

# LEAN-SIX SIGMA Programme

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TEC *Concepts*

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## LEAN-SIX SIGMA Programme – *in-house* or ‘*public*’ **Certified Six Sigma Black Belt training programmes**

TEC’s **Certified Lean-Six Sigma Programme** integrates **Six Sigma**, **Lean Enterprise** and **Kaizen Blitz** principles and practices with practical **Improvement Project** implementation.

Practical training is delivered on site (**single company**) or at ‘public’ training sessions (**group programmes**). All programmes are scheduled over several months (2-days training per month) to maximize the benefits and minimize any disruption to routine work activities.

Participants can also opt to undertake Six Sigma **Improvement Projects** in parallel with the training modules. Their newly acquired skills can therefore put to work immediately to the benefit of your organization.

**Improvement projects are identified within your organization to have significant impacts on performance and customer satisfaction.**

Improvement Project activities serve to support and accelerate the progress of Six Sigma implementation and maximize your organization’s return on its investment. In fact development of individual skills and accomplishment of project objectives go hand-in-hand. We call it **heuristics** – “the art of discovering and invention” or more simply “learn by doing”.



**Six Sigma ‘Belts’** are essential for the successful implementation and consolidation of **Six Sigma**. Managerial level or technical specialist **Green Belts** will subsequently move on to become **Black Belts** on successful completion of their improvement **projects**.

## Six Sigma ↔ Kaizen-Blitz ↔ Lean Enterprise

TEC’s tried and tested **Six Sigma Plus Programme** is designed to provide participants with *all* the *knowledge* and *practical experience* they need to become proactive and effective team members who will actively contribute to sustained improvement initiatives within your organization.

TEC have adopted a pragmatic approach to **Black Belt** training which integrates the **Six Sigma** tools, **Kaizen-Blitz** and essential **Lean Enterprise** topics with **Improvement Project** implementation.

In isolation they do not have any lasting value, but when fused together in this way they provide the foundation for sustainable world class performance.

Measurable improvements kick in during the first month and build progressively during the 6-month programme as the **Improvement Projects** roll out.

The **Six Sigma Plus Programme** tools and techniques coincide with the **R-DMAIC** steps –

- Tools for generating ideas, organizing information and gathering data
- Tools for process and data analysis

- Tools for problem solving and continual improvement
- Tools for statistical analysis
- Tools for implementation and process management

2-day **group training** sessions augmented by **in-company coaching** and **mentoring**

**See the detailed syllabus overleaf →**

## RECOGNIZE (the 6 $\sigma$ 'pre-step')

Overview of the Recognize step

Explaining the 6 $\sigma$  (Six Sigma) approach

The central role of 6 $\sigma$  Improvement Projects

Examples of 6 $\sigma$  Improvement Projects –

potential targets and savings

applying the 6 $\sigma$  methodology in different organizations

Monitoring customer requirements

Overview of 6 $\sigma$  project objectives

Monitoring and using customer requirements  
Preliminary 6 $\sigma$  project identification

Defining 'Lean Enterprise'

The central goals of Lean Enterprise

Defining Kaizen Blitz (Kaikaku) and its role in 'short-sharp' projects

Kaizen Blitz timetabling and operation

Understanding the Six Sigma methodology –

the 1 + 5 steps of R + DMAIC

the toll gates

Introduction to basic statistics –

position, range and variation

calculating the mean and standard deviation

introduction to probability

introduction to Minitab©

introduction to the Normal Distribution and its properties

Workshop sessions focused on the use of basic statistics

Discerning patterns form data –

frequency tables

tally charts

simple histograms

Introduction to process capability –

understanding and illustrating the concept of capability and 'non-capability'

understanding the concept of 'quality = meeting specifications'

appreciating exactly what '6 $\sigma$  performance' means in practical terms

5-S Practice – the first pillar (Sort)

the relation between product quality and work environment

overview of Hiroyuki Hirano's "5 Pillars of the Visual Workplace"

Planning and undertaking a 'red tag' exercise

applying the red-tag sorting criteria

identifying the red-tag target items

dealing with rubbish and 'difficult' items

evaluating the red-tagged items

using a red-tag holding area

Overcoming the SORT 'roadblocks'

Assessing the value and benefits of SORT in the workplace

Using the RECOGNIZE TOLLGATE checklist to confirm completion of all tasks and actions

Creating a Storyboard to illustrate the achievements of the Recognize step

## DEFINE

### Overview of the Define step

#### Improvement projects – the key to 6σ success

types of 6σ projects – process improvement and process design

guidelines for winning 6σ projects – 6σ project selection steps

6σ project selection criteria – examples of winning projects

making the business case – using a business case 'template'

#### Identifying and capturing VOB (voice of the business)

measuring COPQ (cost of poor quality)

#### Identifying and capturing VOC (voice of the customer)

converting customer comments into tangible requirements

defining and quantifying VOC

identifying data sources needed to determine VOC  
using KANO analysis and KANO categorization diagrams

combining Affinity diagrams with KANO

#### Understanding CT'X' analysis

the role of Affinity diagrams in CT'X' analysis

need, drivers, and CT'X' Tree Analysis

categorizing CT'X' attributes –

QCD & R (quality, cost, delivery and responsiveness)

#### Confirming identified CT'X' attributes with customers (the VOC 'link')

ranking customer attributes

defining and quantifying 'customer satisfaction'

relating VOC to internal measures

understanding the difference between a 'requirement' and a 'goal'

evaluating goals with the SMART(ER) test

### Problem identification, definition and quantification

differentiating between 'concerns' and 'problems'

understanding 'improvement opportunities'

identifying, defining and quantifying problems

identifying, defining and quantifying improvement opportunities

### Waste identification

understanding the concepts of the TPS (Toyota Production System)

defining and the TPS core tools –

Jidoka, Heijunka, Muda, Mura and Muri

### Classification of waste –

understanding and identifying the 7 + 1 wastes

using the 'waste-finding checklists'

uncovering waste

using the '5W and 1H' questioning technique

### Business processes and the 6σ 'process approach'

understanding process performance

6σ 'process approach' and 6σ 'formula'

### Creating SIPOC 'high-level' process maps

### Identifying, clarifying and quantifying 6σ improvement projects –

prioritizing improvement initiatives

understanding the pivotal role of the 'Charter'

documenting the 6σ project Charter

undertaking a 'stakeholder analysis'

### Using the DEFINE TOLLGATE checklist to confirm completion of all tasks and actions

### Creating a Storyboard to illustrate the achievements of the Define step

## MEASURE

### Overview of the Measure step –

plan and measure performance against customer requirements or performance goals

develop 'baseline' measures to identify improvement opportunities

### Understanding measurables, quantifiers and goals

relating 'measurables' to 'quantifiers'

### Planning and measuring performance against customer requirements or goals

the relationship between CT'X', stratification and the 6 $\sigma$  'formula'

### Types of measurement

Counting, Appraising (Attribute) and Measuring (Continuous)

characteristics and their associated gauges

### Capturing and recording data

#### 6 $\sigma$ data collection steps

clarifying data collection goals

developing operational definitions and procedures

validating the sample size and the measurement system

creating a document a data collection plan

commencing data collection – display and review

### Dealing with different data types and data collection

understanding the three data 'types'

constructing data collection forms, data sheets and check-sheets

essential guidelines for designing effective data collection forms

### Understanding sampling and frequency

calculating minimum sample size for continuous and attribute data

understanding sampling frequency and natural process cycles

determining sampling frequency

### Fundamentals of data analysis

### Continuous ('variables') data –

Scatter Plots, Run Charts, Tally Charts, Dot-Plots, Histograms

1st pass analysis – establishing the 'baseline'

determining 'position' (mean) and 'spread' (standard deviation)

graphical summary of data – using Minitab®

Check for 'normality' – applying the Anderson-Darling test

### Count data –

Dot Plots

Histograms

Checksheets,

Tally Charts

### Attribute data –

Dot Plots, Histograms

using the Binomial Distribution for analysis –

percentage (%), n (number of trials), p (probability)

designing a 'cause checksheet' – Measles Chart

### VOP (voice of the process) process capability measures

#### Calculating process capability –

Short-term capability indices Cp (best case) and Cpk (worse case)

ppm (parts per million)

#### Understanding process 'yield' –

the fallacy of the 'traditional' view of yield

calculating true FPY (first pass yield)

calculating RTY (rolled throughput yield)

understanding and calculating OFD's (opportunities for defects)

understanding and calculating DPU (defects per unit)

understanding and calculating DPMO (defects per million opportunities)

understanding and calculating RTY (rolled throughput yield)

understanding and calculating Ytp (throughput yield at each opportunity)

## MEASURE – *continued*

Short-term and Long-term variation

Properties of the Normal distribution

Standard Normal (Z) distribution table

Sigma 'Z' score capability

Process sigma conversion table

Minitab® capability analysis

Understanding, identifying and discriminating between sources of variation –

EV (equipment variation)

AV (appraiser variation)

conducting a Gauge R & R (reproducibility and repeatability) study

interpreting the results of a Gauge R & R study

ANOVA (analysis of variance)

COQ (cost of quality)

prevention, appraisal and failure costs

identification and quantification

Location and width errors

Identifying the causes of variation (gauge and appraiser)

COPQ (cost of poor quality)

identification and quantification

Using the MEASURE TOLLGATE checklist to confirm completion of all tasks and actions

Kaizen Blitz costing –

costing to facilitate improvement

devising a Kaizen Blitz costing scheme

team ownership and responsibility

using 'pseudo profit centres'

Creating a Storyboard to illustrate the achievements of the Measure step

Metrics for improved competitiveness –

understanding and using 'metrics'

6 $\sigma$  improvement projects and key metrics

commonly used improvement metrics (adopted by the UK aerospace sector and global Primes)

formulae for the improvement metrics

common 'topic-specific' performance measures

defining 'project-specific' measurables

Measurement uncertainty –

understanding the calibration and selection of gauges

understanding the 'capability' and 'appropriateness' of gauges – resolution, accuracy, bias, precision, imprecision

Measurement system analysis and evaluation (MSA/ MSE)

## ANALYSE

### Overview of the Analyse step

data analysis and process analysis

### Review and refinement of the 6 $\sigma$ Project Charter

Refine problem (or process improvement) definition –

looking at the source – Gemba

developing a Project data collection plan

understanding Gemba guiding principles

### Process mapping, analysis and control –

identifying business and customer-facing processes

defining and mapping the ‘process flow’

using ‘swim-lane’ process maps – X-functional and Deployment maps

defining ‘controlled conditions’ for identified processes

working with SIPOC ‘Turtle’ diagrams

analysing process activities

identifying and reviewing Procedures, Work Instructions and Records

### Understanding and applying the 5 lean enterprise ‘principles’ and ‘drivers’

### Understanding and mapping the ‘value stream’ –

principles of value stream mapping

value stream mapping vs. process mapping

systematic creation of a value stream map

basic value stream mapping symbols

drawing the ‘process flow’

adding in ‘material’ and ‘information’ flows

collecting and recording process data

adding lead-time and processing-time

verify the value stream map

analysing the value stream maps

### Analysing VA and NVA times

### Steps in performing a value analysis –

VA (value added)

BNVA (business non-value added)

NVA (non-value added)

Time value maps

### Value stream metrics

Total Process Cycle (Lead) Time; PCE; Average completion rate

Little’s Law

### Risk evaluation and risk management process

FMEA (Failure Mode and Effects Analysis)

FTA (Fault Tree Analysis)

### Methodology for root cause determination –

getting the facts straight – verifying and recording the facts

locating the ‘point-of cause’

grasping the tendency – structured questioning using ‘4W2H1W’

developing possible causes – zeroing-in on the true root cause

proving the true root cause

### Practical tools for root cause determination –

Brainstorming

5 Whys

Affinity Diagrams

Interrelationship charts

Fishbone Diagram

Is–Is not diagrams

### Looking for trends and patterns with basic statistical analysis –

Regression and correlation analysis

Scatter plot (Correlation diagram)

Time-series plot

Frequency plot

Dot-plot

Anderson-Darling test

## ANALYSE – *continued*

Capability studies

Confidence in statistical analysis –

understanding ‘confidence’ in the statistical context

calculating and interpreting CI – the ‘t-test’

graphical summary of CI – Minitab<sup>®</sup>

Measuring and confirming process improvement

Minitab<sup>®</sup> capability analysis

Fundamental objectives of ‘improvement’ –

centre the process

tighten the variation of the process

reduce scrap

Analysis of ‘improvement’ –

Box plot – analysis of ‘position’

Two-sample ‘t’ test and CI

Individual value plot – variation

Two sample ‘F’ test

5-S Practice – the second pillar (Set in Order)

Set in Order – avoiding many wastes

Motion waste; Searching; Frustration; Poor ergonomics;

Excess inventory; Stock-outs;

Defective products; Unsafe conditions

Standardization – visual controls

colour-coded factory floor areas

lines, aisles and danger/caution areas

indicating traffic flows

tools location – shadow boards

location indicators on shelving units

label locations and storage areas

indication of storage amounts

Principles of storage –

jigs

tools

dies

Principles of economy-of-motion

analysis of the retrieval and layout of parts in the workplace

Using the ANALYSE TOLLGATE checklist to confirm completion of all tasks and actions

Creating a Storyboard to illustrate the achievements of the Analyse step

## IMPROVE

### Overview of the Improve step

improve step 'road-map' and measuring success

### Explanation of the basic tools for 'breakthrough thinking'

pre-Brainstorming questionnaire  
variants of Brainstorming

tools for Creative Thinking techniques and Mind maps

### Collating, sorting and selecting ideas for process improvement and problem resolution

#### Tools for generating possible solutions –

Brainstorming, Channelling, Affinity analysis, White-light Thinking, Anti-solution, Analogy

### DOE – design of experiments

2-level factorial design  
using the Minitab® design generator

### Eliminating waste –

strategy and sources of ideas based on best-practice

### Understanding an eliminating irrationality (load and capacity)

#### Implementing best-practices approaches –

Takt time and Load Levelling  
One-piece (Synchronous) Flow  
Rapid changeover  
KANBAN System

### Error-proofing – including Poka Yoke

### Value Stream Mapping –

creating the 'future-state' situation including improved VA/NVA ratio

### 5-S Practice – the third and fourth pillars (Shine and Standardize)

### Shine – planning the 'campaign'

systematic tidying and routine cleaning of work areas

determining shine targets

determining shine assignments

determining shine responsibilities and methods

### Ongoing inspection and maintenance of cleanliness

#### Standardize making 'good housekeeping' habitual

5-S job cycle charts

visual 5-S

the 5-minute 5-S ritual

standardization level checklist

using the '5W1H' approach with 5-S

tooling considerations (e.g. suspended tools)

integrating jigs, tools, gauges smoothly within the process

eliminating unnecessary equipment – tool unification and substitution

### Sustaining and improving on 5-S practice – compliance conformance audits

#### Assess 6σ solution options and risks –

Impact-effort matrix

Criteria-solution matrix

Six Hats evaluation

Risk evaluation of potential solutions –

the 'PLEASE' and 'RUMBA' criteria

### Zeroing in on improvement/problem resolution actions –

developing and evaluating alternative actions

relating 'causes' to 'actions'

confirming and documenting 'the solution'

### Planning, running and assessing a 'Pilot' study

1<sup>st</sup> pass analysis of the Pilot

Using the IMPROVE TOLLGATE checklist to confirm completion of all tasks and actions

Creating a Storyboard to illustrate the achievements of the Improve step

## CONTROL

### Overview of the Control step

Consolidating, documenting, implementing and sustaining the improved process control

Incorporate error-proofing in controls

Defining and documenting the new (improved) practices –

Process dashboard

Process management chart

Control plan

Work instructions

Incorporating 'best-practice' techniques from Lean Enterprise –

Visual Management Techniques

Standard Operations

TPM (Total Productive Maintenance)

Training process users and providing implementation support –

instructional techniques

feedback and corrective actions following manufacturing process audits

monitoring/authorizing new method

developing a Response plan worksheet

Statistical reconfirmation that improvements are being sustained –

re-confirm the process is still normally distributed (Anderson-Darling)

measure and re-confirm that process capability is being achieved

at the predicted 'improved' levels

ensure no 'mission drift'

assignable causes of (excessive) variation identified and eliminated

Introducing SPC charting

Choosing the right control chart –

SPC charting – individual values

SPC charting –  $\bar{X}$  and R

Training operators in use of SPC –

train operators in the principles and practices of SPC charting

train operators to identify 'out-of-control signals'

points beyond range control limits

long runs above or below average

long runs up or down

Eliminating the 'hidden' factory –

Reminder of 6 $\sigma$  values and expected performance levels

Reminder of the continuing war-on-waste

Identifying the 'hidden' factory

Measuring true FPY (includes in-house re-work and scrap)

Ensuring on-going conformance with work standards and process control –

conducting routine 'manufacturing process audits'

inputs to for management review

5-S Practice – the fifth pillar (Sustain)

Sustain – making a habit of properly maintaining correct housekeeping procedures

Creating conditions to sustain 5-S plans and schedules

Defining specific roles for sustaining adherence to 5-S practices

Auditing 5-S conformance

Tools and techniques to sustain 5-S –

5-S Photo Display; 5-S Storyboards; 5-S Slogans;

5-S Maps; 5-S Focus-months; 5-S Department tours;

5-S Patrols; 5-S Contests

On-going measurement of improved Lean Enterprise performance

## CONTROL – *continued*

Using the Lean-Six Sigma appraisal checklists –

Workplace safety, Order and Cleanliness

Just-in-Time Production

6 $\sigma$  quality built into the product and the process

Empowered teams

Visual management

Continuous Pursuit of 6 $\sigma$  Performance

Overall Lean-6 $\sigma$  company organization and management style

Company services

Using the CONTROL TOLLGATE checklist to confirm completion of all tasks and actions

Creating a Storyboard to illustrate the achievements of the Control step

Creating a Storyboard to illustrate the verified achievements of the 6 $\sigma$  Improvement Project

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We are **TEC** –

Discover an effective way to become a super-effective **Lean-Six Sigma Practitioner** through our innovated 'Accelerated Learning' approach which includes: practical and interactive training days; focused workshops; fully supervised break-through improvement projects; one-to-one coaching sessions; mentoring!

For a fraction of the cost of conventional Six Sigma training, this programme meets the needs of your busy life. Get the training you deserve without all the hassles!

Our approach and methods are based on highly focused research and development that have been refined and perfected as a result of hundreds of successful client implementation programmes, empowerment training courses and work with global supply chain groups.

Contact us today to discuss how the

## TEC – heuristics “learn-by-doing”



Breakthrough improvements reflected in significant and measurable bottom-line results



Practical structured training leads to effective teamwork – “all of us are better than one of us”

### **Heuristics** – “the art of discovering and invention”

We coined the word **heuristics** to capture the essence of our unique approach to working with our clients.

We work with your teams to create a **synergy** between **Six Sigma's R-DMAIC**, the **process approach** and world-class **best-practices** such as **Lean Enterprise** and **Kaizen Blitz**. In the process we create a **team-based** and **holistic environment** which empowers your operational and management staff to make **break-through improvements** in performance on a continual basis.

**TEC** are first and foremost an **implementation** and **empowerment** organization. We have successfully enhanced the careers of over 5,000 individuals world-wide by enabling them to use the latest **automotive** and **aerospace** improvement tools and techniques.

**TEC** are committed to the **process approach** and we vehemently believe in **integrated** and **value-added management systems**.

Our Lean-Six Sigma programme benefit from a wealth of practical experience and incorporates a wealth of ‘real world’ examples to illustrate best-practice implementation strategies.