UNIT 6

Software Quality Assurance

Syllabus UNIT 6

- Quality Management(Features of good quality software)

1. ISO 9000, 9001, 9002, 9003
2. CMM
3. PSP
4. SIX SIGMA

- SOFTWARE MAINTENANCE
- CASE TOOLS
- SOFTWARE CONFIGURATION MANAGEMENT
- SOFTWARE REUSE
- AGILE MODELS

Introduction

▶Traditional definition of quality:

▶**fitness of purpose,**

  ▶a quality product does exactly what the users want it to do.

Fitness of purpose

► For software products,
► fitness of purpose means
  ► satisfaction of the requirements specified in SRS document.

Introduction

- Consider a software product:
  - **functionally correct,**
    - i.e. performs all functions as specified in the SRS document,
  - **but has an almost un-usable user interface.**
    - So cannot be considered as a quality product.

▶ Another example:

  ▶ a product which does everything that users want.

  ▶ but has an almost incomprehensible and unmaintainable code.

Modern view of quality

▶ Associates **several quality factors** with a software product :

  ▶ Correctness

  ▶ Reliability

  ▶ Efficiency (includes efficiency of resource utilization)

  ▶ Portability

  ▶ Usability

  ▶ Reusability

  ▶ Maintainability

Correctness

▶ A software product is correct,

   ▶ if different requirements as specified in the SRS document have been correctly implemented.

   ▶ Accuracy of results.

Portability

- A software product is said to be portable,
  - **if it can be easily made to work in different operating systems**,
  - in different machines,
  - with other software products, etc.

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Reusability

▶A software product has good reusability,

  ▶if different modules of the product <u>can easily be reused</u> to develop new products.

Usability

- A software product has good usability,
  - if different categories of users (i.e. both expert and novice users) can easily invoke the functions of the product.

Maintainability

- A software product is maintainable,
  - if errors can be easily corrected as and when they show up,
  - new functions can be easily added to the product,
  - functionalities of the product can be easily modified, etc.

Software Quality Management System

▶ Quality management system (or quality system):

▶ principal methodology used by organizations to ensure that the products have desired quality.

Quality system

- A quality system consists of the following:
  - Managerial Structure
  - Individual Responsibilities.
- Responsibility of the organization as a whole.

Quality assurance

► Basic premise of modern quality assurance:

  ► if an organization's processes are good and are followed rigorously,

    ► the products are bound to be of good quality.

Business Process reengineering

Business Process Reengineering

Business Process Reengineering (BPR) refers to an attempt to improvise the operation of the business on a broad scale. The primary aim of BPR is to cut down process redundancies and enterprise costs.

Tools

- Customer and Process Focus
- Visualization for End Process and Benchmarking
- Change Management
- Business Process Mapping

Steps

1. Define Objectives and Framework
2. Identify Customer Needs
3. Study the Existing Process
4. Formulate a Redesign Business Plan
5. Implement the Redesign

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Business Process reengineering

- BPR aims at reengineering the way business is carried out in any organization.

- Business process re-engineering is the redesign of business processes to achieve dramatic improvements in critical aspects like quality, output, cost, service, and speed.

- Business process reengineering (BPR) aims at cutting down enterprise costs and process redundancies on a very huge scale

ISO 9000 is a series of three standards:

ISO 9001 **ISO 9002** **ISO 9003**

ISO 9000

- ISO (international Standards Organization):
  - a consortium of 63 countries established to formulate and foster standardization.
- ISO published its 9000 series of standards in 1987.

ISO 9000

▶ A set of guidelines for the production process.
  ▶ not directly concerned about the product itself.
  ▶ a series of three standards exist:
    ▶ ISO 9001, ISO 9002, and ISO 9003.

ISO 9000

- Based on the premise:
  - if a proper process is followed for production:
    - good quality products are bound to follow.

ISO 9000:2000

- ISO 9000:2000 refers to the ISO 9000 update released in the year 2000.

- The ISO 9000:2000 revision had five goals:

1. Meet stakeholder needs

2. Be usable by all sizes of organizations

3. Be usable by all sectors

4. Be simple and clearly understood

5. Connect quality management system to business processes

- ISO 9000:2000 was again updated in 2008 and 2015. ISO 9000:2015 is the most current version.

What is ISO 9000 Certification?

► ISO 9000 certification:

- ► serves as a reference for contract between independent parties.

► The ISO 9000 standard:

- ► specifies guidelines for maintaining a quality system.

ISO 9000:2015 principles of Quality Management

ISO 9001 certification

- ISO 9001 is the only standard within the ISO 9000 family to which organizations can certify.

ISO 9001:

► Applies to:

   ► organizations engaged in design, development, production, and servicing of goods.

   ► applicable to most software development organizations.

ISO 9002:

- ISO 9002 applies to:
  - organizations who do not design products:
    - but are only involved in production.
- Examples of this category of industries:
  - steel or car manufacturing industries
  - buy the product and plant designs from external sources:
    - only manufacture products.
  - not applicable directly to software development organizations.

ISO 9003

- ISO 9003 applies to:
  - organizations involved only in installation and testing of the software products.

Summary

ISO 9000 Series

ISO 9000
- Explains fundamental quality concepts and provides guidelines for the selection and application of each standard

ISO 9001
- Model for quality assurance in design, development, production, installation and servicing.

ISO 9002
- Model for quality assurance in the production and installation of manufacturing systems

More standards in 9000 series

ISO 9003

- Quality assurance in final inspection and testing.

ISO 9004

- Guidelines for the applications of standards in quality management and quality systems.

ISO 9000 and ISO 9004 are guidance standards. They describe what is necessary to accomplish the requirements outlined in standards 9001, 9002 or 9003.

CERTIFICATE

for the management system according to ISO 9001:2008

The proof of the conforming application with the regulation was furnished and in accordance with certification procedure it is certified for the company

Dlubal Software GmbH

Am Zellweg 2
93464 Tiefenbach / Germany
with branch (see enclosure)

Scope

Development, testing, sale and support of analysis software for structural planning and FEM

Certificate Registration No.: TIC 15 100 159481

Valid until: 2018-09-15
Valid from: 2015-12-30

Audit Report No.: 3330 2QV7 A0

This certification was conducted in accordance with the TIC auditing and certification procedures and is subject to regular surveillance audits.

Jena, 2015-12-30

TÜV Thüringen e.V.
Certification body for systems and personnel

DAkkS
Deutsche
Akkreditierungsstelle
D-ZM-16006-05-01

Original certificates are branded with a hologram.

The current validity can be demanded at our homepage www.tuev-thueringen.de

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Certificate of Registration

Intertek

This is to certify that the quality management system of

Solar Technology Inc.

7620 Cetronia Road, Allentown, Pennsylvania, 18106, USA

has been assessed and registered by Intertek as conforming to the requirements of

ISO 9001:2015

The quality management system is applicable to

The design, development, manufacture, distribution, sale, repair and service of: comprehensive traffic monitoring, management, control and safety solutions; electronic message centers; solar power systems; complete remote asset tracking, monitoring, and management solutions; cable assemblies and wire harnesses; printed circuit board assemblies; industrial control panels and controllers; electronic components and mechanical assemblies.

Certificate Number: US-2414g-01
Initial Certification Date: 12 February 2004
Certificate Issue Date: 06 September 2016
Certificate Expiry Date: 05 September 2019

Calin Moldovean, President
Intertek Testing Services NA, Inc.
900 Chelmsford Street, Suite 301-3, Lowell, MA, USA

ANAB
ACCREDITED
ISO/IEC 17021
MANAGEMENT SYSTEMS
CERTIFICATION BODY

CT-ISO 9001-2015-ANAB-EN-LT-L-3.feb.16

Why Get ISO 9000 Certification?

▶ Several benefits:

  ▶ Confidence of customers in an organization increases

    ▶ if organization qualified for ISO 9001 certification.

    ▶ This is especially true in the international market.

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Why Get ISO 9000 Certification?

- Many international software development contracts insist:
  - development organization to have ISO 9000 certification.

Why Get ISO 9000 Certification?

- ▶ Requires:
  - ▶ a well-documented software production process to be in place.
  - ▶ contributes to repeatable and higher quality software.
- ▶ Makes development process:
  - ▶ focussed, efficient, and cost-effective

Why Get ISO 9000 Certification?

► Points out the weakness of an organizations:

   ► recommends remedial action.

► Sets the basic framework:

   ► for development of an optimal process and TQM.

How to Get ISO 9000 Certification?

- An organization intending to obtain ISO 9000 certification:
  - applies to a ISO 9000 registrar for registration.
- ISO 9000 registration process consists of several stages.

ISO 9000 Certification

- 1 Applications
- 2 Pre Assessment
- 3 Document review and Adequacy of Audit
- 4 Compliance Audit
- 5 Registeration
- 6 Continued Inspection

STAGES:
How to Get ISO 9000 Certification?

▶ **Application stage:**

    ▶ Applies to a registrar for registration.

▶ **Pre-assessment:**

    ▶ the registrar makes a rough assessment of the organization.

How to Get ISO 9000 Certification?

▶ Document review and adequacy audit:

  ▶ process and quality-related documents.

  ▶ the registrar reviews the documents

  ▶ makes suggestions for improvements.

- **Compliance audit**: the registrar checks whether the suggestions made by it during review have been complied.

How to Get ISO 9000 Certification?

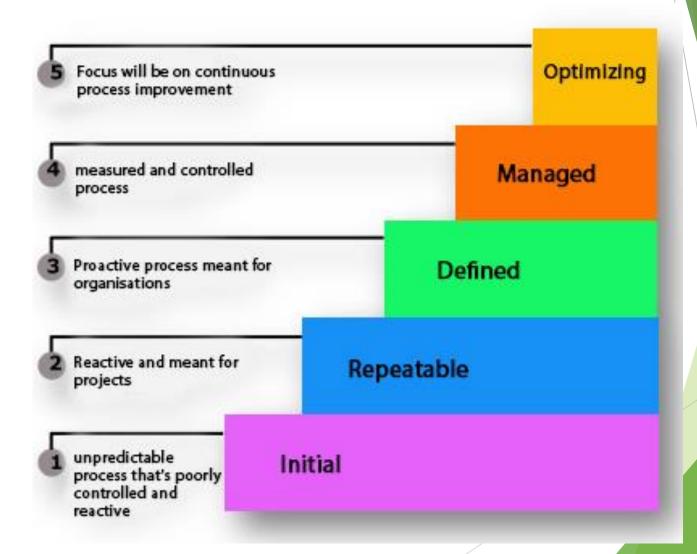► **Registration**:

  ► The registrar awards ISO 9000 certificate after successful completions of all previous phases.

► **Continued surveillance:**

  ► The registrar continues monitoring the organization periodically.

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CMM

5 Focus will be on continuous process improvement — Optimizing

4 measured and controlled process — Managed

3 Proactive process meant for organisations — Defined

2 Reactive and meant for projects — Repeatable

1 unpredictable process that's poorly controlled and reactive — Initial

SEI Capability Maturity Model - CMM

- Developed by Software Engineering Institute (SEI) of the Carnegie Mellon University, USA:
  - to assist the U.S. Department of Defense (DoD) in software acquisition.

SEI Capability Maturity Model

▶ Can be used in two ways:
  ▶ Capability evaluation
  ▶ Software process assessment.

Capability Evaluation

- Provides a way to **assess** the software process capability of an organization.

Software Process Assessment

- Used by an organization to assess its current process:
  - Suggests ways to improve the process capability.
  - This type of assessment is for purely internal use.

SEI Capability Maturity Model

- The SEI CMM classifies software development industries into:
  - Five maturity levels.
  - Stages are ordered so that improvements at one stage provide foundations for the next.

Capability Maturity Model Maturity Levels

Stage 1

Initial
Very few processes. Success is based upon individual effort.

Stage 2

Repeatable
Basic and consisted processes are established. Processes are repeated for similar projects.

Stage 3

Defined
All process are well defined, documented, standardized and integrated usually for the entire organization. Consistent practices are in place.

Stage 4

Quantitatively Managed
Strategic analysis is performed through data collected on the quality of processes. Software and processes are clearly quantified.

Stage 5

Optimising
Pro-active process improvement is implemented through qualitative feedback. Setting leading standards and performance that others follow. Values embedded in corporate culture.

Level 1: (Initial)

- Organization operates
  - without any formalized process or project plans
- An organization at this level is characterized by
  - ad hoc and often chaotic activities.

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Level 1: (Initial)

► Software production processes are not defined,

   ► different engineers follow their own process

   ► development efforts become chaotic.

   ► The success of projects depend on individual efforts and heroics.

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Level 2: (Repeatable)

► Basic project management practices
  - ► tracking cost, schedule, and functionality are followed.

► Size and cost estimation techniques
  - ► function point analysis, COCOMO, etc. used.

► Production process is ad hoc
  - ► not formally defined
  - ► also not documented.

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Level 2: (Repeatable)

- Process used for different projects might vary between projects:
  - earlier success on projects with similar applications can be repeated.
  - Opportunity to repeat process exist when a company produces a family of products.

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Level 3: (Defined)

▶ Management and development activities:
  ▶ **defined and documented.**
  ▶ Common organization-wide understanding of activities, roles, and responsibilities.

Level 3: (Defined)

- The process though defined,
  - process and product qualities are not measured.
- ISO 9001 aims at achieving this level.

Level 4: (Managed)

- **Quantitative quality goals for products are set.**

- Software process and product quality are measured:
  - The measured values are used to control the product quality.
  - Results of measurement used to evaluate project performance
    - rather than improve process.

Level 4: (Managed)

- Organization sets quantitative quality goals
- World-wide about 100 organizations assessed at this level.

Level 5: (Optimizing)

▶ Statistics collected from process and product measurements are analyzed:

    ▶ continuous process improvement based on the measurements.

        ▶ Known types of defects are prevented from recurring by tuning the process

        ▶ lessons learned from specific projects incorporated into the process 59

Level 5: (Optimizing)

► Identify best software engineering practices and innovations:

  ► tools, methods, or process are identified

  ► transferred throughout the organization

► World-wide about 50 organizations have been assessed at this level.

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Key Process Areas

► Each level is associated with a key process area (KPA) that identifies

  ► where an organization at the previous level must focus to reach this level

Level 2 KPAs

▶ Software project planning
  ▶ Size, cost, schedule.
  ▶ project monitoring
▶ Configuration management
▶ Subcontract management

Level 3 KPAs

- ▶ Process definition and documentation
- ▶ Reviews
- ▶ Training program

Level 4 KPAs

- ▶ Quantitative measurements
- ▶ Process management

Level 5 KPAs

- Defect prevention
- Technology change management
- Process change management

Comparison between ISO 9001 and SEI CMM

- ▶ ISO 9001 awarded by an international standards body
  - ▶ can be quoted in official documents and communications
- ▶ SEI CMM assessment is purely for internal use.

Comparison between ISO 9001 and SEI CMM

▶ SEI CMM was developed specifically for software industry:

  ▶ addresses many issues specific to software industry.

▶ SEI goes beyond quality assurance

  ▶ aims for TQM

  ▶ ISO 9001 correspond to SEI level 3.

Comparison between ISO 9001 and SEI CMM

- ▶ SEI CMM provides a list of key areas
  - ▶ on which to focus to take an organization from one level to the other
- ▶ Provides a way for gradual quality improvements over several stages.
  - ▶ e.g trying to implement a defined process before a repeatable process:
    - ▶ counterproductive as managers are overwhelmed by schedule and budget pressure.

Small Organizations

- Often have problems:
  - Undocumented requirements
  - Inexperienced managers
  - Documenting the product
  - Resource allocation
  - Training
  - Peer reviews

Personal Software Process (PSP)

- ▶ Based on the work of Humphrey
- ▶ PSP is a scaled down version of industrial software process
  - ▶ suitable for individual use
- ▶ Even CMM assumes that engineers use effective personal practices

Personal Software Process (PSP)

- ▶ A process is the set of steps for doing a job
- ▶ The quality and productivity of an engineer
  - ▶ largely determined by his process

- ▶ PSP is framework that
  - ▶ helps software engineers to measure and improve the way they work.

Personal Software Process

- PSP is
  - designed to help software engineers do good work
  - based on proven methods and best practices
- PSP provides detailed methods for
  - Estimating effort and planning work
  - Tracing performance against plans
  - Explaining how defined process can help

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The PSP's Purpose

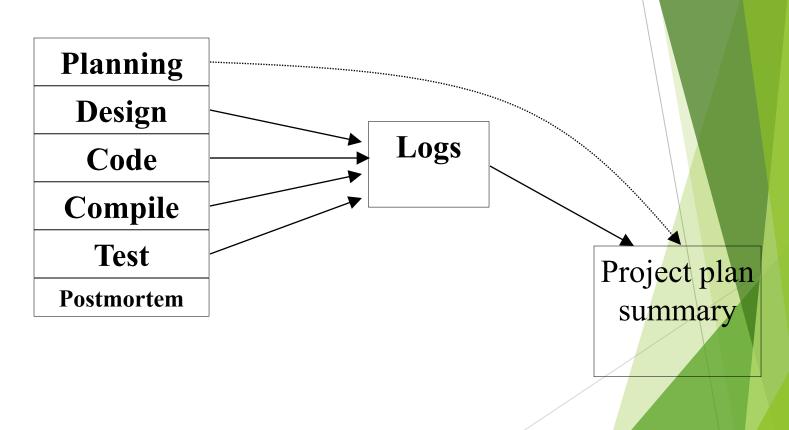- The PSP is to help you improve your software engineering skills.
  - *You manage your work*
  - *Assess your talents*
  - *Build your skills*
  - *Help you to make better plans*
  - *To precisely track your performance*
  - *To measure the quality of your products*
- Whether you design programs, develop requirements, write documentation, or maintain existing software, the PSP can help you to do better work.
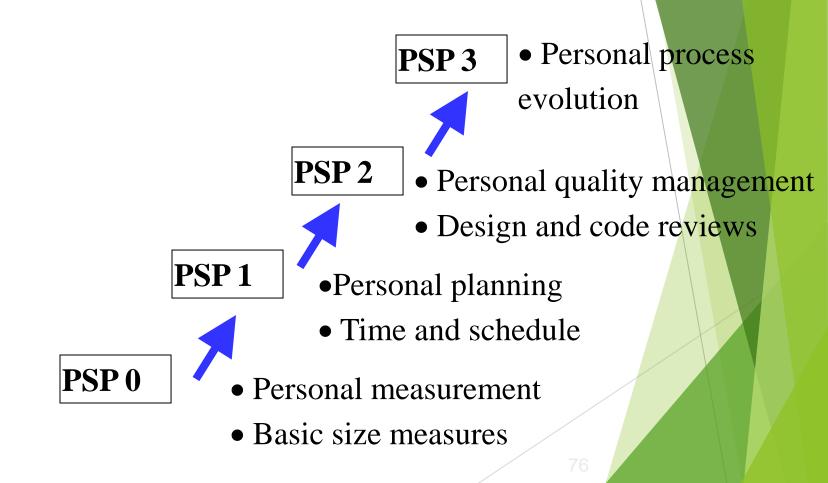
Time Management

- Track the way you spend time
  - Boring activities seem longer then actual
  - Interesting activities seem short
- Record time for
  - Designing
  - Writing code
  - Compiling
  - Testing

Personal Software Process (PSP)

Personal Software Process (PSP)

PSP 3 • Personal process evolution

PSP 2 • Personal quality management
• Design and code reviews

PSP 1 •Personal planning
• Time and schedule

PSP 0 • Personal measurement
• Basic size measures

PSP-Planning

- Problem definition
- Estimate max, min, and total LOC
- Determine minutes/LOC
- Calculate max,min, and total development times
- Enter the plan data in project plan summary form
- record the planned time in Log

PSP-Design

- Design the program
- Record the design in specified format
- Record the Design time in time recording log

PSP-Code

- ▶ Implement the design
- ▶ Use a standard format for code text
- ▶ Record the coding time in time recording log

PSP-Compile

- Compile the program
- Fix all the defects
- Record compile time in time recording log

PSP-Test/Postmortem
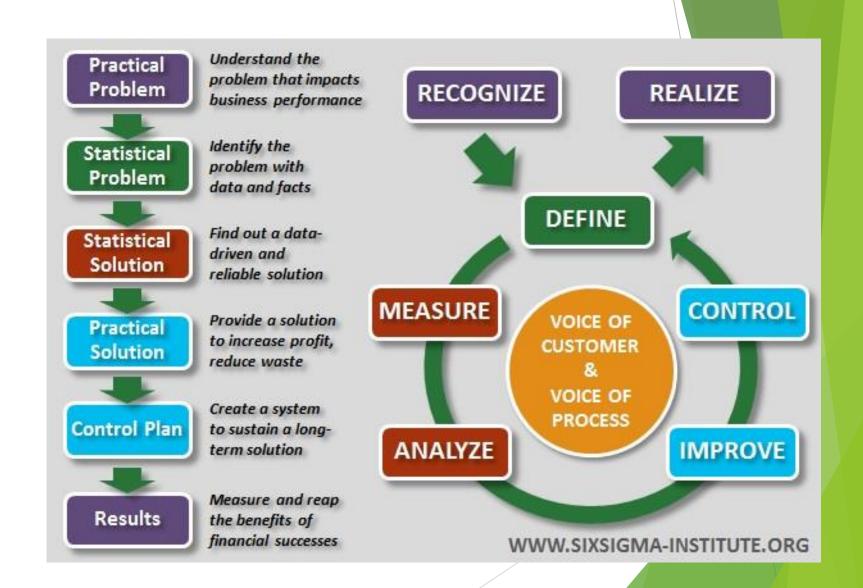
- Test
  - Test the program
  - Fix all the defects found
  - Record testing time in time recording log
- Postmortem
  - Complete project plan summary form with actual time and size data
  - Record postmortem time in time record

Six Sigma

- Six sigma is a quantitative approach to eliminate defects
  - Applicable to all types of industry - from manufacturing, product development, to service

- The statistical representation of Six Sigma quantitatively describes
  - how a process is performing

- Six Sigma is a disciplined, statistical-based, data-driven approach and continuous improvement methodology for eliminating defects in a product, process or service.

- It was developed by Motorola in early to middle 1980's.

Left flow diagram:

Practical Problem	Understand the problem that impacts business performance
Statistical Problem	Identify the problem with data and facts
Statistical Solution	Find out a data-driven and reliable solution
Practical Solution	Provide a solution to increase profit, reduce waste
Control Plan	Create a system to sustain a long-term solution
Results	Measure and reap the benefits of financial successes

Right cycle diagram:

RECOGNIZE

REALIZE

DEFINE

MEASURE

CONTROL

VOICE OF CUSTOMER & VOICE OF PROCESS

ANALYZE

IMPROVE

WWW.SIXSIGMA-INSTITUTE.ORG

Six Sigma

- To achieve six sigma
  - a process must not produce more than 3.4 defects per million opportunities.
  - 5 Sigma -> 230 defects per million
  - 4 Sigma -> 6210 defects per million
- Six sigma methodologies
  - DMAIC (Define, Measure, Analyze, Improve, Control)
  - DMADV: (Define, Measure, Analyze, Design, Verify)

Concepts of Six Sigma Training, DMAIC/DFSS Approach → Project along with Training → Multiple Exams and Refreshers → Post Training Support → Job Notification and Proffesional Network Bulidii

Mock interview and Resume Building → Minitab Training → Lean Management Certification → ISO 9001:2015 Certification → Globally Accepted Certification

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Lean Six Sigma Roles

White Belt	Yellow Belt	Green Belt	Black Belt	Master Black Belt	Champion
Understands the structure and goals of Lean Six Sigma Uses basic Lean Six Sigma vocabulary terms Reports process issues to Green and Black Belts	Understands basic Lean Six Sigma concepts Reports process issues to Green Belts and Black Belts Participates on project teams and receives just-in-time training	Starts and manages Lean Six Sigma projects Has Lean Six Sigma expertise but in less detail than Black Belts Provides just-in-time training to others	Can report to a Master Black Belt Has advanced Lean Six Sigma expertise Functions as a coach, mentor, teacher, and project leader for project teams	Works with leaders to identify gaps and select projects Coaches, mentors, teaches, monitors and leads projects Responsible for Lean Six Sigma implementation and culture change	Executive leader who drives the initiative Helps select projects and remove barriers for project teams Supports change and develops a Lean Six Sigma culture

Six Sigma Methodologies

- The methodologies are implemented by Green belt and Black belt workers
  - Supervised by Master black belt worker

- Pareto Chart:
  - Simple bar chart to represent defect data
  - Identify the problems that occurs with greatest frequency
    - or incur the highest cost

Certificate of Achievement

Maria Damyanova

Has successfully achieved

Lean Six Sigma Black Belt Certification

In accordance with the certification requirements of
Amity Training & Consultancy and The Council for Six Sigma Certification

Course Completion Date: September 18, 2014

AMITY
TRAINING & CONSULTANCY

Validity of this certificate may be verified at
www.amitytraining.com/verify or by scanning this QR Code

Nidhi A Gupta | *CEO*

Certificate No. : 674912XX

Date of issue : September 20, 2014

Current Trends

- Many organizations have already tuned their process for
  - Budget,
  - Schedule, and
  - Quality product.
- Competition is challenging them to:
  - Reduce time for delivery
  - Adopt Six-Sigma methodology