Lean Sigma Green Belt

Lean Six Sigma is a systematic data-driven methodology to eliminate defects and improve the process or product quality. A product or process is said to achieve Six Sigma when the number of defects (or errors) fall outside of 6 standard deviations.

As a Six Sigma Green belt we;

- Manage the basics of Lean 6 Sigma and supervise a project. Master project management; manage the project with a DMAIC process
- Work in a team; understand project change management. Stimulate a work group to improve a situation
- Build the foundations of a Lean approach. Apply 6 sigma tools and methodology in a workshop. Optimize material and information flow, analyse the measures, control and standardise.

The Six Sigma methodology is specified by the DMAIC acronym, named for the five stages: Define, Measure, Analyse, Improve and Control.

- Define: Define the problem
- Measure: Quantify the problem
- Analyse: Identify the cause of the problem
- Improve: Solve the root cause and verify improvement
- Control: Maintain gains

DMAIC Checklist:

Define Stage:

The Define phase is used to share a single view of the project with the team, to define why it is important and to determine the objectives.

- Declare the problem
- Define the Team
    1. Sponsor – this is the person with the problem
    2. Lead (you) – person engage by sponsor to resolve problem by leading a Greenbelt project
    3. Project Team- contribute to activities and adjust processes to fix problem
- Introduce the 6-pack to the team.
- Develop the team. Give them an opportunity to feedback on the 6-pack. Observe the 4 stages of team development to ensure team have bought into project.

Team Development:

- Forming – Provide outlines, allow time for discussions, establish ground rules. Don't ask for decisions or solve the problem.
- Storming – expect conflicts to appear. We want to find consensus on what the project can achieve. Sooth tensions and guide team back to the issues in hand. Confront resistance to change.
- Norming – team will gel at this stage. Keep to the ground rules and hold team building activity.
- Performing – The team will be onboard at this stage. All will have contributed to the Steering committee presentation.

- With the Team complete the Suppliers, Inputs, Process, Outputs, Customers (SIPOC) template.

- With Team complete the Voice of the Customer (VOC) – translate the VOC into Critical to Quality (CTQ) i.e. customer expectations.
- With the team further define the VOC by completing a Process, Defect, Y, Operational objectives P.D.Y.O template.
- As a team complete the Change Management questionnaire.
- As a team complete threats and opportunities matrix. Complete Risk analysis
    - Team brainstorm (categorise post it notes).
    - Define the criticality of risks; that is use a score matrix and score by severity x probability.
    - Tabulate risk category, risk name, risk description, impact, probability, severity x criticality.
    - Risk management plan. For each risk list preventative action, owner, cost
- Compose Elevator speech – 15 sec description of project.

- With the team complete Stakeholder management analysis. That is;
    - Ensure commitment of key players to project
    - Identify all people that can hinder and/or facilitate project (interview strategic groups)
    - Classify Promotors, Neutrals and Resistants. Turn Neutrals into Promotors.
    - Stakeholder Table

Measure Phase:

The Measure phase will inform the project team and aligns it with the way current process operates. Defines and collects the information that the project requires. Confirms that the process is not working and quantifies the problem through graphical summary for each Y of your project.

In the measure phase we map the process with the appropriate level of detail. Narrow the field of potential causes to measure. Check the measurement system and data collected. Collect the data that are relevant to the project. Determine how the process is currently performing (measuring the Y) and confirm or reject the problem identified in the Define phase.

There are 4 sub-phases in the Measure Phase:

- Share the current situation
- Prepare the data collection
- Check the quality of the measurement
- Collect and analyse initial performance

- Decide on correct level of detail for process mapping
    - Macro top level process
        - Sub-processes – site level
            - Activities – Department level
                - Tasks – Team level

- Consider the type of flow to be considered – it may be all 3 of these:
    - Physical – material, products, components, bills
    - Information – data, signs, orders, documents etc
    - People – people

- Decide on an appropriate mapping type to describe the relevant process (Any and all for physical, information and People flows):
  - Value Stream Mapping
  - SIPOC
  - Flow Chart
  - Spaghetti
  - Operations Sheets

VSM - **Share the current situation – For good or for bad, this defines the current process.**

- Represents Information and material flow
- Completed in the following 7 steps
  - Define customer requirements
    - Starting at the end of the process work backwards.
    - Establish customer requirements, Batch size etc.
    - Calculate Takt time (Average time elapsed between 2 deliveries)
  - Identify Process Steps
    - List each stage – we are going to use this for the next step
  - Collect Process data
    - Calculate Cycle time for each stage of the process – Time how long it takes on average to complete 3 parts/process. Complete in VSM as you continue.
    - Calculate Changeover time (time for re-tooling etc) – we want the average time is for 3 parts/ process. Complete in VSM as you continue.
    - Calculate First Time Right (FTR) – Parts not Scrapped / Total Parts produced. Find them for each workstation and complete the VSM.
    - Calculate the Capacity Analysis Metric – Cycle time / FTR. Add this to the VSM etc.
    - Evaluate the bottle neck i.e. the process with the longest process time.
  - Collect Inventory
    - Count inventory – i.e. count how may products or processes that need to be accomplished. Update the WIP on the VSM. Use the TAKT time to turn WIP numbers into WIP time.
  - Identify material flow
    - Use symbols to represent the information flow on the VSM.
      - Push flow
  - Identify information flow
    - Use symbols to represent the information flow on the VSM.
      - Manual
      - Electronic
      - Verbal – informal
  - Calculate summary metrics
    - Lead time – Sum of all the cycle times plus all the WIP Time We want to reduce this gap.
    - Process Efficiency ratio – Cycle time / Lead Time

When composing the VSM start with the end of the process first and work backwards. Gather facts like customer demand etc.

Process Mapping

- Create a Flow chart to represent the current process.
- The flow chart is created in the following steps
    - Define urgency (urgent or non-urgent)
    - Add FTR Yes/No percentages to paths
    - For each step in the path team must specify if it is value adding or not.
    - Add a time ladder i.e. max time for each step.

Operations Sheet

- Write each step and the order of the operations – observe operation and add times.

What is a Value Adding task? It is any process that changes the nature, shape or characteristics, in accordance with the customer's requirements, or that brings a service closer to completion.

Lean is the systematic process of eliminating waste. Before we move onto the next stage master the 7 wastes:

- **Motion:** Motion of People
- **Overproduction:** Resources committed to producing too soon, too quickly or more requested by the customer
- **Waiting:** People idle awaiting information, a repair or task
- **Inventory:** Sleeping raw materials, WIP or finished goods
- **Transportation:** Excess of transpiration for parts or documents
- **Defects and reworks:** Components that the customer would deem unacceptable in terms of quality
- **Over Processing:** Task not requested by the customer or carried out more than once, useless or complex process

Prepare the data collection

- List the factors – simple situation
    - Achieved though observation – complete observation matrix every 10 minutes.
- List the factors – complex situation
    - Achieved though observation – complete observation matrix – continuous.

Observation is not:

- An assessment of the individual.
- An inspection method
- A unilateral approach – all are to input
- Consideration must be given to the person observed

Check the quality of the measurement

- Measurement System Analysis by validating observations and wastes with operators.

Collect and analyse initial performance

- Basic Charts - Visualise findings in Charts and diagrams.
  - Pareto (Helps decide on priorities and sort causes)
  - Histogram (Distribution of a variable, display variability)
  - Line (run) chart (for unexpected events and variations over time)

Note on Kaizen: Kaizen events help facilitate the MAI (Measure Analyse & Improve) and can be performed in a week. That is; map - establish target – search for solutions – action plan. Kaizen events should be launched only if the problem is simple, the scope is narrow, and the data is readily available. Preparation for the event should begin 4 weeks in advance.

- Complete the Kaizen checklist.

Analyse Phase:

A relatively quick phase. The Analyse phase does 2 things:

- Identifies root causes
- Proves their impact on the lack of performance

The Analyse phase can be broken up into three phases:

- Analyse the losses of performance
- Display the critical factors influencing performance
- Identify Root causes

We begin by using box plots and Correlation diagrams to further our analysis:

- Create Boxplot (Establish the Xs (discreate) and Ys (correlation)
- Create Correlation (scatter diagram) diagram (Correlation does not mean causation)

We must now:

- List non-value-added activities, the 7 wastes, the bottleneck, the sources of variability
- Confirmed root causes with their relative impact on non-performance on main abnormalities
- Propose and implement quick wins

Improve Phase:

The Improve phase does 2 things:

- Identifies the best solutions for addressing the root causes
- Elaborates an implementation plan for these solutions

To do this it depends on what we want to improve – Capacity, Productivity or Quality. We list the tools for each below:

Capacity:

- Smooth Demand
  - Demand levelling is used to produce an equivalent quantity of parts / products in a given period
  - It avoids scaling to workload peaks and lack of productivity during slack periods
  - It may generate overproduction wastes at any time

- Mix Demand
  - Mixing customer demands boils down to producing a little of everything, all of the time
  - It results in reduced lead times on ALL products and ensures increased flexibility if the Customer demand changes
  - Mixing Demand means that tooling has to be changed quickly
- TPM (Total Product Maintenance)
  - Increases uptime of machine
  - Avoids machine breakdowns
  - Optimises machine availability during working hours
- SMED (Single-minute Exchange or Die)
  - Optimises changeover duration
  - Optimises machine flexibility
  - Minimises batch size
- OEE (Overall Equipment Effectiveness)
  - Indicator for machines: measure of performance linking the availability of the equipment to productivity and to the quality of the parts.

Productivity:

- Red/Green
  - Identification and elimination of activities with no added value
- Just-in-time
  - One-piece flow and SMED
  - KANBAN (signboard) and other component replenishment systems
- Spaghetti Diagram
  - Analysis and optimisation of the motion of products and people
- TAKT time
- Balancing the workstations
- Adjustment to the duration of operations according to customer demand

Quality

- Standardisation
  - Introduction of standards such as a procedure, instructions, signage, inspection, rules etc
- 6S
  - Process and method for creating an organised, clean and high-performance space
  - Sort(Seiri), Set it in Order (Seiton), Shine (Seiso), Standardise (Seiketsu), Sustain (Shitsuke), Safety.
- Jidoka
  - Automation
- Poka Yoke
  - Avoidance of defective products
  - Introduce corrective actions to prevent recurrence of the problem

JIT – Just in time

The objective is to deliver the right part/information to the right place, at the right time and in the quantity that is strictly necessary. We achieve this through one-piece single flow. To achieve this we

must have agile changeover time (the time from completion of one unit, changeover of machine parts,

- SMED (Single-minute Exchange or Die)
  - Identify Activities to be carried out on changeovers
  - Separate these activities into external times, internal times and useless activities
  - Find actions to remove the useless activities and to convert internal tasks into external tasks
  - Rationalise these setup times
- Pull Flow (The production of each workstation considers the quantities required from the following workstations)
  - Kanban (using labels, cards etc as signals for operators, logistics etc to complete work) for pull flow.

TPM – Total Productive Maintenance

- Total (reference to systematic analysis)
  - Covers all issues
  - All skills
  - The whole structure
- Productive (Preventative and improvement)
  - Productivity
  - The Production / Maintenance pairing
- Maintenance (Managing the underlying conditions of the equipment)
  - For the system
  - For the operation
  - For the work environment

- OEE (Overall Equipment Effectiveness) is the KPI used and gives a breakdown of losses on a piece of equipment or a set of equipment.
  - OEE = Losses due to Availability x Losses due to Performance x Losses due to Quality
    - Losses due to Availability
      - (Total time available – Planned down time – Unplanned downtime)/ (Total available – Planned downtime)
    - Losses due to Performance
      - (Ideal cycle time x Quantity processed)/(Total real operating time in minutes)
    - Losses due to Quality
      - (Quantity produced – quantity defective)/ (quantity processed)

The 7 stages of TPM (Total Productive Maintenance)

- Initial cleaning
  - Find the problems. Disassemble the equipment and bring it up to standard
- Eliminate the causes of deterioration and facilitate cleaning
  - Modify the equipment if needed to eliminate the deterioration
- Prepare cleaning and lubrication standards
  - Follow the manufacturers recommendations
- Organise and improve technical and inspection skills
  - Implement a training plan

- First-Level independent machine maintenance
  - The operators become responsible for these checks
- Standardise the workstation procedures and rules
  - Create standardized documents
- Global autonomous maintenance
  - Ensure that the system is running properly and maintain it

The 5S

- Seiri
  - Sort
- Seiton
  - Set in order
- Seiso
  - Shine
- Seiketsu
  - Standardise
- Shitsuke
  - Sustain

To implement 5S

- Define territorial boundaries
- Designate manager for each boundary
- Train team members in 5S methodology
- Involve the team members and management
- Define rolling 5 S objectives
- Set an example at every level of management

Picking solutions. It likely that there will be a conflict of opinion when it comes to selecting and implementing solutions. To help you overcome these and move forward as a team use the following tools:

- Gain Effort Matrix (Score by Effort (Very Easy, Easy, Medium, Difficult, Very Difficult) against Potential Gain (Low, Medium, High)
  - This yields 3 categories – undesirable solutions, potentially desirable solutions, and most desirable solutions.
- Selection matrix
  - Add weighted scores for relevant criteria in a table.

Future VSM

The Future VSM is a future state visual teaching resource used to get the team to focus on a target solution.

To create a Future VSM, a good overall view is needed of the process and improvement tools – Kanban's, pull flow, capacity analysis.

- The future VSM summarises proposed solution.
- Facilitates to move the group forward together to a solution
- Implement the Lean sigma tools

Risk Management

Review our list of potential improvements. Look at these changes, step by step and consider what problems we may face.

Risk: Potential threat or event that can prevent us from achieving an objective.

Implementing a solution may result in new risks. These may be potentially negative impacts to customers, sales, working environments etc.

- The aim of risk management is to increase success rate of projects by proactively identifying risks and then taking appropriate action to ensure they do not become a problem.

FMEA (Failure, Mode, Effect, Analysis)

This tool helps us to:

- Evaluate the severity, frequency, and detectability of each risk.
- Identify the most important risks
- Take preventative actions
- Manage and document risks

The FMEA takes place in 4 steps:

- Identify risks
- Access risks
- Control risks
- Monitor risks

To evaluate a risk, we calculate its RPN (Risk Priority Number) = Severity x Frequency x Detectability.

RPN < 100: Pass
RPN > 100: mitigation action is required
RPN > 6: mitigation action is required

- Reduce the RPN through mitigation actions on frequency and detectability.

It's time to make the required enhancements – a tool that will help us achieve this is the PDCA (Plan, Do, Check, Act). The PDCA starts in the improve phase and ends in the Control phase. We only complete the "Plan" step in the Improve phase.

Plan – define milestones.

- Draft a list of required actions
- Prioritise, schedule, and assign owner of actions
- Determine resources needed for each activity i.e. time, cost etc.

Driving Chang Management

- Complete Change matrix
- Targeted and tailored communication plan
- Training
- Information via management

Improve Phase

The Control phase does 2 things:

- Implements the actions identified to improve performance
- Prepares the end of the project and introduces the actions needed to sustain improvements

Implement

- Monitor the implementation
- Manage the change

Confirm the results

- Confirmation of graphics
- Asses the performance

Draft the control plan

- Self-inspection
- Quality chart

We make use of the PDCA – specifically the "Do, Check, Act" steps.

We monitor the deployed solutions by gathering data and creating regular reports. We then complete a process that confirms the results through experimentation.

If the results are not as good as expected, we either:

- Start the analysis over again, gather more facts and data or,
- Introduce the initial or revised plan

Training Plan:

- Instructions and presentation
  - List the job elements
  - Identify key points
  - Provide illustration if necessary
  - Add symbols to underline criticality
- Job standard – written jointly with the people that perform the task
  - Safety
  - Standard Tool
  - Standard Action
  - Standard sequence
  - Standard times
- Skills monitoring
  - Helps to ensure that team is strong and cross trained.

Visual Management – keep it simple. The benefits are as follows:

- Quality: Defects are easily identifiable and can be handled quicker
- Quantity: Progress of actions and any delays are immediately apparent
- Team: Responsibility is borne by the team, and not a leader. Problems are resolved jointly
- Customer: Customer Expectations are assessed, and the results are permanently visible

- **Write up conclusions**
  - Roll out solution and assess results
  - Define the checks required to maintain the performance level
  - Quickly detect malfunctions and decide what actions to take
  - Write procedures applicable to processes
  - Capitalise on lessons learned
  - Transfer process to owner and close project

- **Communicate a customised and tailored message detailing the success of the project to the appropriate people**