Preparation Guide

Edition 202305

Content

1. Overview

This Preparation Guide covers two different EXIN certifications:

1. **EXIN LSSA Lean Six Sigma Black Belt** (LSSBB.EN)
2. **EXIN LSSA Lean Six Sigma Black Belt Specialist** (LSSBBS.EN)

Scope

EXIN LSSA Lean Six Sigma Black Belt
It is possible to gain the EXIN LSSA Lean Six Sigma Black Belt certification separately. Candidates interested in the EXIN LSSA Lean Six Sigma Black Belt certification may disregard the practical project assessment criteria, since this exam does not require practical projects.

EXIN LSSA Lean Six Sigma Black Belt Specialist
To gain the EXIN LSSA Lean Six Sigma Black Belt Specialist certification, candidates must finish the required practical projects in addition to gaining the EXIN LSSA Lean Six Sigma Black Belt certification. Candidates interested in the EXIN LSSA Lean Six Sigma Black Belt Specialist certification can find the project criteria in section 3. Practical project assessment criteria.

Certification value
Both EXIN LSSA Lean Six Sigma Black Belt and EXIN LSSA Lean Six Sigma Black Belt Specialist certifications validate a candidate's knowledge on:

- world-class performance
- policy development and deployment
- project management
- creating a solid foundation
- creating a continuous improvement culture
- creating stable and efficient processes
- creating capable processes
- creating future-proof processes

The EXIN LSSA Lean Six Sigma Black Belt Specialist certification also validates a candidate's skills and competences in those same areas through the practical projects.

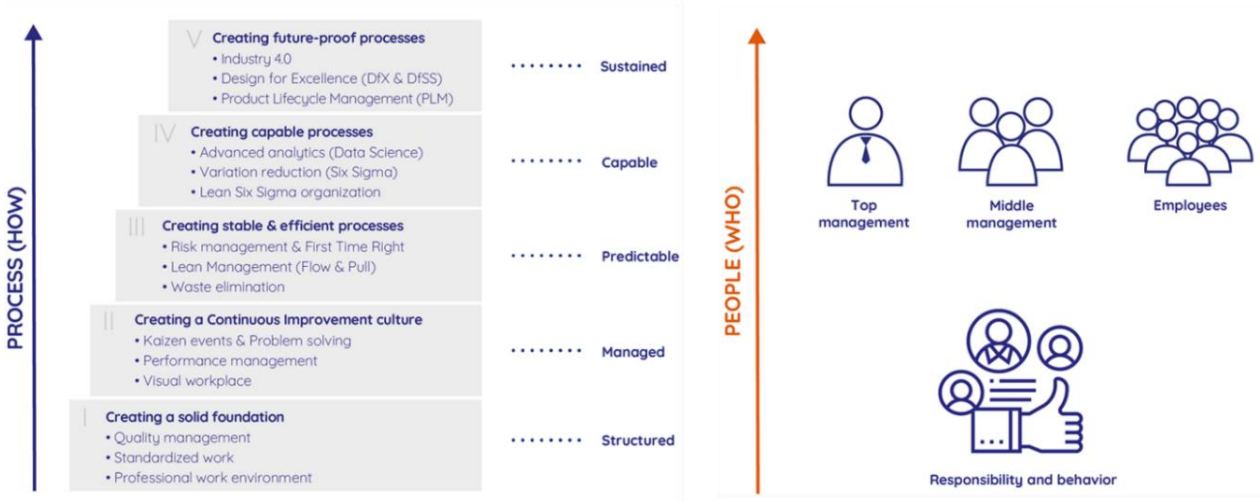
Summary

The LSSA (Lean Six Sigma Academy®) was established in September 2009 with the objective to develop an international recognized certification scheme for all Lean and Six Sigma Belt levels. For each level the LSSA Exam Board has developed preparation guides with clear criteria for skills and competences. These preparation guides specify which of the overall Lean and Six Sigma techniques are expected to be included within certain Belt level competencies.

CIMM summarizes best practices and techniques of different methodologies in one framework, for different stages of maturity. The CIMM framework describes five consecutive stages:

- creating a solid foundation
- creating a continuous improvement culture,
- creating stable and predictable processes
- creating capable processes and
- creating future-proof processes.

For Lean Six Sigma all five levels apply.



For each instrumental technique in the CIMM framework, it is possible to indicate the associated desired behavior. The CIMM framework identifies a number of behaviors for each improvement technique, which helps determine whether or not the implementation of the technology in question will be a success and results in a lasting impact.

Context

The EXIN LSSA Lean Six Sigma Black Belt and EXIN LSSA Lean Six Sigma Black Belt Specialist certifications are part of the EXIN LSSA Lean Six Sigma qualification program.

Target group

Lean Six Sigma Black Belts are experts in executing Lean Six Sigma projects. As a program manager they are responsible for managing complex breakthrough projects and supporting improvement teams with tools and techniques. Very often Lean Six Sigma Black Belts are assigned full time to work on improvement programs.

Lean Six Sigma Black Belts have both skills for applying analytical tools and skills for leading change. The scope of the project is often across departments and organizations. We can distinguish Lean Black Belts that are working on process improvement projects and Lean Six Sigma Black Belts that are working on complex data driven projects. Lean Six Sigma Black Belts master all Lean techniques as well as additional statistical and sophisticated analytical Six Sigma techniques.

In the case that an organization does not employ a Master Black Belt, the Lean Six Sigma Black Belt Specialist may fulfil the role of supporting management in Lean Six Sigma deployment and coaching Green Belts in executing their projects.

Requirements for certification

EXIN LSSA Lean Six Sigma Black Belt

- Successful completion of the EXIN LSSA Lean Six Sigma Black Belt exam.
- Accredited EXIN LSSA Lean Six Sigma Black Belt training, including completion of the training assignments.

EXIN LSSA Lean Six Sigma Black Belt Specialist

- EXIN LSSA Lean Six Sigma Black Belt certification is a pre-requisite to subscribe for the practical assessment.
- Successful completion of the EXIN LSSA Lean Six Sigma Black Belt Specialist assessment.

Candidates are required to pass both elements to be recognized as a certified Lean Six Sigma Black Belt Specialist. Candidates will receive the Specialist certificate if they pass the practical assessment (EXIN LSSA Lean Six Sigma Black Belt Specialist) within a maximum period of three years after achieving the EXIN LSSA Lean Six Sigma Black Belt certification.

Examination details

EXIN LSSA Lean Six Sigma Black Belt

Examination type:	Multiple-choice questions
Number of questions:	60
Pass mark:	63% (38/60 questions)
Open book:	Literature source A and the Preparation Guide may be consulted throughout the exam. Candidates are required to bring their own copy for both the online and the paper-based exams. The exercise books are not allowed during the exam.
Notes:	No
Electronic equipment/aides permitted:	A calculator is permitted. Candidates are required to bring their own calculator or statistical software (e.g. Minitab) to the exam.
Exam duration:	180 minutes

The Rules and Regulations for EXIN's examinations apply to this exam.

EXIN LSSA Lean Six Sigma Black Belt Specialist
The assessment criteria for the practical part include the submission of two practical projects that meet the following criteria:

- Two successful projects at CIMM level-III and IV or higher.
- The project should have a significant impact to the organization (e.g. a financial impact of €50,000.- or a relevant Critical to Quality (CTQ) has substantially been improved).
- The project must follow the DMAIC or DMADV roadmap.
- The templates for submitting the projects can be downloaded from the EXIN website (max. of 25 pages).
- The projects should be signed off by the Champion to declare that the projects have been carried out professionally and that objectives have been achieved and sustainable.
- A single Black Belt can submit the projects for certification in its role of project manager.
- The project must be submitted within three years after passing the EXIN LSSA Lean Six Sigma Black Belt.

The projects will be assessed by a Master Black Belt, assigned by the LSSA. The criteria listed in 3. Practical project assessment criteria will be applied. It is advisable to use these criteria during your project. It is additionally strongly advised that the submission is also checked by an internal (Master) Black Belt Specialist or coach.

- A 'Pass' result will be awarded when all criteria are addressed within the submission and are deemed to be 'Correct' or 'Not Applicable'.
- The submission must contain a justification of any criteria that is claimed to be 'Not Applicable'.

The result of the practical assessment will be either Pass or Fail. No score will be given. In the event of a 'Fail' result, brief guidance will be given on those criteria that are deemed 'Missing' or 'Incorrect'. Subsequently, a single retake resubmission is allowable.

Bloom level

The EXIN LSSA Lean Six Sigma Black Belt and EXIN LSSA Lean Six Sigma Black Belt Specialist certifications test candidates mainly at Bloom level 2, 3 and 4 according to Bloom's Revised Taxonomy:

- Bloom level 2: Understanding - a step beyond remembering. Understanding shows that candidates comprehend what is presented and can evaluate how the learning material may be applied in their own environment. This type of questions aims to demonstrate that the candidate is able to organize, compare, interpret, and choose the correct description of facts and ideas.
- Bloom level 3: Application - shows that candidates have the ability to make use of information in a context different from the one in which it was learned. This type of questions aims to demonstrate that the candidate is able to solve problems in new situations by applying acquired knowledge, facts, techniques, and rules in a different, or new way. These questions usually contain a short scenario.
- Bloom level 4: Analysis - shows that candidates have the ability to break learned information down into its parts to understand it. This Bloom level is mainly tested in the Practical Assignments. The Practical Assignments aim to demonstrate that the candidate is able to examine and break information into parts by identifying motives or causes, make inferences and find evidence to support generalizations.

Training

Contact hours

The recommended number of contact hours for the EXIN LSSA Lean Six Sigma Black Belt training course is 64. This includes practical assignments, exam preparation and short breaks. This number of hours does not include lunch breaks, homework, and the exam.

Indication study effort

EXIN LSSA Lean Six Sigma Black Belt
224 hours (8 ECTS), depending on existing knowledge.

EXIN LSSA Lean Six Sigma Black Belt Specialist
EXIN Lean Sig Sigma Black Belt + 224 hours (8 ECTS) = 448 hours (16 ECTS), depending on existing knowledge.

Training organization

You can find a list of our Accredited Training Organizations at www.exin.com.

2. Exam requirements

The exam requirements are specified in the exam specifications. The following table lists the topics of the module (exam requirements) and the subtopics (exam specifications).

Exam requirements	Exam specifications	Weight
1. World class performance		**10%**
	1.1 Continuous improvement	
	1.2 Customer value (VOC & CTQ)	
2. Policy development and deployment		**10%**
	2.1 Policy development	
	2.2 Policy deployment	
	2.3 Competence development	
3. Project management		**8.5%**
	3.1 Managing a project	
	3.2 Process improvement roadmaps	
4. Creating a solid foundation		**1.5%**
	4.1 Professional work environment	
	4.2 Standardized work	
	4.3 Quality management	
5. Creating a continuous improvement culture		**3.5%**
	5.1 Visual management	
	5.2 Performance management	
	5.3 Basic quality tools	
6. Creating stable and efficient processes		**30%**
	6.1 Process mapping	
	6.2 Performance metrics	
	6.3 Basic statistics	
	6.4 Value stream analysis	
	6.5 Reducing Muda (Waste)	
	6.6 Reducing Muri (Overburden)	
	6.7 Reducing Mura (Unevenness)	
	6.8 Value stream improvement	
	6.9 Process and quality control	
	6.10 Total Productive Maintenance (TPM)	
7. Creating capable processes		**31.5%**
	7.1 Statistical techniques	
	7.2 Distributions	
	7.3 Measurement systems	
	7.4 Hypothesis testing and confidence intervals	
	7.5 Tests for means, variances, and proportions	
	7.6 Correlation and regression	
	7.7 Process capability and performance	
	7.8 Design of Experiments (DOE)	
	7.9 Statistical Process Control (SPC)	
8. Creating future-proof processes		**5%**
	8.1 Product Lifecycle Management (PLM)	
	8.2 Design for Six Sigma	
	8.3 The fourth industrial revolution	
	Total	**100%**

Exam specifications

1 World class performance

The unit 'world class performance' reviews the general philosophy of continuous improvement. It discusses the overview of different process improvement methods and the history of the most important methodologies. It also explains why continuous improvement is important.

1.1 Continuous improvement

The learning element 'continuous improvement' reviews the history, values, and principles of the most common process improvement methodologies. Also, the culture within a continuous improvement organization as well as roles and responsibilities are reviewed.

The candidate can…

1.1.1 understand the origins of quality management, TPM, kaizen, Lean, Six Sigma and Agile.

1.1.2 propagate the Lean Six Sigma philosophy and principles.

1.1.3 deploy a continuous improvement culture within the organization, which represents the collective values, beliefs, and principles.

1.1.4 assess and deploy the organization's maturity level of the organization, which is a combination of developing people and process.

1.1.5 promote the various continuous improvement roles and responsibilities.

1.2 Customer value (VOC & CTQ)

The learning element 'customer value' reviews customer identification (internal/external), customer requirements and the Critical to Quality (CTQ)-measure.

The candidate can…

1.2.1 prioritize and translate the Voice of the Customer (VOC) requirements into internal specification requirements.

1.2.2 differentiate customer experience into dissatisfied, expected, satisfied and desired quality levels (e.g. KANO model).

1.2.3 translate the Voice of the Customer (VOC) into external Critical to Qualities (CTQs) and internal Critical to Qualities (CTQs).

1.2.4 construct a Critical to Quality (CTQ) flowdown that represents the key measurable characteristics of a product or process whose performance standards or specification limits must be met.

2 Policy development and deployment

The unit 'policy development and deployment' reviews how policy development and deployment help organizations in defining a continuous improvement strategy and to run efficiently in achieving their objectives.

2.1 Policy development

The learning element 'policy development' explains the importance of a so-called True North and how to develop an operational excellence strategy.

The candidate can…

2.1.1 describe how Operational Excellence can be applied to processes in different types of enterprises.

2.1.2 define a transition roadmap for a continuous improvement policy development and deployment program.

2.1.3 define and implement a process of business performance management, which includes developing metrics as well as collecting, analyzing, and reporting data about the performance of the organization.

2.1.4 evaluate financial measures e.g. cost of poor quality (COPQ), total cost of quality, working capital (WC) and inventory turn ratio (ITR).

2.2 Policy deployment

The learning element 'policy deployment' is focusing on the execution process of the improvement strategy. Within this element financial and performance metrics will be reviewed.

The candidate can…

2.2.1 describe the impact breakthrough projects can have on process owners, internal and external customers, and other stakeholders.

2.2.2 facilitate initiatives and apply techniques to manage change and overcome resistance (e.g. Kübler-Ross, stakeholder analysis, Kotter approach).

2.2.3 propagate long term and meaningful objectives such as sustainability, dignity.

2.2.4 create an inspiring and healthy work environment throughout the organization.

2.2.5 demonstrate team progress in relation to goals, objectives and other metrics that support team success.

2.2.6 reward and recognize the team for its accomplishments.

2.2.7 describe and apply techniques that motivate team members and support and sustain their participation and commitment.

2.2.8 support the organization in the strategic planning process, applying Hoshin Kanri.

2.2.9 understand how Hoshin Kanri forms the link between policy development and policy deployment.

2.3 Competence development

The learning element 'competence development' reviews how to develop those who need to ensure that the strategy is implemented successfully.

The candidate can…

2.3.1 guide people through the four stages of competence development including lessons learned from former projects.

2.3.2 apply coaching and intervision to those involved in continuous improvement (e.g. Toyota Kata).

2.3.3 use appropriate communication methods (both within the team and from the team to various stakeholders) to report progress.

2.3.4 conduct milestone reviews and support the overall success of the project.

3 Project management

The unit 'project management' outlines the way improvement projects should be executed. A number of process improvement roadmaps is reviewed. The unit also reviews project selection, team formation, planning and execution.

3.1 Managing a project

The learning element 'managing a project' reviews how to set up, plan and execute a project.

The candidate can…

- 3.1.1 define project selection criteria.
- 3.1.2 identify continuous improvement opportunities.
- 3.1.3 apply project selection techniques to select the projects that contribute to the strategy of the organization.
- 3.1.4 develop the project charter in relation to customer requirements and business goals.
- 3.1.5 develop and evaluate the problem statement, project boundaries (scope), objectives, benefits, and measurable targets for the project.
- 3.1.6 support Green Belts in developing their project charter.
- 3.1.7 apply techniques to select team members (e.g. MBTI, Belbin).
- 3.1.8 facilitate the team through the classic stages of development: forming, storming, norming, performing and adjourning.
- 3.1.9 select and construct time management techniques.
- 3.1.10 set up team meetings, tollgates and publish agendas and ensure that the proper people and resources are available.
- 3.1.11 ensure that the project will meet its requirements for time, quality, and costs.
- 3.1.12 manage the project and apply the proper tools and techniques.

3.2 Process improvement roadmaps

The learning element 'process improvement roadmaps' reviews a number of roadmaps, including PDCA and DMAIC.

The candidate can…

- 3.2.1 apply project management methods that can be used in the workplace for kaizen initiatives (e.g. PDCA, A3-report).
- 3.2.2 apply the DMAIC roadmap for Lean and Six Sigma projects.
- 3.2.3 select the proper tools to use during the project.
- 3.2.4 facilitate the problem-solving process (e.g. 8D approach).
- 3.2.5 facilitate self-organizing teams.
- 3.2.6 define clear boundaries for self-organizing teams.
- 3.2.7 propagate Scrum in product development and continuous improvement initiatives.
- 3.2.8 describe the DMADV-roadmap for Design for Six Sigma projects.

4 Creating a solid foundation

The unit 'creating a solid foundation' reviews how to achieve a solid foundation for further process improvement programs. This foundation consists of a proper and organized work environment, reliable equipment, and standardized work.

4.1 Professional work environment

The learning element 'professional work environment' is about good housekeeping and how to set up a proper and safe work environment in a structured manner.

The candidate can…

- 4.1.1 develop an organized work environment by applying 5S (Sort, Straighten, Shine, Standardize, Sustain).
- 4.1.2 understand that an organized environment will improve safety and moral.

4.2 Standardized work

The learning element 'standardized work' is about implementing and improving standards and protocols.

The candidate can…

4.2.1 standardize tasks and processes to establish the foundation for continuous improvement.

4.2.2 develop or modify documents, standard operating procedures (SOPs) and one-point-lessons to ensure that the improvements are sustained over time.

4.2.3 implement Training Within Industry (TWI) principles in the organization.

4.3 Quality management

The learning element 'quality management' is about developing procedures to identify and detect defects. Also preventing mistakes and avoiding problems is part of this element.

The candidate can…

4.3.1 propagate the quality management system and procedures.

4.3.2 facilitate the evaluation of processes, including auditing (internal / external) and identification of opportunities for improvement.

5 Creating a continuous improvement culture

The unit 'creating a continuous improvement culture' reviews how to create a continuous improvement culture at the shop floor. This unit reviews setting up and facilitate kaizen teams. It also reviews a number of problem-solving techniques and tools.

5.1 Visual management

The learning element 'visual management' reviews how to set up a workplace that is organized and self-explaining.

The candidate can…

5.1.1 develop the elements of Visual Workplace.

5.1.2 describe how they can help to control the improved process.

5.2 Performance management

The learning element 'performance management' reviews how to set targets, and how to organize the work to be done. The learning element also reviews how to facilitate improvement teams at the shopfloor that work on kaizen improvement initiatives and Problem Solving.

The candidate can…

5.2.1 implement and facilitate stand-up meetings to drive continuous improvement initiatives.

5.2.2 understand basic principles of Scrum.

5.2.3 describe and propagate the kaizen principles.

5.2.4 empower improvement teams and facilitate kaizen events.

5.2.5 develop root cause analysis, recognize the issues involved in identifying a root cause.

5.2.6 analyze problems by applying problem solving process and tools.

5.3 Basic quality tools

The learning element 'basic quality tools' reviews techniques to visualize data and guidelines how to facilitate and participate in brainstorm sessions.

The candidate can…

5.3.1 apply brainstorm techniques: Affinity diagram, 5-Why's and Ishikawa.

5.3.2 apply and analyze the outcome of basic quality tools to visualize data: Scatter plot, Pareto chart, Bar chart, Pie chart, Time Series Plot, Histogram and Box plot.

6 Creating stable and efficient processes

The unit 'creating stable and efficient processes' reviews how the logistical flow of processes can be improved and made more stable, predictable, and efficient. This unit reviews tools which can be used to visualize and analyze the process flow as well as a number of tools and techniques that can be used to improve efficiency, effectiveness, productivity, and agility of processes. All Level III learning elements and Performance Criteria follow the DMAIC structure.

6.1 Process mapping

The learning element 'process mapping' reviews a number of tools to map and analyze the flow of a process.

The candidate can…

- 6.1.1 distinguish between key process input variables and key process output variables based on a high-level process map e.g. SIPOC.
- 6.1.2 apply process mapping to visualize the flow of activities and decisions within a process.

6.2 Performance metrics

The learning element 'performance metrics' reviews performance metrics for both logistics as for quality.

The candidate can…

- 6.2.1 calculate and analyze performance metrics related to time (e.g. takt time, cycle time, lead time, queue time, WIP and OEE).
- 6.2.2 apply Little's Law.
- 6.2.3 distinguish and calculate performance metrics related to quality (e.g. ppm, DPMO, DPU and RTY).
- 6.2.4 describe the difference between a defect and a defective.
- 6.2.5 calculate rolled throughput yield for a number of defects.

6.3 Basic statistics

The learning element 'basic statistics' reviews different types of data, measurement scales and data collection tools. Also, a set of measures (statistics) that characterizes a given set of data are reviewed.

The candidate can…

- 6.3.1 propagate the importance of reliable and accurate data.
- 6.3.2 describe and distinguish between qualitative and quantitative data (continuous and discrete data).
- 6.3.3 define and analyze nominal, ordinal, interval, and ratio measurement scales.
- 6.3.4 apply Likert scale to convert an ordinal scale into a discrete interval scale.
- 6.3.5 define and analyze tools for collecting data e.g. data sheets, check sheets, concentration diagrams and questionnaires.
- 6.3.6 calculate population parameters and sample statistics: measures of central tendency, measures of dispersion, ratios, and proportions.

6.4 Value stream analysis

The learning element 'value stream analysis' reviews how to create a Value Stream Map of the current situation.

The candidate can…

- 6.4.1 distinguish value adding from non-value adding and necessary activities.
- 6.4.2 apply Value Stream Mapping (VSM) to construct a Current State Map of the process to identify waste and non-value adding activities.
- 6.4.3 understand the way process mining can support the analysis of flow within the organization.
- 6.4.4 recall what product attributes are needed for process mining.

6.5 Reducing Muda (Waste)

The learning element 'reducing Muda' reviews how to identify and eliminate Waste in the organization and its processes.

The candidate can…

6.5.1 identify and analyze process Waste (Muda): Overproduction, Waiting, Transport, Overprocessing, Inventory, Movement, Defects and Unused expertise.

6.6 Reducing Muri (Overburden)

The learning element 'reducing Muri' reviews how to identify overburden in the organization. This element also reviews how to implement flow and work balancing to reduce overburden.

The candidate can…

6.6.1 describe the importance of flow for reducing Muri.

6.6.2 develop flow in the organization.

6.6.3 describe the importance of Work balancing for reducing Muri.

6.6.4 develop Work balancing.

6.6.5 describe how competence management supports the reduction of Muri.

6.6.6 set up and apply a competence management system.

6.7 Reducing Mura (Unevenness)

The learning element 'reducing Mura' reviews how to identify unevenness in the organization and its processes. This element also reviews a number of techniques to reduce unevenness.

The candidate can…

6.7.1 describe the importance of pull for reducing Mura.

6.7.2 develop and implement pull in the organization by applying Kanban systems.

6.7.3 implement a balanced process flow by both volume leveling, type leveling and one piece flow.

6.7.4 differentiate between the different order fulfilment strategies.

6.7.5 reduce change over times by implementing Single Minute Exchange of Die (SMED).

6.8 Value stream improvement

The learning element 'value stream improvement' reviews how the techniques and tools that reduce Muda, Muri and Mura can be applied in constructing a Future State Value Stream Map.

The candidate can…

6.8.1 define the gap between the current state and the target condition.

6.8.2 develop a Future state map using Value Stream Mapping (VSM).

6.8.3 apply techniques to reduce Muda, Mura and Muri.

6.9 Process and quality control

The learning element 'process and quality control' looks at how results that have been achieved in process improvement projects can be sustained. This element reviews the following techniques and principles: Process FMEA (pFMEA), Control plan, Jidoka and Poka Yoke.

The candidate can…

6.9.1 deploy the importance of the First Time Right principle.
6.9.2 implement a culture of stopping to fix problems to get quality right the first time.
6.9.3 empower the work force to stop the line when there is a quality problem (Jidoka).
6.9.4 apply Poka Yoke to prevent quality problems.
6.9.5 prepare all elements of a Process FMEA (pFMEA), calculate the risk priority number (RPN) and action priority (AP).
6.9.6 review the effect of FMEA results on processes, products, and services.
6.9.7 prepare a control plan to document and hold gains.
6.9.8 define controls and monitoring systems.
6.9.9 transfer of responsibility from the project team to the process owner.

6.10 Total Productive Maintenance (TPM)

The learning element 'total productive maintenance' reviews the coherence between reliable systems and equipment and continuous improvement.

The candidate can…

6.10.1 describe the eight pillars of TPM and describe how it can be used for process improvement.
6.10.2 apply elements of TPM to control the improved process.
6.10.3 calculate the Overall Equipment Effectiveness (OEE) performance metric.
6.10.4 calculate utilization.

7 Creating capable processes

The unit 'creating capable processes' focuses on reducing variation in a stable process with the objective to create a process capable of meeting customer requirements. This unit reviews the application of Six Sigma and statistical tools used to assure a valid and reliable performance measurement system, to collect data and to analyze the performance of processes. Six Sigma focuses on quality breakthrough improvement projects. All Level IV learning elements and Performance Criteria follow the DMAIC structure.

7.1 Statistical techniques

The learning element 'statistical techniques' reviews a number of metrics that are often used in Six Sigma projects. The element also reviews a number of sampling methods for assuring data accuracy and integrity.

The candidate can…

7.1.1 evaluate special cause and common cause variation.
7.1.2 develop and apply appropriate sampling methods that ensure representative data e.g. random sampling, stratified sampling and systematic sampling.
7.1.3 calculate power and sample size for common hypothesis tests.

7.2 Distributions

The learning element ‘distributions’ reviews a number of continuous and discrete distributions. The element also reviews the central limit theorem and a number of probability concepts.

The candidate can…

7.2.1 interpret Probability Density Functions and Cumulative Distribution Functions.

7.2.2 apply continuous distributions: Normal, Weibull, Student’s t, Chi square, F-distribution, Lognormal and Exponential distribution.

7.2.3 apply normality test (Anderson-Darling) describe shape parameters (Skewness and Kurtosis).

7.2.4 apply discrete distributions: Poisson, Binomial.

7.2.5 apply the central limit theorem.

7.2.6 identify non-normal data and use Box-Cox or Johnson transformation.

7.3 Measurement systems

The learning element ‘measurement systems’ reviews how to evaluate measurement systems.

The candidate can…

7.3.1 define and implement measurement methods for both continuous and discrete data.

7.3.2 analyze measurement systems for continuous data.

7.3.3 interpret repeatability and reproducibility (R&R), stability, bias, linearity, precision to tolerance and number of distinct categories.

7.3.4 analyze measurement systems for qualitative properties.

7.3.5 establish attribute agreement within appraiser, between appraisers and appraisers versus standard.

7.4 Hypothesis testing and confidence intervals

The learning element ‘hypothesis testing and confidence intervals’ reviews test methods that are used to test a hypothesis. This learning element also discusses confidence intervals that indicate the reliability of test conclusions.

The candidate can…

7.4.1 define and analyze the significance level, power, type I and type II errors in statistical tests.

7.4.2 calculate confidence, prediction, and tolerance intervals.

7.4.3 distinguish between statistical and practical significance.

7.5 Tests for means, variances, and proportions

The learning element ‘tests for means, variances and proportions’ reviews the most common hypothesis tests to investigate the difference between population means (μ); difference in variances (σ); difference in proportion (p) and difference in counts (λ). Also, the ANOVA analysis is reviewed.

The candidate can…

7.5.1 apply and analyze hypothesis tests for means.

7.5.2 apply and analyze hypothesis tests for variances.

7.5.3 apply ANOVA and analyze the results and the main effect and interaction plots.

7.5.4 apply and analyze hypothesis tests for proportions.

7.5.5 apply and analyze Chi-square goodness-of-fit test and Contingency tables.

7.5.6 apply and analyze non-parametric tests: Mann-Whitney, Kruskal Wallis and Mood's median test.

7.6 Correlation and regression

The learning element 'correlation and regression' describes the predictive models using regression techniques to determine the relation between factors on a response.

The candidate can…

7.6.1 calculate and analyze the correlation coefficient and determine its statistical significance (p-value).
7.6.2 recognize the difference between correlation and causation.
7.6.3 apply linear and polynomial regression analysis.
7.6.4 analyze the regression model for estimation and prediction.
7.6.5 interpret the residual analysis to validate the model.
7.6.6 apply attributes data using (binary) logistic regression to investigate sources of variation.
7.6.7 apply multivariate studies such as principal components and factor analysis.

7.7 Process capability and performance

The learning element 'process capability and performance' explains process capability and performance in relation to specification limits.

The candidate can…

7.7.1 apply and analyze process capability studies.
7.7.2 develop sampling plans to verify stability.
7.7.3 calculate and analyze Cp and Cpk to assess process capability.
7.7.4 describe and use appropriate assumptions and conventions when only short-term data or attributes data are available and when long-term data are available.
7.7.5 analyze the relationship between long-term and short-term capability.
7.7.6 calculate and analyze Pp and Ppk to assess process performance.
7.7.7 interpret the relationship between capability and performance indices.
7.7.8 calculate the process capability and process sigma level for attribute data.

7.8 Design of Experiments (DOE)

The learning element 'Design of Experiments' reviews efficient ways of experimenting. Design of Experiments examines the influence of factors and interactions on a process.

The candidate can…

7.8.1 design experiments by determining the objective, selecting factors, responses and measurement methods.
7.8.2 apply DOE elements: responses, factors, levels, transfer function, run order, randomization, balanced designs, residual error, main effects, interaction effects, replicates, repetitions, curvature and center points.
7.8.3 design and analyze full factorial experiments.
7.8.4 understand and apply contrast, covariate, blocking.
7.8.5 design and analyze fractional factorial experiments and describe how confounding affects their use.
7.8.6 understand and apply alias tables and folding.
7.8.7 design and analyze Response Surface Models (RSM) such as Box Behnken and Central Composite Designs.
7.8.8 analyze the response surface using path of steepest ascent and apply Evolutionary Operations (EVOP).

7.9 Statistical Process Control (SPC)

The learning element 'Statistical Process Control' explains the controls methods used to identify out-of-control situations and deviations over time. Different types of SPC charts are reviewed.

The candidate can…

7.9.1 describe the objectives of SPC.

7.9.2 select and construct the following types of control charts: Xbar-R, Xbar-S, individuals and moving range (I MR), median, p, np, c, u, short-run SPC and moving average.

7.9.3 interpret control charts and distinguish between common and special cause variation using rules for determining statistical control.

8 Creating future-proof processes

The unit 'Creating future-proof processes' is about applying Lean Six Sigma techniques in the product development process with the objective to design products and services that will perform on a Six Sigma level from the earliest phase.

8.1 Product Lifecycle Management (PLM)

The learning element 'Product Lifecycle Management' reviews the entire lifecycle of products from inception, engineering, and manufacturing to service and disposal.

The candidate can…

8.1.1 understand the lifecycle for products from creation, engineering, manufacturing to service and disposal.

8.1.2 participate in new product and process development.

8.2 Design for Six Sigma

The learning element 'design for Six Sigma' reviews a number of methodologies and techniques that can be applied within Design for Six Sigma, such as Quality Function Deployment, Reliability engineering and Tolerance analysis.

The candidate can…

8.2.1 understand the impact of design for excellence and modularization on cost, manufacturability, producibility and maintainability.

8.2.2 understand that QFD can be applied to translate customer requirements into product performance measures.

8.2.3 describe key functions of a design, the primary potential failure modes relative to each function and the potential causes of each failure mode.

8.2.4 describe critical parameter management (CPM) and the DMADV roadmap.

8.2.5 understand that reliability specifications and design tests can be used to demonstrate reliability specifications.

8.2.6 understand basic principles of failure rate function of lifetime tests.

8.2.7 understand the basic principles of tolerance analysis using worst case, RSS, Monte Carlo and empirical methods.

8.3 The fourth industrial revolution

The learning element 'the fourth industrial revolution' reviews the role of continuous improvement methodologies that currently used and the fourth industrial revolution.

The candidate can…

8.3.1 understand the future of operational management.

8.3.2 describe elements of Industry 4.0.

3. Practical project assessment criteria

Kaizen & Lean project criteria PDCA

Phase	Nr	Criteria
Plan	1	Project addresses a clear problem description or business opportunity.
	2	Problem description has been clearly defined.
	3	Goals have been clearly defined and are measurable.
	4	VOC and VOB have been clearly defined and requirements are understood.
	5	Scope of the project has been clearly delineated.
	6	Key stakeholders have been identified.
	7	Relevant CTQ(s) have been selected and a CTQ-flowdown has been constructed.
	8	High level process description has been made (e.g. SIPOC).
	9	The collected data has been proven to be representative for the project.
	10	Validity of the data has been verified in an appropriate way.
	11	Historical data has been used to visualize process performance over time.
	12	Performance against requirements has been checked.
	13	Variation in the process has been considered (common cause or special cause).
	14	Short term versus long term performance has been considered.
	15	Process has been mapped in detail (e.g. VSM Current State).
Do	1	Potential factors of influence have been determined.
	2	Analysis have been used to identify factors with highest influence.
	3	Hypothesis for root cause has been defined properly.
	4	Input data has been collected and analyzed correctly.
Check	1	Graphical and statistical techniques have been applied to investigate root causes.
	2	Major root causes have been identified.
	3	Conclusions are clear and have demonstrated strong evidence/are statistically valid.
	4	Risks have been identified and addressed (e.g. pFMEA).
	5	Improved process meets the requirements of the VOC and VOB.
Act	1	There is a clear communication and action plan towards the stakeholders.
	2	The client (Champion) has approved the improvement proposal.
	3	An improvement of the CTQ compared to the baseline is demonstrated.

kaizen & Lean project criteria DMAIC

Phase	Nr	Criteria
Define	1	Project addresses a clear problem description or business opportunity.
	2	Problem description has been clearly defined.
	3	Goals have been clearly defined and are measurable.
	4	VOC and VOB have been clearly defined and requirements are understood.
	5	Scope of the project has been clearly delineated.
	6	Key stakeholders have been identified.
	7	Relevant CTQ(s) have been selected and a CTQ-flowdown has been constructed.
	8	High level process description has been made (e.g. SIPOC).
Measure	1	The collected data has been proven to be representative for the project.
	2	Validity of the data has been verified in an appropriate way.
	3	Historical data has been used to visualize process performance over time.
	4	Performance against requirements has been checked.
	5	Variation in the process has been considered (common cause or special cause).
	6	Short term versus long term performance has been considered.
Analyze	1	Process has been mapped in detail (e.g. VSM Current State).
	2	Potential factors of influence have been determined.
	3	Analysis have been used to identify factors with highest influence.
	4	Hypothesis for root cause has been defined properly.
	5	Input data has been collected and analyzed correctly.
	6	Graphical and statistical techniques have been applied to investigate root causes.
	7	Major root causes have been identified.
	8	Conclusions are clear and have demonstrated strong evidence/are statistically valid.
Improve	1	Risks have been identified and addressed (e.g. pFMEA).
	2	Improved process meets the requirements of the VOC and VOB.
	3	There is a clear communication and action plan towards the stakeholders.
	4	The client (Champion) has approved the improvement proposal.
	5	An improvement of the CTQ compared to the baseline is demonstrated.
Control	1	Standards are adjusted and documentation has been updated (pFMEA, CP).
	2	Roles and responsibilities have been described.
	3	Employees are instructed and/or trained.
	4	Evidence of 'In-Control situation' is available and sufficient.
	5	Improvements have proven to be sustainable.
	6	Measures have been put in place to monitor process performance.
	7	Project report has been completed. Lessons learned have been communicated.
	8	Champion signed that project targets and/or savings have been achieved.
	9	The controller signed the project for approval.

Design for Six Sigma project criteria DMADV

Phase	Nr	Criteria
Define	1	Project addresses a clear problem description or business opportunity.
	2	Project charter includes the risks to investigate.
	3	Goals have been clearly defined and are measurable.
	4	VOC and VOB have been clearly defined and requirements are understood.
	5	Scope of the project has been clearly delineated.
	6	Key stakeholders have been identified.
	7	Functional requirements have been defined.
	8	High level process description has been made (e.g. SIPOC).
Measure	1	Risks or customer requirements have been made tangible and specific.
	2	Historical data and issues have been taken into account.
	3	Customer requirements have been translated into technical requirements.
	4	Relevant CTQ(s) have been selected and a CTQ-flowdown has been constructed.
	5	It has been defined how the CTQs are measured.
	6	The measurement procedure has been validated (Gage R&R).
Analyze	1	All risks have been identified and a mitigation plan is available (e.g. dFMEA)
	2	Design concepts have been developed.
	3	Potential factors of influence have been identified.
	4	Data have been collected and analyzed.
	5	Transfer functions Yi = f(X1, X2,…,Xn) have been developed.
	6	Graphical and statistical techniques have been applied to investigate risks.
	7	Transfer function shows (theoretical) that capability meets customers specifications.
	8	There is a clear difference between confirmed and non-confirmed information.
Design	1	Validation plan is designed.
	2	Samples, prototypes or concepts are available for validation.
	3	Risk mitigation measures have been identified (e.g. Poka Yoke, Control Plan).
	4	Product Lifecycle management and reliability have been addressed (if applicable).
	5	Optimum settings for all significant factors of influence have been defined.
Verify	1	Pilot run results have been evaluated.
	2	Factors of influence will be controlled in a way that the risk will not appear.
	3	Documentation has been updated (pFMEA, CP, SOPs).
	4	Training has been performed for the new product/process.
	5	Project report has been completed. Lessons learned have been communicated.
	6	Full scale ramp-up plan has been developed.
	7	Project has been completed within time and budget.
	8	Champion has signed off the project.

4. Literature

Exam literature

The knowledge required for the exam is covered in the following literature:

A. H.C. Theisens
Climbing the Mountain: Lean Six Sigma Black Belt. Mindset, Skill set & Tool set.
LSSA B.V. (third edition, January 2022)
ISBN: 9789492240354 (hardcopy)

Additional literature

B. H.C. Theisens
Climbing the Mountain: Lean Six Sigma Green & Black Belt. Exercise book.
LSSA B.V. (second edition, January 2022)
ISBN: 9789492240385 (hardcopy)

C. H.C. Theisens
Climbing the Mountain: Lean Six Sigma Yellow Belt. Mindset, Skill set & Tool set.
LSSA B.V. (fourth edition, January 2022)
ISBN: 9789492240330 (hardcopy)

D. H.C. Theisens
Climbing the Mountain: Lean Six Sigma Orange Belt. Mindset, Skill set & Tool set.
LSSA B.V. (first edition, March 2021)
ISBN: 9789492240248 (hardcopy)

E. H.C. Theisens
Climbing the Mountain: Lean Six Sigma Green Belt. Mindset, Skill set & Tool set.
LSSA B.V. (fifth edition, April 2021)
ISBN: 9789492240323 (hardcopy)

Comment

Additional literature is for reference and depth of knowledge only.

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