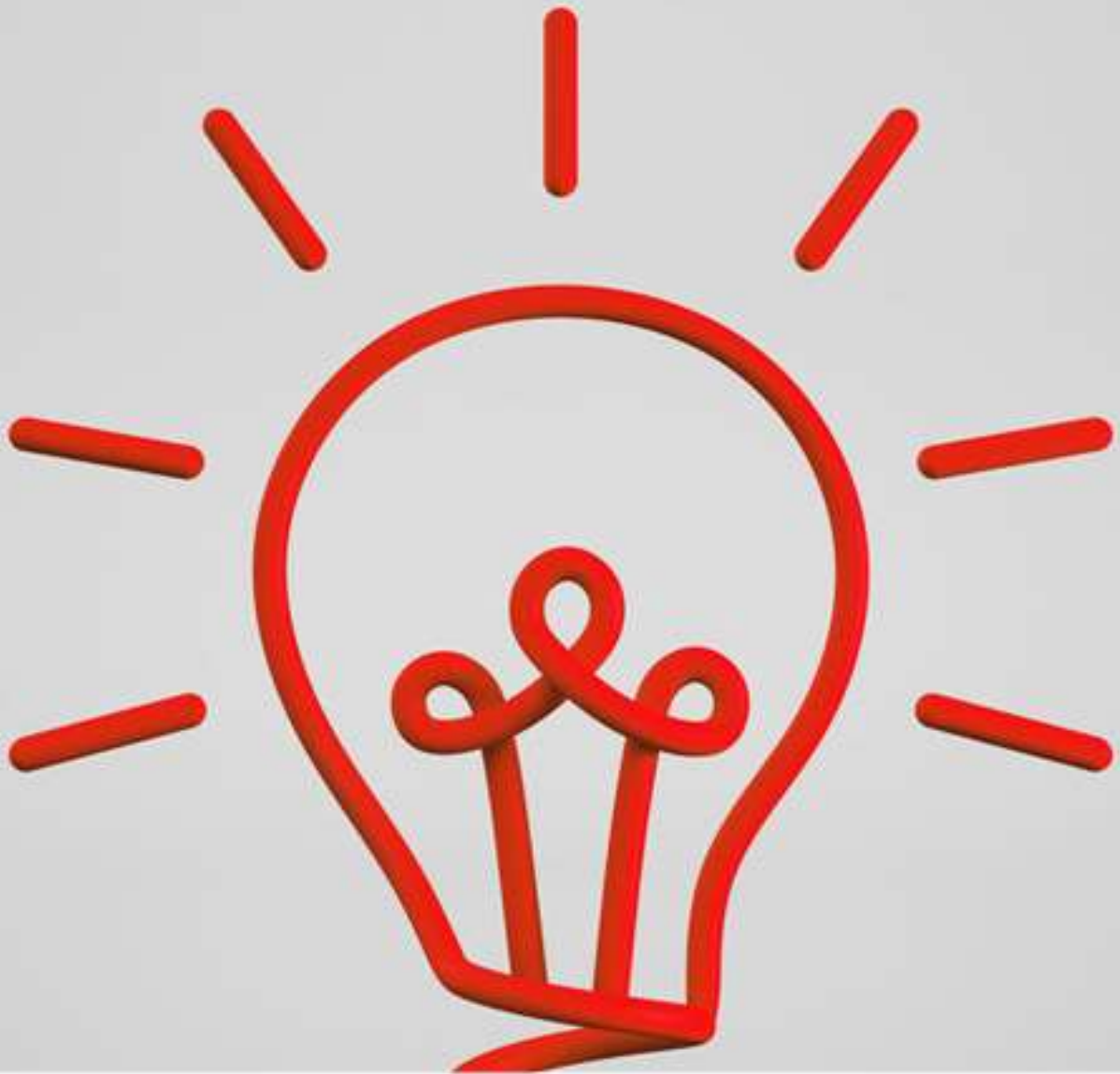


SIX SIGMA

process improvement approach



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About the Tutorial

Six Sigma is a methodology for pursuing continuous improvement in customer satisfaction and profit. It is a management philosophy attempting to improve effectiveness and efficiency.

In this tutorial, you will learn what Six Sigma is and how to use Six Sigma in an organization.

Audience

This tutorial has been prepared for the beginners to help them understand the basic functionality of Six Sigma.

Prerequisites

We assume the readers of this tutorial have prior exposure to Quality Control and Quality Assurance and related terminologies.

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1. INTRODUCTION

Six Sigma is a highly disciplined process that helps us focus on developing and delivering near-perfect products and services.

Features of Six Sigma

- Six Sigma's aim is to eliminate waste and inefficiency, thereby increasing customer satisfaction by delivering what the customer is expecting.
- Six Sigma follows a structured methodology, and has defined roles for the participants.
- Six Sigma is a data driven methodology, and requires accurate data collection for the processes being analyzed.
- Six Sigma is about putting results on Financial Statements.
- Six Sigma is a business-driven, multi-dimensional structured approach for:
 - Improving Processes
 - Lowering Defects
 - Reducing process variability
 - Reducing costs
 - Increasing customer satisfaction
 - Increased profits

The word *Sigma* is a statistical term that measures how far a given process deviates from perfection.

The central idea behind Six Sigma: If you can measure how many "defects" you have in a process, you can systematically figure out how to eliminate them and get as close to "zero defects" as possible and specifically it means a failure rate of 3.4 parts per million or 99.9997% perfect.

Key Concepts of Six Sigma

At its core, Six Sigma revolves around a few key concepts.

- **Critical to Quality:** Attributes most important to the customer.
- **Defect:** Failing to deliver what the customer wants.
- **Process Capability:** What your process can deliver.
- **Variation:** What the customer sees and feels.

- **Stable Operations:** Ensuring consistent, predictable processes to improve what the customer sees and feels.
- **Design for Six Sigma:** Designing to meet customer needs and process capability.

Our Customers Feel the Variance, Not the Mean. So Six Sigma focuses first on reducing process variation and then on improving the process capability.

Myths about Six Sigma

There are several myths and misunderstandings surrounding Six Sigma. Some of them are given below:

- Six Sigma is only concerned with reducing defects.
- Six Sigma is a process for production or engineering.
- Six Sigma cannot be applied to engineering activities.
- Six Sigma uses difficult-to-understand statistics.
- Six Sigma is just training.

Benefits of Six Sigma

Six Sigma offers six major benefits that attract companies:

- Generates sustained success
- Sets a performance goal for everyone
- Enhances value to customers
- Accelerates the rate of improvement
- Promotes learning and cross-pollination
- Executes strategic change

Origin of Six Sigma

- Six Sigma originated at Motorola in the early 1980s, in response to achieving 10X reduction in product-failure levels in 5 years.
- Engineer Bill Smith invented Six Sigma, but died of a heart attack in the Motorola cafeteria in 1993, never knowing the scope of the craze and controversy he had touched off.
- Six Sigma is based on various quality management theories (e.g. Deming's 14 point for management, Juran's 10 steps on achieving quality).

2. KEY ELEMENTS

There are three key elements of Six Sigma Process Improvement:

- Customers
- Processes
- Employees

The Customers

Customers define quality. They expect performance, reliability, competitive prices, on-time delivery, service, clear and correct transaction processing and more. This means it is important to provide what the customers need to gain customer delight.

The Processes

Defining processes as well as defining their metrics and measures is the central aspect of Six Sigma.

In a business, the quality should be looked from the customer's perspective and so we must look at a defined process from the outside-in.

By understanding the transaction lifecycle from the customer's needs and processes, we can discover what they are seeing and feeling. This gives a chance to identify weak areas within a process and then we can improve them.

The Employees

A company must involve all its employees in the Six Sigma program. Company must provide opportunities and incentives for employees to focus their talents and ability to satisfy customers.

It is important to Six Sigma that all the team members should have a well-defined role with measurable objectives.

3. ORGANIZATION

Under a Six Sigma program, the members of an organization are assigned specific roles to play, each with a title. This highly structured format is necessary in order to implement Six Sigma throughout the organization.

There are seven specific responsibilities or "role areas" in a Six Sigma program, which are as follows.

Leadership

A leadership team or council defines the goals and objectives in the Six Sigma process. Just as a corporate leader sets a tone and course to achieve an objective, the Six Sigma council sets the goals to be met by the team. Here is the list of Leadership Council Responsibilities:

- Defines the purpose of the Six Sigma program
- Explains how the result is going to benefit the customer
- Sets a schedule for work and interim deadlines
- Develops a mean for review and oversight
- Support team members and defend established positions

Sponsor

Six Sigma sponsors are high-level individuals who understand Six Sigma and are committed to its success. The individual in the sponsor role acts as a problem solver for the ongoing Six Sigma project. Six Sigma is generally led by a full-time, high-level champion, such as an Executive Vice President.

Sponsors are the owners of processes and systems, who help initiate and coordinate Six Sigma improvement activities in their areas of responsibilities.

Implementation Leader

The person responsible for supervising the Six Sigma team effort, who supports the leadership council by ensuring that the work of the team is completed in the desired manner, is the Implementation Leader.

Ensuring success of the implementation plan and solving problems as they arise, training as needed, and assisting sponsors in motivating the team are some of the key responsibilities of an implementation leader.

Coach

Coach is a Six Sigma expert or consultant who sets a schedule, defines result of a project, and who mediates conflict, or deals with resistance to the program.

Duties include working as a go-between for sponsor and leadership, scheduling the work of the team, identifying and defining the desired results of the project, mediating disagreements, conflicts, and resistance to the program and identifying success as it occurs.

Team Leader

It is an individual responsible for overseeing the work of the team and for acting as a go-between with the sponsor and the team members.

Responsibilities include communication with the sponsor in defining project goals and rationale, picking and assisting team members and other resources, keeping the project on schedule, and keeping track of steps in the process as they are completed.

Team Member

An employee who works on a Six Sigma project, given specific duties within a project, and has deadlines to meet in reaching specific project goals.

Team members execute specific Six Sigma assignments and work with other members of the team within a defined project schedule, to reach specifically identified goals.

Process Owner

The individual who takes on responsibility for a process after a Six Sigma team has completed its work.

Extended Definitions of Roles – Belt Colors

The assignment of belt colors to various roles is derived from the obvious source, the martial arts. Based on experience and expertise, following roles have evolved over the years.

Note: The belt names are a tool for defining levels of expertise and experience. They do not change or replace the organizational roles in the Six Sigma process.

Black Belt

The person possessing this belt has achieved the highest skill level and is an experienced expert in various techniques. As applied to the Six Sigma program, the individual designated as a Black Belt has completed a thorough internal training program and has the experience of working on several projects.

The black belt holder is usually given the role of a team leader, the person who is responsible for execution and scheduling.

Master Black Belt

A person who deals with the team or its leadership; but is not a direct member of the team itself. This may be equivalent to the role played by the coach, or for more technical and complex projects.

The Master Black Belt is available to answer procedural questions and to resolve the technical issues that come up.

Green Belt

The Green Belt designation can also belong to the team leader or to a member of the team working directly with the team leader.

A Green Belt is less experienced than a Black Belt but is cast in a key role within the team.

4. GET STARTED

The starting point in gearing up for Six Sigma is to verify if you are ready to embrace a change that says, "There is a better way to run your organization."

Is Six Sigma Right for You?

There are a number of essential questions and facts that you need to consider in making a readiness assessment:

- Is the strategic course clear for the company?
- Is the business healthy enough to meet the expectations of analysts and investors?
- Is there a strong theme or vision for the future of the organization that is well understood and consistently communicated?
- Is the organization good at responding effectively and efficiently to new circumstances?
- Evaluating current overall business results.
- Evaluating how effectively do we focus on and meet customers' requirements.
- Evaluating how effectively are we operating.
- How effective are your current improvement and change management systems?
- How well are your cross-functional processes managed?
- What other change efforts or activities might conflict with or support Six Sigma initiative?
- Six Sigma demands investments. If you cannot make a solid case for future or current return, then it may be better to stay away.
- If you already have in place a strong, effective, performance and process improvement offer, then why do you need Six Sigma?

There could be many questions to be answered to have an extensive assessment before deciding if you should go for Six Sigma or not. This may need time and a thorough consultation with Six Sigma Experts to take a better decision.

The Cost of Six Sigma Implementation

Some of the most important Six Sigma budget items can include the following:

- Direct Payroll for the individuals dedicated to the effort full time.

- Indirect Payroll for the time devoted by executives, team members, process owners and others, involved in activities like data gathering and measurement.
- Training and Consultation fee to teach Six Sigma Skills and getting advice on how to make efforts successful.
- Improvement Implementation Cost.

Six Sigma Start-up

Now you have decided to go for Six Sigma. So what is next?

Deploying Six Sigma within an organization is a big step and involves many activities including define, measure, analyze, improve, and control phases. Here are some steps, which are required for an organization at the time of starting Six Sigma implementation.

- **Plan your own route:** There may be many paths to Six Sigma but the best is the one that works for your organization.
- **Define your objective:** It is important to decide what you want to achieve, and priorities are important.
- **Stick to what is feasible:** Set up your plans so that they can match your influences, resources and scope.
- **Preparing Leaders:** They are required to launch and guide the Six Sigma Effort.
- **Creating Six Sigma organization:** This includes preparing Black Belts and other roles and assigning them their responsibilities.
- **Training the organization:** Apart from having black belts, it is required to impart training of Six Sigma to all the employees in the organization.
- **Piloting Six Sigma effort:** Piloting can be applied to any aspect of Six Sigma including solutions derived from process improvement or design redesign projects.

Project Selection for Six Sigma

One of the most difficult challenge in Six Sigma is the selection of the most appropriate problem to attack. There are generally two ways to generate projects:

- **Top-down:** This approach is generally tied to business strategy and is aligned with customer needs. The major weakness is they are too broad in scope to be completed in a timely manner (most six sigma projects are expected to be completed in 3-6 months).
- **Bottom-up:** In this approach, Black Belts choose the projects that are well-suited for the capabilities of teams. A major drawback of this approach is that, projects may not be tied directly to strategic concerns of the management thereby, receiving little support and low recognition from the top.

5. METHODOLOGY

Six Sigma has two key methodologies:

- **DMAIC:** It refers to a data-driven quality strategy for improving processes. This methodology is used to improve an existing business process.
- **DMADV:** It refers to a data-driven quality strategy for designing products and processes. This methodology is used to create new product designs or process designs in such a way that it results in a more predictable, mature and defect free performance.

There is one more methodology called **DFSS** - Design For Six Sigma. DFSS is a data-driven quality strategy for designing or redesigning a product or service from the ground up.

Sometimes a DMAIC project may turn into a DFSS project because the process in question requires complete redesign to bring about the desired degree of improvement.

DMAIC Methodology

This methodology consists of the following five steps.

Define --> Measure --> Analyze --> Improve --> Control

- **Define:** Define the problem or project goal that needs to be addressed.
- **Measure:** Measure the problem and process from which it was produced.
- **Analyze:** Analyze data and process to determine root cause of defects and opportunities.
- **Improve:** Improve the process by finding solutions to fix, diminish, and prevent future problems.
- **Control:** Implement, control, and sustain the improvement solutions to keep the process on the new course.

We will discuss more on DMAIC Methodology in the subsequent chapters.

DMADV Methodology

This methodology consists of five steps:

Define --> Measure --> Analyze --> Design --> Verify

- **Define:** Define the Problem or Project Goal that needs to be addressed.
- **Measure:** Measure and determine customers' needs and specifications.

- **Analyze:** Analyze the process to meet the customer needs.
- **Design:** Design a process that will meet customers' needs.
- **Verify:** Verify the design performance and ability to meet customer needs.

DFSS Methodology

DFSS is a separate and emerging discipline related to Six Sigma quality processes. This is a systematic methodology utilizing tools, training, and measurements to enable us to design products and processes that meet customer expectations and can be produced at Six Sigma Quality levels.

This methodology can have the following five steps.

Define --> Identify --> Design --> Optimize --> Verify

- **Define:** Define what the customers want, or what they do not want.
- **Identify:** Identify the customer and the project.
- **Design:** Design a process that meets customers' needs.
- **Optimize:** Determine process capability and optimize the design.
- **Verify:** Test, verify, and validate the design.

6. DEFINE PHASE

There are five high-level steps in the application of Six Sigma to improve the quality of output. The first step is **Define**. During the Define phase, four major tasks are undertaken.

Project Team Formation

Perform two activities:

- Determine who needs to be on the team.
- What roles will each person perform?

Picking the right team members can be a difficult decision, especially if a project involves a large number of departments. In such projects, it could be wise to break them down into smaller pieces and work towards completion of a series of phased projects.

Document Customers Core Business Processes

Every project has customers. A customer is the recipient of the product or service of the process, targeted for improvement. Every customer has one or multiple needs from his or her supplier. For each need provided for, there are requirements for the need. The requirements are the characteristics of the need that determine whether the customer is happy with the product or service provided. So, document customer needs and related requirements.

A set of business processes is documented. These processes will be executed to meet customer's requirements and to resolve their Critical to Quality issues.

Develop a Project Charter

This is a document that names the project, summarizes the project by explaining the business case in a brief statement, and lists the project scope and goals. A project charter has the following components:

- Project name
- Business case
- Project scope
- Project goals
- Milestones
- Special requirements

- Special assumptions
- Roles and responsibilities of the project team

Develop the SIPOC Process Map

A process is defined as a series of steps and activities that take inputs, add value, and produce an output.

SIPOC is a process map that identifies all the following elements of a project:

- **S**uppliers
- **I**nput
- **P**rocess
- **O**utput
- **C**ustomers

The SIPOC process map is essential for identifying:

- The way processes occur currently.
- How those processes should be modified and improved throughout the remaining phases of DMAIC.

Conclusion

At the conclusion of the design phase, you should know who the customer or end-user is, their resistance issues, and requirements. You should also have a clear understanding of goals and the scope of the project including budget, time constraints, and deadlines.

7. MEASURE PHASE

During the Measure Phase, the overall performance of the Core Business Process is measured. There are three important parts of Measure Phase.

Data Collection Plan and Data Collection

A data collection plan is prepared to collect the required data. This plan includes what type of data needs to be collected, what are the sources of data, etc. The reason to collect data is to identify areas where current processes need to be improved.

You collect data from three primary sources: input, process, and output.

- The input source is where the process is generated.
- Process data refers to tests of efficiency: the time requirements, cost, value, defects or errors, and labor spent on the process.
- Output is a measurement of efficiency.

Data Evaluation

At this stage, the collected data is evaluated and sigma is calculated. It gives an approximate number of defects.

- A Six Sigma defect is defined as anything outside of customer specifications.
- A Six Sigma opportunity is the total quantity of chances for a defect.

First we calculate Defects Per Million Opportunities (DPMO), and based on that a Sigma is decided from a predefined table:

$$\text{DPMO} = \frac{\text{Number of defects}}{\text{Number of Units} \times \text{Number of opportunities}} \times 1,000,000$$

As stated above, Number of defects is the total number of defects found, Number of Units is the number of units produced, and number of opportunities means the number of ways to generate defects.

For example, the food ordering delivery project team examines 50 deliveries and finds out the following:

- Delivery is not on time (13)
- Ordered food is not according to the order (3)
- Food is not fresh (0)

So now, DPMO will be as follows:

$$\text{DPMO} = \frac{13 + 3}{50 \times 3} \times 1,000,000 = 106,666.7$$

According to the Yield to Sigma Conversion Table given below, 106,666.7 defects per million opportunities is equivalent to a sigma performance of between 2.7 and 2.8.

This is the method used for measuring results as we proceed through a project. This beginning point enables us to locate the cause and effect of those processes and to seek defect point so that the procedure can be improved.

Failure Mode and Effects Analysis - FMEA

The final segment of the measure phase is called FMEA. It refers to preventing defects before they occur. The FMEA process usually includes rating possible defects, or failures, in three ways:

- The likelihood that something might go wrong.
- The ability to detect a defect.
- The level of severity of the defect.

You may use a rating scale. For example, rate each of these three areas from 1 to 10, with 1 being the lowest FMEA level and 10 being the highest. The higher the level, the more severe the rating. Hence, a high FMEA indicates the need to devise and implement improved measuring steps within the overall process. This would have the effect of preventing defects. Clearly, there is no need to spend a lot of time on this procedure if the likelihood of a defect is low.

Yield to Sigma Conversion Table

Yield %	Sigma	Defects Per Million Opportunities
99.9997	6.00	3.4
99.9995	5.92	5
99.9992	5.81	8
99.9990	5.76	10
99.9980	5.61	20

99.9970	5.51	30
99.9960	5.44	40
99.9930	5.31	70
99.9900	5.22	100
99.9850	5.12	150
99.9770	5.00	230
99.9670	4.91	330
99.9520	4.80	480
99.9320	4.70	680
99.9040	4.60	960
99.8650	4.50	1350
99.8140	4.40	1860
99.7450	4.30	2550
99.6540	4.20	3460
99.5340	4.10	4660
99.3790	4.00	6210
99.1810	3.90	8190
98.9300	3.80	10700
98.6100	3.70	13900

98.2200	3.60	17800
97.7300	3.50	22700
97.1300	3.40	28700
96.4100	3.30	35900
95.5400	3.20	44600
94.5200	3.10	54800
93.3200	3.00	66800
91.9200	2.90	80800
90.3200	2.80	96800
88.5000	2.70	115000
86.5000	2.60	135000
84.2000	2.50	158000
81.6000	2.40	184000
78.8000	2.30	212000
75.8000	2.20	242000
72.6000	2.10	274000
69.2000	2.00	308000
65.6000	1.90	344000
61.8000	1.80	382000

58.0000	1.70	420000
54.0000	1.60	460000
50.0000	1.50	500000
46.0000	1.40	540000
43.0000	1.32	570000
39.0000	1.22	610000
35.0000	1.11	650000
31.0000	1.00	690000
28.0000	0.92	720000
25.0000	0.83	750000
22.0000	0.73	780000
19.0000	0.62	810000
16.0000	0.51	840000
14.0000	0.42	860000
12.0000	0.33	880000
10.0000	0.22	900000
8.0000	0.09	920000

8. ANALYZE PHASE

Six Sigma aims to define the causes of defects, measure those defects, and analyze them so that they can be reduced. We consider five specific types of analyses that help to promote the goals of the project. These are source, process, data, resource, and communication analysis. Now we will see them in detail.

Source Analysis

This is also called **root cause analysis**. It attempts to find defects that are derived from the sources of information or work generation. After finding the root cause of the problem, attempts are made to resolve the problem before we expect to eliminate defects from the product.

Three Steps to Root Cause Analysis

- **The open step:** During this phase, the project team brainstorms all the possible explanations for current sigma performance.
- **The narrow step:** During this phase, the project team narrows the list of possible explanations for current sigma performance.
- **The close step:** During this phase, the project team validates the narrowed list of explanations that explain sigma performance.

Process Analysis

Analyze the numbers to find out how well or poorly the processes are working, compared to what's possible and what the competition is doing.

Process analysis includes creating a more detailed process map, and analyzing the more detailed map, where the greatest inefficiencies exist.

The source analysis is often difficult to distinguish from process analysis. The process refers to the precise movement of materials, information, or requests from one place to another.

Data Analysis

Use of measures and data (those already collected or new data gathered in the analyze phase) to discern patterns, tendencies or other factors about the problem that either suggest or prove/disprove possible cause of the problem.

The data itself may have defect. There may be a case when products or deliverables do not provide all the needed information. Hence data is analyzed to find out defects and attempts are made to resolve the problem before we expect to eliminate defects from the product.

Resource Analysis

We also need to ensure that employees are properly trained in all departments that affect the process. If training is inadequate, you want to identify that as a cause of defects.

Other resources include raw materials needed to manufacture, process, and deliver the goods. For example, if the Accounting Department is not paying vendor bills on time and, consequently, the vendor holds up a shipment of shipping supplies, it becomes a resource problem.

Communication Analysis

One problem common to most processes high in defects is poor communication. The classic interaction between a customer and a retail store is worth studying because many of the common communication problems are apparent in this case.

The same types of problems occur with internal customers as well, even though we may not recognize the sequence of events as a customer service problem.

The exercise of looking at issues from both points of view is instructive. A vendor wants payment according to agreed-upon terms, but the Accounting Department wants to make its batch processing uniform and efficient. Between these types of groups, such disconnects demonstrate the importance of communication analysis.

Conclusion

Analysis can take several forms. Some Six Sigma programs tend to use a lot of diagrams and worksheets, and others prefer discussion and list making. There are many tools that can be used to perform analysis like Box Plot, Cause and Effect Diagram, Progressive Analysis, Ranking, Pareto Analysis, Prioritization Matrix, Value Analysis, etc. The proper procedure is the one that works best for your team, provided that the end result is successful.

9. IMPROVE PHASE

If the project team does a thorough job in the root causation phase of analysis, the Improve Phase of DMAIC can be quick, easy, and satisfying work.

The objective of Improve Phase is to identify improvement breakthroughs, identify high gain alternatives, select preferred approach, design the future state, determine the new Sigma level, perform cost/benefit analysis, design dashboards/scorecards, and create a preliminary implementation plan.

- Identify Improvement Breakthroughs:
 - Apply idea-generating tools and techniques to identify potential solutions that eliminate root causes.
- Identify/Select High Gain Alternatives:
 - Develop criteria to evaluate candidate improvement solutions.
 - Think systematically and holistically.
 - Prioritize and evaluate the candidate solutions against the solution evaluation criteria.
 - Conduct a feasibility assessment for the highest value solutions.
 - Develop preliminary solution timelines and cost-benefit analysis to aid in recommendation presentation and future implementation planning.

Improvement can involve a simple fix once we discover the causes of defects. However, in some cases, we may need to employ additional tools as well. These include:

- Solution alternatives
- Experiments with solution alternatives
- Planning for future change

10. CONTROL PHASE

The last phase of DMAIC is control, which is the phase where we ensure that the processes continues to work well, produce desired output results, and maintain quality levels. You will be concerned with four specific aspects of control, which are as follows.

Quality Control

The ultimate purpose in control is the overall assurance that a high standard of quality is met. Customer's expectations depend on this, so control is inherently associated with quality.

Since the purpose of Six Sigma is to improve the overall process by reducing defects, quality control is the essential method for keeping the whole process on track; for enabling us to spot trouble and fix it; and for judging how effectively the project was executed and implemented.

Quality is at the heart of Six Sigma philosophy. Reducing defects has everything to do with striving for perfection. Whether we reach perfection or not, the effort defines our attitude toward quality itself.

Standardization

Standardization enables processes to go as smoothly as possible. In a manufacturing environment, the value of standardization has been proven over and over.

We need to devise a control feature to processes so that the majority of work is managed in a standardized manner.

Control Methods and Alternatives

The development of a new process or any change to an existing process requires the development of procedures to control work flow.

When a process cannot be managed in the normal manner, we need to come up with alternatives, short of forcing compliance to the standardized method.

Responding when Defects Occur

The final step in a control process is knowing how to respond once a defect is discovered. The weak links in the procedure, where defects are most likely to occur, can and should be monitored carefully so that defects can be spotted and fixed before the process continues.

The response to a defect may be to prevent a discovered flaw from becoming a defect at all. In the best designed systems, defects can be reduced to near zero, so that we may actually believe that Six Sigma can be attained.

Conclusion

The project team determines how to technically control the newly improved process and creates a response plan to ensure the new process, and also maintains the improved sigma performance.

11. TECHNICAL TOOLS

This chapter gives an overview of the 10 most important technical tools, which a Six Sigma team member needs to master as they progress through the DMAIC methodology.

While these tools are considered technical in nature, most of them are relatively easy to learn and apply. They are covered in the order they are used in the DMAIC methodology.

Tool #1 – The Critical to Quality (CTQ) Tree

The critical-to-quality tree is used during the design phase of DMAIC. It is used to brainstorm and validate the needs and requirements of the customer of the process, targeted for improvement.

The steps in creating a CTQ tree are as follows:

- Identify the customer of the process targeted for improvement.
- Identify the need of the customer.
- Identify the first level of requirements of the need, that is, some characteristic of the need that determines whether the customer is happy with the need.
- Drill down to more detailed level(s) of the requirement if necessary.

Tool #2 – The Process Map

During the Define phase, the project team creates the first of several process maps. A process map is a picture of the current steps in the process targeted for improvement.

A process map has five major categories of work from the identification of the suppliers of the process, the inputs the suppliers provide, the name of the process, the output of the process, and the customers of the process. Each of these steps is summarized as SIPOC to indicate the steps to the team that must be conducted to complete a process map.

Tool #3 – The Histogram

This tool is used during the Analysis stage of DMAIC. The project team reviews data collected during the Measure stage of DMAIC.

It is often suggested that the data be organized into graphs or charts, which makes it easier to understand, what the data is saying about the process.

Data is of two types - Discrete data (go/no go, fail or pass) and Continuous data (time, height etc.).

Tool #4 – The Pareto Chart

Histogram is useful for continuous data, same way when the data is discrete, most teams create a Pareto chart. Discrete data is counted data - go/no-go, off/on, yes/no, and defect/no defect type data.

An Italian economist Vilfredo Pareto, in the sixteenth century proved mathematically that 80 percent of the world's wealth was controlled by 20 percent of the population. This 80-20 rule eventually proved applicable in arenas other than economics.

When dealing with discrete data, the project team should create reason codes for why a defect occurs, and count and categorize the data into these reason codes and a Pareto chart should be prepared.

Tool #5 – The Process Summary Worksheet

The goal of a Six Sigma project team is to improve effectiveness and efficiency. Efficiency is measured in terms of cost, time, labor, or value.

The process summary worksheet is a "roll-up" of the sub process map indicating which steps add value in the process and which steps don't add value.

Tool #6 – The Cause-Effect Diagram

The most important tool to assist the project team in determining root causation is the cause-effect diagram. This tool captures all the ideas of the project team relative to what they feel are the root causes behind the current sigma performance and finally help in finding a root cause of the problem.

Tool #7 – The Scatter Diagram

Once ideas have been prioritized after use of the cause-effect diagram, the most important thing the project team does is to validate the remaining ideas with fact and data.

The scatter diagram takes an idea about root causation and tracks corresponding data, in the response the team is trying to improve. The team can validate an idea about root causation through one of the three methods. Using basic data collection, a designed experiment, or through the scatter diagram.

Tool #8 – The Affinity Diagram

An affinity diagram is used to help sort and categorize a large number of ideas into major themes or categories. It is especially useful when the team is ready to brainstorm solutions in the Improve stage of DMAIC. The steps in creating an affinity diagram are:

- Have each team member write one idea per Post-it note and post on a wall randomly.
- As ideas are read off for clarification, sort ideas into similar groups.
- Create a 'header' card for each general category of ideas below it.

Tool #9 – The Run Chart

We have discussed the histogram and Pareto chart. Think of both of these tools as similar to a camera where a snapshot of the process has been taken. But the run chart is similar to a camcorder, recording some process element over time.

Tool #10 – The Control Chart

Similar to a run chart, a control chart uses the data from a run chart to determine the upper and lower control limits. Control limits are the expected limits of variation above and below the average of the data. These limits are mathematically calculated and indicated by dotted lines.

Conclusion

We saw 10 major technical tools that project team members use during the time they are on a Six Sigma team. These are not the only tools a Six Sigma team may use. However, the tools covered here are those that are most common for every team member to be aware of and knowledgeable about.

12. DEFECT METRICS

Before we go ahead, let us define two terms:

- A Six Sigma defect is defined as anything outside of customer specifications.
- A Six Sigma opportunity is the total quantity of chances for a defect.

This chapter provides a list formulae normally used to measure different metrics related to Six Sigma defects.

Defects Per Unit – DPU

$$\text{DPU} = \frac{\text{Total Number of Defects}}{\text{Total number of Product Units}}$$

The probability of getting 'r' defects in a sample having a given DPU rate can be predicted with the Poisson Distribution.

Total Opportunities – TO

$$\text{TO} = \text{Total number of Product Units} \times \text{Opportunities}$$

Defects Per Opportunity – DPO

$$\text{DPO} = \frac{\text{Total Number of Defects}}{\text{Total Opportunity}}$$

Defects Per Million Opportunities – DPMO

$$\text{DPMO} = \text{DPO} \times 1,000,000$$

Defects Per Million Opportunities or DPMO can be then converted to sigma values using Yield to Sigma Conversion Table given in Six Sigma - Measure Phase.

According to the conversion table:

$$6 \text{ Sigma} = 3.4 \text{ DPMO}$$

How to Find Your Sigma Level

- Clearly define the customer's explicit requirements.
- Count the number of defects that occur.
- Determine the yield-percentage of items without defects.
- Use the conversion chart to determine DPMO and Sigma Level.

Simplified Sigma Conversion Table

If your yield is:	Your DPMO is:	Your Sigma is:
30.9%	690,000	1.0
62.9%	308,000	2.0
93.3	66,800	3.0
99.4	6,210	4.0
99.98	320	5.0
99.9997	3.4	6.0

13. SUMMARY

We can summarize the following points:

- Six Sigma is a philosophy of quality improvement.
- Six Sigma is 3.4 defects in one million opportunities (DPMO).
- Components of Six Sigma are Customer, Process, and Employees.
- Six Sigma implementation requires the following roles:
 - Business Leader
 - Sponsor
 - Black Belt
 - Master Black Belt
 - Green Belt
- The generic cycle of Six Sigma includes the following phases: Define, Measure, Analyze, Improve, and Control.
- Six Sigma is dedicated to 'Customer Focus'.

14. GLOSSARY

This introductory tutorial provides just a glimpse of Six Sigma and it is by no means a comprehensive one. We recommend our readers to explore other resources available on the Net to collect more information on Six Sigma. For readers' benefit, we have listed down a few resources in our Resources section.

Given below is a glossary of terms commonly used in the domain of Six Sigma:

"As Is" Process Map

It depicts a process as it is, currently. "As is" process maps are usually characterized by several input options, bottlenecks and multiple handoffs, inspections and rework loops.

"Should be" Process Map

A depiction of a new and improved version of a process, used in DMAIC and iDMAIC projects, where all non-value added steps are removed.

Affinity Chart

An affinity diagram is a tool for organizing large quantities of information from many people. It is often used with brainstorming and other creative thinking activities. The ideas are usually written on sticky notes, then categorized into groupings of similar ideas.

Analyze Phase (DMAIC)

Analyze phase identifies the root causes of the problem and confirms them with data.

Area SIXSIGMA Council

Leadership group (Area VP, AMD, AD, MBBs, and often GMs) guiding the implementation of quality and SIXSIGMA within the organization; establishes, reviews, and supports the progress of SIXSIGMA DMAIC and iDMAIC projects.

Assumption Busting

A questioning process that helps identify and eliminate preconceptions or blind spots that hold people back from proposing or pursuing the best solution.

Attribute Data

It is any data that is not quantified on an infinitely divisible scale. Includes a count, proportion, or percentage of a characteristic (e.g. region, location, room type ...) or category (e.g. gender: male/female ...). This is in contrast to "continuous" data that is not limited to categories (e.g. cost in dollars).

Balanced Scorecard

It categorizes ongoing measures into a few significant areas such as finance, process, people, and innovation. It is used as a presentation tool to update sponsors, senior management, and others on the progress of a business or process; also useful for process owners.

Baseline Measures

Data that reflects the performance level that exists at the beginning of an improvement project, before any solutions are initiated. It is the "Before" snapshot to be compared later with the "After" view.

Best Practice

A completed project (usually, but not always a Six Sigma project) that is particularly valuable for use in other properties based on meeting the following three conditions: success, transferability, and Speed of benefit realization

Black Belt

An associate fully assigned to Six Sigma and trained in the DMAIC methodology, analytical tools, and team leadership skills. Black Belts are responsible for guiding DMAIC projects to completion. They lead DMAIC projects, assist with Quick Hits, and provide coaching and expert support for iDMAIC transfer projects. Their role in Best Practice and Innovation transfer projects is to assist and coach the Import team on the DMAIC tools and methodology.

Both/And

It is a narrowing/selection process that seeks to identify solution ideas, which are similar (AND) as well as workable together, even when not similar ideas (BOTH). This technique helps the team seek connections and combinations of ideas to develop better and more workable solutions.

Box Plot

It is a graphic display of groupings of data that compares the groupings to the others on one chart. An example of the tool would be looking at the variation in check-in time by different front desk associates.

Critical to Quality (CTQ)

Refers to what customers consider important in any given process. Collecting Voice of the customer data leads to the discovery of CTQs, which are translated into distinct requirements that can be measured.

Cause and Effect Diagram (Fishbone/Ishikawa)

Brainstorming tool used for proposing root-causes (the "bones of the fish") for a specific effect (the head of the fish). This can be used in combination with the Affinity

Diagram to determine the major categories. Also commonly used in combination with the "5 Whys" technique, in order to help people understand the root cause.

Charter

It is a team document defining the context, specifics, and plans of an improvement project. It includes business case, problem and goal statements, constraints and assumptions, roles, preliminary plan, and scope.

Checksheet

Forms, tables, or worksheets that are set up ahead of time for people to use in data collection; it allows for collection of stratified data in a consistent way.

Common Cause Variation

It is normal, everyday influence on a process. This form of variation is usually harder to eliminate and requires changes to the process. Problems from common causes are referred to as "chronic pain".

Complexity Matrix

A tool used to assist teams in determining the level of complexity of a project.

Continuous Data

Any quantity measured on a continuous scale that can be infinitely divided; primary types include time, dollars, size, weight, temperature, and speed.

Control Phase (DMAIC)

Control phase in DMAIC evaluates the solutions and the plan, standardizes the solutions, and outlines the steps for ongoing improvements including opportunities for using the solutions elsewhere.

Control Chart

It is a specialized graph that shows process performance over time, shows average upper and lower control limits and helps determine the influences of common (usual) causes or special (unusual) causes.

Correlation

It is a measure of the degree to which two variables are related. It is calculated to quantify the strength of the relationship between the two variables.

Cost of Poor Quality (COPQ)

It is a financial measure depicting the impact of problems due to internal and external failures in the process which includes labor and material costs for handoffs, rework, waste or scrap, inspection, and other non-value-adding activities.

Process capability (Cpk or Cp)

Process capability is the degree to which a process can meet customer requirements.

Criteria Matrix

It is a decision-making tool used when potential choices must be weighed against key factors such as cost, ease to implement, impact on customer, etc. It encourages use of facts, data, and clear business objectives in the decision-making.

Customer

It is an internal or external person/organization who receives the output product or service of the process.

Customer Requirements

They define the needs and expectations of the customer; translated into measurable terms and used in the process to ensure compliance with the customers' needs.

Cycle Time

The time it takes to complete a process from start to finish. It includes actual work time and waiting time.

Define, Measure, Analyze, Design, and Verify (DMADV)

It describes the application of SIXSIGMA tools for designing new products and processes.

DMAIC

Acronym for a Process Improvement/Management System that stands for Define, Measure, Analyze, Improve, and Control; lends structure to Process Improvement, Design or Redesign applications.

DMAIC 1 Training

It is DMAIC training for Master Black Belts, Black Belts and Green Belts. This course begins the SIXSIGMA problem-solving methodology (DMAIC), focusing on first steps of Define, Measure and a portion of Analyze.

DMAIC 2 Training

It is DMAIC training for Master Black Belts, Black Belts and Green Belts. This course is the conclusion of DMAIC method, finishing Analyze, Improve, and Control.

DMAIC 3 Training

It is DMAIC training for Master Black Belts. This course deepens the participant's mastery of problem solving and statistical tools.

DMAIC Project

Projects that follow the DMAIC methodology led by a Black Belt; is generally goes for a duration of 3-4 months and can cross functional boundaries. A DMAIC project focuses on improving an existing process using the 5 steps Define, Measure, Analyze, Improve, and Control.

Defects Per Million Opportunities (DPMO)

Calculation used in SIXSIGMA initiatives to show how much "better" or "worse" a process is by indicating the amount of defects in a process per one million opportunities.

Dashboard (or Process Scorecards)

It is a graphical tool that provides a summary update on key indicators of process performance. It can include "alarms" to show if and when a key indicator is nearing a problem level.

Data Collection Plan

It is a structured approach to identifying the required data to be collected and the approach to collecting it. It includes: the measure, the measure type, data type, operational definition, and the sampling plan if new data is necessary.

Decision Tree

Used during the SIXSIGMA Council process to determine project selection weighting. It focuses properties on the area (either Revenue, cost Reduction or ASI, GSI) that needs the greatest attention to achieve overall property goals.

Defect

It is any instance or occurrence where the product or service fails to meet customer requirements.

Defect Opportunity

It is a potential defect on a unit of importance to the customer.

Defective

It is any unit with one or more defects.

Define Phase (DMAIC)

It is the first phase of DMAIC, where the project's purpose and scope are defined. Background information on the process and customer is collected. The output of this phase includes a clear statement of the improvement (i.e. business case and Project Definition Form), a high-level map of the process (SIPOC), and a list of what is important to the customer.

Deployment Process Map

A map or graphical view of the steps in a process shows the sequence as it moves across departments, functions, or individuals.

Descriptive Statistics

It is a statistical profile of the collected data which includes measures of averages, variation, and other numbers which help team members assess "how bad" a problem is and to pinpoint where to focus further analysis and solutions.

Design for SIXSIGMA (DFSS)

Describes the application of SIXSIGMA tools to product development and Process Design efforts with the goal of "designing in" SIXSIGMA performance capability.

Discounted Cash Flows (DCF)

A method of financial analysis that allows comparisons of dissimilar projects on the basis of their overall value in today's dollars. DCF converts future cash flows into equivalent current dollar equivalents.

Discrete Data (Attribute Data)

It is any data not quantified on an infinitely divisible scale. Includes a count, proportion, or percentage of a characteristic or category

Division SIXSIGMA Council

Leadership group (Presidents and direct reports, Division SIXSIGMA leader, AMDs, and often MBBs and GMs) guiding the implementation of quality and SIXSIGMA within the division; establishes, reviews, and supports the progress of SIXSIGMA DMAIC and iDMAIC projects. The Division Council is responsible for driving the SIXSIGMA initiative within that division and is accountable for project, process and business results.

Documentation

Documentation is a historical account of the activities and decisions made throughout a DMAIC project, Quick Hit, and iDMAIC project, which is used to facilitate sharing of best practices across an organization and as part of the project close-out process.

E-SIXSIGMA Project Tool (eTool)

Online database capturing project (DMAIC, Quick Hit, and iDMAIC) information including the proposed project goals, problem statement, projected cost and benefits, as well as tollgate documentation information from each phase of DMAIC and iDMAIC projects.

Effectiveness

It is a measure related to how well the process output meets the needs of the customer. It links primarily to customer satisfaction.

Efficiency

It is a measure related to the quantity of resources used in producing the output of a process.

External Failure

It is when defective units pass all the way through a process and are received by the customer.

Failure Modes and Effects Analysis (FMEA)

A useful technique for preventing future problems and reducing risks to a solution.

Used to identify and assess errors & defects which could result in a threat to quality, safety or reliability; it is useful in implementing improvements, redesign or design of processes. It is also a tool for process owners to build prevention and contingency steps into the project plan.

Fishbone Diagram

See Cause and Effect Diagram.

Five Whys

Five Whys are often used to generate a cause and effect. It is the technique of asking "Why" five times in order to dig into each potential cause. "Why" is asked until the root cause is revealed.

Force Field Analysis

It involves a list of the factors that support and factors that "hurt" an idea; "restraining" factors are listed on one side of the page and "driving forces" listed on the other. Frequency Plot or Histogram

It is a graphical representation of the shape or distribution of the data by showing how often different values occur. It helps to answer the question: "Is the process capable of meeting my customer requirements".

Functional Map

See Deployment Process Map.

Future Focused Cause and Effect

A traditional cause and effect diagram used for brainstorming future actions employed during the Improve phase of a DMAIC project.

Gantt Chart

It is a project planning and management tool that displays all the tasks or activities associated with a project or initiative as well as the relationships/dependencies between these tasks.

Global SIXSIGMA Council

Leadership group (Starwood's Senior Operating Committee and Division Presidents) guiding the implementation of quality and SIXSIGMA within the organization, which establishes, reviews, and supports the progress of SIXSIGMA DMAIC and iDMAIC projects. The Global SIXSIGMA Council is responsible for designing and driving SIXSIGMA throughout Starwood.

Goal Statement

Description of the intended target or desired results of Process Improvement or Design/Redesign activities; usually outlined during the proposal phase of the PDF, revised in the Define phase of a DMAIC project and supported with actual numbers and details once data is obtained.

Green Belt

Associates trained to the same level as Black Belts, but not on full-time assignment to SIXSIGMA. They may do DMAIC projects, lead smaller SIXSIGMA projects on a part-time basis, serve on larger projects as team members, and/or undertake implementation of Quick Hits or Innovation Transfer projects.

Handoff

Any time in a process when one person (or job title) or group passes the item moving through the process to another person; a handoff has the potential to add defects, time, and cost to a process.

Hawthorne Effect

It is an increase in worker productivity that results from the psychological stimulus of being temporarily singled out and made to feel important.

Histogram or Frequency Plot

See Frequency Plot.

Hypothesis Statement

It is the complete description of the suspected causes of a process problem.

iDMAIC

iDMAIC stands for "Innovation DMAIC". iDMAIC is a methodology designed to ensure consistent and rapid transfer of innovation throughout Starwood. Innovations can be DMAIC projects, Quick Hits, or other Starwood Innovations.

Internal Rate of Return (IRR)

It is a way to compare potential projects by calculating the financial value of a project against the investment required

Impact/Effort Matrix

A graphical representation of different projects plotted along two axes (Y = Impact, X = Effort). It is a project selection tool that allows comparison of dissimilar projects during the project selection portion of the SSC process.

Implementation Plan

A project management tool used in the "Improve" stages of DMAIC and iDMAIC, compiling tools such as Stakeholder Analysis, FMEA, Poka-yoke, SOPs and pilot results (if conducted) in a consolidated format.

Improve Phase (DMAIC)

The goal of Improve phase is to pilot and implement solutions that address root causes. This step helps to eliminate any errors/false starts when the team finally implements the solution.

Innovation Transfer

The successful transfer of a new idea, method or solution from one property to another may be a Quick Hit, Best Practice, or any other innovation.

Input

It is any product, service, or piece of information that comes into the process from a supplier.

Input Measures

Measures related to and describing the input into a process; can be predictors of process and output measures.

Ishikawa Diagram

See Cause and Effect.

Kano Analysis

It is a graph of how customer satisfaction is effected by a particular problem, change, or other variable. The graph is divided into three regions of customer reactions to the variable: "Dissatisfiers", "Satisfiers", and "Delighters".

Leading SIXSIGMA Training (LSS)

It is an introductory course for top-management to SIXSIGMA at Starwood, the SIXSIGMA problem-solving methodology (DMAIC), and the project selection process.

Leading Teams Training (LT)

It is a Team Leadership workshop designed to give participants the necessary skills to be able to lead teams in a challenging environment. The participants, Master Black Belts, Black Belts, and Green Belts are also introduced to the SIXSIGMA problem-solving methodology (DMAIC) and the project selection process.

Learning Cycle

An individual and team based learning exercise that helps individuals identify their own and others' views on the team decision making process and the team's overall performance.

Learning Map

It is an experiential, accelerated, and high-involvement learning activity to introduce SIXSIGMA concepts and the initiative at each Starwood property. It consists of a table-sized visual "SIXSIGMA: Innovation and Improvement" map and a set of cards that direct the participants through a discovery learning activity.

Master Black Belt (MBB)

It is a SIXSIGMA business champion and coach for Black Belts. The MBB is trained in the DMAIC process, analytical tools, and facilitation skills. The MBB is responsible for project selection for the Property and Area, ensuring that the DMAIC process is being implemented, and that all projects are on-track towards completion.

Measure (General Definition)

It is a numerical evaluation of based on observable data. A few examples of measures could be number of new reservations per day, the number of check-ins per week, the number of employees scheduled per shift.

Measure Phase (DMAIC phase)

The Measure phase focuses the improvement effort by gathering information on the current situation.

Moment of Truth

It is any event or point in a process when the internal/external customer comes in contact with a process. At each of these points the customer has an opportunity to form an opinion (positive, neutral, or negative) about the process or organization.

Multiple Regression

It is quantitative method relating multiple factors to the output of a process. The statistical study of the relationship of a combination of multiple variables ($X_1, X_2, X_3, \dots, X_n$) to a single output Y .

Multivoting

It is a narrowing or prioritization tool. Faced with a list of ideas, problems, causes, etc., each member of a group is given a set number of "votes". Those items or issues receiving the most votes get further attention/consideration.

Net Present Value (NPV)

It is the equivalent value in today's dollars of a stream of future cash flows. NPV calculation seeks to quantify the concept that money received in the future is worth less than money received today.

Non-value-adding Activities

Any step in a process that do not add value to the customer or process. For example, rework, handoffs, inspection, delays, etc.

Operational Definition

A clear, precise definition of the factor being measured or the term being used; ensures a clear understanding of terminology and the ability to collect data or operate a process consistently.

Optional Best Practices

A completed project usually, but not always a Six Sigma DMAIC or Quick Hit project, that is particularly valuable for use in other properties.

Original Team (Original DMAIC/Quick Hit Project Team)

It is the team that originated and completed the original process improvement project (DMAIC or Quick Hit) in their property. The role of the Original Team is to ensure proper project documentation to ease transfer and to provide advice, clarification and assistance to teams importing their project.

Output

It is any product, service, or piece of information coming out of, or resulting from, the activities in a process.

Output Measures

These are the measures related to and describing the output of the process; total figures/overall measures.

Pareto Principle and Chart

A Pareto Chart is a data display tool based on Pareto Principle; or 80/20 rule. It is used to help a team focus on the specific causes or issues that have the greatest impact if solved.

Pilot

It is the trial implementation of a solution on a limited scale to ensure its effectiveness and test its impact.

Plan-Do-Check-Act (or PDCA)

It is basic model or set of steps in continuous improvement; also referred to "Shewhart Cycle" or "Deming Cycle".

Poka-Yoke

Poka-Yoke is a Japanese term for "mistake proofing". Mistake proofing typically looks at every step in the process in detail, and uses creative thinking to develop ways to keep errors from occurring.

Precision

It is the accuracy of a measurement. When used in reference to sampling, this entails how much of change you need to be able to detect. As the need for precision increases, so does the sample size.

Preliminary Plan

It is used in the early phase of a project, while developing milestones for team activities related to process improvement; includes key tasks, target completion dates, responsibilities, potential problems, obstacles and contingencies, and communication strategies.

Process

It is a series of steps or actions that lead to a desired result or output. A set of common tasks that creates a product, service, process or plan that will satisfy a customer or group of customers.

Process Owner

Process owners are the responsible individuals for a specific process.

Process Capability

Statistical measures that summarize how much variation there is in a process relative to customer specifications.

Process Improvement

Improvement approach focused on incremental changes, involves solutions to eliminate or reduce defects, costs, or cycle time; leaves basic design and assumptions of a process intact.

Process in Control

A statistical concept indicating that a process is operating within an expected range of variation and that variation is being influenced mainly by "common cause" factors; processes operating in this state are referred to as "in control".

Process Management

It involves defining and documenting a process, monitoring it on an ongoing basis to ensure that measures are providing feedback on the flow/function of a process; key measures include financial, process, people, and innovation.

Process Map or Flowchart

Graphic display of the flow or sequence of events that a product or service follows; it shows all activities, decision points, rework loops, and handoffs.

Process Measures

It is a measure related to individual steps in the process and/or the overall process; can be predictors of output measures.

Process Redesign

It is a method of restructuring a process by eliminating handoffs, rework, inspection points, and other non-value-adding activities; typically means a "clean slate" design and accommodates major changes or improvements.

Project Definition Form (PDF)

It is the summary of pertinent information that describes a SIXSIGMA project. This includes problem statement, goal statement, scope, business case, financial benefits and costs, project timing, resource requirements, measures, etc

Project Management

It is the use of tools, techniques, and/or software to track a project and prevent barriers to on-time success.

Project Nomination (iDMAIC)

A Black Belt, MBB, Sponsor, or General Manager associated with a project nominates the project for Innovation Transfer, using the e-Six Sigma project tool. The nominator evaluates the project.

Project Selection (iDMAIC)

During quarterly review meetings, each Division Council reviews all projects that have been nominated as best practices.

Project Sponsor

This is a member of the executive committee, strong advocate of the project and can assist with barriers that may come up.

Project Rationale

It is a broad statement defining area of concern or opportunity, including impact/benefit of potential improvements, or risk of not improving a process; links to business strategies, the customer, and/or company values.

Property SIXSIGMA Council

It is the governing group responsible for project selection and status monitoring at each Starwood property. The members of the SSC are the General Manager, the Executive Committee and the Black Belt.

Proportion Defective

Percentage (or fraction such as 1/8) of defective units; number of defective units divided by the total number of units.

Propose

It is the very first phase in the lifecycle of a SIXSIGMA project (DMAIC or Quick Hit). in which the potential project idea or opportunity is proposed to the property SIXSIGMA Council.

Quick Hit Project

It is a small project that can be quickly implemented and that does not require a Black Belt to resolve and implement.

RACI Matrix

A project management tools that identifies all required tasks or activities, the parties are involved in those tasks as well as their level or type of involvement.

A RACI is used to ensure clarity on roles and responsibilities in a team environment.

Return on Investment (ROI)

It is a measure of the financial returns from an investment opportunity, expressed as a percentage. All else being equal, projects with a larger ROI are more attractive investment opportunities.

Random Sampling

It is a method that allows each item or person chosen to be measured, to be selected completely by chance.

Regression

It is the statistical study of relationships. An analytical tool that allows an assessment of a key outcome and extent to which one or more factors being studied can explain the variation in results see also Simple Linear Regression; Multiple Regression.

Repeatability/Reproducibility

Repeatability means that the same person taking a measurement on the same unit gets the same result. Reproducibility means that the other people, other instruments or other labs get the same result you get when measuring the same item or characteristic.

Required Best Practices

A project designated by the division or global leadership team that delivers superior performance when implemented across a class of properties. "Required" means that all properties in a "class" must implement the best practice by a specified point in time.

Response Plans

The plans that are developed during the "Control" phase for DMAIC and iDMAIC projects to ensure that the gains achieved can be maintained.

Reverse SIXSIGMA

This is a method which can be used by MBBs (and BBs) in times of financial contingency to help guide restructuring discussions

Revision Plan

A mechanism for updating processes, procedures, and documentation.

Rework Loop

It is an instance in a process when the item or data moving through the process needs correction by returning it to a previous step in the process.

Risk Management

Risk management is thinking ahead, identifying potential problems, and preparing for things that may go wrong.

Rolled Throughput Yield

The cumulative calculation of defects through multiple steps in a process; calculated as the product of the individual yield at each step.

Run Chart (or time plot, trend chart)

Measurement display tool showing variation in a factor over time; indicates trends, patterns, and instances of special causes of variation.

SIPOC

A SIPOC is a high-level process map that includes Suppliers, Inputs, Process, Outputs, and Customers, and defines the start and end points of a process.

SIXSIGMA

It is a term used to describe process improvement initiatives using sigma-based process measures and/or striving for SIXSIGMA-level performance.

SIXSIGMA Council Training

A course designed to enable property Executive Committees and senior leaders to make value-driven decisions by identifying, prioritizing, and sizing projects for their Black Belts.

SIXSIGMA Councils

It is a leadership group that guides the implementation of quality or SIXSIGMA within an organization; establishes, reviews, and supports the progress of quality improvement teams.

Statistical Process Control (SPC)

It is use of data gathering and analysis to monitor processes, identify performance issues, and determine variability/capability.

Sampling

Collecting and using a portion of all of the data to draw conclusions (for example, timing the check-in process for every tenth guest).

Sampling Bias

It is collecting an unrepresentative "slice" of data that leads to inaccurate conclusions.

Scatter Plot or Diagram

It is the graph used to show the relationship or correlation between two factors or variables.

Scope

It defines the boundaries of the process; clarifies specifically where the start and end points for improvement reside, defines where and what to measure and analyze and needs to be within the sphere of control of the team, working on the project.

Simple Linear Regression

The statistical study of the relationship between a single variable X to a single output Y.

Solution Statement

A clear description of the proposed solution used to evaluate and select the best solution to implement.

Special Cause Variation

It is an event that impacts processes only under "special" circumstances i.e., not part of the usual, daily operation of the process.

Stakeholder Analysis

Identifies all stakeholders impacted by a project and their anticipated and required levels of support for the project. Typical stakeholders include managers, people who work in the process under study, other departments, customers, suppliers and finance.

Standard Deviation

Standard Deviation is an indicator of the amount of variation or inconsistency in any group of items or processes.

Standard Operating Procedure (SOP)

A document that compiles all procedures, job tasks, scripts of interactions with customers or others, data collection instructions and forms, and an updated list of resources to be consulted for clarification of procedures.

Storyboard

It is a visual display outlining the highlights of a project and its components leading the team to a solution.

Stratification

Stratification means dividing data into groups based on key characteristics. The purpose of dividing data into groups is to detect a pattern that localizes a problem and explains why the frequency of impact varies between times, locations or conditions.

Sub-process

It is a sub-component of a larger process.

Supplier

It is a person or an organization that feeds inputs (products, services, or information) into the process.

Systematic Sampling

Sampling method in which elements are selected from the population at a uniform level. Systematic or subgroup sampling ensures the sample represents the process because each time period is represented.

Team Leader

For DMAIC projects, the team leader is usually the Black Belt. For Quick Hit and iDMAIC projects, it is typically the Sponsor or Process Owner. For large DMAIC projects with more than one BB or MBB, the Team leader is the main point of contact for the project.

Team Member

It is an active member of a Six Sigma Project team, heavily involved in the measurement, analysis, and improvement of a process.

Tollgate

It is a review session that determines whether activities up to that point in a project have been satisfactorily completed. Tollgates are commonly conducted to review critical decisions during a project.

Transfer Team

Team formed at a property, with responsibility for importing a Best Practice (Optional or required), led by a Team leader appointed by the property Six Sigma Council, and coached by the Black Belt at the property when needed. Transfer teams will use the iDMAIC methodology to import innovation into their properties.

Transfer Team Leader (Process Owner/Department Head)

A person selected by the GM and property SIXSIGMA Council to lead an iDMAIC project based primarily on proximity and decision-making authority relative to the process involved. This person has primary responsibility for implementing the project, leading the team, and interacting with others to gather information and understanding necessary to succeed. Often, the transfer team leader will be the department head or process owner of the process being improved with the best practice. The ability to lead the team and to anticipate clear barriers are important characteristics for a person in this role.

Transfer Team Member

Associates selected by the Transfer Team Leader and Six Sigma Council to serve on the iDMAIC project based on their knowledge of key aspects of the process, experience with the current process, enthusiasm for improvement, and ability to champion change.

Transfer Project

It is a project that a property imports from another property.

Tree Diagram

It is a branching diagram used to break any broad goal into increasingly detailed levels of actions.

Trend Chart

See Run chart.

Value Adding Activities

These are the activities introduced to improve the current process closer to the ideal process.

Value-enabling Activities

Steps/tasks in a process allowing work to move forward; can also be viewed as necessary steps that are not themselves adding value but that contribute to the delivery of the product or service. Examples include selecting new employees, purchasing supplies, and balancing the books.

Variation

These are the changes or fluctuations that determine how stable or predictable a process may be or affected by environment, people, equipment, methods, measurements, and materials.

Voice of the Customer (VOC)

It is a systematic approach to gather and analyze customer requirements, expectations, level of satisfaction and dissatisfaction through complaints, surveys, comments, market research, focus groups and interviews.

WACC

Weighted Average Cost of Capital used to compare the value of 2 or more potential projects. Discount rate used in financial analysis. Represents the average cost for a company to finance itself from equity and debt. In 2002, this rate was 12%, and was used for all SIXSIGMA projects and locations.

Web-based Event (Required and Optional Best Practices)

It is a web-based kick-off communication from the Export team, to the transfer Team featuring a well-documented presentation of their Best Practice project. The event can be synchronous (participation to a live event) or asynchronous (review of a recorded event).

Yield

Total number of units handled correctly through the process steps, typically expressed as a percentage. Yield simply indicates how many items were delivered at the end of the process with no defect.