VALUE ADDED 616

Lean Six Sigma Black Belt Certification Checklist

Candidate Name_____ Date of Review_____

The following items will be reviewed by the VA616 Certification Review Board (CRB) in agreement with American Meridian University when considering final qualification as a Certified Lean Six Sigma Black Belt:

- ☐ 160 contact-hours
  - ☐ 40-hour LSSGB course and 120-hour LSSBB course, or
  - ☐ 160-hour LSSGB and LSSBB combined course
- ☐ Minimum combined score of 80% on weekly exams
  - ☐ Week 1: Define Phase (25 questions) and Measure Phase (20 questions)
  - ☐ Week 2: Analyze Phase (20 questions) and Improve Phase (10 questions)
  - ☐ Week 3: Improve Phase (10 questions) and Control Phase (15 questions)
- ☐ Project requirements
  - ☐ Two completed DMAIC projects, or
  - ☐ One kaizen event and one DMAIC project, or
  - ☐ VA616 LSSGB in-class DMAIC project and VA616 LSSBB in-class DMAIC project

Body of Knowledge Alignment

Value Added 616 holds certification validation through the Department of Defense, and an articulation agreement with American Meridian University (AMU). That means our training and certification standards are aligned to the body of knowledge (BoK) and certification requirements of the Department of Defense, and your certification is recognized as college credits with AMU.

A frequently asked question is how the DoD and American Society for Quality (ASQ) BoKs align? The DoD standards were developed in collaboration with ASQ and ASQ certified Lean Six Sigma Master Black Belts in the early 2000s. Therefore, the two bodies of knowledge only differ where it makes sense for the industries they serve. VA616 opted for the DoD standards and certification because it is more stringent and rigorous. [Our name on your certification is our reputation – we don't take that lightly]. Rest assured that a certification aligning to DoD standards is nationally recognized and will open equal opportunities throughout our industry.

Lean Six Sigma Black Belt Body of Knowledge

The topics in this Body of Knowledge (BoK) include detailed explanations and the taxonomy level used for development of the examination. The descriptor in parentheses at the end of each entry refers to the taxonomy level at which the topic will be tested.

Enterprise-Wide Deployment

1. Enterprise view

a. History of organizational improvement. Identify the origin of various continuous improvement tools including quality control, statistical process control (SPC), total quality management/leadership (including the 14 points), Lean, Six Sigma, theory of constraints, etc. (Remember)

b. Foundations of Lean Six Sigma. Describe the organizational value of Lean Six Sigma in terms of its philosophy and principles, and identify how lean tools, the DMAIC model, and the theory of constraints relate to each other. (Apply)

c. Business systems and processes. Identify the interrelationships between organizational structure and processes. Describe how the selection and management of value streams relates to the organizational structure and processes and confirm the link of value streams to organizational strategic plans. (Apply)

d. Suppliers, inputs, processes, outputs, outcomes, customers (SIPOOC). Describe how SIPOOC can be used to identify appropriate value streams, based on how the value streams influence enterprise systems (cost, quality, schedule, financial paths, business flow, etc.). (Apply)

2. Leadership

a. Enterprise leadership roles and responsibilities. Identify the roles and responsibilities of executive leadership and how their involvement can affect the deployment of Lean Six Sigma initiatives (providing resources, accountability, etc.). (Analyze)

b. Lean Six Sigma roles and responsibilities. Define the roles and responsibilities of Lean Six Sigma Green Belt, Lean Six Sigma Black Belt, Lean Six Sigma Master Black Belt, value stream champion, process owners, customers, and stakeholders. (Apply)

c. Linking projects to organizational goals. Describe how projects or kaizen events are identified and selected, such as identifying constraints in the value stream and knowing when to use Lean Six Sigma instead of other problem-solving approaches. (Apply)

Business Processes

1. Process management and results

a. Basic process management. Identify and describe the nine steps of the process management, from defining the mission and vision through acknowledging the team and reporting results. (Analyze)

b. Process performance metrics. Recognize the effect process performance metrics can have on enterprise decisions, such as how metrics propagate upward and allocate downward. (Analyze)

c. Benchmarking. Define and distinguish between various types of benchmarking. (Apply)

d. Supply chain management. Describe customer-supplier relationships and how these relationships and the supply chain are affected by project initiatives. (Understand)

e. Financial measures. Define and use financial measures including net present value (NPV), return on investment (ROI), cost of quality (COQ), etc., to underscore potential financial results. (Understand)

f. Balanced Scorecard. Describe how balanced scorecard is used to evaluate organizational goals against customer expectations and organizational processes. (Apply)

2. Voice of the customer

a. Identify the customer. Identify and segment various customers (internal, external, long-term, loyal, etc.) that will be impacted by changes to existing value streams. (Analyze)

b. Collect and validate customer data. Determine which measurement method to use to collect customer feedback (surveys, focus groups, interviews, observation, etc.) in order to understand customer's needs, expectations, and requirements, and use appropriate methods to ensure measurement validity and reliability (review questions for bias, ambiguity, etc.). (Apply)

c. Customer data analysis. Determine which graphical, qualitative, or statistical tools are most appropriate for analyzing customer data. (Analyze).

d. Identify critical to x (CTx) requirements. Identify and use various metrics to evaluate product and process performance that are critical to quality (CTQ), cost (CTC), process (CTP), safety (CTS), and delivery (CTD). (Analyze)

e. X-Y Matrix. Define, interpret, and use an X-Y matrix in customer requirements analysis. (Analyze)

3. Change management

a. Organizational roadblocks. Identify the inherent structures of an organization (such as its culture and construct) and describe how they can become barriers to improvement. (Analyze)

b. Change agent. Describe the role of change agent. (Analyze)

c. Motivation techniques. Define and apply various techniques used to support and sustain participation in process improvement efforts. (Analyze)

d. Conflict resolution technique. Use various techniques to help conflicting parties recognize common goals and ways they can work together to achieve them. (Apply)

e. Communication planning and deployment. Develop and deploy communication plans that support process improvement efforts and will help prevent rumors, false expectations, and other obstacles from interfering with successful implementation of the change. (Analyze)

Project Team Management

1. Initial steps

a. Initiating teams. Describe and identify the elements required when launching a team (clear purpose and goals, commitment, ground rules, etc.) and how they affect the team's success (ability to gain support from management, team empowerment, team cohesion, etc.). (Analyze)

b. Selecting team members. Determine the appropriate number and type of team members (in terms of skills sets, technical/subject-matter expertise, etc.) based on the team's charter and goals, and ensure appropriate representation of the stakeholders. (Analyze)

c. Team roles. Define and describe team roles and responsibilities, including team leader, facilitator, etc. (Apply)

2. Team stages. Identify and facilitate the stages of team evolution (forming, storming, norming, performing, adjourning/mourning). (Understand)

3. Team building and facilitation techniques. Apply various techniques (such as coaching, mentoring, intervention, etc.) to build and guide a team, and use appropriate tools to overcome common problems such as overbearing, dominant, or reluctant participants, the unquestioned acceptance of opinions as facts, groupthink, feuding, floundering, the rush to accomplish/finish, digressions, and tangents. (Evaluate)

4. Team performance evaluation. Measure team progress in relation to goals, objectives, and metrics that support team success, and recognize and reward accomplishments. (Analyze)

5. Team tools. Define, select, and apply the following creative and management and planning tools used by teams in various situations: brainstorming, nominal group technique, multi-voting, affinity diagrams, tree diagrams, various matrix diagrams and interrelationship digraphs, activity network diagrams, etc. (Evaluate)

Define the Problem or Opportunity

1. Documentation and presentation

a. Documentation elements. Create data- and fact-driven project documents and determine appropriate tools for recording and using them (e.g., spreadsheets, storyboards, phased reviews, management reviews). (Analyze)

b. Presentation. Determine the appropriate style to use when communicating complex or technical issues (e.g., visual displays of data and information) considering the target audience and the purpose of the presentation. (Evaluate)

2. Charter and plan

a. Charter and plan elements. Create a project charter and plan (including objectives, scope, boundaries, resources, transition, and closure) for a kaizen event or Lean Six Sigma project. (Analyze)

b. Charter negotiation. Use various negotiation techniques when changes to the charter are proposed by various stakeholders and team members and determine when it is appropriate to make changes to the charter. (Analyze)

c. Execution. Use various tools to track a Lean Six Sigma project or event (tollgates, milestones, red flags, etc.). (Analyze)

3. Mission, vision, and problem statement. Develop a mission and vision statement for a project and develop a problem statement containing a clear case for action and describing current and desired performance level of process. (Analyze)

4. Project scope. Identify the boundaries of project using value stream maps, SIPOOC, and other tools to align with the goals of the organization and to ensure that it has value to the customer. (Evaluate)

5. Project metrics. Identify or establish process performance measurements that point to the critical elements of the process and can be connected to financial benefits. (Apply)

Measure the Current State

1. Process analysis

a. Process inputs and outputs. Identify process input variables and output variables, and document their relationships through cause and effect diagrams, relational matrices, and data collection and analysis. (Evaluate)

b. Process flow and effective utilization. Evaluate process flow and utilization by identifying the waste and constraints along the critical chain and analyzing work in progress (WIP), work in queue (WIQ), touch time, takt time, cycle time, and throughput. (Evaluate)

c. Tools. Develop and review value stream maps, process maps, written procedures, work instructions, flowcharts, spaghetti diagrams, circle diagrams, etc. (Evaluate)

2. Collecting and summarizing data

a. Types of data. Identify, define, classify, and compare qualitative and quantitative data, continuous (variables) and discrete (attributes) data, and their types of distributions (binomial and Poisson). Identify opportunities to convert attributes data to variables measures. (Analyze)

b. Methods for collecting data. Prepare data collection plans, and apply methods for collecting data using check sheets, data coding, automatic gauging, etc. (Evaluate)

c. Measurement scales. Define and apply nominal, ordinal, interval, and ratio measurement scales. (Apply)

d. Techniques for ensuring data accuracy and integrity. Define and apply techniques for ensuring data accuracy and integrity such as random sampling, stratified sampling, sample homogeneity, etc. (Evaluate)

3. Basic statistics

a. Central limit theorem. Define the central limit theorem and describe its significance in the application of inferential statistics for confidence intervals, control charts, etc. (Understand)

b. Descriptive statistics. Define, compute, and interpret measures of dispersion and central tendency (mean, median, mode, variance, standard deviation, and z-values), and construct and interpret frequency distributions and cumulative frequency distributions. (Analyze)

c. Drawing valid statistical conclusions. Distinguish between enumerative (descriptive) and analytical (inferential) studies and distinguish between a population parameter and a sample statistic. (Analyze)

d. Graphical methods. Construct, apply, and interpret diagrams and charts such as box and-whisker plots, run charts, scatter diagrams, histograms, normal probability plots, etc. (Evaluate)

4. Measurement systems

a. Measurement methods. Describe measurement systems and identify measurement methods for continuous and discrete data. (Apply)

b. Measurement system analysis (MSA). Determine measurement system capability by using tools such as repeatability and reproducibility studies, correlation, bias, linearity, etc. (Analyze)

5. Statistical process control (SPC)

a. Objectives and benefits. Identify and explain the objectives and benefits of SPC (e.g., controlling process performance, distinguishing special from common causes). (Evaluate)

b. Selection of variable. Identify and select critical characteristics for monitoring by control chart. (Evaluate)

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

d. Selection and application of control charts. Identify, select, construct, and use control charts, including individual and moving range (ImR/XmR), p, np, c, and u. (Apply)

e. Analysis of control charts. Interpret control charts and distinguish between common and special causes using rules for determining statistical control. (Evaluate)

6. Analyzing process capability

a. Designing and conducting process capability studies. Identify, describe, and apply the elements of designing and conducting process capability studies, including identifying characteristics, identifying specifications and tolerances, developing sampling plans, and verifying stability and normality. (Apply)

b. Calculating process performance vs. specification. Distinguish between natural process limits and specification limits, and calculate process performance metrics, such as percent defective, parts per million (PPM), defects per million opportunities (DPMO), defects per unit (DPU), process sigma, rolled throughput yield (RTY), activity-based costing, etc. (Analyze)

c. Process capability indices. Define, select, and calculate Cp and Cpk, and assess process capability. (Apply)

d. Short-term and long-term capability studies. Describe the appropriate assumptions and conventions to use when only short-term data or attributes data are available. Describe the changes in relationships that occur when long-term data are used. Describe and interpret the relationships between long-term and short-term capability. (Apply)

e. Process capability for non-normal data. Describe the cause of non-normal data and determine when it is appropriate to use a Box-Cox or other power transformation techniques. (Understand)

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

Analyze the Data

1. Wastes. Define and apply the classic eight wastes: overproduction, inventory, defects, over-processing, waiting, motion, wasted capital and transportation. Analyze value-added and non-value-added activities and develop metrics and evaluate data to identify constraints in value flow. (Analyze)

2. Measuring and modeling relationships between variables

a. Simple and multiple least-squares linear regression. Describe and interpret the regression equation; apply and interpret hypothesis tests for regression statistics; use the regression model for estimation and prediction and analyze the uncertainty in the estimate. (Understand) [NOTE: Models that have non-linear parameters will not be tested.]

b. Simple linear correlation. Describe and interpret the correlation coefficient and its confidence interval; apply and interpret a hypothesis test for the correlation coefficient. Describe the difference between correlation and causation. (Understand) [NOTE: Serial correlation will not be tested.]

c. Diagnostics. Analyze residuals of the model. (Understand)

3. Basic hypothesis testing

a. Statistical vs. practical significance. Define, compare, and contrast statistical and practical significance. (Apply)

b. Significance level, power, type I and type II (Alpha and Beta) errors. Apply and interpret the significance level, power, type I, and type II errors of statistical tests. (Understand)

c. Sample size. Describe the impact of sample size for any given hypothesis test. (Apply)

d. Null and alternate hypotheses. Develop the null or alternate hypothesis as required in various situations. (Apply)

e. Probability (p) value. Interpret p-value in rejecting or failing to reject null hypothesis. (Apply)

4. Advanced hypothesis testing

a. Point and interval estimation. Define and interpret the efficiency and bias of estimators; interpret and draw conclusions from statistics such as standard error, tolerance intervals, and confidence intervals; distinguish between confidence intervals and prediction intervals. (Understand)

b. Tests for means, variances, and proportions. Define and determine applicability of hypothesis tests for means (t-test, ANOVA, etc.), variances (F-Test, Levene's test, etc.), and proportions, and interpret results for significance of process inputs. (Understand)

c. Paired-comparison tests. Define, determine applicability, and interpret paired comparison parametric hypothesis tests. (Understand)

d. Goodness-of-fit tests. Define, determine applicability, and interpret chi-square tests. (Understand)

5. Failure mode and effects analysis (FMEA). Describe the purpose and elements of FMEA and how this tool is used for processes, products, and services. (Evaluate)

6. Tools for identifying significant or root cause. Describe, use, and interpret various root cause analysis tools, including (1) the five whys, (2) fishbone (Ishikawa) diagrams, and (3) the cause and effect matrix. (Evaluate)

Improve the Process

1. Design of experiments (DOE)

a. Basic terms. Define independent and dependent variables, factors and levels, response, treatment, error, repetition, and replication. (Understand)

b. Planning and organizing experiments. Describe and apply the basic elements of experiment planning and organizing, including determining the experiment objective, selecting factors, responses, and measurement methods, choosing the appropriate design, etc. (Understand)

c. Design principles. Define and apply the principles of power and sample size, balance, replication, order, efficiency, randomization and blocking, interaction, and confounding. (Understand)

d. Design and analysis. Construct full-factorial and fractional designs of experiments and interpret computational and graphical results. Describe the limitations of fractional factorials caused by confounding. (Understand)

2. Eliminating waste. Define, describe and select the following tools and techniques for eliminating waste and improving processes: 1) Pull/Kanban, 2) 5S, 3) Flow, 4) Standard work, 5) Poka-yoke, 6) Cycle-time reduction, 7) Set-up time reduction. (Evaluate)

3. Theory of constraints. Describe and use Goldratt's process for exploiting and elevating constraints and explain how to subordinate non-constraints in a process. (Application)

4. Critical chain project management. Define and use project buffer management, the drum-buffer-rope method, etc., and distinguish between critical chain and critical path. (Understand)

5. Implement the improved process

a. Plan the implementation. Develop a plan for implementing the improved process. Identify the issues and roadblocks that may be encountered when the plan is implemented and determine the best methods for responding to those issues. (Evaluate)

b. Conduct a pilot or a simulation. Describe and apply the concepts required to conduct a pilot and identify the steps needed for a successful pilot or simulation. (Analyze)

c. Select the optimum solution. Analyze data collected from the pilot or simulation to determine the best solution. (Evaluate)

d. Roll out the optimum solution. Implement a full-scale version of the improved process and monitor results. (Analyze)

Control and Sustain the Improved Process

1. Implement and maintain controls

a. Control plan. Develop a follow-up plan that will identify appropriate controls for ensuring the ongoing success of the improved process. (Evaluate)

b. Total productive maintenance (TPM). Define TPM and its elements and describe how it can be used as a control in the improved process. (Remember)

c. Visual factory. Define the elements of visual factory and describe how they can help control the improved process. (Understand)

d. Measurement system reanalysis. Recognize the need to improve or revise measurement system capability as process capability improves. Evaluate the use of control measurement systems and ensure that measurement capability is sufficient for its intended use. (Apply)

2. Sustain the improvement

a. Knowledge management and lessons learned. Identify and document the lessons learned and ensure that those lessons and process successes are disseminated to participants in future process improvement opportunities. Recognize how the improved process can be replicated and applied to other processes in the organization. (Analyze)

b. Training plan. Determine an appropriate training plan for ensuring the continued support of the improved processes. (Analyze)

c. Monitor for new constraints. Identify the steps required to monitor the improved process for new constraints and additional opportunities for improvement. (Analyze)

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 understanding 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 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.