BODY OF KNOWLEDGE

Certified Six Sigma Green Belt (CSSGB)

Topics included in this body of knowledge (BoK) are explanations (subtext) and cognitive levels for each topic or subtopic in the test. These details will be used by the Examination Development Committee as guidelines for writing test questions and are designed to help candidates prepare for the exam by identifying specific content within each topic that can be tested. Except where specified, the subtext is not intended to limit the subject or be all-inclusive of what might be covered in an exam but is intended to clarify how topics are related to the role of the Certified Six Sigma Green Belt (CSSGB). The descriptor in parentheses at the end of each subtext entry refers to the highest cognitive level at which the topic will be tested. A complete description of cognitive levels is provided at the end of this document.

I. Overview: Six Sigma and the Organization (13 Questions)

A. Six Sigma and Organizational Goals

1. **Value of Six Sigma**
   Recognize why organizations use Six Sigma, how they apply its philosophy and goals, and the evolution of Six Sigma from quality leaders such as Juran, Deming, Shewhart, Ishikawa, and others. (Understand)

2. **Organizational goals and Six Sigma projects**
   Identify the linkages and supports that need to be established between a selected Six Sigma project and the organization's goals, and describe how process inputs, outputs, and feedback at all levels can influence the organization as a whole. (Understand)

3. **Organizational drivers and metrics**
   Recognize key business drivers (profit, market share, customer satisfaction, efficiency, product differentiation) for all types of organizations. Understand how key metrics and scorecards are developed and how they impact the entire organization. (Understand)

B. Lean Principles in the Organization

1. **Lean concepts**
   Define and describe lean concepts such as theory of constraints, value chain, flow, and perfection. (Apply)

2. **Value stream mapping**
   Use value stream mapping to identify value-added processes and steps or processes that produce waste, including excess inventory, unused space, test inspection, rework, transportation, and storage. (Understand)

C. Design for Six Sigma (DfSS) Methodologies

1. Road maps for DfSS

Distinguish between DMADV (define, measure, analyze, design, verify) and IDOV (identify, design, optimize, verify), and recognize how they align with DMAIC. Describe how these methodologies are used for improving the end product or process during the design (DfSS) phase. (Understand)

2. Basic failure mode and effects analysis (FMEA)

Use FMEA to evaluate a process or product and determine what might cause it to fail and the effects that failure could have. Identify and use scale criteria, calculate the risk priority number (RPN), and analyze the results. (Analyze)

3. Design FMEA and process FMEA

Define and distinguish between these two uses of FMEA. (Apply)

II. Define Phase (23 Questions)

A. Project Identification

1. Project selection

Describe the project selection process and what factors should be considered in deciding whether to use the Six Sigma DMAIC methodology or another problem-solving process. (Understand)

2. Process elements

Define and describe process components and boundaries. Recognize how processes cross various functional areas and the challenges that result for process improvement efforts. (Analyze)

3. Benchmarking

Understand various types of benchmarking, including competitive, collaborative, and best practices. (Understand)

4. Process inputs and outputs

Identify process input and output variables and evaluate their relationships using the supplier, input, process, output, customer (SIPOC) model. (Analyze)

5. Owners and stakeholders

Identify the process owners and other stakeholders in a project. (Apply)

B. Voice of the Customer (VoC)

1. Customer identification

Identify the internal and external customers of a project, and what effect the project will have on them. (Apply)

2. Customer data

Collect feedback from customers using surveys, focus groups, interviews, and various forms of observation. Identify the key elements that make these tools effective. Review data collection questions to eliminate vagueness, ambiguity, and any unintended bias. (Apply)

3. Customer requirements

Use quality function deployment (QFD) to translate customer requirements statements into product features, performance measures, or opportunities for improvement. Use weighting methods as needed to amplify the importance and urgency of different kinds of input; telephone call vs. survey response; product complaint vs. expedited service request. (Apply)

C. Project Management Basics

1. Project charter

Define and describe elements of a project charter and develop a problem statement that includes baseline data or current status to be improved and the project's goals. (Apply)

2. Project scope

Help define the scope of the project using process maps, Pareto charts, and other quality tools. (Apply)

3. **Project metrics**
   Help develop primary metrics (reduce defect levels by x-amount) and consequential metrics (the negative effects that making the planned improvement might cause). (Apply)

4. **Project planning tools**
   Use Gantt charts, critical path method (CPM), and program evaluation and review technique (PERT) charts to plan projects and monitor their progress. (Apply)

5. **Project documentation**
   Describe the types of data and input needed to document a project. Identify and help develop appropriate presentation tools (storyboards, spreadsheet summary of results) for phase reviews and management updates. (Apply)

6. **Project risk analysis**
   Describe the elements of a project risk analysis, including feasibility, potential impact, and risk priority number (RPN). Identify the potential effect risk can have on project goals and schedule, resources (materials and personnel), costs and other financial measures, and stakeholders. (Understand)

7. **Project closure**
   Review with team members and sponsors the project objectives achieved in relation to the charter and ensure that documentation is completed and stored appropriately. Identify lessons learned and inform other parts of the organization about opportunities for improvement. (Apply)

D. Management and Planning Tools

Define, select, and apply these tools: 1) affinity diagrams, 2) interrelationship digraphs, 3) tree diagrams, 4) prioritization matrices, 5) matrix diagrams, 6) process decision program charts (PDPC), and 7) activity network diagrams. (Apply)

E. Business Results for Projects

1. **Process performance**
   Calculate process performance metrics such as defects per unit (DPU), rolled throughput yield (RTY), cost of poor quality (CoPQ), defects per million opportunities (DPMO), sigma levels, and process capability indices. Track process performance measures to drive project decisions. (Analyze)

2. **Communication**
   Define and describe communication techniques used in organizations: top-down, bottom-up, and horizontal. (Apply)

F. Team Dynamics and Performance

1. **Team stages and dynamics**
   Define and describe the stages of team evolution, including forming, storming, norming, performing, adjourning, and recognition. Identify and help resolve negative dynamics such as overbearing, dominant, or reluctant participants, the unquestioned acceptance of opinions as facts, groupthink, feuding, floundering, the rush to accomplishment, attribution, discounts, digressions, and tangents. (Understand)

2. **Team roles and responsibilities**
   Describe and define the roles and responsibilities of participants on Six Sigma and other teams, including Black Belt, Master Black Belt, Green Belt, champion, executive, coach, facilitator, team member, sponsor, and process owner. (Apply)

3. **Team tools**
   Define and apply team tools such as brainstorming, nominal group technique, and multivoting. (Apply)

4. **Team Communication**
   Identify and use appropriate communication methods (both within the team and from the team to various stakeholders) to report progress, conduct reviews, and support the overall success of the project. (Apply)

III. Measure Phase (23 Questions)

A. Process Analysis and Documentation

Develop process maps and review written procedures, work instructions, and flowcharts to identify any gaps or areas of the process that are misaligned. (Create)

B. Probability and Statistics

1. **Basic probability concepts**
   Identify and use basic probability concepts: independent events, mutually exclusive events, multiplication rules, permutations, and combinations. (Apply)

2. **Central limit theorem**
   Define the central limit theorem and describe its significance in relation to confidence intervals, hypothesis testing, and control charts. (Understand)

C. Statistical Distributions

Define and describe various distributions as they apply to statistical process control and probability: normal, binomial, Poisson, chi square, Student's t, and F. (Understand)

D. Collecting and Summarizing Data

1. **Types of data and measurement scales**
   Identify and classify continuous (variables) and discrete (attributes) data. Describe and define nominal, ordinal, interval, and ratio measurement scales. (Analyze)

2. **Sampling and data collection methods**
   Define and apply various sampling methods (random and stratified) and data collection methods (check sheets and data coding). (Apply)

3. **Descriptive statistics**
   Define, calculate, and interpret measures of dispersion and central tendency. Develop and interpret frequency distributions and cumulative frequency distributions. (Evaluate)

4. **Graphical methods**
   Construct and interpret diagrams and charts that are designed to communicate numerical analysis efficiently, including scatter diagrams, normal probability plots, histograms, stem-and-leaf plots, box-and-whisker plots. (Create)

E. Measurement System Analysis (MSA)

Calculate, analyze, and interpret measurement system capability using gauge repeatability and reproducibility (GR&R) studies, measurement correlation, bias, linearity, percent agreement, and precision/tolerance (P/T). (Evaluate)

F. Process and Performance Capability

1. **Process performance vs. process specifications**
   Define and distinguish between natural process limits and specification limits, and calculate process performance metrics. (Evaluate)

2. **Process capability studies**
   Define, describe, and conduct process capability studies, including identifying characteristics, specifications, and tolerances, and verifying stability and normality. (Evaluate)

3. **Process capability (Cp, Cpk) and process performance (Pp, Ppk) indices**
   Describe the relationship between these types of indices. Define, select, and calculate process capability and process performance. Describe when Cpm measures can be used. Calculate the sigma level of a process. (Evaluate)



4. **Short-term vs. long-term capability and sigma shift**
   Describe the assumptions and conventions that are appropriate to use when only short-term data are used. Identify and calculate the sigma shift that occurs when long- and short-term data are compared. (Evaluate)

IV. Analyze Phase (15 Questions)

A. Exploratory Data Analysis

1. **Multi-vari studies**
   Select appropriate sampling plans to create multi-vari study charts and interpret the results for positional, cyclical, and temporal variation. (Create)

2. **Correlation and linear regression**
   Describe the difference between correlation and causation. Calculate the correlation coefficient and linear regression and interpret the results in terms of statistical significance (p-value). Use regression models for estimation and prediction. (Evaluate)

B. Hypothesis Testing

1. **Basics**
   Distinguish between statistical and practical significance. Determine appropriate sample sizes and develop tests for significance level, power, and type I and type II errors. (Apply)

2. **Tests for means, variances, and proportions**
   Conduct hypothesis tests to compare means, variances, and proportions (paired-comparison t-test, F-test, analysis of variance [ANOVA], chi square) and interpret the results. (Analyze)

V. Improve Phase (15 Questions)

A. Design of Experiments (DoE)

1. **Basic terms**
   Define and describe terms such as independent and dependent variables, factors and levels, responses, treatments, errors, repetition, blocks, randomization, effects, and replication. (Understand)

2. **DoE graphs and plots**
   Interpret main effects analysis and interaction plots. (Apply)

B. Root Cause Analysis

Use cause and effect diagrams, relational matrices, and other problem-solving tools to identify the true cause of a problem. (Analyze)

C. Lean Tools

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

2. **Cycle-time reduction**
   Use various techniques to reduce cycle time (continuous flow, setup reduction). (Analyze)

3. **Kaizen and kaizen blitz**
   Define and distinguish between these two methods and apply them in various situations. (Apply)

VI. Control Phase (11 Questions)

A. Statistical Process Control (SPC)

1. **SPC Basics**
   Describe the theory and objectives of SPC, including measuring and monitoring process performance for both continuous and discrete data. Define and distinguish between common and special cause variation and how these conditions can be deduced from control chart analysis. (Analyze)

2. **Rational subgrouping**
   Define and describe how rational subgrouping is used. (Understand)

3. **Control charts**
   Identify, select, construct, and use control charts: $\bar{X}$-R, $\bar{X}$-s, individual and moving range (ImR or XmR), median, p, np, c, and u. (Apply)

B. Control Plan

Assist in developing and implementing a control plan to document and monitor the process and maintain the improvements. (Apply)

C. Lean Tools for Process Control

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

2. **Visual factory**
   Define the elements of a visual factory and describe how it can be used to control the improved process. (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.

Visit **asq.org/cert** for comprehensive exam information.

