CSSBB

CERTIFIED SIX SIGMA BLACK BELT

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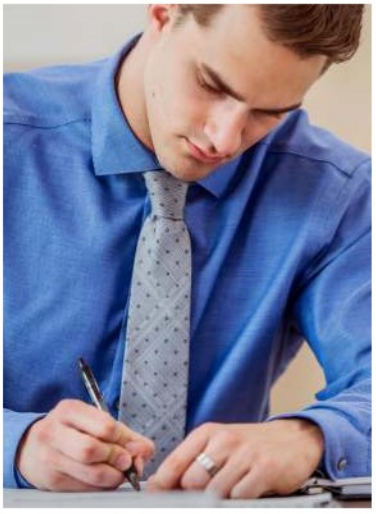
Certification from ASQ is considered a mark of quality excellence in many industries. It helps you advance your career and boosts your organization's bottom line through your mastery of quality skills. Becoming certified as a Six Sigma Black Belt confirms your commitment to quality and the positive impact it will have on your organization.



Examination

Each certification candidate is required to pass a written examination that consists of multiple-choice questions that measure comprehension of the body of knowledge.

Certified Six Sigma Black Belt

The Certified Six Sigma Black Belt (CSSBB) is a professional who can explain Six Sigma philosophies and principles, including supporting systems and tools. A Black Belt should demonstrate team leadership, understand team dynamics, and assign team member roles and responsibilities. Black Belts have a thorough understanding of all aspects of the DMAIC model in accordance with Six Sigma principles. They have basic knowledge of lean enterprise concepts, are able to identify nonvalue-added elements and activities, and are able to use specific tools.

CSSBB

Computer Delivered - the CSSBB examination is a one-part, 165-question, four-and-a-half-hour exam and is offered in English only. One hundred and fifty questions are scored and 15 are unscored.

Paper and Pencil – The CSSBB examination is a one-part, 150-question, four-hour exam and is offered in English only.

Experience Required

Six Sigma Black Belt requires two completed projects with signed affidavits, or one completed project with a signed affidavit and three years of work experience, in one or more areas of the Six Sigma Black Belt Body of Knowledge.

For comprehensive exam information on Six Sigma Black Belt certification, visit **asq.org/cert**.

Minimum Expectations

Organization-wide Planning and Deployment

- Will understand how to deploy Six Sigma within a project.
- Will be able to implement tools and techniques to deploy strategic directions for initiatives.
- Will understand the roles and responsibilities for Six Sigma projects and how each group influences project deployment, and will be able to support communications about the project deployment.
- Will be able to apply operational change management techniques within their defined scope or domain.

Organizational Process Management and Measures

- Will be able to define various types of benchmarking.
- Will be able to describe various types of performance measures, and select an appropriate financial measure for a given situation and calculate its result.

Team Management

- Will understand the components and techniques used in managing teams, including time management, planning and decision-making tools, team formation, motivational techniques and factors that demotivate a team, and performance evaluation and reward.
- Will be able to describe elements that can result in a team's success.
- Will be able to use appropriate techniques to overcome various group dynamics challenges.

Define

- Will be able to select data collection methods and collect voice of the customer data, and use customer feedback to determine customer requirements.
- Will understand the elements of a project charter (problem statement, scope, goals, etc.) and be able to use various tools to track the project progress.

Measure

- Will be able to define and use process flow metrics and analysis tools to indicate the performance of a process.
- Will be able to develop and implement data collection plans, and use techniques in sampling, data capture, and processing tools.
- Will be able to define and describe measurement system analysis tools.
- Will apply basic probability concepts and understand various distributions.
- Will be able to calculate statistical and process capability indices.

Analyze

- Will be able to analyze the results of correlation and regression analyses.
- Will be able to define multivariate tools.
- Will be able to perform hypothesis tests for means, variances, and proportions, and analyze their results.

- Will understand the components and concepts for ANOVA, chi square, contingency tables, and nonparametric tests.
- Will understand the elements and purpose of FMEA and use root cause analysis tools.
- Will be able to identify and interpret the seven classic wastes.
- Will be able to use gap analysis tools.

Improve

- Will be able to define and apply design of experiments (DOE) principles, and distinguish among the various types of experiments.
- Will be able to apply various lean tools and techniques to eliminate waste and reduce cycle time.
- Will understand how to implement an improved process and how to analyze and interpret risk studies.

Control

- Will be able to apply, use, and analyze the various statistical process control (SPC) techniques.
- Will understand total productive maintenance (TPM) and visual factory concepts.
- Will be able to develop control plans and use various tools to maintain and sustain improvements.

Design For Six Sigma (DFSS) Framework and Methodologies

- Will understand common DFSS and DFX methodologies, and elements of robust designs.

BODY OF KNOWLEDGE

Certified Six Sigma Black Belt (CSSBB)

Topics in this body of knowledge (BoK) include additional detail in the form of subtext explanations and the cognitive level at which test questions will be written. This information will provide guidance for the candidate preparing to take the exam. The subtext is not intended to limit the subject matter or be all-inclusive of what might be covered in an exam. It is meant to clarify the type of content to be included in the exam. The descriptor in parentheses at the end of each entry refers to the maximum cognitive level at which the topic will be tested. A complete description of cognitive levels is provided at the end of this document.

I. Organization-Wide Planning and Deployment (Questions 12)

A. Organization-wide Considerations

1. **Fundamentals of Six Sigma and lean methodologies**
   Define and describe the value, foundations, philosophy, history, and goals of these approaches, and describe the integration and complementary relationship between them. (Understand)

2. **Six Sigma, lean, and continuous improvement methodologies**
   Describe when to use Six Sigma instead of other problem-solving approaches, and describe the importance of aligning Six Sigma objectives with organizational goals. Describe screening criteria and how such criteria can be used for the selection of Six Sigma projects, lean initiatives, and other continuous improvement methods. (Apply)

3. **Relationships among business systems and processes**
   Describe the interactive relationships among business systems, processes, and internal and external stakeholders, and the impact those relationships have on business systems. (Understand)

4. **Strategic planning and deployment for initiatives**
   Define the importance of strategic planning for Six Sigma projects and lean initiatives. Demonstrate how hoshin kanri (X-matrix), portfolio analysis, and other tools can be used in support of strategic deployment of these projects. Use feasibility studies, SWOT analysis (strengths, weaknesses, opportunities, and threats), PEST analysis (political, economic, social, and technological) and contingency planning and business continuity planning to enhance strategic planning and deployment. (Apply)

B. Leadership

1. **Roles and responsibilities**
   Describe the roles and responsibilities of executive leadership, champions, sponsors, process owners, Master Black Belts, Black Belts, and Green Belts in driving Six Sigma and lean initiatives. Describe how each group influences project deployment in terms of providing or managing resources, enabling changes in organizational structure, and supporting communications about the purpose and deployment of the initiatives. (Understand)

2. **Organizational roadblocks and change management**
   Describe how an organization's structure and culture can impact Six Sigma projects. Identify common causes of Six Sigma failures, including lack of management support and lack of resources. Apply change management techniques, including stakeholder analysis, readiness assessments, and communication plans to overcome barriers and drive organization-wide change. (Apply)

II. Organizational Process Management and Measures (10 Questions)

A. Impact on Stakeholders

Describe the impact Six Sigma projects can have on customers, suppliers, and other stakeholders. (Understand)

B. Benchmarking

Define and distinguish between various types of benchmarking, e.g., best practices, competitive, collaborative, breakthrough. Select measures and performance goals for projects resulting from benchmarking activities. (Apply)

C. Business Measures

1. **Performance measures**
   Define and describe balanced scorecard, key performance indicators (KPIs), customer loyalty metrics, and leading and lagging indicators. Explain how to create a line of sight from performance measures to organizational strategies. (Analyze)

2. **Financial measures**
   Define and use revenue growth, market share, margin, net present value (NPV), return on investment (ROI), and cost benefit analysis (CBA). Explain the difference between hard cost measures (from profit and loss statements) and soft cost benefits of cost avoidance and reduction. (Apply)

III. Team Management (18 Questions)

A. Team Formation

1. **Team types and constraints**
   Define and describe various teams, including virtual, cross-functional, and self-directed. Determine what team type will work best for a given a set of constraints, e.g., geography, technology availability, staff schedules, time zones. (Apply)

2. **Team roles and responsibilities**
   Define and describe various team roles and responsibilities for leader, facilitator, coach, and individual member. (Understand)

3. **Team member selection criteria**
   Describe various factors that influence the selection of team members, including the ability to influence, openness to change, required skill sets, subject matter expertise, and availability. (Apply)

4. **Team success factors**
   Identify and describe the elements necessary for successful teams, e.g., management support, clear goals, ground rules, timelines. (Apply)

B. Team Facilitation

1. **Motivational techniques**
   Describe and apply techniques to motivate team members. Identify factors that can demotivate team members and describe techniques to overcome them. (Apply)

2. **Team stages of development**
   Identify and describe the classic stages of team development: forming, storming, norming, performing, and adjourning. (Apply)

3. **Team communication**
   Describe and explain the elements of an effective communication plan, e.g., audience identification, message type, medium, frequency. (Apply)

4. **Team leadership models**
   Describe and select appropriate leadership approaches (e.g., direct, coach, support, delegate) to ensure team success. (Apply)

C. Team Dynamics

1. **Group behaviors**
   Identify and use various conflict resolution techniques (e.g., coaching, mentoring, intervention) to overcome negative group dynamics, including dominant and reluctant participants, groupthink, rushing to finish, and digressions. (Evaluate)

2. **Meeting management**
   Select and use various meeting management techniques, including using agendas, starting on time, requiring pre-work by attendees, and ensuring that the right people and resources are available. (Apply)

3. **Team decision-making methods**
   Define, select, and use various tools (e.g., consensus, nominal group technique, multi-voting) for decision making. (Apply)

D. Team Training

1. **Needs assessment**
   Identify the steps involved to implement an effective training curriculum: identify skills gaps, develop learning objectives, prepare a training plan, and develop training materials. (Understand)

2. **Delivery**
   Describe various techniques used to deliver effective training, including adult learning theory, soft skills, and modes of learning. (Understand)

3. **Evaluation**
   Describe various techniques to evaluate training, including evaluation planning, feedback surveys, pre-training and post-training testing. (Understand)

IV. Define (20 Questions)

A. Voice of the Customer

1. **Customer Identification**
   Identify and segment customers and show how a project will impact both internal and external customers. (Apply)

2. **Customer data collection**
   Identify and select appropriate data collection methods (e.g., surveys, focus groups, interviews, observations) to gather voice of the customer data. Ensure the data collection methods used are reviewed for validity and reliability. (Analyze)

3. **Customer requirements**
   Define, select, and apply appropriate tools to determine customer needs and requirements, including critical-to-X (CTX when "X" can be quality, cost, safety, etc.), CTQ tree, quality function deployment (QFD), supplier, input, process, output, customer (SIPOC), and Kano model. (Analyze)

B. Business Case and Project Charter

1. **Business case**
   Describe business case justification used to support projects. (Understand)

2. **Problem statement**
   Develop a project problem statement and evaluate it in relation to baseline performance and improvement goals. (Evaluate)

3. **Project scope**
   Develop and review project boundaries to ensure that the project has value to the customer. (Analyze)

4. **Goals and objectives**
   Identify specific, measureable, actionable, relevant, and time bound (SMART) goals and objectives on the basis of the project's problem statement and scope. (Analyze)

5. **Project performance measurements**
   Identify and evaluate performance measurements (e.g., cost, revenue, delivery, schedule, customer satisfaction) that connect critical elements of the process to key outputs. (Analyze)

6. **Project charter review**
   Explain the importance of having periodic project charter reviews with stakeholders. (Understand)

C. Project Management (PM) Tools

Identify and use the following PM tools to track projects and document their progress. (Evaluate)

1. **Gantt charts**
2. **Toll-gate reviews**
3. **Work breakdown structure (WBS)**
4. **RACI model (responsible, accountable, consulted, and informed)**

D. Analytical Tools

Identify and use the following analytical tools throughout the DMAIC cycle. (Apply)

1. **Affinity diagrams**
2. **Tree diagrams**
3. **Matrix diagrams**
4. **Prioritization matrices**
5. **Activity network diagrams**

V. Measure (25 Questions)

A. Process Characteristics

1. **Process flow metrics**
   Identify and use process flow metrics (e.g., work in progress (WIP), work in queue (WIQ), touch time, takt time, cycle time, throughput) to determine constraints. Describe the impact that "hidden factories" can have on process flow metrics. (Analyze)

2. **Process analysis tools**
   Select, use, and evaluate various tools, e.g., value stream maps, process maps, work instructions, flowcharts, spaghetti diagrams, circle diagrams, gemba walk. (Evaluate)

B. Data Collection

1. **Types of data**
   Define, classify, and distinguish between qualitative and quantitative data, and continuous and discrete data. (Evaluate)

2. **Measurement scales**
   Define and use nominal, ordinal, interval, and ratio measurement scales. (Apply)

3. **Sampling**
   Define and describe sampling concepts, including representative selection, homogeneity, bias, accuracy, and precision. Determine the appropriate sampling method (e.g., random, stratified, systematic, subgroup, block) to obtain valid representation in various situations. (Evaluate)

4. **Data collection plans and methods**
   Develop and implement data collection plans that include data capture and processing tools, e.g., check sheets, data coding, data cleaning (imputation techniques). Avoid data collection pitfalls by defining the metrics to be used or collected, ensuring that collectors are trained in the tools and understand how the data will be used, and checking for seasonality effects. (Analyze)

C. Measurement Systems

1. **Measurement system analysis (MSA)**
   Use gauge repeatability and reproducibility (R&R) studies and other MSA tools (e.g., bias, correlation, linearity, precision to tolerance, percent agreement) to analyze measurement system capability. (Evaluate)

2. **Measurement systems across the organization**
   Identify how measurement systems can be applied to marketing, sales, engineering, research and development (R&D), supply chain management, and customer satisfaction data. (Understand)

3. **Metrology**
   Define and describe elements of metrology, including calibration systems, traceability to reference standards, and the control and integrity of measurement devices and standards. (Understand)

D. Basic Statistics

1. **Basic statistical terms**
   Define and distinguish between population parameters and sample statistics, e.g., proportion, mean, standard deviation. (Apply)

2. **Central limit theorem**
   Explain the central limit theorem and its significance in the application of inferential statistics for confidence intervals, hypothesis tests, and control charts. (Understand)

3. **Descriptive statistics**
   Calculate and interpret measures of dispersion and central tendency. (Evaluate)

4. **Graphical methods**
   Construct and interpret diagrams and charts, e.g., box-and-whisker plots, scatter diagrams, histograms, normal probability plots, frequency distributions, cumulative frequency distributions. (Evaluate)

5. **Valid statistical conclusions**
   Distinguish between descriptive and inferential statistical studies. Evaluate how the results of statistical studies are used to draw valid conclusions. (Evaluate)

E. Probability

1. **Basic concepts**
   Describe and apply probability concepts, e.g., independence, mutually exclusive events, addition and multiplication rules, conditional probability, complementary probability, joint occurrence of events. (Apply)

2. **Distributions**
   Describe, interpret, and use various distributions, e.g., normal, Poisson, binomial, chi square, Student's t, F, hypergeometric, bivariate, exponential, lognormal, Weibull. (Evaluate)

F. Process Capability

1. **Process capability indices**
   Define, select, and calculate Cp and Cpk. (Evaluate)

2. **Process performance indices**
   Define, select, and calculate Pp, Ppk, Cpm, and process sigma. (Evaluate)

3. **General process capability studies**
   Describe and apply elements of designing and conducting process capability studies relative to characteristics, specifications, sampling plans, stability, and normality. (Evaluate)

4. **Process capability for attributes data**
   Calculate the process capability and process sigma level for attributes data. (Apply)

5. **Process capability for non-normal data**
   Identify non-normal data and determine when it is appropriate to use Box-Cox or other transformation techniques. (Apply)

6. **Process performance vs. specification**
   Distinguish between natural process limits and specification limits. Calculate process performance metrics, e.g., percent defective, parts per million (PPM), defects per million opportunities (DPMO), defects per unit (DPU), throughput yield, rolled throughput yield (RTY). (Evaluate)

7. **Short-term and long-term capability**
   Describe and use appropriate assumptions and conventions when only short-term data or only long-term data are available. Interpret the relationship between short-term and long-term capability. (Evaluate)

VI. Analyze (22 Questions)

A. Measuring and Modeling Relationships Between Variables

1. **Correlation coefficient**
   Calculate and interpret the correlation coefficient and its confidence interval, and describe the difference between correlation and causation. (Evaluate)

2. **Linear regression**
   Calculate and interpret regression analysis, and apply and interpret hypothesis tests for regression statistics. Use the regression model for estimation and prediction, analyze the uncertainty in the estimate, and perform a residuals analysis to validate the model. (Evaluate)

3. **Multivariate tools**
   Use and interpret multivariate tools (e.g., factor analysis, discriminant analysis, multiple analysis of variance (MANOVA)) to investigate sources of variation. (Evaluate)

B. Hypothesis Testing

1. **Terminology**
   Define and interpret the significance level, power, type I, and type II errors of statistical tests. (Evaluate)

2. **Statistical vs. practical significance**
   Define, compare, and interpret statistical and practical significance. (Evaluate)

3. **Sample size**
   Calculate sample size for common hypothesis tests: equality of means and equality of proportions. (Apply)

4. **Point and interval estimates**
   Define and distinguish between confidence and prediction intervals. Define and interpret the efficiency and bias of estimators. Calculate tolerance and confidence intervals. (Evaluate)

5. **Tests for means, variances, and proportions**
   Use and interpret the results of hypothesis tests for means, variances, and proportions. (Evaluate)

6. **Analysis of variance (ANOVA)**
   Select, calculate, and interpret the results of ANOVAs. (Evaluate)

7. **Goodness-of-fit (chi square) tests**
   Define, select, and interpret the results of these tests. (Evaluate)

8. **Contingency tables**
   Select, develop, and use contingency tables to determine statistical significance. (Evaluate)

9. **Nonparametric tests**
   Understand the importance of the Kruskal-Wallis and Mann-Whitney tests and when they should be used. (Understand)

C. Failure Mode and Effects Analysis (FMEA)

Describe the purpose and elements of FMEA, including risk priority number (RPN), and evaluate FMEA results for processes, products, and services. Distinguish between design FMEA (DFMEA) and process FMEA (PFMEA), and interpret their results. (Evaluate)

D. Additional Analysis Methods

1. **Gap analysis**
   Analyze scenarios to identify performance gaps, and compare current and future states using predefined metrics. (Analyze)

2. **Root cause analysis**
   Define and describe the purpose of root cause analysis, recognize the issues involved in identifying a root cause, and use various tools (e.g., 5 whys, Pareto charts, fault tree analysis, cause and effect diagrams) to resolve chronic problems. (Analyze)

3. **Waste analysis**
   Identify and interpret the seven classic wastes (overproduction, inventory, defects, over-processing, waiting, motion, transportation) and resource under-utilization. (Analyze)

VII. Improve (21 Questions)

A. Design of Experiments (DOE)

1. **Terminology**
   Define basic DOE terms, e.g., independent and dependent variables, factors and levels, response, treatment, error, nested. (Understand)

2. **Design principles**
   Define and apply DOE principles, e.g., power, sample size, balance, repetition, replication, order, efficiency, randomization, blocking, interaction, confounding, resolution. (Apply)

3. **Planning experiments**
   Plan and evaluate DOEs by determining the objective, selecting appropriate factors, responses, and measurement methods, and choosing the appropriate design. (Evaluate)

4. **One-factor experiments**
   Design and conduct completely randomized, randomized block, and Latin square designs, and evaluate their results. (Evaluate)

5. **Two-level fractional factorial experiments**
   Design, analyze, and interpret these types of experiments, and describe how confounding can affect their use. (Evaluate)

6. **Full factorial experiments**
   Design, conduct, and analyze these types of experiments. (Evaluate)

B. Lean Methods

1. **Waste elimination**
   Select and apply tools and techniques for eliminating or preventing waste, e.g., pull systems, kanban, 5S, standard work, poka-yoke. (Analyze)

2. **Cycle-time reduction**
   Use various tools and techniques for reducing cycle time, e.g., continuous flow, single-minute exchange of die (SMED), heijunka (production leveling). (Analyze)

3. **Kaizen**
   Define and distinguish between kaizen and kaizen blitz and describe when to use each method. (Apply)

4. **Other improvement tools and techniques**
   Identify and describe how other process improvement methodologies are used, e.g., theory of constraints (TOC), overall equipment effectiveness (OEE). (Understand)

C. Implementation

Develop plans for implementing proposed improvements, including conducting pilot tests or simulations, and evaluate results to select the optimum solution. (Evaluate)

VIII. Control (15 Questions)

A. Statistical Process Control (SPC)

1. **Objectives**
   Explain the objectives of SPC, including monitoring and controlling process performance, tracking trends, runs, and reducing variation within a process. (Understand)

2. **Selection of variables**
   Identify and select critical process characteristics for control chart monitoring. (Apply)

3. **Rational subgrouping**
   Define and apply the principle of rational subgrouping. (Apply)

4. **Control chart selection**
   Select and use control charts in various situations: $\bar{X}$-R, $\bar{X}$-s, individual and moving range (ImR), p, np, c, u, short-run SPC, and moving average. (Apply)

5. **Control chart analysis**
   Interpret control charts and distinguish between common and special causes using rules for determining statistical control. (Analyze)

B. Other Controls

1. **Total productive maintenance (TPM)**
   Define the elements of TPM and describe how it can be used to consistently control the improved process. (Understand)

2. **Visual controls**
   Define the elements of visual controls (e.g., pictures of correct procedures, color-coded components, indicator lights), and describe how they can help control the improved process. (Understand)

C. Maintain Controls

1. **Measurement system reanalysis**
   Review and evaluate measurement system capability as process capability improves, and ensure that measurement capability is sufficient for its intended use. (Evaluate)

2. **Control plan**
   Develop a control plan to maintain the improved process performance, enable continuous improvement, and transfer responsibility from the project team to the process owner. (Apply)

D. Sustain Improvements

1. **Lessons learned**
   Document the lessons learned from all phases of a project and identify how improvements can be replicated and applied to other processes in the organization. (Apply)

2. **Documentation**
   Develop or modify documents including standard operating procedures (SOPs), work instructions, and control plans to ensure that the improvements are sustained over time. (Apply)

3. **Training for process owners and staff**
   Develop and implement training plans to ensure consistent execution of revised process methods and standards to maintain process improvements. (Apply)

4. **Ongoing evaluation**
   Identify and apply tools (e.g., control charts, control plans) for ongoing evaluation of the improved process, including monitoring leading indicators, lagging indicators, and additional opportunities for improvement. (Apply)

IX. Design for Six Sigma (DFSS) Framework and Methodologies (7 Questions)

A. Common DFSS Methodologies

Identify and describe define, measure, analyze, design, and validate (DMADV) and define, measure, analyze, design, optimize, and validate (DMADOV). (Understand)

B. Design for X (DFX)

Describe design constraints, including design for cost, design for manufacturability (producibility), design for test, and design for maintainability. (Understand)

C. Robust Designs

Describe the elements of robust product design, tolerance design, and statistical tolerancing. (Understand)

LEVELS OF COGNITION

Based on Bloom's Taxonomy—Revised (2001)

In addition to **content** specifics, the subtext for each topic in this BoK also indicates the intended **complexity level** of the test questions for that topic. These levels are based on "Levels of Cognition" (from Bloom's Taxonomy—Revised, 2001) and are presented below in rank order, from least complex to most complex.

REMEMBER | Recall or recognize terms, definitions, facts, ideas, materials, patterns, sequences, methods, principles, etc.

UNDERSTAND | Read and understand descriptions, communications, reports, tables, diagrams, directions, regulations, etc.

APPLY | Know when and how to use ideas, procedures, methods, formulas, principles, theories, etc.

ANALYZE | Break down information into its constituent parts and recognize their relationship to one another and how they are organized; identify sublevel factors or salient data from a complex scenario.

EVALUATE | Make judgments about the value of proposed ideas, solutions, etc., by comparing the proposal to specific criteria or standards.

CREATE | Put parts or elements together in such a way as to reveal a pattern or structure not clearly there before; identify which data or information from a complex set is appropriate to examine further or from which supported conclusions can be drawn.

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