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Six Sigma Certification Program by HI Academy

Version: September 2019

In summary …

- Two variants: Lean Six Sigma (= *six sigma for manufacturing*) and Design for Six Sigma (= *six sigma for product development*)
- Two degrees: green belt (GB) and black belt (BB)
- Two tests:
  - Theoretical exam
  - Practical test: 1 project (GB) or 2 projects (BB)

Requirements and tests

To obtain the certificate, candidates need to demonstrate mastery at the GB or BB level of the learning objectives specified in the Six Sigma curriculum. This is tested in the theoretical exam, and in addition, candidates need to submit one (GB) or two (BB) successful projects, demonstrating that they can apply the Six Sigma way of working effectively.

Theoretical exam

The theoretical exam comprises 40 multiple-choice questions and takes two hours. The exam is an open-book exam, but it is not allowed to use a laptop computer, phone, tablet, or other electronic equipment. Candidates pass the exam if their grade is 5.5 (on a scale from 0 to 10) or higher.

Practical test

Not until candidates have passed the theoretical exam can they submit their project(s). BB candidates should submit both projects at the same time. If the project(s) are evaluated positively, the candidate graduates and receives the GB or BB certificate. The following regulations apply:

- The project documentation should follow the steps of DMAIC or DIDOV. These steps should be mentioned and followed explicitly in the documentation.
- The documentation should be concise and to-the-point. Guideline: max. 30 powerpoint slides (or comparable length if another format is used).
- The documentation should be accompanied by a project discharge form, signed by the project's champion and a controller (or officials with comparable responsibilities).

Through the project(s), candidates should demonstrate that they master these skills:

- That they are able to complete a project successfully. Mastery of this skills is demonstrated if
  - The project has been completed (including the last stages of DMAIC or DIDOV)
  - The project has delivered real and substantial benefits.
- That they are able to structure a project following the principles of DMAIC or DIDOV. The submitted project(s) are judged on criteria such as:
  - Have the project's objectives been translated into specific CTQs, and are these CTQs used consistently throughout the project?
  - Did the candidate do a data-driven diagnosis of the *as-is* situation?
  - Did the candidate offer *evidence* for the effectiveness of proposed improvement actions?

Practical information

- Theoretical exam:
  - 2 options per year in Eindhoven
  - Enrolment: HI Academy, mr. Martijn van Raamsdonk (academy@holland-innovative.nl)
- Practical test:
  - Candidates should first pass the theoretical exam
  - BBs should submit both completed projects at the same time
  - Submit project(s) to HI Academy, mr. Martijn van Raamsdonk (academy@holland-innovative.nl)
- Exam fee:
  - Theoretical exam: €350 per attempt
  - Practical test + certification: €525

Board of Examiners

The Board of Examiners is responsible for the curriculum and requirements, and they determine whether candidates pass. The Board of Examiners are Jeroen de Mast (chair), Marcel Logger, Martijn van Raamsdonk.

Exam regulations: BB

Six Sigma Black belt

Attainment levels and exam criteria

Article 1 General characterization
The degree of *Six Sigma Black Belt* represents professional skills in the area of process improvement and product development:

- The skill to structure problems and approach them systematically following Six Sigma's DMAIC model.
- The skill and statistical expertise to collect and analyze data for diagnosing problems, optimizing processes and designing products.
- Knowledge of standard models for quality control and reliability.
- The skill to apply a selection of techniques and methods for problem solving.
- Elementary knowledge of and insight in the dynamics of a political forcefield and human dynamics.
- Elementary knowledge of and skills in the management of change in organizations and project management.
- Variant "Design for Six Sigma": knowledge of the process of product and process design, as embodied in the DIDOV model.
- Variant "Lean Six Sigma": advanced practical knowledge of the principles and practices of *lean manufacturing*.

Article 2 Assessments and criteria
To qualify for certification to the degree of Six Sigma Black Belt, candidates must:

- Pass the theoretical exam.
- Submit two successfully completed Six Sigma projects and obtain a positive review from the board of examiners.

The theoretical exam tests candidates' understanding of the Six Sigma methodology and techniques, the proficiency of candidates in applying principles and techniques to analyze, evaluate and solve realistic problems, and candidates' understanding of Minitab output.
The exam is an open-book exam: it is allowed to bring and consult books, notes and binders. The theoretical exam is in English and comprises 40 multiple-choice questions. Candidates must present a valid ID. Candidates need a grade of 5.5 or higher to pass the theoretical exam.

The following regulations apply to the two Six Sigma projects that candidates must submit:

- The projects are evaluated according to these criteria:
  - Candidates need to demonstrate that they are able to apply the principles and techniques covered in the curriculum successfully. Therefore, both projects must have been completed successfully, and must have achieved real and substantial benefits.
  - Candidates need to demonstrate that they can apply the Six Sigma way of working, as operationalized in the DMAIC or DIDOV method. Also, candidates need to show that they are able to select a suitable project.
- The monetary benefits of each project should be more than €50 000 annually (EBIT). For projects having non-monetary benefits only, the board of examiners decides whether the project is of sufficient weight.
- The submitted documentation must follow the structure of the steps of DMAIC or DIDOV, as shown in the project-review template. Candidates will receive the project-review template upon enrolling in the certification process. Projects whose documentation does not follow the steps of DMAIC or DIDOV will be rejected. The board of examiners may demand that candidates reformat their documentation using the project-review template before submitted projects are taken into consideration.

- The submitted documentation must include a statement signed by the project champion and a controller (or officials with similar responsibilities). The (concise) statement declares that the project report is a fair and realistic representation of the project and its benefits.
- A project can be submitted in support of a certification by one person only. Projects conducted by multiple GBs or BBs should therefore be attributed to one of the Black Belts.

All documentation submitted in support of a certification will be treated by the board of examiners as confidential.

Article 3 Curriculum and attainment levels

The topics listed below are the curriculum for the theoretical exam. These topics should be understood and candidates must also be able to apply them. In particular, candidates should be able to use Minitab and interpret analysis results produced by Minitab. Using the techniques and methods in the curriculum, candidates must be able to analyze and evaluate realistic problems. Candidates should master statistical methods and techniques on a functional but not on a technical level: they should know when to apply which methods or techniques, and how results are to be interpreted and used, but knowledge of the mathematical underpinning and computation is not required.

Define phase and project management:

- Have insight in the aims and way of working of (lean / design for) six sigma in an organization:
  - Function of six sigma in business management, manufacturing engineering and product design.
  - Basic principles underlying the methodology.
  - Organizational structure for the deployment of lean six sigma initiatives.
- Understand and be able to apply the DMAIC (Define-Measure-Analyze-Improve-Control) roadmap.
- Be familiar with relevant models for formulating the project charter:
  - SIPOC and process mapping
  - Benefit analysis
- Have insight in and be able to work with basic principles of project management:
  - Managing teams
  - Stakeholder analysis
  - Understanding and managing political resistance
  - Deployment of a lean six sigma program
  - Implementation of change in the organization

Measure phase:

- Be able to give an operational definition of a problem:
  - CTQs and the CTQ flowdown
  - Pareto charts
  - Measurement plans
- Know how to assess the validity and reliability of measurement procedures:
  - Validity and measurement error
  - Gage R&R studies
  - Agreement (kappa) studies
- Be able to apply elementary statistical methods and concepts:
  - Types of data and the structure of datasets
  - Descriptive (sample) statistics, the histogram and the boxplot
  - Estimation of the mean and standard deviation; confidence intervals
  - Distribution functions: the normal, Weibull and lognormal distribution
  - Estimating probabilities: the empirical CDF, the probability plot
  - Dealing with irregularities in the data (outliers, rounding, multi-modality)
  - Correlation, scatter plot

Analyze phase:

- Be able to measure and diagnose the current process and its performance:
  - Statistical control and the control chart
  - Process capability analysis (normal and nonnormal), incl. capability statistics (C_p, P_{pk}, Z-value, etc), incl. within and overall analysis.
- Be familiar with and be able to apply techniques for the identification of influence factors:
  - Types of influence factors (control and nuisance variables, disturbances, process inefficiencies)
  - Brainstorming, BOB vs WOW study, exploratory data analysis
  - Process matrix

Improve phase:

- Know how to establish the effect of influence factors and how to prove the effectiveness of candidate remedies:
  - Basic principles of statistical testing and modelling: p-value, R^2 value, hypothesis testing.
  - 2-sample t-test.
  - ANOVA: p-value, R^2, equal variances test, residual analysis.
  - Regression: p-value, R^2, residual analysis, prediction interval, nonlinear (quadratic) terms, multiple regression (general linear model GLM).
  - Cross tabulation and chi-square analysis.
  - Analysis of historical and unplanned data: dealing with common problems and complications.
- Know how to design and analyze an experiment (DOE):
  - Basic principles and steps of experimentation
  - 2-level (factorial) designs, center points, fractional factorial designs, blocking.
  - 3-level designs: Box-Behnken designs, central composite designs.
  - Analysis techniques: p-values, R^2, S, transfer function, residual analysis, contour plots, factorial plots, response optimizer.
- Be familiar with standard patterns for process improvement and optimization:
  - Robust design
  - Tolerance design

Control phase:

- Be familiar with standard models and structures for process control:
  - Understand the nature of control (vs. improvement)
  - Juran's control pyramid
  - Structures for the day-to-day planning and control of normal work: standard operating procedures, norms, roles & responsibilities, process documentation.
  - Control loops and the control plan, incl. process controls, the OCAP.
  - Continuous improvement, kaizen, dashboard, logbook.
  - Statistical process control (SPC), incl. CUSUM and EWMA control charts.

Specialization "Lean Six Sigma":

- Master diagnostic techniques from lean manufacturing:
  - Foundations of lean manufacturing (basic principles and assumptions)
  - Standard forms of waste, muri/muda/mura
  - *Lean* versus *fat* processes: the pursuit of minimal levels of WIP
  - Value stream map
  - Gemba study
- Be familiar with standard patterns for process improvement and optimization:
  - Best practices from lean manufacturing: 5S, visual management.
  - Process flow optimization: capacities, workload, utilization, line balancing.

Specialization "Design for Six Sigma":

- DfSS:
  - DIDOV
- Reliability:
  - Techniques for identifying failure opportunities: FMEA, FRACAS
  - Principles for the mitigation of failure opportunities: mistake proofing.

Exam regulations: GB

Six Sigma Green belt

Attainment levels and exam criteria

Article 1 General characterization

The degree of *Six Sigma Green Belt* represents professional skills in the area of process improvement and product development:

- The skill to structure problems and approach them systematically following six sigma's DMAIC model.
- The skill and statistical expertise to collect and analyze data for diagnosing problems, optimizing processes and designing products.
- Knowledge of standard models for quality control and reliability.
- The skill to apply a selection of techniques and methods for problem solving.
- Variant "Design for Six Sigma": knowledge of the process of product and process design, as embodied in the DIDOV model.
- Variant "Lean Six Sigma": practical knowledge of the principles and practices of *lean manufacturing*.

Article 2 Assessments and criteria

To qualify for certification to the degree of Six Sigma Green Belt, candidates must:

- Pass the theoretical exam.
- Submit one successfully completed Six Sigma project and obtain a positive review from the board of examiners.

The theoretical exam tests candidates' understanding of the Six Sigma methodology and techniques, the proficiency of candidates in applying principles and techniques in standard situations, and candidates' understanding of Minitab output.

The exam is an open-book exam: it is allowed to bring and consult books, notes and binders. The theoretical exam is in English and comprises 40 multiple-choice questions. Candidates must present a valid ID. Candidates pass need a grade of 5.5 or higher to pass the theoretical exam.

The following regulations apply to the Six Sigma project that candidates must submit:

- The project is evaluated according to these criteria:
  - Candidates need to demonstrate that they are able to apply the principles and techniques covered in the curriculum successfully. Therefore, the project must have been completed successfully, and must have achieved real and substantial benefits.
  - Candidates need to demonstrate that they can apply the Six Sigma way of working, as operationalized in the DMAIC or DIDOV method. Also, candidates need to show that they are able to select a suitable project.
- The monetary benefits of the project should be more than €20 000 annually (EBIT). For projects having non-monetary benefits only, the board of examiners decides whether the project is of sufficient weight.

- The submitted documentation must follow the structure of the steps of DMAIC or DIDOV, as shown in the project-review template. Candidates will receive the project-review template upon enrolling in the certification process. Projects whose documentation does not follow the steps of DMAIC or DIDOV will be rejected. The board of examiners may demand that candidates reformat their documentation using the project-review template before submitted projects are taken into consideration.
- The submitted documentation must include a statement signed by the project champion and a controller (or officials with similar responsibilities). The (concise) statement declares that the project report is a fair and realistic representation of the project and its benefits.
- A project can be submitted in support of a certification by one person only. Projects conducted by multiple GBs or BBs should therefore be attributed to one of the Green Belts.

All documentation submitted in support of a certification will be treated by the board of examiners as confidential.

Article 3 Curriculum and attainment levels

The topics listed below are the curriculum for the theoretical exam. These topics should be understood and candidates must also be able to apply them. In particular, candidates should be able to use Minitab and interpret analysis results produced by Minitab. Candidates must be able to apply the techniques and methods in the curriculum in standard situations. Candidates should master statistical methods and techniques on a functional but not on a technical level: they should know when to apply which methods or techniques, and how results are to be interpreted and used, but knowledge of the mathematical underpinning and computation is not required.

Define phase and project management:

- Have insight in the aims and way of working of (lean / design for) six sigma in an organization:
  - Function of six sigma in business management, manufacturing engineering and product design.
  - Basic principles underlying the methodology.
- Understand and be able to apply the DMAIC (Define-Measure-Analyze-Improve-Control) roadmap.
- Be familiar with relevant models for formulating the project charter:
  - SIPOC and process mapping
  - Benefit analysis

Measure phase:

- Be able to give an operational definition of a problem:
  - CTQs and the CTQ flowdown
  - Pareto charts
  - Measurement plans
- Know how to assess the validity and reliability of measurement procedures:
  - Validity and measurement error
  - Gage R&R studies
  - Agreement (kappa) studies
- Be able to apply elementary statistical methods and concepts:
  - Types of data and the structure of datasets
  - Descriptive (sample) statistics, the histogram and the boxplot
  - Estimation of the mean and standard deviation; confidence intervals
  - Distribution functions: the normal, Weibull and lognormal distribution
  - Estimating probabilities: the empirical CDF, the probability plot
  - Dealing with irregularities in the data (outliers, rounding, multi-modality)
  - Correlation, scatter plot

Analyze phase:

- Be able to measure and diagnose the current process and its performance:
  - Statistical control and the control chart
  - Process capability analysis (normal and nonnormal), incl. capability statistics (C_p, P_{pk}, Z-value, etc), incl. within and overall analysis.
- Be familiar with and be able to apply techniques for the identification of influence factors:
  - Types of influence factors (control and nuisance variables, disturbances, process inefficiencies)
  - Brainstorming, BOB vs WOW study, exploratory data analysis
  - Process matrix

Improve phase:

- Know how to establish the effect of influence factors and how to prove the effectiveness of candidate remedies:
  - Basic principles of statistical testing and modelling: p-value, R^2 value, hypothesis testing.
  - 2-sample t-test.
  - ANOVA: p-value, R^2, equal variances test, residual analysis.
  - Regression: p-value, R^2, residual analysis, prediction interval, nonlinear (quadratic) terms.
  - Cross tabulation and chi-square analysis.
- Have an elementary understanding of the design and analysis of experiments (DOE):
  - Basic principles and steps of experimentation
  - Analysis techniques: p-values, R^2, S, transfer function, residual analysis

Control phase:

- Be familiar with standard models and structures for process control:
  - Understand the nature of control (vs. improvement)
  - Juran's control pyramid
  - Structures for the day-to-day planning and control of normal work: standard operating procedures, norms, roles & responsibilities, process documentation.
  - Control loops and the control plan, incl. process controls, the OCAP.
  - Continuous improvement, kaizen, dashboard, logbook.

Specialization "Lean Six Sigma":

- Master diagnostic techniques from lean manufacturing:
  - Foundations of lean manufacturing (basic principles and assumptions)
  - Standard forms of waste, muri/muda/mura
  - *Lean* versus *fat* processes: the pursuit of minimal levels of WIP
  - Value stream map
  - Gemba study
- Be familiar with standard patterns for process improvement and optimization:
  - Best practices from lean manufacturing: 5S, visual management.

Specialization "Design for Six Sigma":

- DfSS:
  - DIDOV
- Reliability:
  - Techniques for identifying failure opportunities: FMEA, FRACAS
  - Principles for the mitigation of failure opportunities: mistake proofing.

Algemene reglement

(general exam regulations in Dutch)

Artikel A1 Toepasselijkheid regeling

1. Deze regeling is van toepassing op de certificering tot verschillende graden in *Lean Six Sigma* en *Design for Six Sigma* door de Holland Innovative Academy.

Artikel A2 Examencommissie

1. De naleving en uitvoering van deze examenregeling zijn de verantwoordelijkheid van de examencommissie, alsmede de organisatie van theorie-examens, communicatie daarover met kandidaten, en borging van de kwaliteit en betrouwbaarheid van de examens. Deze commissie bestaat op het moment van in werking treden uit Jeroen de Mast (voorzitter), Marcel Logger en Martijn van Raamsdonk.

Artikel A3 Vorm van examinering

1. Examinering bestaat uit een theorie-examen en een praktijkdeel (bestaande uit één respectievelijk twee projecten).
2. Om voor certificering in aanmerking te komen, moet een kandidaat voor zowel het theorie-examen als het praktijkdeel werk leveren dat als voldoende wordt beoordeeld.
3. Kandidaten hebben recht op een representatief voorbeeldexamen.

Artikel A4 Intekening voor theorie-examen en praktijkdeel

1. Kandidaten geven bij aanmelding aan of zij in de betreffende ronde alleen het theorie-examen doen, of alleen het praktijkdeel, of beide onderdelen. Inschrijving voor het praktijkdeel kan uitsluitend als reeds een voldoende is behaald voor het theorie-examen, en indien de twee projecten beide tegelijk worden ingediend.
2. Voor inschrijving voor een certificeringsronde is een kandidaat examengeld verschuldigd.
3. Als het werk van een kandidaat voor één of beide examenonderdelen als onvoldoende wordt beoordeeld, of als een kandidaat slechts voor één van beide onderdelen een poging doet, dan zal in de betreffende ronde niet tot certificering worden overgegaan. De kandidaat kan zich in een volgende ronde opnieuw inschrijven, maar is dan opnieuw examengeld verschuldigd (tenzij de examinator een uitzondering maakt).

Artikel A5 Vaststelling en bekendmaking van de uitslag

1. De examinator stelt de uitslag van het theorie-examen zo spoedig mogelijk, doch uiterlijk binnen 10 werkdagen vast.
2. De examinator geeft uiterlijk binnen 10 werkdagen een eerste beoordeling van de ingediende projecten voor het praktijkdeel. De eerste beoordeling kan zijn: ‘Geaccepteerd’, ‘Acceptabel onder voorbehoud’, ‘Niet geaccepteerd’. Indien de eerste beoordeling ‘Acceptabel onder voorbehoud’ luidt, zal de examinator om een aantal specifieke verduidelijkingen of aanvullingen vragen, en een termijn stellen waarin de kandidaat een herziene versie kan indienen. Na verstrijken van de gestelde termijn zal de examinator een definitieve beoordeling geven op basis van de laatst ingediende versie. Deze definitieve beoordeling zal zijn in termen van ‘Geaccepteerd’ of ‘Niet geaccepteerd’.
3. De Holland Innovative Academy beheert de administratie van de resultaten van de *Lean Six Sigma* certificering in een examenarchief.
4. De door kandidaten op papier gemaakte theorie-examens worden gedurende tenminste 6 maanden na de examendatum bewaard.
5. Bij de uitslag van het theorie-examen wordt de kandidaat gewezen op het inzage- en nabesprekingsrecht (artikel 8).

6. Een kandidaat kan beroep aantekenen tegen de wijze waarop de uitslag tot stand is gekomen bij de examencommissie.

Artikel A6 Cijfers

1. Voor het theorie-examen wordt een cijfer gegeven op een schaal van 1 tot en met 10. Cijfers worden gegeven met maximaal één decimaal achter de komma.
2. Het praktijkdeel wordt beoordeeld in termen van 'Geaccepteerd' of 'Niet geaccepteerd'.
3. De eindbeoordeling op basis waarvan al dan niet tot certificering wordt overgegaan, is in termen van 'geslaagd' of 'gezakt'.

Artikel A7 Geldigheidsduur resultaten

1. De geldigheidsduur van het theorie-examen is 5 jaar. Dat betekent: een kandidaat met een voldoende resultaat voor het theorie-examen, hoeft voor certificering niet opnieuw theorie-examen te doen, mits de kandidaat binnen vijf jaar ook het praktijkdeel positief afsluit.

Artikel A8 Inzagerecht

1. De examens zijn uitsluitend een middel om de vaardigheden van kandidaten te toetsen. Ze zijn niet bedoeld als lesstof. Om te voorkomen dat examenvragen en -antwoorden gaan circuleren (en dat kandidaten daarop gaan focussen in plaats van het voorbereiden van de stof) geeft Holland Innovative Academy de examens na de beoordeling niet vrij, maar krijgen kandidaten uitsluitend de uitslag te horen.
2. Aan kandidaten die gezakt zijn, biedt Holland Innovative Academy de mogelijkheid om het beoordeelde werk in te zien en kort te bespreken met een examinator. De examinator kan bepalen dat dit geschiedt op een bepaalde plaats en een bepaald tijdstip. Kandidaten dienen hun wens om het gemaakte werk in te zien kenbaar te maken binnen 20 dagen nadat de uitslag bekend is gemaakt. Het doel van deze nabespreking is uitsluitend om de gezakte kandidaat aanknopingspunten te geven voor het voorbereiden van een herexamen.

Artikel A9 Certificering

1. De examencommissie stelt de uitslag en de datum van certificering vast, indien zij heeft vastgesteld dat de kandidaat zowel het theorie-examen als het praktijkdeel met goed gevolg heeft afgelegd.
2. Een certificaat kan slechts worden uitgereikt, nadat de kandidaat aan alle procedurele vereisten heeft voldaan, waaronder de betaling van het examengeld.
3. Ten bewijze dat het examen met goed gevolg is afgelegd, wordt door de examencommissie een certificaat uitgereikt.

Artikel A10 Fraude

1. In gevallen van verdenkingen van fraude zal de examencommissie besluiten over de te volgen handelswijze.
2. Indien de examencommissie oordeelt dat er sprake is van fraude, kan de examencommissie besluiten om de kandidaat uit te sluiten van de mogelijkheid tot certificering. De kandidaat heeft in zo'n geval geen recht op restitutie van het betaalde examengeld.

Artikel A11 Vertrouwelijkheid

1. De documentatie die kandidaten indienen voor het praktijkdeel zal als vertrouwelijk worden behandeld. De examencommissie ziet erop toe dat de documentatie uitsluitend wordt ingezien door haar eigen leden en personen die door haar zijn aangesteld om het werk te beoordelen. De documentatie zal uitsluitend worden ingezien met het doel van toetsing voor het examen.

2. De documentatie die kandidaten indienen voor het praktijkdeel zal gearchiveerd worden voor de duur van 7 jaar. Daarna zal de documentatie vernietigd worden. De Holland Innovative Academy draagt zorg voor de archivering, onder verantwoordelijkheid van de examencommissie.

Artikel A12 Aanpassingen ten behoeve van een kandidaat met een functiebeperking

1. Een kandidaat met een functiebeperking kan op een daartoe strekkend schriftelijk verzoek in aanmerking komen voor aanpassingen in het theorie-examen. Deze aanpassingen worden zoveel mogelijk op hun individuele functiebeperking afgestemd, maar mogen de kwaliteit of moeilijkheidsgraad van het examen niet wijzigen.
2. Over zulke verzoeken voor aanpassingen in de examenprocedure beslist de examencommissie.
3. Een verzoek tot aanpassing wordt geweigerd indien toekenning ervan een buitenproportioneel beslag legt op de organisatie.

Artikel A13 Hardheidsclausule

In gevallen waarin de examenregeling niet voorziet, en in gevallen waarin sprake is van onevenredige benadeling of onbillijkheid van overwegende aard, beslist de examencommissie.