



Using Lean Six Sigma to Accelerate CMMI[®] Implementation



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Objectives



- Overview of Capability Maturity Model Integration (CMMI), Lean, and Six Sigma and how they combine in practice
- Why the Army is adopting Lean Six Sigma (LSS)
- How the CECOM Software Engineering Center (SEC) intends to leverage LSS to accelerate CMMI implementation to support the Warfighter



CMMI



- Constellation of models for development, acquisition, and services
- Transcends disciplines (software, hardware, systems) to eliminate stovepipes and use an integrated approach
- Emphasizes process as a means to achieving quality (over people and technology)
- Collection of best practices which, when adopted/adapted can result in:
 - Predictable cost/schedule estimates
 - Lower project risks
 - Better addressing the customer's requirements
 - Greater chance of project completion



What is Lean?



**That's lean,
not lean!**

- Customer-focused process improvement methodology
- Identifies Customer Value-Added, Business Value-Added, and Non-Value-Added (NVA) steps in a process
- Improve process by eliminating NVA steps (waste)



**That's waste,
not waist!**



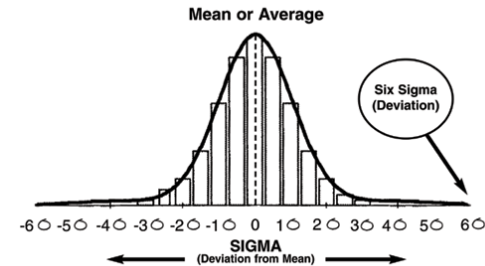
Waste - TIMWOOD



- **T**ransportation – moving material/product from one place to another
- **I**nventory – material/product waiting to be processed
- **M**otion – excess movement
- **W**aiting – delays caused by shortages, approval, or downtime
- **O**verproduction – producing more than is needed
- **O**verprocessing – adding more value than the customer is willing to pay for (e.g., gold-plating)
- **D**efects/Rework – correcting mistakes



6σ



- Quality-focused process improvement methodology used to **reduce cost by improving quality**
- Uses the DMAIC roadmap:
 - **Define** – define your business problem and create a process map
 - **Measure** – identify critical to quality inputs and outputs (e.g., cost, schedule) and collect data to establish baselines for the current process
 - **Analyze** – calculate your process efficiency/performance and identify root causes for inefficiencies
 - **Improve** – develop and implement pilot solutions
 - **Control** – launch implementation, develop process control plans, and hand off control to the process owner

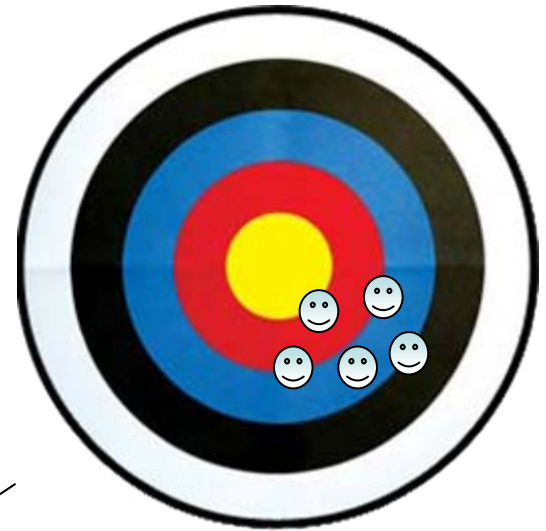
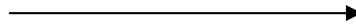


Six Sigma Focuses on the Elimination of Variation and Improving Performance

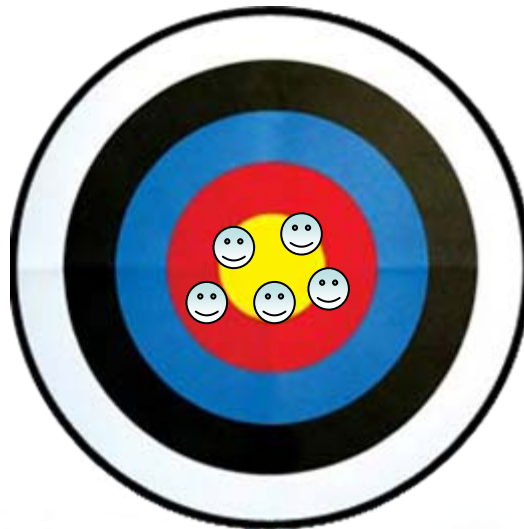


Process has more variance and is less under control.

First get process under control and get a handle on it. Then move it onto target.



Process has less variance but still missing the bulls eye = not completely under control.



Process has little variance and reaches target = under control



Lean and Six Sigma – Perfect Together



- Customer and quality focused process
- Simplifies the process, reducing cost and schedule
- Increases quality





Lean Six Sigma and the Army - 1



AMC Leadership Message



General Benjamin Griffin, Commanding General, U.S. Army Materiel Command

"Our theme. . .to be faster, more agile, less bureaucratic. . .must fight this everyday, was adopted for one reason: better support to the Warfighter. It is our duty to improve quality, speed, and agility and eliminate waste in both our industrial and administrative processes. AMC will continue aggressive implementation of Lean Six Sigma with a sense of duty that demands we relentlessly strive to improve our support to the Joint Warfighter and Army transformation. Our effort stresses success stories, aggressively adopts lessons learned, and seeks leaders who are willing and able to change the way we are doing business."

» [Lean Six Sigma Policy Signed by General Griffin - May 2005](#)

AMC LSS Knowledge Center

- Deputy Under Secretary of the Army issued the Lean Six Sigma Deployment Order 071700 April 2006 to implement LSS throughout the Department of the Army



Lean Six Sigma and the Army - 2

- General Griffon briefed at the Industrial Base Conference in August 2005 about the transformation of the Army Materiel Command (AMC)
- Focus on end-to-end supply chain processes
 - Solve the customer's (Warfighter's) problems **completely** by insuring that all goods and services work, and work together
 - **Don't waste** the customer's **time**
 - Provide **exactly what** the customer wants
 - Provide what's wanted **exactly where** it's wanted
 - Provide what's wanted **exactly when** it's wanted
 - Continually aggregate solutions to **reduce** the customer's **time and hassle**





SEC's Implementation



- Independent sub-organizations implemented SW-CMM and CMMI
 - Fort Huachuca SW-CMM Level 3
 - Fort Monmouth SW-CMM Level 3
 - Fort Sill CMMI Maturity Level 5
- In 2003, SEC began a CMMI process improvement initiative at the enterprise level by performing a gap analysis
- A CMMI infrastructure was staffed to work on the gaps
 - Leverage our assets
 - Institutionalize our best practices
- SEC-wide appraisal achieved Maturity Level 2 in August 2007
- SEC's continuous process improvement goals include
 - Continuing CMMI-based improvement – achieve Maturity Level 3
 - Introducing Lean Six Sigma improvement projects



Lean Six Sigma With CMMI



- SEC merged CMMI and LSS into one process improvement organization
 - CMMI Management Steering Group
 - LSS Deployment Director
- Major sub-organizations within SEC are developing customer-focused process improvement plans including CMMI & LSS
- LSS initiative is training a cadre of LSS Green Belts and Black Belts
- Process improvement organization looking for LSS project opportunities
 - Assign Green Belts and Black Belts to projects



CMMI Implementation Lessons Learned



- Collected 814 lessons learned from stakeholders
- Lessons learned data revealed many challenges and opportunities to be addressed
- Stratified lessons learned data into categories

Process Area Descriptions
Process Area Implementation
Training
Roles
Appraisal

- Prioritized lessons learned data



LSS Implementation

Define

- Select Project
- Charter
- Form LSS team
- SIPOC
- Value Stream Map

Measure

- Survey relevant stakeholders as to their areas of pain – VOC
- Establish metrics

Analyze

- Analyze metrics
- Find non-value added activities

Improve

- Eliminate non-value-added steps
- Pilot “leaned” process
- Solicit feedback from pilot recipients

Control

- Implement improved process throughout SEC
- Monitor using improved metrics
- Turn over to Process Owner



LSS Project - Selection



- Selected Process and Product Quality Assurance (PPQA) Process Area (PA)
 - Collected Voice of the Customer (VOC)
 - Based on a review of lessons learned and Project Leaders' feedback
 - “...it seems that the checklist and the Process Description are too broad. Also, repeated questions that are already covered in other process areas should be removed.”
 - “...early involvement of PPQA with checking compliance with SEC's processes is critical...”
 - “There are too many checks which consume a lot of QA resources. How do we ensure 100% coverage of projects?”
 - “QA needs to ensure timely non-compliance closure...”
 - PPQA Process Owner agreed to sponsor LSS Project
 - Provided his requirements
 - PPQA Practitioners to audit a project faster, more effectively and to increase the amount of projects that are audited in a given month/year. Currently this is a lengthy process requiring much time, resources, and rework.
 - Drafted charter for Sponsor's approval



PPQA – Define

- Sponsor set goals:
 - QA audits are performed in ___% less time
 - Rework is reduced by ___%





PPQA – Define

- Develop Supplier Input Process Output Customer (SIPOC) chart to identify critical inputs and outputs of the process and capture the voice of the customer

S

QA Rep
Project Lead

I

CMMI Model
SEC Processes
SEC PPQA Process
Audit Checklist
Project

P

SEC PPQA
Audit Process

O

QA Audit
Report

C

Project Lead
Management



PPQA – Measure & Analyze



- Collected measurement data to perform a root cause analysis
 - How long does an audit currently take?
 - Why is it taking so long to do an audit?
 - Why is there significant rework?
- CMMI redundancies carried over to PPQA checklists
- PPQA needed to be involved earlier in the CMMI implementation to avoid rework





Inputs: CMMI's Built-in Redundancies



- Checks & Balances
- Friendly Reminders
- CMMI says “What” not “How”

CMMI Process Areas

Project Planning (PP)

Project Monitoring & Control (PMC)

Configuration Management (CM)

Requirements Management (REQM)

Product & Process Quality (PPQA)

Assurance

Measurement & Analysis (M&A)

Organizational Training (OT)

CMMI Generic Practices

GP 2.2 **Plan the Process (PP)**

GP 2.3 Provide Resources

GP 2.4 Assign Responsibility

GP 2.5 **Train People (OT)**

GP 2.6 **Manage Configurations (CM)**

GP 2.7 Identify and Involve Relevant Stakeholders

GP 2.8 **Monitor and Control the Process (PMC)**

GP 2.9 **Objectively Evaluate Adherence (PPQA)**

GP 2.10 Review Status with Higher Level Management

CEC M CMMI Process Area/Generic Goal Relationship



CONFIGURATION MANAGEMENT

SG 1 Establish Baselines

- SP 1.1 Identify Configuration Items
- SP 1.2 Establish a Configuration Management System
- SP 1.3 Create or Release Baselines

SG 2 Track and Control Changes

- SP 2.1 Track Change Requests
- SP 2.2 Control Configuration Items

SG 3 Establish Integrity

- SP 3.1 Establish Configuration Management Records
- SP 3.2 Perform Configuration Audits

GENERIC GOAL 2

GG 2 Institutionalize a Managed Process

- GP 2.1 Establish an Organizational Policy
- GP 2.2 Plan the Process
- GP 2.3 Provide Resources
- GP 2.4 Assign Responsibility
- GP 2.5 Train People
- GP 2.6 Manage Configurations
- GP 2.7 Identify and Involve Relevant Stakeholders
- GP 2.8 Monitor and Control the Process
- GP 2.9 Objectively Evaluate Adherence
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PROJECT PLANNING

SG 1 Establish Estimates

- SP 1.1 Estimate the Scope of the Project
- SP 1.2 Establish Estimates of Work Product and Task Attributes
- SP 1.3 Define Project Lifecycle
- SP 1.4 Determine Estimates of Effort and Cost

SG 2 Develop a Project Plan

- SP 2.1 Establish the Budget and Schedule
- SP 2.2 Identify Project Risks
- SP 2.3 Plan for Data Management
- SP 2.4 Plan for Project Resources
- SP 2.5 Plan for Needed Knowledge and Skills
- SP 2.6 Plan Stakeholder Involvement
- SP 2.7 Establish the Project Plan

SG 3 Obtain Commitment to the Plan

- SP 3.1 Review Plans That Affect the Project
- SP 3.2 Reconcile Work and Resource Levels
- SP 3.3 Obtain Plan Commitment

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PROCESS & PRODUCT QUALITY ASSURANCE

SG 1 Objectively Evaluate Processes and Work Products

- SP 1.1 Objectively Evaluate Processes
- SP 1.2 Objectively Evaluate Work Products and Services

SG 2 Provide Objective Insight

- SP 2.1 Communicate and Ensure Resolution of Noncompliance Issues
- SP 2.2 Establish Records

GENERIC GOAL 2

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CMMI Built-in Redundancies



Table 6.2 Generic Practice and Process Area Relationships

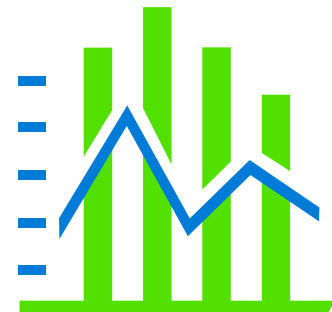
<i>Generic Practice</i>	<i>Roles of Process Areas in Implementation of the Generic Practice</i>	<i>Generic Practice</i>	<i>Roles of Process Areas in Implementation of the Generic Practice</i>
<u>GP 2.2</u> <u>Plan the Process</u>	Project Planning: The project planning process can implement GP 2.2 in full for all project-related process areas (except for Project Planning itself).	<u>GP 2.7</u> <u>Identify and Involve Relevant Stakeholders</u>	Project Planning: The part of the project planning process that implements Project Planning SP 2.6, "Plan Stakeholder Involvement," can implement the stakeholder identification part (first two subpractices) of GP 2.7 in full for all project-related process areas. Project Monitoring and Control: The part of the project monitoring and control process that implements Project Monitoring and Control SP 1.5, "Monitor Stakeholder Involvement," can aid in implementing the third subpractice of GP 2.7 for all project-related process areas.
<u>GP 2.5</u> <u>Train People</u>	Organizational Training: The organizational training process supports the implementation of GP 2.5 as applied to all process areas by making the training that addresses strategic or organization-wide training needs available to those who will perform or support the process. Project Planning: The part of the project planning process that implements Project Planning SP 2.5, "Plan for knowledge and skills needed to perform the project," together with the organizational training process, supports the implementation of GP 2.5 in full for all project-related process areas.	<u>GP 2.8</u> <u>Monitor and Control the Process</u>	Project Monitoring and Control: The project monitoring and control process can implement GP 2.8 in full for all project-related process areas.
<u>GP 2.6</u> <u>Manage Configurations</u>	Configuration Management: The configuration management process can implement GP 2.6 in full for all project-related process areas as well as some of the organizational process areas.	<u>GP 2.9</u> <u>Objectively Evaluate Adherence</u>	Process and Product Quality Assurance: The process and product quality assurance process can implement GP 2.9 in full for all process areas (except perhaps for Process and Product Quality Assurance itself).

Source: CMMI for Development
Version 1.2, pp. 95-97



PPQA - Improve

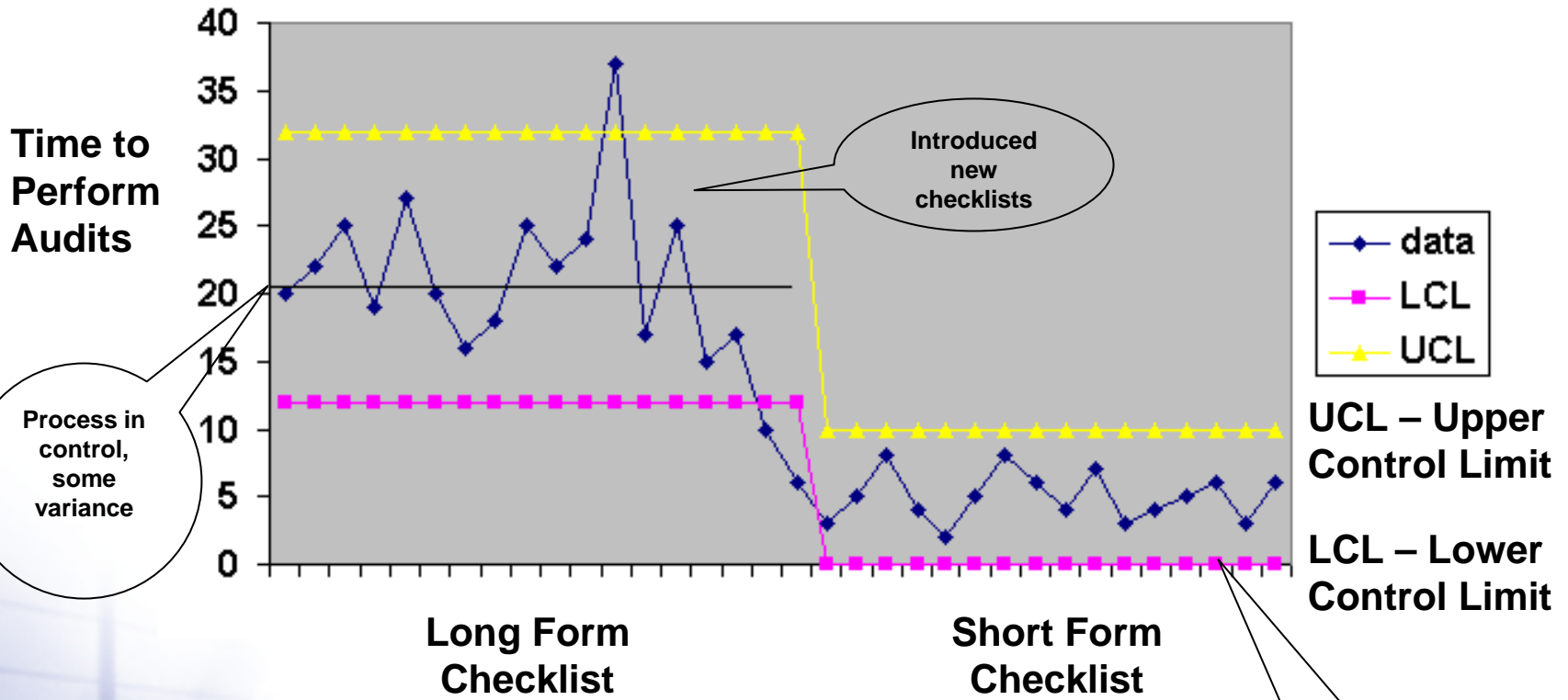
- PPQA leaned their audit checklists to remove duplicate checks that cross process areas
- PPQA is involved during initial project planning
 - Audit checklists are available prior to audit
- Future: Use Integrated IPT to analyze all SEC CMMI processes to minimize duplication
 - Lean SEC Process Descriptions





PPQA - Improve

Notional Control Chart



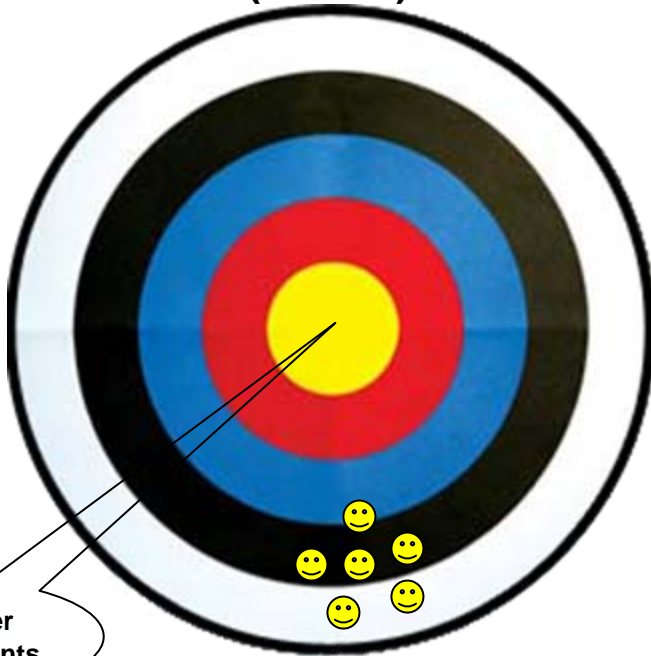


PPQA - Improve

Gage R&R

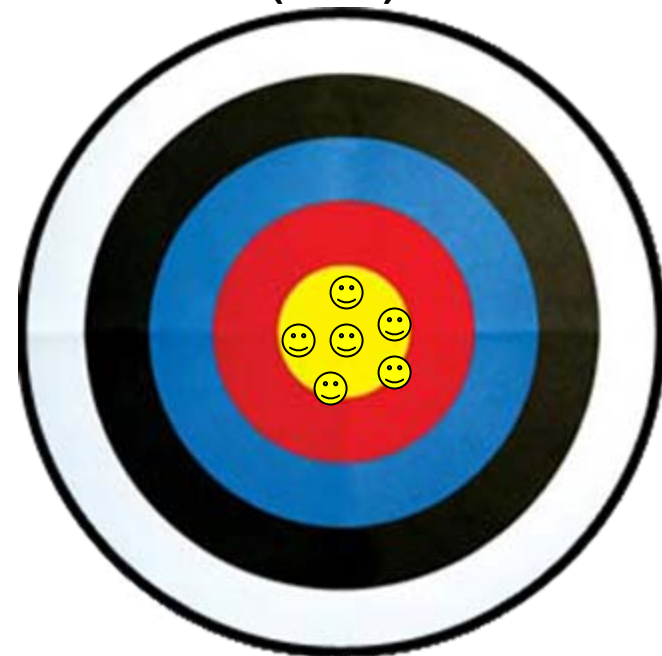
To Evaluate Reproducibility & Repeatability

**Long Form Audit
(Before)**



**Process capability:
In control but does not meet
Customer requirements**

**Short Form Audit
(After)**

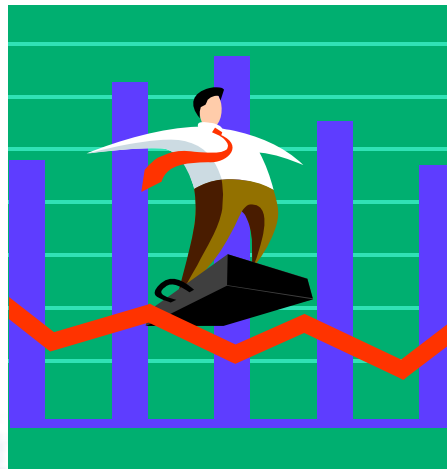


**Process capability:
In control and meets
Customer requirements**



PPQA - Control

- Soliciting feedback from Project Leads
- Audits are measurably shorter
- Checklists are easier to use
- Project Leads are happier with the process





CMMI + LSS at SEC



Software Engineering Center

Management Steering Group

Process Improvement Staff

Process Group

IPTs

LSS Deployment Director

LSS Sponsors

Black Belts

Green Belts



CMMI

Documented and Defined Processes

LSS

Tools and techniques to define,
lean and improve processes



Conclusions

- LSS is a useful methodology for implementing CMMI process improvements
 - Provides the tools and techniques that facilitate implementation
- Lean way of thinking reduces redundancies and administrative process overhead
 - “Leaning” a process removes the non-value-added steps, minimizing the documentation for documentation’s sake
- Faster CMMI implementation optimizes the processes that support the Warfighter



Acronyms

- AMC – Army Materiel Command
- CMMI – Capability Maturity Model® Integration
- CTQ – Critical to Quality
- IPT – Integrated Product Team
- LCMC – Life Cycle Management Command
- LSS – Lean Six Sigma
- NVA – Non-Value-Added
- PA – Process Area
- PG – Process Group
- PPQA – Process and Product Quality Assurance
- QA – Quality Assurance
- SEC – Software Engineering Center
- SIPOC – Supplier Input Process Output Customer
- SW-CMM – Software Capability Maturity Model®
- VOC – Voice of the Customer