Lean Six Sigma Project – A Beginner's Guide

- Nilakantasrinivasan

Lean Six Sigma Project – A beginner's guide is a series that explains how to run Lean Six Sigma projects in detail. The biggest benefit of combining Lean and Six Sigma is to deliver more value to customers and business. In order for a Six Sigma Green Belt to be successful with a project, they must know what's to be done, and how to accomplish them! This guide is a step-by-step procedure to execute the 5 phases of a Lean Six Sigma project.

Lean Six Sigma improvement projects follow 5 phase DMAIC approach. A six sigma project is not an academic exercise, but its primary objective is to impact customers, business, and employees positively. Thus stakeholder buy-in and sponsorship are very important factors for its success. Every project should have at least one project sponsor (One sponsor is just fine, two is OK, but greater than that is undesirable). The project sponsor is usually the process owner or a senior management executive who is accountable for the overall project and its success. They take the lead in identifying the project & its objectives, and in team formation.

The team composition should be cross-functional. The sponsor also has to decide whether this Six Sigma project should be led by a Black Belt or Green Belt. Once identified, the respective Six Sigma Belt plays the lead role in the project. It is their responsibility to complete the project on time, and deliver desired results. Now, for the remaining part of this beginner's guide, let's assume that it is a Lean Six Sigma Green Belt Project.
The duration of a typical project should be between 3 to 4 months. The overall project plan for all Six Sigma improvement projects are mapped to Define, Measure, Analyze, Improve, and Control. There are defined deliverables for each of these phases which have to be accomplished before progressing further. At the end of each phase, a formal tollgate is used to stage a gate review by the sponsors. Various Six Sigma concepts and tools can be applied to progress and accomplish desired phase-wise outcomes.

In order to make sure the project meets the timeline, and set-out objectives; the Green belt and team members are to meet regularly. In addition to this, Six Sigma Green Belts are mentored by Black Belts or Master Black Belts.

In a nutshell, following are the broad outlines for each of the DMAIC phases of Lean Six Sigma Project:

- Define – Identify the project objective and define the problem to be solved
- Measure – Collect necessary data regarding the problem and establish current performance
- Analyze – Use the data collected to analyze and screen factors which are the root causes for a problem
- Improve – Identify suitable solutions to overcome the root causes
- Control – Implement the solutions and monitor its results

Next, as a part of this beginner's guide, let's understand how to accomplish the deliverable of the Define phase here.

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Define Phase of Lean Six Sigma Project – A Beginner's Guide

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Define Phase is the first phase of Lean Six Sigma Project. Following are the deliverable of this phase:

- Develop the Project Charter
- Identify the Project CTQ
- Create Process Maps

Develop the Project Charter

Project Charter is an important document that summarizes the purpose, current scenario & goal, measures of success (CTQ), project's scope, quantitative & indicative project benefits, and team members. This is the most important document, as it creates a term of reference for this entire Lean Six Sigma project. In order to prepare the project charter, several meetings and preparatory steps may be needed. In some cases, gathering the Voice of Customer (VOC) may be required to even understand the problem.

Project Scoping determines exactly how the project will contribute to overall business, whether the efforts will be diverted to maximum impact area, team composition, financial resources required, etc. In Six Sigma, a tool called 'In-Frame Out-Frame' is used to decide on the scope.

Six Sigma Green Belt should closely work with the Project Sponsor to complete the Project Charter.

Identify the Project CTQ

CTQ refers to Critical to Quality metric. This is a measure of success for the project. Usually, there is only one CTQ for DMAIC projects. It can either be a measure of efficiency or effectiveness. However, it is a key performance indicator for Voice of Customer or Voice of Business. Further, it should be measurable. Usually, its indicative or accurate current performance is reported in the project charter.

The above two deliverable run parallel, and they are of significant importance because they mark the formal kick-off of the project, team member induction, Lean Six Sigma training (if not included earlier).

Create Process Maps

In order to understand the end-to-end process; a detailed process document is created by the team. However, in case such documentation already exists, then it becomes easy for the project team members to revisit it.

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Process maps can be either high level end-to-end process documentation such as SIPOC (Suppliers, Inputs, Process, Outputs & Customers), deployment process-charts which use Swim-lane technique or step-by-step process flow-chart. In some cases, just mapping the process itself can result in meeting the Lean Six Sigma project objectives!
Six Sigma Green Belt can involve all her team members in this activity. Two best ways of mapping a process are to interview all the parties involved in the process or to conduct a work-out session with all parties. Latter requires good facilitation skills.

Once the process maps have been created, the team can use them to identify the bottlenecks, challenges, issues, inputs & outputs, delays, etc. Essentially, it can be used to decide which part of the process is important, and needs to be introspected.
On completion of the above deliverable, a formal define tollgate review is conducted. Then the project moves to Measure Phase.

Measure Phase of Lean Six Sigma Project – A Beginner's Guide

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Measure Phase of Lean Six Sigma Project is the second phase. Following are the deliverable of this phase:

- Identify all possible causes (Cause & Effect Diagram)
- Validate Measurement System, Data Collection & Sampling
- Establish Process Capability

Identify all possible causes (Cause & Effect Diagram)

In the measure phase of a Lean Six Sigma Project, the team brainstorms to identify all possible causes or reasons for the occurrence of the problem. Thus, there is a direct linkage between a project charter and this deliverable. Fish-bone diagram is a structured brainstorming method used to carry out this activity. Fish-bone diagram is also called as Ishikawa or Cause & Effect diagram. After completing this brainstorming, the team applies the 5-why technique to further explore the underlying causes for all the reasons identified in the fish-bone diagram. At the end of these two activities, the team has an exhaustive list of possible causes for the problem. Usually there are around 50~100 possible causes for the problem. It is the responsibility of Six Sigma Green Belt to facilitate these activities.

As a next step, using their process knowledge and experience, the team has to agree on few causes; which potentially cause the problem. There are several methods to do this, but the most popular method is the use of Cause & Effect Matrix (C-E Matrix). Potential Causes are suspects that are causing the problem. However, before acting on them, the team needs to gather data or facts to validate them.

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Validate Measurement System, Data Collection & Sampling

Data Collection plays a very important role in all Six Sigma projects. But before collecting data, the team has to assess if the measurement system (measuring instrument, appraiser & environment in which measurement happens) is accurate and precise. Hence the team has to perform Measurement System Analysis (MSA) – aka Gage R&R. Once the team ascertains that the measurement is good, then a data collection plan is prepared. Data Collection Plan (DCP) includes the measures whose data needs to be collected, how much data to collect, data source, and who will collect the data, etc. While the entire team can participate in this activity, Six Sigma Green Belt has to take a lead role, as this will involve technical concepts of Gage R&R covered in the training program.

Unlike conventional data collection; in Lean Six Sigma projects, data is collected on both the CTQ and the potential causes identified in a Cause & Effect Matrix. Due to the quantum of data involved in most businesses, it isn't practically viable to collect data of the entire population. Hence the team has to resort to statistical sampling methods.

As a next step, data collection is executed. From time-to-time a Six Sigma project team needs to validate the data collected. Sometimes, the data collectors need to be trained and retrained. Once the data collection is complete, it is ready for a process capability assessment. Usually many projects get delayed because of poor data quality or delay in collecting sufficient data. When a Six Sigma Green Belt takes special care, this activity can get completed on time.

Establish Process Capability

Process Capability is the ability of the process to deliver as per customer requirement. There are various process capability indices, but in Lean Six Sigma projects, sigma capability is the most popular measure. This exercise gives an accurate report on the current process performance. As these indices are covered in the training program, Six Sigma Green Belt has to take a lead role in conducting this study. The output of Process Capability study can be used to validate the process objectives and anticipated benefits in the charter. If needed, the Lean Six Sigma project charter can be revisited.

On completion of the above deliverable, and a formal Measure Phase tollgate review, the team is ready to move into Analyze phase.

Analyze Phase of Lean Six Sigma Project – A Beginner's Guide

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Analyze Phase of Lean Six Sigma Project is the third phase. Following are the deliverable of this phase that Six Sigma Green Belt should deliver with her team:

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- Statistically validate root causes
- Perform Value Stream Mapping & Process Value Analysis
- Control & Impact Matrix

Statistically Validate Root Causes

The data that has been collected in the Measure Phase is used to draw statistical associations between CTQ measures and causes. The causes that are statistically significant are the root causes. There are a variety of statistical tools to establish this association. Depending on the type of data – continuous or discrete – tools are selected. Such tests are generally called as Hypothesis tests. 2-t Test, Z-test, t-test, ANOVA, Chi-Square Test, Correlation, Regression, etc., are few common hypothesis tests.
The procedure to perform, and interpret all the above tests are usually covered in detail in Lean Six Sigma Green Belt Training programs.

Perform Value Stream Mapping & Process Value Analysis

Value Stream Mapping (VSM) is a popular tool used in Lean methodology; as an alternate approach to statistically identifying Root Causes, or in conjunction with it is the application of Value Stream Mapping and Process Value Analysis. It is used to identify the 7 types of Wastes (Muda – in Japanese) in a process. VSM is a holistic method to visually document the way in which value is getting built in a process.
The 7 types of process wastes are generally referred to as Non-Value Added tasks in conventional Six Sigma. The procedure of associating every task in a process as either Value Adding (VA), Non-Value Adding (NVA), or Value-Enabling (VE) is called as Process Value Analysis. These methods are very useful in projects where extensive data collection is not possible, or in projects with Turn-Around Time or Delay reduction.

Control-Impact Matrix

The final deliverable of the Analyze phase is to summarize all the findings from Statistical validation or Process Value Analysis (& VSM) in a 2×2 matrix called as Control-Impact Matrix. It is important to ensure that the project doesn't end up as an academic exercise or research study. Hence, the Lean Six Sigma team needs to identify root causes which have high impact, and well within the control of the team. This is done through a team discussion with the involvement of the project sponsor.
Once the root causes have been identified, & a formal Analyze Tollgate review is completed; the Lean Six Sigma Project is ready to move to the Improve Phase.

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Improve Phase of Lean Six Sigma Project – A Beginner's Guide

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Improve phase is the fourth phase of **Lean Six Sigma projects**. Following are the deliverable of this phase:

- Identify Solutions to overcome the impact of root causes
- Refine Solutions (FMEA, Poka-Yoke)
- Pilot Solutions
- Statistically validate results

Identify Solutions to overcome the impact of root causes

For each of the root causes identified in the Analyze phase, the Lean Six Sigma Team uses an apt structured or unstructured brainstorming method to generate various alternatives to overcome the problem. These techniques may include Channeling, Anti-solutions, Analogy, Wishful thinking, Random word stimulus methods, etc.

SCAMPER is another popular method which can be used by the Six Sigma Green Belt to systematically improve the current process using any of the following methods: Simplify or Substitute, Combine, Adapt, Modify, Put to different use, Eliminate & Reduce.

If there are too many options that the team has identified, then a variety of solution screening methods can be used to select the best solution for implementation. These screening methods include NGT (Nominal Group Technique), N/3 Voting, Criteria Based Matrix (CBT), etc.

Proposed solutions can be a new process, technology change, policy changes, alterations of inputs, measurement system refinement, customer, employee or vendor education, etc. In such cases, either revised process map, future state value stream mapping, etc., may need to be proceeded. The solution that the team has selected should directly impact the CTQ of the project. Six Sigma Green Belt should validate this.

Refine Solutions (FMEA, Poka-Yoke)

Before implementing solutions, the Six Sigma Green Belt needs to ensure that the proposed solutions are complete and well refined. This will ensure that there are no delays, rework during implementation, and the full impact on CTQ is derived. In order to do this, a tool called Failure Modes Effect Analysis (FMEA) is used. The main purpose of this tool is to assess all the risks involved with a solution, and how to mitigate them by refining the solution before implementation. Risk Priority Number (RPN) derived from FMEA helps in prioritizing the risks and acting on them in a systematic manner.
Mistake-proofing (Poka-Yoke, in Japanese) is a method used to ensure that the proposed solution doesn't create additional defects or errors. This can be used in conjunction with FMEA.

Pilot Solutions

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Now the solution is ready for pilot. The purpose of the pilot is to assess its impact in a control group setting. Based on the qualitative and quantitative results of the pilot, necessary alternations can be incorporated to the final solution. Six Sigma Green Belt should closely work with the process owners during pilot to understand ground realities and build ownership.

Statistically validate results

In Lean Six Sigma Projects, it is an important step to statistically validate the impact on CTQ(before implementation & after Implementation). Hypothesis tests like 2-t test, ANOVA, Chi-square tests, etc., are used to perform this statistical validation. These tests help to identify if the improvement is significant or marginal in nature. Six Sigma Green Belt should be able to select and perform appropriate tests using statistical softwares.
On successful completion of these deliverable and formal Improve tollgate review, the Lean Six Sigma project team is ready to move to the Control phase.

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Control phase is the fifth and final phase of Lean Six Sigma projects. Following are the deliverable of this phase:

- Prepare Control Plan
- Final Implementation
- Establish Statistical Process Control (SPC)
- Benefits Computation & Closure

Prepare Control Plan

Control Plan or Process Management Plan is a document ensuring that a robust mechanism to monitor and follow-up is established before the solution is implemented. Most Lean Six Sigma projects don't exist after a few years of implementation. Usually, it is because of a poor control plan. A control plan covers: which metrics will be monitored, method of monitoring, how often, by whom and what has to be done when they go out of control (aka Reaction Plan).
It is recommended to have a control plan that is easy to implement and sustain.

Final Implementation

Real implementation of a solution is part of the Control phase. Change management skills of the green belt is tested during this stage.

Establish Statistical Process Control (SPC)

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As a part of the control plan, the method of monitoring has to be specific. Statistical Process Control uses well known Control Charts or Shewhart Charts. A control chart, computes the lower and upper control limits as a threshold to monitor any process measures; like CTQ. As the threshold is breached, the reaction plan has to be triggered. As the name suggests, it is a chart that is based on the principles of statistics, and hence there are no false alarms. Instilling the discipline of creating control charts and monitoring as per Control Plan is part of the rigor of a Lean Six Sigma Green Belt.

Benefits Computation & Closure

The last deliverable of the Lean Six Sigma project is Benefits Computation and Closure. But before that, the project is monitored for enough time (2 weeks to 2 months) to ensure that benefits are sustained. When the Lean Six Sigma Team is satisfied with the results, then the improved process is formally handed-over to the process owner.
Financial and non-financial benefits are computed based on actual results, and a formal sign-off from the finance manager and sponsor is obtained. This will be the project closure.
The Lean Six Sigma team celebrates its success; distributes rewards for active team members; and finally the Six Sigma Green Belt Certification Ceremony is undertaken.

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Neil started Canopus Business Management Group in 2009. He helps a range of large enterprises in services and manufacturing, with particular emphasis on execution of business & functional strategies, customer experience & process transformation. He has worked with banking, outsourcing, IT, discrete manufacturing & telecom business processes. He draws on extensive experience (15 years) in Hoshin Kanri, Blue Ocean Strategy, Lean, Six Sigma, Outsourcing, Change Management and Touch point Management to deliver composite solutions that put client's business in an Advantageous & Profitable position.

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