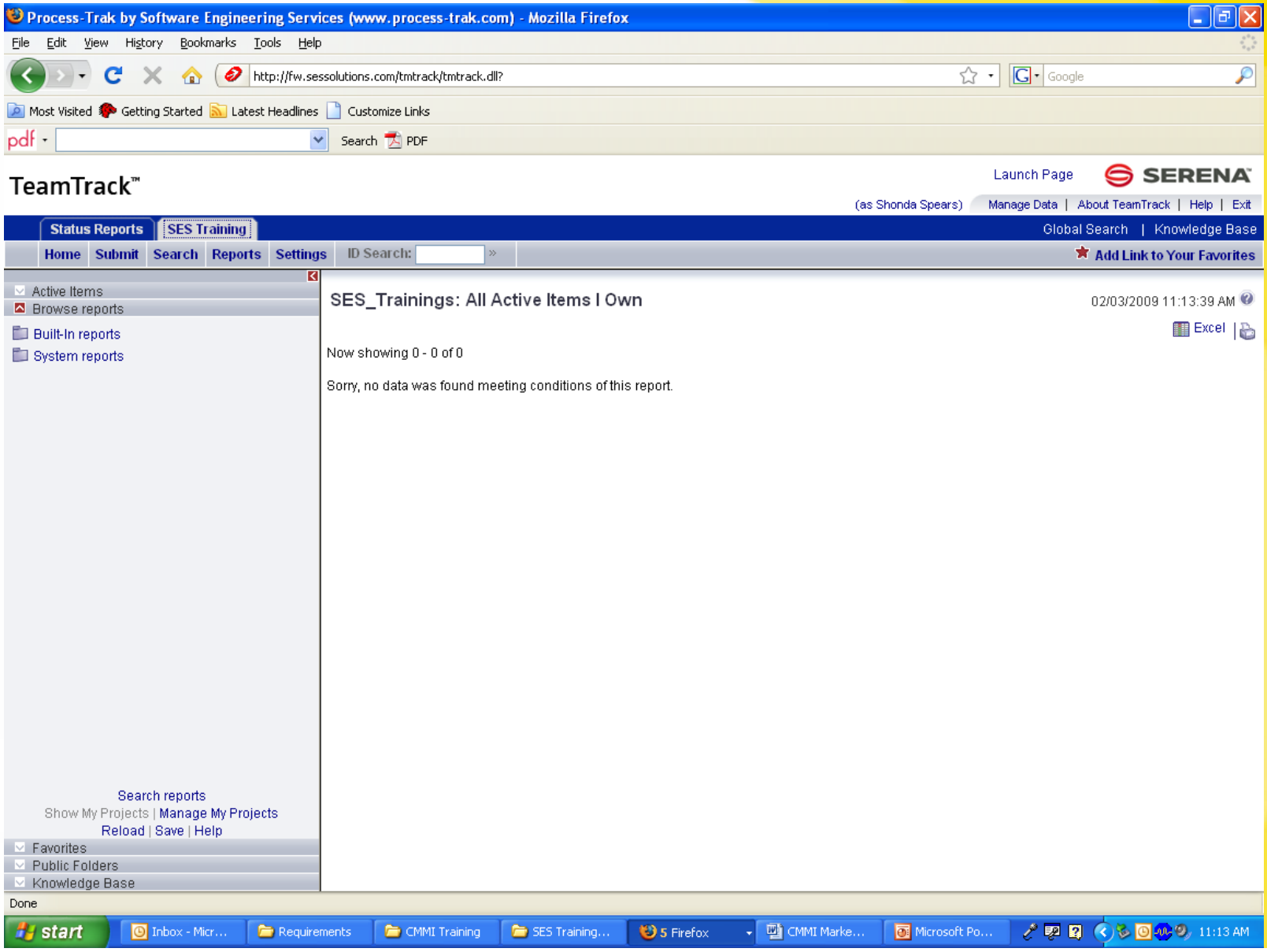
Software Engineering SERVICES

Login to TeamTrack



Software Engineering SERVICES

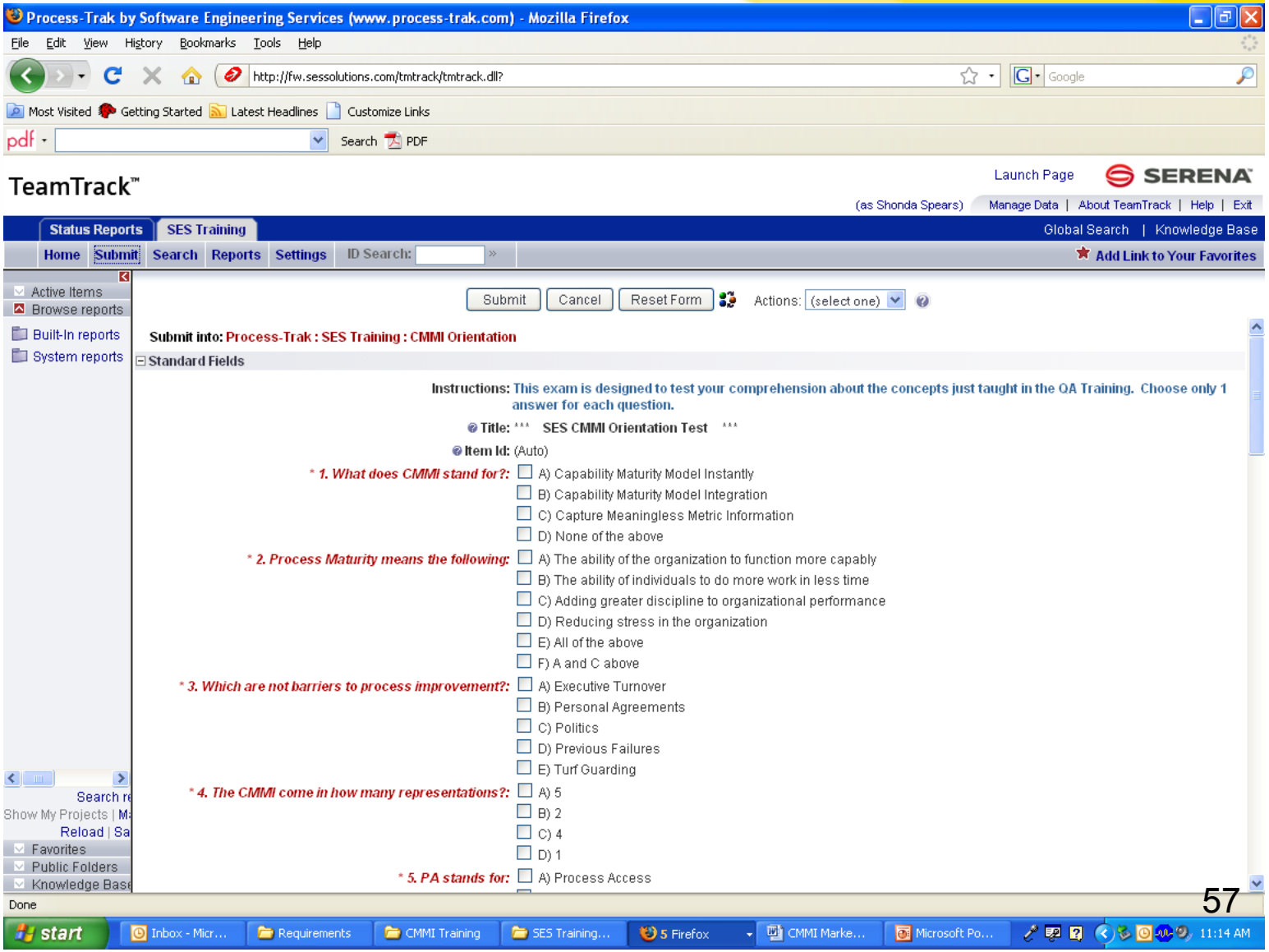
Logged in as Shonda Spears



Software Engineering SERVICES

Answer Multiple Choice Questions

After you have answered all 25 questions, click submit to complete your quiz.



Software Engineering SERVICES

Further Info

CMMI Homepage

https://teammember.sessolutions.com/sescmmi.aspx

Quiz Page

http://fw.sessolutions.com/tmtrack/tmtrack.dll?

- Raj Sharma- rsharma@sessolutions.com
- Norm Mandy- nmandy@sessolutions.com

Software Engineering SERVICES