



IN COLLABORATION WITH



**THE OHIO STATE UNIVERSITY**  
FISHER COLLEGE OF BUSINESS

## Lean Six Sigma Green Belt Body of Knowledge

| Mastery Requirement Key<br>Bloom's Taxonomy |   |
|---|---|
| <b>RE</b>                                   | <b>Remember</b> terminology, facts, and definitions   |
| <b>UN</b>                                   | <b>Understand</b> and explain ideas and concepts  |
| <b>AP</b>                                   | <b>Apply</b> information, methods, and procedures in a new way or in a different context                                  |
| <b>AN</b>                                   | <b>Analyze</b> critically to compare and contrast, discriminate through experimentation, and identify inter-relationships |
| <b>EV</b>                                   | <b>Evaluate</b> to draw conclusions and reach judgements through interpretation of analytical work                        |
| <b>CR</b>                                   | <b>Create</b> new methods, processes, systems, concepts, and ideas  |

| Topic Area     | Topic  | Mastery Requirement* | Mastery Assessment   |
|----------------|--|----------------------|--|
| <b>General</b> |  |                      |  |
|                | Lean Six Sigma Defined                         | <b>UN</b>            | Describe nature and purpose of Lean Six Sigma  |
|                | Integration of Lean and Six Sigma              | <b>UN</b>            | Compare and contrast focus and approaches (Process Velocity and Quality)   |
|                | Y=f(X) Input Determines Output                 | <b>EV</b>            | Express business processes as a transfer function  |
|                | The Business Case for Lean Six Sigma           | <b>AP</b>            | Describe value proposition of Lean Six Sigma as a methodology  |
|                | Origins of Lean and Six Sigma                  | <b>UN</b>            | Understand historical perspective and evolution  |
|                | DMAIC - The Lean Six Sigma Improvement Process | <b>EV</b>            | Apply DMAIC methodology to organize project thinking and work  |
|                | Lean and DMAIC                                 | <b>AP</b>            | Apply DMAIC methodology at varying levels of complexity based on project requirements and mix of "Lean" vs "Variation Reduction" activities. |
|                | Thought Process Mapping                        | <b>AN</b>            | Employ Question->Action->Answer approach to guide critical thinking  |

| Topic Area                | Topic                                    | Mastery Requirement* | Mastery Assessment                                     |
|---------------------------|--|----------------------|--|
| <b>Project Management</b> |  |                      |  |
|                           | Organizing for Success                   | <b>UN</b>            | Understand critical organizational success factors     |
|                           | Working Relationships & Responsibilities | <b>UN</b>            | Understand typical work role definitions and structure |

|                              | Project Selection                                | <b>AP</b>            | Select projects based on systematic analysis of key organizational performance metrics, comparing actual to imperative to identify gaps  |
|------------------------------|--|----------------------|--|
|                              | Project Charter                                  | <b>CR</b>            | Create project charter with compelling business case, clear objectives, and appropriate scope of action  |
|                              | Project Tracking                                 | <b>EV</b>            | Systematically plan and execute project work activities  |
|                              | Leading Project Teams                            | <b>AP</b>            | Provide positive leadership energy to accomplish project goals through people: communicate, convince, coordinate and compel  |
|                              | Leading Change                                   | <b>AP</b>            | Apply change management techniques to accomplish project objectives  |
|                              | Stakeholder Analysis - RACI Matrix               | <b>AP</b>            | Recognize stakeholders, their needs, possible conflicts or resistance, and plan and communicate accordingly  |
|                              |  |                      |  |
| Topic Area                   | Topic  | Mastery Requirement* | Mastery Assessment   |
| <b>Define Phase of DMAIC</b> |  |                      |  |
|                              | Process Thinking and The Value Stream            | <b>UN</b>            | Define high level value streams  |
|                              | Process Mapping - Overview                       | <b>AN</b>            | Understand alternate forms of process mapping and apply criteria to select the appropriate type of map for the situation   |
|                              | SIPOC Maps                                       | <b>AP</b>            | Construct SIPOC map incorporating relevant elements  |
|                              | Process Flow Charts and Swim Lanes               | <b>AP</b>            | Construct Flow Chart using standard symbols and with activities identified by department or function   |
|                              | Value-Added Flow Charts ( 7/8 Wastes)            | <b>AP</b>            | Construct Flow Chart which identifies non-value-added activities   |
|                              | Spaghetti Charts                                 | <b>AP</b>            | Construct chart to map the physical flow of materials or virtual flow of information   |
|                              | Value Stream Mapping (Current State, Takt Time)  | <b>AP</b>            | Construct Value Stream Map of current/future process state, showing order flows, processing time by step, inventories, delays, set-up times, takt time, and overall cycle time (lead time), waste and bottlenecks. |
|                              | Voice of The Customer                            | <b>UN</b>            | Express importance of customer-driven activities   |
|                              | Understanding Customer Requirements (Kano Model) | <b>AP</b>            | Apply Kano Analysis to identify opportunities to "delight" customers   |
|                              | Sources of Customer Data                         | <b>UN</b>            | Recognize sources for VOC data   |
|                              | Conducting Surveys                               | <b>UN</b>            | Recognize situations calling for a survey to collect customer data   |
|                              | Surveys - Sampling Frame                         | <b>AP</b>            | Incorporate sample frame considerations to achieve representative sample   |
|                              | Structuring Survey Questions                     | <b>AP</b>            | Structure survey questions to achieve desired results and avoid bias   |
|                              | The Degree of Uncertainty in Sampling            | <b>AP</b>            | Factor uncertainty into survey analysis  |

|                               | Guideline for Margin of Error                             | <b>AP</b>            | Incorporate margin of error into analysis of survey results  |
|-------------------------------|---|----------------------|--|
|                               | Affinity Diagram Tool Set                                 | <b>AP</b>            | Use Affinity Diagram to sort and group customer data   |
|                               | CTQC Tree Diagram   | <b>AP</b>            | Develop Tree Diagram to refine general customer requirements into Critical To Quality Requirements.                              |
|                               | Operational Definitions                                   | <b>CR</b>            | Craft operational definitions to express customer requirements in clear and objective terms                                      |
|                               | Voice Of The Customer As Specifications                   | <b>AN</b>            | Translate customer requirements into internal process/product specifications   |
|                               | Define Phase Tollgate Review                              | <b>EV</b>            | Review critical questions for the Define Phase to ensure that answers have been developed  |
|                               |   |                      |  |
| Topic Area                    | Topic   | Mastery Requirement* | Mastery Assessment   |
| <b>Measure Phase of DMAIC</b> |   |                      |  |
|                               | Measurements and Basic Statistics                         | <b>UN</b>            | Describe the role of measurements and basis statistics in the Measure phase of a DMAIC project                                   |
|                               | Business Problem Solving Using Statistics                 | <b>AN</b>            | Express practical problems as statistical question, and translate statistical answers into practical answers                     |
|                               | Basic Statistical Terms                                   | <b>AP</b>            | Describe basic statistical terms in structuring actions to answer critical questions   |
|                               | Descriptive and Inferential Statistics                    | <b>AP</b>            | Differentiate between Descriptive and Inferential Statistics   |
|                               | Discrete vs. Continuous Measurements                      | <b>AP</b>            | Identify the most useful type of data to collect to meet project requirements  |
|                               | Measurement Subjects                                      | <b>AP</b>            | Distinguish between type of measures subjects  |
|                               | Graphical Summaries                                       | <b>AN</b>            | Interpret the information conveyed by graphical representations of data  |
|                               | Statistical Software (Minitab, EngineRoom, JMP, or other) | <b>AP</b>            | Demonstrate use of statistical software to analyze data  |
|                               | Pareto Chart  | <b>AN</b>            | Use Pareto Charts to rank by frequency and interpret the output  |
|                               | Measuring Central Tendency                                | <b>AN</b>            | Calculate and interpret appropriate measures of central tendency in analyzing process performance (mean, median, mode)           |
|                               | Quantifying Process Variability                           | <b>AN</b>            | Calculate and interpret appropriate measures of variation in analyzing process performance (variance, standard deviation, range) |
|                               | The Normal Distribution                                   | <b>AN</b>            | Apply normal distribution concepts to assessments of capability and employ Z-scores to model probability                         |
|                               | Cause & Effect Matrix Toolset                             | <b>EV</b>            | Systematically identify process inputs which potential to significantly affect output of interest                                |
|                               | Measurement System Analysis (MSA)                         | <b>UN</b>            | Appreciate the important role of measurement system analysis   |
|                               | Measurement As A Process                                  | <b>AP</b>            | Apply the study of measurement system capability as a process  |

|                               | Requirements of Measurement Systems                     | <b>AP</b>            | Execute measurement analysis to address the requirements of a reliable system              |
|-------------------------------|---|----------------------|--|
|                               | Gauge R & R (Variable Data)                             | <b>EV</b>            | Evaluate systems used to collect variable data   |
|                               | MSA - Graphing  | <b>EV</b>            | Apply graphical analysis to enhance MSA evaluation   |
|                               | Attribute Measurement System Analysis                   | <b>EV</b>            | Evaluate systems used to collect variable data   |
|                               | Calibration of Measurement Systems                      | <b>AP</b>            | Apply calibration guidelines to ensure measurement system reliability over time            |
|                               | Collecting Data   | <b>EV</b>            | Develop a data collection plan   |
|                               | Developing a Sampling Plan                              | <b>AP</b>            | Incorporate effective sampling guidelines  |
|                               | Establishing Baseline Performance                       | <b>EV</b>            | Select and apply the appropriate measurement and interpret results                         |
|                               | Throughput Yield and Rolled Throughput Yield            | <b>EV</b>            | Calculate and interpret results  |
|                               | The Process Sigma Level                                 | <b>EV</b>            | Calculate and interpret results  |
|                               | Charting Process Behavior (SPC) Background              | <b>UN</b>            | Describe origin and purpose of Control Charts  |
|                               | Trend Charts (Run Charts)                               | <b>EV</b>            | Create and interpret this type of chart  |
|                               | SPC Concepts & Control Limits                           | <b>AP</b>            | Employ Control Limits to evaluate process stability  |
|                               | Types of SPC Charts                                     | <b>AP</b>            | Recognize which chart should be applied in a given situation                               |
|                               | Rational Subgrouping                                    | <b>EV</b>            | Develop a rational sampling plan to represent the entire process output                    |
|                               | X and Moving Range Charts                               | <b>EV</b>            | Create and interpret this type of chart  |
|                               | Attribute Control Charts                                | <b>EV</b>            | Create and interpret this type of chart  |
|                               | X bar and R Charts, Xbar and S                          | <b>EV</b>            | Create and interpret this type of chart  |
|                               | Process Capability (Cp, Cpk, Pp, Ppk)                   | <b>EV</b>            | Assess process capability, factoring in prerequisites of process stability and normality   |
|                               | Normality Assessment, Transformation of Non-Normal Data | <b>EV</b>            | Recognize impact of non-normality and take actions as required to transform data           |
|                               | Rapid Improvements - Leading Kaizen Events              | <b>EV</b>            | Organize and execute rapid improvement events (Kaizen Blitz)                               |
|                               | Future State VSM - Line Balancing                       | <b>EV</b>            | Create future state Value Stream Maps, incorporating balancing of resources                |
|                               | MEASURE - Tollgate Review                               | <b>EV</b>            | Review critical questions for the Measure Phase to ensure that answers have been developed |
|                               |   |                      |  |
| Topic Area                    | Topic   | Mastery Requirement* | Mastery Assessment   |
| <b>Analyze Phase of DMAIC</b> |   |                      |  |
|                               | Finding The Root Cause - Basic Concepts                 | <b>AP</b>            | Recognize and apply alternate methods of root cause identification and validation          |
|                               | Cause & Effect Diagram                                  | <b>EV</b>            | Draw upon process experience to systematically identify potential root causes              |
|                               | 5-Why, 1-How  | <b>EV</b>            | Use sequential questions to uncover causal relationships                                   |
|                               | Box Plots   | <b>EV</b>            | Investigate the effect of discrete inputs on continuous outputs                            |

|                   |   |                             |   |
|-------------------|---|-----------------------------|---|
|                   | Scatter Plots                                       | <b>EV</b>                   | Evaluate correlation between variables graphically  |
|                   | Correlation and Regression Analysis                 | <b>EV</b>                   | Evaluate correlation between variables statistically  |
|                   | Multiple Regression                                 | <b>EV</b>                   | Identify relationships between multiple inputs and a continuous output and build a mathematical model of the relationship   |
|                   | Estimating Population Proportion                    | <b>AP</b>                   | Determine required sample size to estimate population proportion  |
|                   | Estimating Population Mean                          | <b>AP</b>                   | Determine required sample size to estimate population mean  |
|                   | Hypothesis Testing: Purpose, Concepts and Language  | <b>AP</b>                   | Recognize situations where a formal test of hypothesis is warranted   |
|                   | Formatting the Hypothesis to be Tested              | <b>EV</b>                   | Properly format null and alternate hypotheses   |
|                   | Types of Error - Alpha and Beta                     | <b>AN</b>                   | Understand types of error and incorporate into testing plan   |
|                   | Power Analysis                                      | <b>AN</b>                   | Design test to meet Power requirements  |
|                   | Confidence Intervals                                | <b>AN</b>                   | Apply confidence intervals to interpret the results of a test   |
|                   | Treatment Comparisons using Control Charts          | <b>EV</b>                   | Recognize the role of control charts in evaluating process changes  |
|                   | Comparing Two Proportions - Z-test                  | <b>EV</b>                   | Select the correct test, structure null and alternate hypotheses, satisfy underlying assumptions, analyze for statistically significant difference, and interpret results |
|                   | Comparing Two Means - t-test                        | <b>EV</b>                   | Select the correct test, structure null and alternate hypotheses, satisfy underlying assumptions, analyze for statistically significant difference, and interpret results |
|                   | Comparing Multiple Means - ANOVA /F-test            | <b>EV</b>                   | Select the correct test, structure null and alternate hypotheses, satisfy underlying assumptions, analyze for statistically significant difference, and interpret results |
|                   | Comparing Two Variances - F-test                    | <b>EV</b>                   | Select the correct test, structure null and alternate hypotheses, satisfy underlying assumptions, analyze for statistically significant difference, and interpret results |
|                   | Confidence Intervals - Least Significant Difference | <b>EV</b>                   | Employ confidence intervals to evaluate observed differences  |
|                   | Design of Experiments (DOE): Purpose, Principles    | <b>UN</b>                   | Describe purpose and principles of DOE  |
|                   | DOE: Process, Components, Guidelines                | <b>AN</b>                   | Recognize the correct circumstances to employ DOE and follow the experimental process in doing so   |
|                   | DOE: Blocking                                       | <b>EV</b>                   | Determine proper use of blocking  |
|                   | DOE: Single Factor Experiments                      | <b>EV</b>                   | Compare effectiveness of 3 or more alternative treatments or methods, including blocking for sources of known variation.  |
|                   | ANALYZE - Tollgate Review                           | <b>EV</b>                   | Review critical questions for the Analyze Phase to ensure that answers have been developed.   |
|                   |   |                             |   |
| <b>Topic Area</b> | <b>Topic</b>  | <b>Mastery Requirement*</b> | <b>Mastery Assessment</b>   |

|                               |  |                             |  |
|-------------------------------|--|-----------------------------|--|
| <b>Improve Phase of DMAIC</b> |  |                             |  |
|                               | Design for Six Sigma (DFSS) Overview       | <b>UN</b>                   | Recognize the complementary role of Design for Six Sigma   |
|                               | Benchmarking                               | <b>AN</b>                   | Conduct benchmarking studies for comparative purposes  |
|                               | Brainstorming                              | <b>AP</b>                   | Facilitate effective brainstorming   |
|                               | Multi-voting                               | <b>AP</b>                   | Employ multi-voting to prioritize actions  |
|                               | FMEA                                       | <b>EV</b>                   | Prioritize, evaluate and resolve potential risks   |
|                               | Error-proofing                             | <b>EV</b>                   | Implement process changes to prevent the root cause of errors  |
|                               | Prioritizing and Selecting a Solution      | <b>EV</b>                   | Systematically select improvement solution sets  |
|                               | The A3 One-Page Report                     | <b>AN</b>                   | Employ the A-3 approach when necessary to organize and communicate project activities  |
|                               | Continuous Flow & Little's Law             | <b>AN</b>                   | Analyze and resolve constraints to move process toward continuous flow   |
|                               | Quick Changeover Toolset Viewed            | <b>EV</b>                   | Improve process flow by reducing changeover or set-up time   |
|                               | Cellular Processing Toolset Viewed         | <b>EV</b>                   | Implement work-cells to improve process flow   |
|                               | Internal Pull Systems                      | <b>AN</b>                   | Set up internal pull system to improve flow and reduce inventories   |
|                               | Corrective Action Matrix                   | <b>AP</b>                   | Organize and track improvement activities while driving accountability for implementation                                    |
|                               | Piloting a Solution                        | <b>AP</b>                   | Trial and evaluate solutions on a small scale prior to full implementation   |
|                               | System Dynamics                            | <b>EV</b>                   | Identify potential unintended consequences and while develop robust process knowledge of balancing and reinforcing forces    |
|                               | IMPROVE - Tollgate Review                  | <b>EV</b>                   | Review critical questions for the Improve Phase to ensure that answers have been developed                                   |
|                               |  |                             |  |
| <b>Topic Area</b>             | <b>Topic</b>                               | <b>Mastery Requirement*</b> | <b>Mastery Assessment</b>  |
| <b>Control Phase of DMAIC</b> |  |                             |  |
|                               | Verifying Improvements with Control Charts | <b>AN</b>                   | Evaluate "before" vs "after" data to validate process improvements, and employ control charts for ongoing process management |
|                               | The Process Control Plan                   | <b>EV</b>                   | Establish a process management system for ongoing data collection, monitoring, and reaction                                  |
|                               | Visual Control                             | <b>AN</b>                   | Institute visual control techniques to improve process management  |
|                               | 5-S Approach                               | <b>AN</b>                   | Apply 5-S techniques to organize and streamline the workplace  |
|                               | Total Productive Maintenance               | <b>AP</b>                   | Implement TPM practices to improve process reliability and eliminate downtime  |

|  |   |           |   |
|--|---|-----------|---|
|  | Best Practices and Lessons Learned              | <b>EV</b> | Evaluate successful actions and proactively share lessons learned with the broader organization     |
|  | Standardized Work - Documenting Process Changes | <b>AP</b> | Establish and document standard work to reduce variability  |
|  | Ending the Project Viewed - Project Hand-off    | <b>AP</b> | Employ a systematic process to transfer responsibilities to the process owner and close the project |
|  | CONTROL - Tollgate Review                       | <b>EV</b> | Review critical questions for the Control Phase to ensure that answers have been developed          |