Six Sigma Green Belt Course

(Certificate in Lean Sigma Quality)

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Six Sigma Green Belt Course – IT Sligo

The Six Sigma Green Belt programme is run over one year. While it is recommended that candidates commence the course in September, it is also possible to join the course in either September or January. The programme comprises of three modules which are as follows:

- Six Sigma I (Quality Tools)
- Six Sigma II (Statistical Control)
- Six Sigma III (Project)

The delivery of the six sigma modules I & II in parallel with the six sigma project allows the student to use the tools for a real life project thus gaining a better understanding of the six sigma methodology. This 'learning by doing' approach also allows for better integration of the tools into the students workplace. Full details of each module are at the end of the document.
The three modules followed by the 1 day workshop cover the requirements of the Six Sigma Green Belt award. This flexible approach will allow for cost savings and participation at all levels within the organisation from supervisor and technician through to engineering and management level.

Six Sigma Green Belt Course (Note: 2015 fees listed below - please see IT Sligo website www.itsligo.ie for latest fees).

Module	Credits	Cost Per Student €	Duration	Dates
Six Sigma I (Quality Tools)	5	500	15 weeks	September start date
Six Sigma II (Statistical Control)	5	500	15 weeks	January start date
Six Sigma III (Project)	5	500	15 weeks	Sep & Jan start dates
Total (3 Modules) Green Belt	**15**	**€1500**	30 weeks	
External Six Sigma Green Belt Exam & Workshop	N/A	€220	1 Day	Run twice per year – normally in June and

For example, students who just want an introduction to Six Sigma at the Green Belt level could take Six Sigma I. If more detailed Six Sigma statistical knowledge is required, students could then take Six Sigma II and Six Sigma III.
The costs shown above include course fees, examinations fees, access to the online lectures, access to the learning management system Moodle where course notes and reading material are provided. The only additional cost for the student is the cost of the Six Sigma Demystified textbook and six month access to Minitab software which is estimated to be approx €70 per student.

Six Sigma Green Belt Exam

Successful completion of the three modules satisfies the requirements of the International Quality Federation (http://www.iqfnet.org/), the organisation responsible for Six Sigma Green Belt certification. This (optional) external certification to Green Belt is organised through an Irish based training company. The Green Belt fee covers a 1 day workshop for Green Belt exam revision along with the cost of the exam. It includes:

- Set of notes to cover the Green Belt exam material
- Sample Set of Exam Questions
- Access to On Line Study Guide
- Access to On Line Examination
- Green Belt Certification based on successful completion of the examination.

Note that this (optional) external Green belt exam is in addition to the normal QQI accredited end of semester exams which are held by IT Sligo.

Academic Qualification - Courses HETAC Accredited

The modules are also accredited by Quality Qualifications Ireland (QQI) with successful candidates receiving a Certificate in Lean Sigma Quality (15 credits at Level 7 on the National Framework of Qualifications).
This means that a student can study for an online programme which is both nationally and internationally recognised. The on-line student sits the same exam as the full time student and is awarded the same qualification.

Further Study Options

Students completing the Green Belt with IT Sligo can progress to a Six Sigma Black belt award. In addition, as IT Sligo offer online Quality programs at Levels 7, 8 and 9 on the National Qualifications Framework (NQF), there will be a progression path for those students who pass the modules and wish to continue on with a degree in Quality or Manufacturing Management. Students who meet the eligibility criteria to enter the full degree programme can therefore upgrade skills in specific areas while still earning credits towards a final degree award.

Six Sigma Green Belt FAQs:

Q1: **Who is the Six Sigma Green Belt course aimed at?**
Answer: Six Sigma Green Belt provides participants with enhanced problem-solving skills, using the DMAIC (Define, Measure, Analyse, Improve and Control) model. This certification is in great demand by companies across all sectors in either manufacturing, pharmaceutical, healthcare or service sectors. It is suitable for all levels within the organisation from supervisor and technician through to engineering and management level.

Q2: **What are the course fees?**
Answer: The course fees are shown above and should be checked with the latest fees on the IT Sligo website. The costs shown above include course fees, examinations fees, access to the online lectures, access to the learning management system Moodle where course notes and reading material are provided. The only additional cost for the student is the cost of the Six Sigma Demystified textbook and Minitab software which is estimated to be approx €70 per student. **Note: If you wish to take the external Quality America certification, then the one day workshop and exam is €220. This is paid directly to Quality America and not to IT Sligo.**

Q3: **My company is paying my fees, can IT Sligo issue me with an invoice?**
Answer: An invoice can be issued to your employer - you will need to contact admissions@itsligo.ie to organise this.

Q4: **Does the course fee include VAT?**
Answer: There is no VAT on training courses in Ireland so the fee shown on the website is the total amount payable.

Q5: **What are the prerequisites for the Six Sigma Green Belt course?**
Answer: Applicants are expected to have a Leaving Certificate or equivalent due to the Statistics covered in the course syllabus. It is preferable that you would be in a position to complete a Six Sigma Green belt project with an employer. If you are unable to complete a work based project, a research type project related to Lean Six Sigma can be completed. More details on the project requirements are listed below.

Q6: **Is there an induction programme for new students?**
If you are commencing the course in September, it is recommended that you attend our 1 day online induction days normally held on the second Friday in September at IT Sligo. Although not mandatory, it will give you an opportunity to become familiar with the technology and meet fellow students and lecturers. You will be notified of the exact days for the induction once you register on the course.

Q7: **What type of exams are needed to pass this course?**
Answer: The Six Sigma 1 module is assessed through continuous assessment. This is a series of Quizzes and assignments completed during the semester. For the Six Sigma 2 module, there is a 2.5 hour written exam held in Sligo, Dublin and Cork. For the Six Sigma 3 module there is a project presentation and report. For the (optional) external exam, there is also an online Green Belt exam which you need to pass within 6 months of completing the course.

Q8: **Is the external Green Belt exam mandatory?**
Answer: The Quality America external Green belt is not mandatory and all participants in the course who successfully complete the three modules will receive a Certificate in Lean Sigma Quality from IT Sligo.

Q9:**How and where do I take the external Green Belt exam from Quality America?**
Answer: After completing the 1 day exam preparation workshop, you then have six months to complete the online Quality America exam. This exam can be taken anytime online.

Q10: **If I fail in any of the exams, what is the provision to repeat?**
Answer: Repeat exams are held in August each year in IT Sligo. There is a nominal repeat exam fee - approx €50. You can repeat exams twice.

Q11: **How long does the course last?**
Answer: The course duration is 2 semesters. The course will run from September - December and from Jan - April each year. You may enrol in either September or January each year.

Q12: **How many hours of lectures are there per week?**
Answer: There are approx. 2-3 hours of lectures delivered live online over the Internet each week. These are also recorded so you can watch them anytime if you cannot attend the live lecture.

Q13: **How much study time is required per week?**
Answer: For each module we recommend approx 5 hours per week study time although if you are already familiar with some of the topics from your prior work or educational experience, this will be less. For the Project, this can be done as part of your work schedule and we estimate 4-6 hours per week.

Q14: **How often do I need to attend IT Sligo?**
There is no requirement to attend IT Sligo except for exams at the end of each semester. Exam centres are also available in Dublin and Cork. All lectures are delivered live online each week and recordings are also available if you cannot log in to the live lecture. You can use our online technology to present online on your Six Sigma green belt project.

Q15: **What is included in the course?**
Answer: You will have full access to online course notes and online live lectures. The textbook (Six Sigma Demystified, Paul Keller) cost is approx €25 and will have to be purchased by the student.

Q16: **Are there any grants available for course fees?**
Answer: Currently, no grants are available. The course has in the past been grant aided by the Irish government under the Springboard initiative for those applicants not in employment. If grants are available for this years course, this will be listed on the Six Sigma course page on the IT Sligo website. Many students have their company sponsor them as the IT Sligo course is competitively priced. Should grants become available we will notify all applicants.

Q17: **What type of work based project needs to be completed for a Six Sigma Green Belt?**
Answer: The work based project will be undertaken by the student and should address a substantive issue in the workplace. The project will test the student's ability to define a real-life problem of concern to the organisation, design a strategy for addressing the problem, gather data, formulate and evaluate options and make recommendations. The project should follow the Six Sigma DMAIC methodology. While it is recommended that the problem is addressed as part of a cross-functional team, it is important that the student makes a significant contribution to the success of the project. A financial saving must be identified for Green Belt projects.

Examples of projects that qualify:

- Manufacturing product defect reduction
- Human resources recruitment cycle-time reduction
- Reduced accounts payable invoice processing costs
- Reduced machine setup time
- Design related project using DFSS

Projects that do NOT qualify:

- Projects that do NOT follow the DMAIC methodology and use of associated tools.
- Pre-packaged or classroom exercises that are mock or simulated projects that were previously completed and/or that do not include actual "hands on" work
- Any project without measured before-and-after cost benefits
- Research type projects – see below.

Q18: **What if I am <u>not</u> currently in employment and cannot complete a work based project with an employer?**
Answer: If you are unable to complete a work based project, a research type project related to Lean Six Sigma can be completed. It will still be possible for those students undertaking a Research project to obtain (external) Green Belt certification. Upon successfully completing the external 1 day workshop and external Green Belt exam, you will be awarded a Green Belt certificate (<u>without Project</u>). You can update this in the future to a Green Belt (<u>with Project</u>) should you complete a suitable Green Belt project with an employer.
There may also be an option to conduct a Six Sigma project using the facilities of our automated manufacturing cell at IT Sligo to complete your project. More details will be provided at the induction day at the start of the course.

Q19: **Is the external Green Belt fee covered under Springboard funding?**
Answer: The external green belt certification from Quality America is in addition to the Certificate in Lean Sigma Quality that you obtain from IT Sligo. The fee for the external exam goes to the external provider and not to IT Sligo. It is therefore <u>not</u> covered under Springboard funding.

Q20: **What will be the QQI level of credits I will receive by completing this course?**
Answer: You receive 15 credits at Level 7 if you successfully complete all three modules. You will also receive a QQI Certificate in Lean Sigma Quality.

Q21: **Do I have to take all three modules in one semester?**
Answer: Modules can be studied over a longer period of time if required - up to 2 years. For example you can take the Six Sigma 1 & 2 modules during the first year followed by the Six Sigma 3 module. You will receive 5 credits each single module you successfully complete. Please check the website to ensure that all modules are being offered in both semesters.

Q22: **Who certifies the external Green Belt exam?**
Answer: Certification to Green Belt is organised through an Irish based training company and Quality America Inc. Quality America Inc, is one of the premier providers of Six Sigma Training and consultancy in the US and internationally with over 3,000 students trained and certified to date. More than 50 organizations, colleges and universities use their Six Sigma instructor materials. The Green Belt programme is based on the 'Six Sigma Demystified' text by Paul A. Keller, Vice President Quality America. Further information is available on: http://www.qualityamerica.com/

Q23: **I am studying for a Quality / Engineering degree in IT Sligo. Are there any exemptions from the external Green Belt award?**
Answer: Students completing the degrees listed below meet the requirements of the internationally recognised Six Sigma Green Belt award. Students receive this award in addition to their degree by sitting an external Green Belt exam. The following are the exemptions based on the degree you are studying:

Level 7 BSc Quality: You receive 3 exemptions. You need to enrol in the following:
1) External (Quality America) Green Belt exam

Level 7 BSc Manufacturing Management: You receive 3 exemptions. You need to enrol in the following:
1) External (Quality America) Green Belt exam

Level 7 BEng Polymer: You receive 3 exemptions. You need to enrol in the following:
1) External (Quality America) Green Belt exam

Level 7 Certificate in Quality (Yellow Belt): You receive 1 exemptions. You need to enrol in the following:
1) Six Sigma 2 – Statistical Control
2) Six Sigma 3 - Project
3) External (Quality America) Green Belt exam

However even though you are exempt from some modules, you would need to review the Six Sigma Green Belt syllabus and carry out your own self study on any areas you need to revise.

Module Syllabi

The following is an overview of each module on the Six Sigma Course which follows the internationally recognised Green belt body of knowledge.

Module Title	**Six Sigma I – Quality Tools**

Overview: Six Sigma and the Organisation

A. Six sigma and organizational goals

- Value of six sigma
- Recognize why organizations use six sigma, how they apply its philosophy and goals, and the origins of six sigma (Juran, Deming, Shewhart, etc.). Describe how process inputs, outputs, and feedback impact the larger organization.
- Organizational drivers and metrics
- Recognize key drivers for business (profit, market share, customer satisfaction, efficiency, product differentiation) and how key metrics and scorecards are developed and impact the entire organization.
- Organizational goals and six sigma projects
- Describe the project selection process including knowing when to use six sigma improvement methodology (DMAIC) as opposed to other problem-solving tools, and confirm that the project supports and is linked to organizational goals.

B. Lean principles in the organization

- Lean concepts and tools
- Define and describe concepts such as value chain, flow, pull, perfection, etc., and tools commonly used to eliminate waste, including kaizen, 5S, error-proofing, value-stream mapping, etc.
- Value-added and non-value-added activities
- Identify waste in terms of excess inventory, space, test inspection, rework, transportation, storage, etc., and reduce cycle time to improve throughput.
- Theory of constraints
- Describe the theory of constraints.

C. Design for Six Sigma (DFSS) in the organization

- Quality function deployment (QFD)
- Describe how QFD fits into the overall DFSS process.
- Design and process failure mode and effects analysis (DFMEA & PFMEA)
- Define and distinguish between design FMEA (DFMEA) and process (PFMEA) and interpret associated data.
- Road maps for DFSS
- Describe and distinguish between DMADV (define, measure, analyze, design, verify) and IDOV (identify, design, optimize, verify), identify how they relate to DMAIC and how they help close the loop on improving the end product/process during the design (DFSS) phase.

II. Six Sigma – Define

A. Process Management for Projects

- Process elements
- Define and describe process components and boundaries. Recognize how processes cross various functional areas and the challenges that result for process improvement efforts.
- Owners and stakeholders
- Identify process owners, internal and external customers, and other stakeholders in a project.
- Identify customers
- Identify and classify internal and external customers as applicable to a particular project, and show how projects impact customers.
- Collect customer data
- Use various methods to collect customer feedback (e.g., surveys, focus groups, interviews, observation) and identify the key elements that make these tools effective. Review survey questions to eliminate bias, vagueness, etc.
- Analyze customer data
- Use graphical, statistical, and qualitative tools to analyze customer feedback.
- Translate customer requirements
- Assist in translating customer feedback into project goals and objectives, including critical to quality (CTQ) attributes and requirements statements. Use voice of the customer analysis tools such as quality function deployment (QFD) to translate customer requirements into performance measures.

C. Management and planning tools

- Define, select, and use the seven new quality tools:
- 1) affinity diagrams,
- 2) interrelationship digraphs,
- 3) tree diagrams,
- 4) prioritization matrices,
- 5) matrix diagrams,
- 6) process decision program (PDPC) charts, and
- 7) activity network diagrams.

D. Business results for projects

- Process performance
- Calculate process performance metrics such as defects per unit (DPU), rolled throughput yield (RTY), cost of poor quality (COPQ), defects per million opportunities (DPMO) sigma levels and process capability indices.
- Track process performance measures to drive project decisions.
- Failure mode and effects analysis (FMEA)
- Define and describe failure mode and effects analysis (FMEA). Describe the purpose and use of scale criteria and calculate the risk priority number (RPN).

III. Six Sigma – Measure

A. Process analysis and documentation

- Process modeling
- Develop and review process maps, written procedures, work instructions, flowcharts, etc.
- Identify process input variables and process output variables (SIPOC), and document their relationships through cause and effect diagrams, relational matrices, etc.

B. Collecting and summarizing data

- Types of data and measurement scales
- Identify and classify continuous (variables) and discrete (attributes) data. Describe and define nominal, ordinal, interval, and ratio measurement scales.
- Data collection methods
- Define and apply methods for collecting data such as check sheets, coded data, etc.
- Techniques for assuring data accuracy and integrity
- Define and apply techniques such as random sampling, stratified sampling, sample homogeneity, etc.
- Descriptive statistics
- Define, compute, and interpret measures of dispersion and central tendency, and construct and interpret frequency distributions and cumulative frequency distributions.
- Graphical methods
- Depict relationships by constructing, applying and interpreting diagrams and charts such as stem-and-leaf plots, box-and-whisker plots, run charts, scatter diagrams, Pareto charts, etc.
- Depict distributions by constructing, applying and interpreting diagrams such as histograms, normal probability plots, etc.

Mandatory Green Belt Textbook

Authors	Title	Publishers	Year

Paul A. Keller	*Six Sigma Demystified – 2nd Edition* 450 pages ISBN:978-0-07-174679-3	McGraw-Hill Professional	2011

Module Title	Six Sigma II - Statistical Control

Indicative Syllabus

I. Six Sigma – Measure

A. Probability and statistics

- Drawing valid statistical conclusions
- Distinguish between enumerative (descriptive) and analytical (inferential) studies, and distinguish between a population parameter and a sample statistic.
- Central limit theorem and sampling distribution of the mean
- Define the central limit theorem and describe its significance in the application of inferential statistics for confidence intervals, control charts, etc.
- Basic probability concepts
- Describe and apply concepts such as independence, mutually exclusive, multiplication rules, etc.

B. Probability distributions

- Describe and interpret normal, binomial, and Poisson, chi square, Student's t, and F distributions.

C. Measurement system analysis

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

E. Process capability and performance

- Process capability studies
- Identify, describe, and apply the elements of designing and conducting process capability studies, including identifying characteristics, identifying specifications and tolerances, developing sampling plans, and verifying stability and normality.
- Process performance vs. specification
- Distinguish between natural process limits and specification limits, and calculate process performance metrics such as percent defective.
- Process capability indices
- Define, select, and calculate C_p and C_{pk}, and assess process capability.
- Process performance indices
- Define, select, and calculate P_p, P_{pk}, C_{pm}, and assess process performance.
- Short-term vs. long-term capability
- Describe the assumptions and conventions that are appropriate when only short-term data are collected and when only attributes data are available. Describe the changes in relationships that occur when long-term data are used, and interpret the relationship between long- and short-term capability as it relates to a 1.5 sigma shift.
- Process capability for attributes data
- Compute the sigma level for a process and describe its relationship to P_{pk}.

II. Six Sigma – Analyze

A. Exploratory data analysis

- Multi-vari studies
- Create and interpret multi-vari studies to interpret the difference between positional, cyclical, and temporal variation; apply sampling plans to investigate the largest sources of variation.
- Simple linear correlation and regression
- Interpret the correlation coefficient and determine its statistical significance (p-value); recognize the difference between correlation and causation. Interpret the linear regression equation and determine its statistical significance (p-value). Use regression models for estimation and prediction.

B. Hypothesis testing

- Basics
- Define and distinguish between statistical and practical significance and apply tests for significance level, power, type I and type II errors. Determine appropriate sample size for various test. .
- Tests for means, variances, and proportions
- Define, compare, and contrast statistical and practical significance.
- Paired-comparison tests
- Define and describe paired-comparison parametric hypothesis tests.
- Single-factor analysis of variance (ANOVA)
- Define terms related to one-way ANOVAs and interpret their results and data plots.
- Chi square
- Define and interpret chi square and use it to determine statistical significance.

III. Six Sigma – Improve & Control

Design of experiments (DOE)

- Basic terms
- Define and describe basic DOE terms such as independent and dependent variables, factors and levels, response, treatment, error, repetition, and replication.
- Main effects
- Interpret main effects and interaction plots.

Statistical process control (SPC)

- Objectives and benefits
- Describe the objectives and benefits of SPC, including controlling process performance, identifying special and common causes, etc.
- Rational subgrouping
- Define and describe how rational subgrouping is used.
- Selection and application of control charts
- Identify, select, construct, and apply the following types of control charts: –R, –s, individuals and moving range (ImR / XmR), median ( ), p, np, c, and u.
- Analysis of control charts
- Interpret control charts and distinguish between common and special causes using rules for determining statistical control.

Implement and validate solutions

- Use various improvement methods such as brainstorming, main effects analysis, multi-vari studies, FMEA, measurement system capability re-analysis, and post-improvement capability analysis to identify, implement, and validate solutions through F-test, t-test, etc .

Control plan

- Assist in developing a control plan to document and hold the gains, and assist in implementing controls and monitoring systems.

Indicative Practicals/Projects

Entering data into Minitab. Copying and pasting from and to Excel
Plotting and editing graphs in Minitab
Generating reports with Minitab.
Use of Minitab to plot data eg. Scatter diagrams, Histograms
Use of Minitab to plot $\bar{X}$ and R Control chart data
Plotting attribute Control charts with Minitab

Module Title	Six Sigma III – Project

Subject Aims:
The work-based project aims to provide students with the opportunity to apply and integrate the Six Sigma skills and knowledge they have gained on the programme. The project(s) will be undertaken by the student and should address a substantive issue in the workplace. The project(s) will test the student's ability to define a real-life problem of concern to the organisation, design a strategy for addressing the problem (DMAIC), gather data, formulate and evaluate options and make recommendations. While it is recommended that the problem is addressed as part of a cross-functional team, it is important that the student makes a significant contribution to the success of the project. Students will be given the opportunity to reflect on the strengths and weaknesses of their own leadership and communication skills, and those of the organisation with recommendations for change identified.

Syllabus Content
The student should bring the learning from the subjects covered in the course to conceive, define and agree a project which is work based and relevant to the subject matter. A mentor will be assigned to each project, which may be individual or group projects. The mentor will act as a guide in agreeing the relevance, and scope of the project, and monitor the progress on a regular basis. Updates will be sent to the mentor on an agreed basis. There will be a final presentation on the project to which marks will be awarded.

The lectures on this module will address the following elements of the Six Sigma Green Belt body of knowledge.

A. Project management basics
- Project charter and problem statement
- Define and describe elements of a project charter and develop a problem statement, including baseline and improvement goals.
- Project scope
- Assist with the development of project definition/scope using Pareto charts, process maps, etc.
- Project metrics
- Assist with the development of primary and consequential metrics (e.g., quality, cycle time, cost) and establish key project metrics that relate to the voice of the customer.
- Project planning tools
- Use project tools such as Gantt charts, critical path method (CPM), and program evaluation and review technique (PERT) charts, etc.
- Project documentation
- Provide input and select the proper vehicle for presenting project documentation (e.g., spreadsheet output, storyboards, etc.) at phase reviews, management reviews and other presentations.
- Project risk analysis
- Describe the purpose and benefit of project risk analysis, including resources, financials, impact on customers and other stakeholders, etc.
- Project closure
- Describe the objectives achieved and apply the lessons learned to identify additional opportunities.

B. Team dynamics and performance
- Team stages and dynamics
- Define and describe the stages of team evolution, including forming, storming, norming, performing, adjourning, and recognition. Identify and help resolve negative dynamics such as overbearing, dominant, or reluctant participants, the unquestioned acceptance of opinions as facts, groupthink, feuding, floundering, the rush to accomplishment, attribution, discounts, plops, digressions, tangents,
- Six sigma and other team roles and responsibilities
- Describe and define the roles and responsibilities of participants on six sigma and other teams, including black belt, master black belt, green belt, champion, executive, coach, facilitator, team member, sponsor, process owner, etc.
- Team tools
- Define and apply team tools such as brainstorming, nominal group technique, multi-voting, etc.
- Communication
- Use effective and appropriate communication techniques for different situations to overcome barriers to project success.