FUNDAMENTALS OF SIX SIGMA

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CHAPTER 1

Introduction to Six Sigma

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Six Sigma is a method for enhancing output quality by locating and removing the root causes of errors and reducing variability in production and business processes. A manufacturing process's level of maturity can be determined by the percentage of defect-free goods it produces, or by its sigma rating. A six sigma process is one in which it is statistically anticipated that 99.99966% of all possibilities to generate some aspects of a component would be free of flaws.

History of Six Sigma:

The Six-Sigma methodology and toolset is used to enhance processes. While employed by Motorola in 1986, Engineer Sir Bill Smith introduced it. . Motorola created the well-known Quasar televisions in the 1980s, however at the time there were several flaws owing to variances in sound and picture quality. A Japanese company took over the production of Quasar television using the same raw materials, equipment, and labour, and within a few months, they were producing Quasar TV sets with fewer faults. This result was attained by raising managerial standards. Six Sigma was introduced by Bob Galvin, the CEO of Motorola, in 1986. On December 28, 1993, it was registered as a Motorola Trademark, and it later emerged as a quality leader.

Characteristics of Six Sigma:

The following list of Six Sigma characteristics:

Statistical Quality Control: The Greek letter (Sigma) from the Greek alphabet is used to signify Standard Deviation in statistics. Six Sigma is derived from this letter. Variance is measured using the standard deviation, which is a crucial tool for identifying non-conformance with regard to output quality.

Methodical Approach: Since it includes a well-defined systematic application technique in DMAIC and DMADV that can be utilized to improve the quality of production, Six Sigma is not just a quality improvement strategy in theory. The phrase Design-Measure-Analyze-Improve-Control (DMAIC) is an acronym. DMADV, often known as the other approach, stands for Design-Measure- Analyze-Design-Verify.

Fact- and data-based approach: Six Sigma's statistical and systematic components demonstrate the technique's scientific foundation. This highlights crucial aspects of Six Sigma, which is fact- and data-based.

A project- and goal-based focus: The Six Sigma method is applied to a project within an organization in accordance with its specifications and needs. To achieve the greatest results, the approach is flexible to fit the needs and circumstances of the projects.

Customer Focus: The Six Sigma methodology is fundamentally based on the customer. The standards for quality improvement and control are based on particular customer demands.

The Six Sigma approach demands that firms get organised when it comes to regulating and enhancing quality. Teamwork View to Quality Management. Depending on a person's position within the Quality Management team, Six Sigma involves a lot of training.

Benefits of Six Sigma

Six sigma is about giving consumers, investors, and employees better value rather than concentrating on quality for the sake of quality.

Six Sigma in mathematics: Six Sigma is a term that comes from the statistical field of "process capability studies." The Greek letter "," or "sigma," stands for the confidence interval from the "mean." Six analysis of variance from the "mean" are represented as "Six Sigma."

Commercial procedures: A series of tasks that come together to provide a certain service or item for clients is known as a business process or process. A process matrix or a flowchart can be used to illustrate it. Every company's effectiveness and implementation of a business strategy depend on its business procedures. The core of six sigma is comprehending and improving the business process.

Commercial System: A collection of business procedures that work together to create a single, recognizable company unit are referred to as a business system. It is made up of processes, which are made up of sub-processes, which are made up of individual tasks, and so on.

Process Management: Data collection focuses on the process' input and output since feedback from the procedure is utilized to control it. Each sub process or task serves as an input for the one after it or as an output for the one before it.

Impact of Six Sigma on Strategy

The effectiveness and significance of Six Sigma projects can be increased by organizational objectives. Although strategy is carried out to accomplish goals, Six Sigma experts can be crucial to making sure that strategy is carried out. Specific Six Sigma projects may receive the highest priority as a result of objectives. For instance, if a company wishes to increase customer happiness by 25%, customer voice-related Six Sigma initiatives might be given top priority and integrated into the overall organizational strategy for accomplishing the target. Six Sigma experts could create consumer surveys, test questionnaires, collect customer data, analyses data, and set up focus groups, to mention a few activities, to participate in the execution of this approach. Additionally, corporate objectives can breathe fresh life into some outdated initiatives. Project ideas that have never received support from a Champion can be revived and perhaps obtain support by virtue of the applicability of new objectives. Six Sigma experts can act as role models for staff members in executing strategy by allowing organizational goals to coincide with Six

Sigma projects. Additionally, Six Sigma specialists can match the demands set by corporate objectives with Pareto's Principle, also known as the 80-20 rule, to improve the process of selecting Six Sigma projects for Champions and Master Black Belts. Six Sigma professionals can identify the crucial 20% of projects that can produce 80% of the results that are required for attaining objectives by taking into account variables including savings, chance of success, cost, and time of completion. While objectives might point Six Sigma experts in the direction of the proper kinds of projects, logic-based hypotheses like Pareto's Principle can help in identifying the precise initiatives that are essential for success. Although Six Sigma experts are typically thought of as people who show cost savings, they should also be thought of as those who carry out plan. Six Sigma specialists can maximize their contributions to the success of the organization by centering the project selection process on the most urgent organizational objectives.

Basic Six Sigma Team Management

It is a big responsibility to lead a Six Sigma team. Six Sigma is a team procedure that necessitates multifaceted cooperation. A Six Sigma project cannot be managed by one person on their own. The organization is the one that genuinely manages Six Sigma, just as the organization is the one that benefits from Six Sigma. However, that management must be run by people with specialized training. Starting at the top of the organization, managing Six Sigma teams successfully is essential. The teams must be given the tools and power they need to integrate Six Sigma principles into their daily operations by the company leadership. Additionally, they must make sure that Six Sigma initiatives are in line with organizational objectives and that any obstacles to Six Sigma implementation are removed.

Since they have the greatest direct responsibility for overseeing the Six Sigma team, it is particularly crucial that Six Sigma team leaders are properly chosen and trained. The team leader and primary change agent for the Six Sigma process is a Six Sigma Black Belt. The Black Belt's job is to make Six Sigma adoption easier inside the culture. In order to maintain strong bottom-line results, they coordinate and lead Six Sigma teams. Black Belts are people who have received Six Sigma training and have prior experience managing cross-functional process improvement action teams. The Six Sigma Black Belt should exhibit team leadership, comprehend team dynamics, and delegate tasks to team members.

Different Six Sigma Teams:

Six Sigma teams come in a variety of shapes and sizes. Depending on the kind of project you need to finish, you'll require a particular kind of team. Some teams will fall under more than one of the following definitions. For instance, many Six Sigma teams are cellular and self-managed.

Ad hoc: Concocted for a single, quick project. Skills of team members closely match project requirements.

Cellular: A stable core of team members with a variety of skills.

Self-directed: Runs business with little direction from management. Typically makes decisions about its own practices and activities. Lean and Agile techniques are frequently used.

Cross-functional: Comprised of personnel from numerous departments. Typically, they possess quite diverse skill and knowledge sets.

Parallel teams: Two teams pursuing the same goal simultaneously. As an alternative, one team supporting another.

Roles of Six Sigma Team Members

A Six Sigma team has many different responsibilities that could be played. Some of these are crucial, permanent positions. As needed, other people will enter and exit a project at different times.

Team Leader: The team's leader is in charge of mobilizing the group. Occasionally a coordinator the project manager on occasion.

Facilitator: Usually a Black Belt or Master Black Belt serves as the facilitator. Instructs the group

Scribe: Keeps track of the team's actions.

Sponsor: Business executive who is the Six Sigma project's sponsor. Tends to establish project goals and get resources for the team. Frequently the team's point of contact with top management.

Champion: A senior executive who backs a particular Six Sigma project. Assures the availability of resources. Any cross-functional team problems are fixed. (In some cases, the sponsor and this are the same. Various businesses utilise various titles.

Six Sigma Leader: The executive in charge of the company's Six Sigma culture is known as the Six Sigma Leader.

Process Owner: The person in charge of the business process that a Six Sigma project is aiming to improve.

Team member: An individual who will contribute to a team's initiative. Usually possesses pertinent, specific talents.

Gatekeeper: Verifies the outputs. Compares them to the requirements.

Management: Offers inspiration and resources.

Teams with high and low performance in Six Sigma

There are a few important determinants of team performance.

Interdependence: This has two components. Collaborating on projects and utilizing one other's expertise to complete work more rapidly.

Team mechanics: They must be distinctly stated. Then, they must be adhered to.

Communication: Data sharing is crucial to the success of any endeavor. The team needs to be aware of who to update on every advancement. Furthermore, who is accountable for it?

Conflict: Healthy dispute resolution between group members.

Support: It's important to have the backing of managers. They can offer the support and resources that are required.

Three essential components of Six Sigma Process Improvement are as follows:

A. Clients
B. Procedures
C. Workers

The Clients

Customers establish quality. They need performance, dependability, affordable rates, timely deliveries, customer service, transparent and accurate transaction processing, and more. In order to achieve customer satisfaction, it is crucial to deliver what the consumers need.

Procedures

The core of Six Sigma is identifying processes together with associated metrics and measurements.

A specified process must be seen from the outside-in since in business, quality should be evaluated from the customer's point of view.

We may learn what the consumer is experiencing by knowing the transaction lifecycle from their procedures and demands. This provides an opportunity to identify process weak points so that we can strengthen them.

The Employees

The Six Sigma programme must be implemented by the whole staff of the organisation. For workers to concentrate on their skills and capacity to serve clients, the company must provide them possibilities and incentives.

Six Sigma places a premium on each team member having a well-defined position with quantifiable goals.

Adopting Six Sigma

There is currently a strong corpus of scientific evidence showing that effective deployment includes concentrating on a limited number of high-leverage items after almost two decades of Six Sigma experience. The procedures and frameworks needed to deploy Six Sigma effectively are clearly defined.

One. Leadership The main responsibility of leadership is to establish a clear vision for Six Sigma success and to convey that vision often, consistently, and clearly too all levels of the company. In other words, initiative must be led by leadership.

Their main duty is to make sure that the enterprise's overall goals, objectives, and progress are correctly linked with those of Six Sigma. To achieve this, the company must be changed such that employees naturally seek Six Sigma as part of their daily activities. In addition to changing the reward, recognition, incentive, and compensation systems, this calls for the development of new posts and departments. The adoption of Six Sigma will start with senior leadership receiving the concept, guiding principles, and resources they need to set up their company for success.

Construction. Senior executives oversee the creation and instruction of an infrastructure to manage and support Six Sigma using their newly gained expertise.

Information sharing and awareness. The company is simultaneously being "soft-wired" in order to foster a change-capable atmosphere where creativity and innovation may thrive. a top-level DMAIC project focuses on the change initiative and the communication needed to build buy-in for the effort.

Systems for stakeholder input. Systems are created to foster tight connection with clients, staff members, and suppliers. This entails creating strict procedures for gathering and assessing information from suppliers, owners, employees, and customers. Baseline studies are carried out to establish the beginning point and to pinpoint the cultural, governmental, and administrative barriers to success.

Systems for process feedback. Along with a set of indicators for tracking development and success, a framework for continuous process improvement is created. Six Sigma measurements concentrate on the organization's strategic objectives, motivating factors, and important business processes.

Choosing a project. People with process expertise at different levels of the organisation offer Six Sigma initiatives to enhance business processes. Senior managers choose Six Sigma initiatives in accordance with established methodology.

Achieving the six sigma guiding principles

The following are the top five Six Sigma tenets:

Recognize your stakeholders' and consumers' CTQs. You must understand your client's needs, desires, and expectations in order to provide the greatest possible customer experience. You must hear and comprehend the voice of the customer (VOC). Recognize your organization's procedures and make sure they adhere to the CTQs of your clients. You must understand how your procedures operate and what they are intended to accomplish. Each process should have a distinct goal that is centred on the CTQs, or customer needs.

Reduce variance and manage by facts. Making decisions more effectively is made possible by measurement and management by facts. You can determine when to act and when not to act by knowing variety.

Equipping and including the people in the process to be genuinely productive, your organization must provide its employees the tools they need to question and enhance its working methods and procedures.Conduct systematic improvement activities. Working methodically makes it easier to avoid making snap decisions and offering quick fixes.To enhance current processes, Six Sigma use the DMAIC (Define, Measure, Analyze, Improve and Control) methodology. We use DMADV while creating new procedures.

SWOT Analysis

Strengths and weaknesses, opportunities, and threats, or SWOT analysis, is a framework that can be used to evaluate a company's competitive position and make future plans. A SWOT analysis has several advantages because it illustrates and assesses internal and external elements as well as possibilities for the present and the future. A realistic, fact-based, and data-driven picture of the strengths and weaknesses inside a company, its projects, or the industry is provided by a SWOT analysis. In order to ensure that the SWOT analysis is accurate, a firm must steer clear of assumptions or grey areas. Instead, it ought to concentrate on actual circumstances. Companies should use it as a reference, not as a recommendation.

Understanding of SWOT Analysis:

Any organization can utilize a SWOT analysis to evaluate its performance, potential, competition, risk, and reward. It also comprises a component of the company, such as a division, product, market, or another organization. The method makes use of internal data to steer firms away from failing or less likely to succeed tactics and toward ones that are more likely to succeed. They can get assistance in determining if a business, product, or industry is strong or weak and why from investors, rivals, and independent SWOT experts (Figure 1.1).

Figure 1.1: Represent the SWOT Analysis Stages.

SWOT framework:

The SWOT framework provides a very clear method to comprehend the various aspects of the business. It is quite organized and contains assessments and corporate features that enable us to spot market trends and conduct analysis.

Strengths: They are the good aspects of your business, the internal elements that offer it an edge over rivals in the marketplace. It might be more effective production methods, distinctive patents, or differentiated customer service. The distinction between strength and necessity is an essential factor to consider. Only when a trait offers a benefit can it be deemed a strength. For instance, having a quality production process is not a strength but a requirement if all competitors offer high-quality goods. It is separated into internal and external elements (which we will discuss later), as well as the four quadrants of the according to the assessment of strengths, weaknesses, opportunities, and dangers.

Weaknesses: Consider relationships and procedures while evaluating your organization's weaknesses, which are internal factors. Consider what can be done better and what behaviours should be avoided.This is a worthwhile exercise in self-reflection and honesty. Face the issues head-on and be realistic. In order to obtain accurate and worthwhile information, it is crucial to be as truthful as you can.

Opportunities: Additionally, SWOT analyses opportunities, which are chances for improvement, expansion, or any other circumstance that benefits the business.The business must adopt a mindset in order to take advantage of them. Future possibilities, such as market trends or emerging technology, must also be considered.A business that takes advantage of possibilities becomes more competitive, which boosts great differential.

Threats: Threats are outside forces that could hurt the business. Examples include labour shortages, market shifts, and supply issues.

Therefore, it's critical to shield the business from issues of this nature. Managers must foresee these hazards and create a planning procedure to mitigate or eliminate their effects. It's crucial to avoid being shocked by this. Threatening economic conditions include things like debt and a cash shortage. Due to these issues, the organization has less opportunities to seize them and is more vulnerable to the negative effects of market developments.

The SWOT matrix can also be utilized as a tool for developing one's own self-awareness. We might think of the internal variables as the person's self-reflections and the exterior factors as their social interactions and the context in which they are placed.

SWOT Applications:

1. Problem-solving
2. Decision-making
3. Change management
4. Long-term planning
5. The launch of new initiatives.

SWOT analysis uses:

A SWOT analysis can provide you with a high-level overview of your business or project. It can assist you in:

1. Utilize your strengths

2. Strengthen your weaknesses or make accommodations for them
3. Take advantage of market shifts
4. Reduce risk by guarding against recognized dangers.

Design for Six Sigma

There has never been more rivalry for goods and services in the contemporary global economy. For numerous, remarkably comparable products, consumers have numerous options. Many manufacturing firms are constantly attempting to launch novel goods or penetrate untapped markets. The consumer's requirements and expectations are occasionally met by the items, and other times they are not. Prior to reintroducing the product to the market, the corporation will often redesign the item, sometimes creating and testing many iterations. Multiple product redesigns are wasteful and expensive. If the product fit the customer's true wants and expectations the first time around, with a greater degree of product quality, it would be considerably more advantageous. Prior to the completion of the design, Design for Six Sigma (DFSS) focuses on carrying out additional work to ensure that you completely understand the customer's needs and expectations. Every stakeholder must be involved in every function of DFSS. You can produce new goods or processes with higher levels of quality by using a DFSS technique.

There are various methodologies that can be used when developing new products or processes, and this makes Design for Six Sigma (DFSS) different from other approaches. DMAIC, which stands for Define, Measure, Analyze, Improve and Control, is used in traditional Six Sigma. This approach works best when used to refine an existing procedure or make small adjustments to a product's design. Contrarily, Design for Six Sigma is mainly utilized for completely redesigning a product. The DFSS implementation processes appear to differ depending on the company or organization using them. Instances include DMADV, DCCDI, and IDOV. The focus of all approaches appears to be on thoroughly understanding consumer wants and incorporating this knowledge into the design of the product and process. To guarantee that every part of the product is taken into account, from market research through the design phase, process implementation, and product launch, the DFSS team must be cross-functional. With DFSS, the objective is to minimize flaws and variances at their source while designing products and procedures. According to reports, a process created utilizing DFSS should have at least 4.5 sigma.

Benefits:

1. To determine the necessary Critical to Quality (CTQ) variables
2. To improve the capacity of the process
3. Reduce any flaws or variations
4. To provide dependable and predictable processes in order to increase client satisfaction
5. To create the greatest performance to achieve the goals and increase process effectiveness

Speed, quality, and performance of the goods or services cannot be sacrificed in the modern world. In order to create products or services that satisfy customers, you typically have limited resources, a tight budget, little time, and a lot of work. There is a danger that the project won't proceed as planned or that the client's expectations won't be satisfied. The DFSS enters the picture in this situation. Due to the high cost of revamping the products or services and must obtain the pilot or prototype with all the specifications needed for initial production or manufacture. With the aid of DFSS, it has been seen that time to market can be shortened by up to 40% while maintaining high quality and satisfying client requirements. This is because DFSS is a proactive design method with quantifiable or measurable data and with established design tools .

Tools for DFSS:

Project Charter: The project team outlines the objectives, deliverables, timetable, budget, and roles in the project charter, which is a crucial initial step in the design process. In this step, parameters for project success are also identified.

Voice of the Customer (VOC): By examining past customer feedback and surveying potential customers through focus groups, questionnaires, and surveys, it is possible to ascertain what the customer wants.

Quality Function Deployment (QFD): Design decisions for new goods or services are made using a range of media under the Quality Function Deployment (QFD) methodology. Critical To Quality (CTQ) qualities of the product and process are converted into customer needs.

Design for Reliability (DFR) and Design for Testability (DFT): These techniques, Design for Reliability (DFR) and Design for Testability (DFT), can assist in optimizing the design for the product's lifecycle to save costs and maintain reliability.

FMEA stands for Failure Modes and Effect Analysis: It is a tool used to identify probable flaws in product design and manufacturing processes and to create controls to reduce or fix them.

Design of Elements (DOE): To provide a reliable design, optimize parameter values and cut down on variation.

Pilot: Conducting a small-scale test of a new good or service can assist in preventing lost sales and unhappy clients. Before conducting a large-scale deployment, assess if the product satisfies performance and consumer expectations and make any necessary adjustments. Prior to the pilot test, computer simulation may be possible in some circumstances.

Validation: In addition to pilots and simulations, companies can use design reviews, certification testing, customer assessments, peer reviews, focus groups, and market testing to determine whether a product is successful.

Finally, it might be useful to utilize a DFSS scorecard to assess the overall success of the product. Project teams can then assess if the outcomes fulfil the quality target.

Continued Six Sigma Growth

Businesses all throughout the nation hurriedly adopted Six Sigma after successful companies like GE and Motorola. Unfortunately, many firms failed to do improvements well or to adequately comprehend statistical process control before going ahead with improvements because of the haste to implement the process. Although firms have employed Six Sigma techniques to achieve millions, if not billions, in savings and efficiency, some businesses left the process with a foul taste in their mouths. The following misunderstandings and myths, which are still common in many businesses today, are the consequence of that terrible taste:

Common sense is disregarded in Six Sigma since it is only interested in measurements. Contrarily, Six Sigma often builds on conventional common sense assumptions, typically arrived at via brainstorming, and supports those presumptions with data. There are two causes behind this misconception. First, in a Six Sigma atmosphere, managers and other people who are accustomed to making calls without being questioned are suddenly questioned. They are not just challenged, but occasionally real fact contradicts them. Second, there are instances when data is incorrectly utilised to support findings that defy logic or precedent. It is simple to point the finger at the Six Sigma process when such findings turn out to be incorrect since the underlying statistical theories are not well understood.

The cost of Six Sigma is too high. While the initial expenses of implementing Six Sigma throughout an organisation, in part owing to the requirement for training, might be high, the long-term costs of doing so are often relatively cheap. Budgetary considerations must be taken into account when organisations adopt Six Sigma, although when done effectively, Six Sigma often generates savings that outweigh the cost of implementation.

Six Sigma can repair any issue. Six Sigma advocates who think they can use the technique as a panacea to solve every issue stand in opposition to the doubters. While Six Sigma may be used to solve any process-related issue, it may not necessarily be applicable to issues with culture or people. Statistics won't assist if low morale or other human resource issues are the cause of a problem. However, Six Sigma may be utilised to enhance the process if morale is low because it is challenging to work with it or is performing badly, which will raise morale.

Applying Six Sigma Knowledge

Applying Six Sigma Knowledge Leaders often seek out analysts, Six Sigma specialists, and subject-matter experts for cost-benefit evaluations after identifying areas of concern. By calculating sigma levels, costs of defects, downtime, and other metrics, Six Sigma teams try to identify how flawed a process is as well as how much fixing it could cost. After then, issues are ranked in order of priority based on their seriousness and the organization's capacity to resolve them.

Teams start working through the priority list, periodically checking the analysis to see whether the list has not altered. The bulk of this book is devoted to explaining how teams use Six Sigma to identify and solve issues.

Six Sigma Certification Levels

A person who has earned a Six Sigma certification has shown their practical Six Sigma understanding and application. Some businesses provide internal certification procedures. The majority of employees who want certification sign up for a Six Sigma training course either on-site or online. The majority of institutions that provide Six Sigma training also provide a route to certification. Six Sigma levels are distinguished by belt level, and you may enrol in courses for certification at various levels.

White Belt

A Six Sigma expert White belts are knowledgeable about the fundamentals of the Six Sigma technique, but they aren't often active participants in process improvement teams. For auxiliary staff members inside a company, white belt training is a useful introduction to Six Sigma and may provide the knowledge essential to comprehend why project teams do what they do. Employees can examine project procedures, comprehend material provided at milestone meetings, and participate more effectively in project selection processes thanks to the training. When businesses want to establish a Six Sigma culture, white belt training may be applied to all staff levels.

Noting that White Belt training often only offers a very basic introduction and review of Six Sigma, it is important to note that not all Six Sigma specialists see it as a legitimate Six Sigma certification.

Yellow Belt

A yellow belt certification is a step up from a white belt certification; although still regarded as a fundamental introduction to Six Sigma ideas, a yellow belt learns the fundamentals of the DMAIC approach, which is often used to improve processes. Frequently covered in Six Sigma yellow belt training are the following ideas:

Responsibilities in Six Sigma

Management and growth of teams Basic high-quality instruments like histograms, run charts, scatter diagrams, and Pareto charts

Measurement system analysis; data gathering; and common Six Sigma metrics

Root cause investigation

A brief explanation of hypothesis testing

At the yellow belt level, instruction often focuses on grasping the overarching approach and fundamental data collecting.

Although yellow belts are not need to know how to perform hypothesis tests, they do need to be familiar with the terminology and the results of such studies. Yellow belts are often workers who need to understand the whole procedure and the justifications for its implementation.

Green Belt

Working in Six Sigma teams, certified green belts are often supervised by a black belt or master black belt. Green belts may sometimes take the initiative or manage little initiatives by themselves. Green belts often possess intermediate statistical analysis skills; they may solve data and analysis issues, assist Black Belts in using Six Sigma tools on a project, or educate other employees about the Six Sigma technique as a whole.

Middle managers, business analysts, project managers, and other professionals with a need to routinely participate in process improvement projects but who may not be full-time Six Sigma experts inside a company may all be green belts. Due to the fact that they handle the majority of the statistical data collecting and analysis under the guidance of qualified Black Belts, Green Belts are sometimes referred to as the Six Sigma methodology's beehives.

The following ideas are often covered in Green Belt instruction:

Failure mechanism and effect analysis, project and team management, and all the knowledge required for yellow belt certification

Basic hypothesis testing techniques, statistical distributions, descriptive statistics, waste reduction, and Kaizen are among the topics covered in this course.

Standard control charts

Black Belt

On process improvement projects, a qualified Six Sigma Black Belt often serves as the project manager. They might also be employed by a corporation in management, analyst, or planning positions. Everything specified for yellow and green belt certification, as well as the following, are common minimum criteria for black belt certification:

Understanding of the vast array of Six Sigma project and brainstorming tools

Statistics from intermediate to advanced knowledge of various quality assurance and process improvement initiatives, such as Lean and Total Quality Management.

The capacity to create procedures

1. More sophisticated process diagramming tools, such as flow charts and value stream maps
2. Using analytic tools, such as Excel or Minitab

Master Black Belt

The highest certification level attainable for Six Sigma is Master Black Belt. Master Black Belts often oversee Black Belts and Green Belts within a corporate organisation, counsel on particularly problematic project issues, provide guidance and instruction on complex statistical concepts, and lead Six Sigma technique training sessions for others.

Exams for Certification

The majority of certification programmes demand that applicants pass an exam in order to become certified; however, some additionally call for green and black belt candidates to provide evidence of their expertise by involvement in Six Sigma projects.If a test is necessary for white or yellow belt certification, it is often brief and only covers the methodology's fundamental ideas. Exams for the green belt rank are lengthy and may include questions on statistics and simple math. Black belt tests, which assess knowledge and application, may last up to four hours. Exams may include challenging statistical puzzles or inquiries about the possible course of action for a project leader. This book is based on the official body-of-knowledge criteria for The Council for Six Sigma Certification (CSSC), even if examinations vary depending on the company.

CHAPTER 2

Basic Six Sigma Team Management

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Within a business, Six Sigma is often administered on two levels. A group or council of top managers, such as executives, often manages the enterprise-wide Six Sigma culture under the supervision of a Master Black Belt or Black Belt. This team is ultimately responsible for establishing the Six Sigma culture inside a business, giving final clearance to initiatives, and holding others accountable for metrics, success, and performance. While many of these people could also serve as project sponsors or champions, as a whole, they don't often become engaged in the day-to-day operations of initiatives.A high-level Six Sigma leadership group's responsibilities may include:

1. Formulating a case for the use of Six Sigma throughout the company and promoting process improvement as a cultural objective.
2. Clearly defining the aims of Six Sigma projects will guarantee that they are in line with organisational objectives.
3. Holding Six Sigma teams and the company responsible for advancements and output.
4. Collecting and examining results measures
5. Frank communication of victories and defeats to the group.
6. Rewarding groups and people for attaining Six Sigma success advocating for the financing and resources required for urgent upgrading initiatives.

Putting Together a Six Sigma Team

You can't just have a crew assembled and prepared to start working on every project that comes along. Six Sigma teams must be specially crafted for the current processes and objectives. The same Six Sigma experts—Black Belt leaders, data analysts, or project managers might work on various projects, but individual subject matter experts and team members only add significant value if they are conversant in the procedure or have something relevant in their background that they can contribute in terms of education, knowledge, or experience. Additionally, not every team member will contribute regularly throughout the duration of a project. Instead of hiring Six Sigma expertise, businesses often send their current staff members to Six Sigma training.

Teams are often established by executive leadership groups working with Six Sigma leaders and experts. Any team working to enhance a process should comprise, at the very least: a Six Sigma leader; a process owner; a process specialist; and someone to oversee the budget and accounting.The process owner may also be the process expert, doing some of those duties jointly. The team may also need technical resources, such as a programmer or IT leader, as well as members of the human resources, compliance, legal, or other auxiliary departments, depending on expectations and requirements.

Three Different Team Member Types

Organizations should keep in mind that there are three fundamental team member kinds with regard to a Six Sigma project while assembling teams. The usual team members come first. These people take part in all team events and practically all meetings, depending on the team. Project managers, process owners and experts, and designated subject matter experts that the team or executives consider would be essential components of their group are all regular team members.Second, members of ad hoc teams provide expertise as required. These are often those who work closely with the process, such as subject matter experts or workers. It would be detrimental to the existing level of productivity to remove these individuals from their regular duties for every single team event. Instead, when more information or support is requested, these individuals are included into team meetings as necessary.

Finally, members of the resource team are only invited to a meeting or team activity if the project team leader thinks their expertise is required to give information, advice, or assistance in obtaining resources. Members of resource teams often work in support areas like compliance, human resources, or accounting. Members of the resource team may also be departmental managers or leaders with ties to the process being enhanced. A member of the marketing department could be appointed as a resource team member if, for instance, a team is trying to strengthen the customer service division and needs feedback from that division.

Guidelines for Choosing Team Members

The majority of Six Sigma process improvement teams are small; five regular team members are often regarded as a decent quantity. Burnout may result from overcrowding the team, which can hinder brainstorming sessions and cause communication issues. When a corporation has several big Six Sigma teams, there is a strong likelihood that team members are working on many different projects at once. Regular team members shouldn't be required to serve on more than one team and handle daily responsibilities, however ad hoc or resource team members may serve numerous projects and manage their own work on a daily basis. In fact, those in charge of the organisation may want to think about lowering the workload expected of team members who are working on a project full-time.

Other pointers for choosing team members are as follows:

1. Choosing staff members who are knowledgeable about the project's customers, products, or processes.
2. Picking workers who have shown their capacity and desire to contribute to progress in a group setting.
3. Choosing staff members who have access to and comprehension of the data needed to analyse and assess the process or issue.
4. Choosing workers who can contribute at least five hours a week to the team.
5. Aligning staff skill sets with current initiatives; for example, if a project is anticipated to include just technical advancements, it would be less probable to add a team member with marketing expertise.
6. Eliminating political barriers via team selection; if a certain employee in a company is likely to be a barrier to a team, sometimes including that employee on the team might enhance the likelihood that they will support the effort.

Roles of Team Members

Although the duties of the team members are based on Six Sigma process improvement best practises, teams and team leaders should not be unduly rigid, according to best practises. Six Sigma leaders and experts with experience know how to adhere to best practises while also building customised teams that are adapted to the current project or process.

Champions and Sponsors

These are often the senior-level executives who are in charge of the most important projects in Six Sigma settings. Even the Black Belt is required to provide reports to the project champion or sponsor. Since the senior leader is often in charge of the project's outcome, he or she frequently requests updates on its status; sometimes, the sponsor or champion serves as a point of contact between the team and the leadership council. The champion or sponsor, who is the senior leader, is also in charge of aiding the team in securing funding and resources to guarantee project success. Additional responsibilities for this position include:

Mentoring the team, especially throughout the project charter phase. The sponsor often offers suggestions on the project's scope and potential team members.

1. Finding the team's resources, such as assistance from other departments, funds, tools, labour hours, and time.
2. Managing corporate politics so that the team is relieved of this responsibility.
3. Collaborating with other managers within the company to support the team in successfully enhancing a process and implementing changes into the working environment on a regular basis.

Owners of a business or process

The person who directs the process in a leadership position is often the company or process owner. When a Six Sigma team's solution is ready to be sent out to all team members or utilised on a regular basis, the process owner is often the one who will "receive" it. As a result, the process owner is often a member of the team since they are required to comprehend the rationale behind any changes. The process owner must also be knowledgeable with the controls developed by the Six Sigma team since he or she will be in charge of maintaining and overseeing them after the process moves from a team environment to regular production.

On a Six Sigma team, a process owner often serves as a process expert. The process owner has knowledge of the current process, is aware of the requirements of customers and workers connected to the process, and may already have access to process data. However, the process owner isn't necessarily the sole process expert on a team; sometimes, the process owner doesn't have enough regular contact with the process to qualify as an expert.

Black Belts and others must be cautious of process owners who are averse to change or who think they know it all while leading or managing a Six Sigma team. Someone who is fixed in their ways may not want other team members to be involved or may think that certain adjustments are "impossible" because they are novel. Some process owners who are also leaders could prevent team members from joining a team because they are worried that they will be overshadowed or that they will pose a challenge to their authority. These are some of the issues with politics and human resources. Black Belts and project managers must diplomatically collaborate with champions, sponsors, and process managers to find solutions for the problems that Six Sigma leaders encounter.

Leaders in Six Sigma

Although some businesses may let Green Belts to handle modest efforts with sporadic comments and direction from Black Belts, Six Sigma programmes are typically led by qualified Black Belts. The Black Belt often only works with one team or project at a time and is in charge of the regular work that a team completes in most businesses.In the best-case scenario, companies may match Black Belts with initiatives in fields they are already knowledgeable about. For instance, a bank may employ a number of Black Belts. Each Black Belt may specialise in dealing with certain departments or processes; for example, one Black Belt could typically work with accounting, another with customer-facing processes, a third with customer-facing procedures, and a fourth with online operations. This could not always be achievable due to the potential shortage of Black Belt resources. The majority of trained Black Belts can apply Six Sigma techniques to process improvements, even in fields they aren't very knowledgeable about. Although it might be burdensome for workers and isn't always the ideal option, in certain situations, different managers or other people who are qualified as Black Belts can lead processes in addition to their usual tasks.

Black Belt project managers often strive to:

1. Assist in developing a project's justification.
2. Offer suggestions for the members of the project team.
3. Oversee teams during each DMAIC process. As team members get familiar with and use Six Sigma tools, educate and assist them.
4. Exercise supervision via effective time management, judgment, and planning.

Maintain deadlines and schedules, sometimes in collaboration with a qualified project manager; provide knowledge in the form of statistical analysis or analytical recommendations; and help with project transition. Regularly report to your sponsor or champion.

At the conclusion of the project, provide documentation.

Master Black Belts have a general leadership position in many Six Sigma initiatives in various businesses. Black Belts heading Six Sigma teams may collaborate with Master Black Belts to address particularly challenging issues or seek assistance for complicated statistical analysis. Master Black Belts serve as mentors to several teams. Master Black Belts enable team members continually advance their understanding of Six Sigma processes by providing continuous education to both Black and Green Belts.

Project Directors

Some businesses combine Six Sigma improvement approaches with conventional project management procedures. A project manager is often assigned to a Six Sigma project in these businesses. Although organisational structures differ, the project manager often does not serve as the team leader. Instead, the PM supports the Black Belt as a leader by maintaining paperwork and deadlines, assisting in meeting facilitation, and ensuring that actions are taken after meetings. At first glance, adding a PM to a team would seem like it would be problematic for a Black Belt, but when the two positions complement one another, the Black Belt gains. A Six

Sigma exert is free to focus on the brainstorming session or statistical analysis at hand without having to worry about deadlines or if the meeting is straying too far from the agenda.

Timekeeper

Although not all Six Sigma teams use them, timekeepers may assist keep meetings on schedule, lower the possibility of scope creep, and boost overall productivity. Any team member who does not frequently conduct meetings, facilitate brainstorming sessions, or maintain track of team activities and notes might serve as the timekeeper. The timekeeper should gently guide teams toward adhering to agenda timelines or provide the project leader an indication that time is up for the current subject, but not police time in such a rigorous manner that the advantages of flexible conversation and brainstorming are lost.

A timekeeper requires an agenda to follow in order to work effectively. A thorough agenda for each meeting is often the job of the Black Belt or project manager. Teams should always be aware that agendas may alter during meetings at the project manager's or project leader's discretion, thus the agenda should contain clear indicators of how long each item is anticipated to take.

Team captains should choose a dependable and well-organized timekeeper. Any team member might easily lose track of time during heated debates and disagreements, and the timekeeper is also a team member. The timekeeper's responsibilities as a team member also include: Monitoring the time and the agenda.

Alert team members when an agenda item's time limit is approaching; teams may wish to establish a five-minute notice rule so they have some time to wrap up a debate.

Signal that a given debate or article has finished

Project managers have the option to disregard agendas, but they should also support the timekeeper's capacity to gently interrupt. Timekeepers are unable to function if they are ridiculed by other team members for keeping track of the time.

Minute-takers or scribes

During Six Sigma brainstorming and team meetings, there is a lot of conversation that has to be recorded. Notes are crucial because they enable team members to examine what has been said, compile lists of activities and follow-ups from discussions, and keep track of charts, graphs, and diagrams produced during brainstorming sessions. While everyone is welcome to take notes, the team leader should choose one individual to serve as the group's official scribe. Sometimes such individual is a Six Sigma team leader collaborating with a qualified project manager. Other times, it is a team member who is seen as meticulous and well-organized.It is exceedingly difficult to take notes while conducting a conversation or exercise, thus the Black Belt or other project leader should never serve as the scribe. While working directly with other team members, the Black Belt is prone to overlook critical facts and may take some notes throughout the talk.

As quickly as feasible after a meeting, the scribe should write up notes or minutes of the meeting and distribute them to the whole team. Teams often use portals or shared file systems to store notes and other documents in an easily accessible area. Team members may check the notes and add any missing material if necessary.

Recording the diagrams and brainstorming that took place during a Six Sigma project meeting might be difficult. This is particularly true if teams write diagrams using whiteboards, paper, or sticky notes since the scribe is not always equipped with the knowledge or expertise to replicate such papers in a digital format. The diagrams may be photographed using a smartphone or digital camera, which is a recording technique that many contemporary Six Sigma teams adopt. A Black Belt or Green Belt may then turn the raw schematics into a digitized version so that the information can be presented to leadership or other departments if needed. The photos can then be posted into the team's shared workspace.

Group Members

The project manager, the sponsor or champion, and the whole organizational leadership team are responsible for choosing candidates for each of these positions. Six Sigma teams often include one to three more regular team members in addition to the project leader, process owner, and process expert.

Team members also:

Participate in brainstorming sessions, talks, and other team activities in addition to serving as the team's timekeeper or scribe as instructed by the team leader.

1. Compile data and do analyses as directed by the Black Belt. Team members that carry out these duties are often Green Belts.
2. Work as directed by the project manager between meetings. Update the team on the status of specific tasks and their outcomes.
3. Examine the work produced by other team members and the team as a whole, providing comments and ideas.

Timelines, Plans, and Objectives

The Six Sigma project process includes planning and managing a timetable. Organizational executives must know when team resources will be available for other projects, when results may be anticipated, and how long a project will take to complete. Without this knowledge, management cannot make plans for continuous development, and staff members may feel shackled to a project that never seems to end. In this part, we'll discuss the significance of milestones and two approaches for developing a project timetable or schedule.

Timeline Based on Phases

We've briefly discussed the DMAIC approach, which is often followed by a set of stages in Six Sigma projects. Define, Measure, Analyze, Improve, and Control are the five steps that DMAIC divides a project into. By allocating a specific number of weeks to each phase, seasoned Six Sigma specialists can often offer a very basic and raw estimate of time for projects and processes. It's also important to keep in mind that several of the stages will probably overlap.

A Black Belt or other Six Sigma leader will often start with the total time needed when developing a rough timetable for a project. He or she either makes an educated guess as to how long it will take to complete an improvement or works within a timeline set by the leadership group. The leadership team can specify, for instance, that an upgrade must be finished within four months.

The Black Belt may provide an estimated DMAIC process timeline that resembles the picture below using a four-month timetable and the information that is already known about the process, issue, and resources.

The expert estimates a 16-week schedule, with the Define phase taking three weeks and the Measure phase taking five. As is typical for Six Sigma projects, the Measure phase overlaps with both the Define and Analyze phases.

The advantage of this method is that you can rapidly produce a timeline. The drawbacks are that leadership may see this as a strict schedule, which may lead to excessive expectations, and someone without expertise with Six Sigma and a decent level of understanding of the process being improved may easily underestimate the time necessary for each step.

Make sure everyone understands that the time for each step might alter as you go when providing such a schedule, since it is just a preliminary estimate.

Important Path Method

A project team must provide additional information and feedback when using the critical route technique to define deadlines for different project components.

A critical path diagram can be one of the tasks the team completes during the Define phase, thus you won't be able to offer a comprehensive timeframe until the project is under way.

Critical path diagram creation

You may draw a critical path diagram for the whole project or for each stage separately. We'll take the Define phase of a project to eliminate bad debt (uncollected bills) in a medical billing setting as an example as we go through the stages of making a critical path diagram.

1. Determine the essential requirements or actions to finish the project or a certain phase of the project.

   The team must choose a team, charter the project, specify the issue, and develop a baseline measure in order to finish the define phase of our project to reduce bad debt in a medical billing environment.

2. Sequence important tasks.

   The following steps should be completed by the team in the sequence specified in step one: Form a team, Charter the project and identify the challenge (these activities may be done concurrently), Develop a baseline metric

3. Give each job a time limit.

   A Six Sigma expert predicts that selecting a team, drafting a problem statement, and developing a baseline measure will all take one week, one day, and two weeks, respectively.

4. Draw a graphic of the activities, stacking parallel or simultaneous processes, and include timing information. Creating the diagram goes from left to right. Before the tasks to the right may be finished, the tasks to the left must be finished. Things are stacked when they can be completed simultaneously.

5. Trace the diagram's critical route.

   The crucial route passes via the step with the longest time estimate when steps are stacked. For instance, when working on a project charter, which takes place from Monday to Friday, the team can develop a problem statement. On Tuesday, the problem statement will be finished. The team won't have completed all of those processes, however, until the project charter has been completed (Figure 2.1).

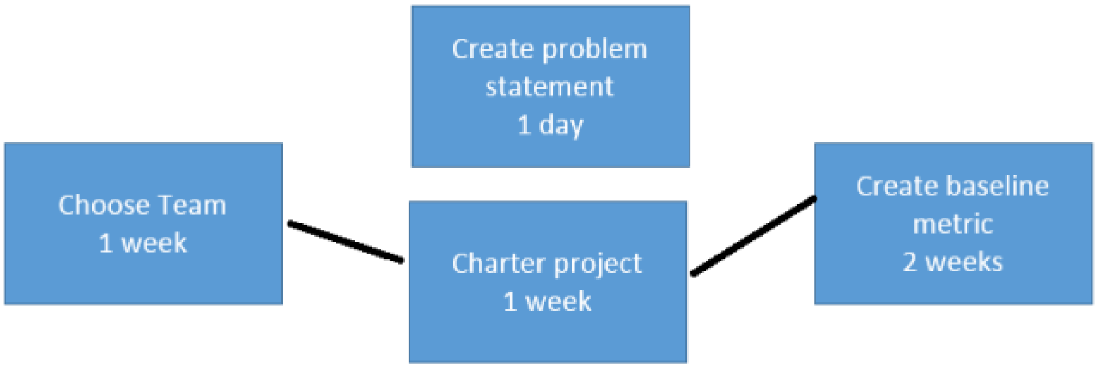

Figure 2.1 trace the diagram's critical route

6. Total the lengthiest intervals from every part.

   In this instance, the team increases the Define phase's duration by 1 week, 1 week, and 2 weeks altogether. Although we used a fairly simple example, the critical route approach may be used to predict durations for very complicated projects or processes.

Milestone Conferences:

Create milestone meetings and dates once a timetable has been defined to assist the team stay on course and update the sponsor or champion on developments. Milestones are often established at the conclusion of each step in a DMAIC project (Define, Measure, Analyze, Improve, and Control). However, teams are free to create their own milestones, and sponsors may need them if they are authorising significant financial or resource demands for a project.

To manage objectives and tasks, you can also establish milestones inside a team environment. These milestones may be shared only within the team. For instance, a team working for a chain of sandwich restaurants wants to enhance the method used to assemble sandwiches. They have established the following benchmarks:

The team or the Black Belt will meet with the sponsor at the milestone times to deliver the findings or outcomes of each project phase. Every date provides the group with something to strive towards. The team has decided, however, that certain activities must be carried out during the Measure phase. To ensure that everyone is using the same terminology while discussing measures, they must first develop a few definitions.

The group must also collect information on the temperature at which items are prepared and kept. To assess the time it takes to create different sandwiches, the team also plans to carefully watch sandwich shop personnel.The team may establish internal deadlines for the Measure phase, such as definition creation by January 25, temperature data collection by February 5, and time data collection by February 10, as examples.

The team can more easily remain on target and accomplish work if each phase and major job are divided into smaller components. Smaller jobs are more likely to be completed since they appear more achievable.

Budgets

Project budgets are something that teams, and team leaders in particular, must constantly be aware of. While performance, quality, and customer satisfaction are used to gauge success, Six Sigma teams also report to corporate leadership. Success for leaders is also evaluated in terms of time and money. You can achieve deadlines with the support of a solid schedule and effective milestones, and you can maintain a project on budget with the knowledge of financial drivers, effective communication, and financial supervision.The fact that not all team members are usually fully aware of the financial factors is one of the difficulties when dealing with finances in a Six Sigma project. Financial information may also be limited in certain circumstances; for example, companies often do not want particular information about employee salary made available to different team members. In some situations, it may be necessary for a project-leading Black Belt to handle some information and analysis alone, particularly if the data is crucial or sensitive.

Process improvement initiatives function best when all team members are made aware of as many of the drivers and data as feasible, barring any issues with sensitive data. Teams are better able to make practical judgements about how to enhance a procedure when they are aware of the amount of funds a champion is ready to pursue on their behalf. Budget constraints can prevent the most effective approach from being implemented. The team cannot execute a solution that, for instance, calls for an $80,000 capital expenditure in equipment if the improvement project has a budget of $50,000.Organizations have varying budgetary concerns. Certain team expenditures, such as those for new equipment, employing new staff, or buying new goods or software, are of particular interest to management in certain businesses. Some businesses approach project budgets more precisely, taking into account the cost of team members' labour hours as well as the costs of training and executing a solution outside of a team setting.

Executives of Six Sigma teams must make sure they are aware of how companies and leaders handle project costs. When starting a new project with a company or sponsor, it's important to have open and honest discussions about the budgeting process, the level of concessions sponsors are ready to make, and the Six Sigma leader's anticipated contribution to budget maintenance.

Defined Success Measures

Finally, Six Sigma teams need to have a clear definition of success. Leaders must make sure that all team members, sponsors, and leaders agree on what success looks like in order to run a Six Sigma project and team effectively. The team runs the danger of scope creep and becoming lost in an unending project if success isn't even defined. Teams run the danger of finishing a project without satisfying the client, sponsor, or all team members if success is not clearly defined. The team may feel a project has been completed successfully but leadership considers it to have been a failure if a sponsor and the team cannot agree on what success looks like.In the end, effective management of Six Sigma teams depends on many of the same principles as effective leadership in other contexts. The correct team members are chosen, expectations are set clearly, work is approached methodically, and progress is communicated honestly and openly. These actions enable each team member to succeed and contribute to the group.

CHAPTER 3

Lean Concept

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Lean six sigma is the fusion of the lean and six sigma techniques to decrease waste, defects variation, and improve efficiency and outcomes. Lean emphasizes effectiveness, while Six Sigma focuses on how efficiency can produce quicker outcomes. Together, they are more effective than each technique used separately. A thorough grasp of the employee's duties, responsibilities, organizational structures, and training needs is essential for a successful Lean Six Sigma deployment. Lean Six Sigma is built on a set of guiding principles that combine elements of the Six Sigma methodology and the Lean methodology. Six Sigma seeks to increase quality by removing the root causes of problems, whereas Lean focuses mostly on eliminating inefficient processes.Lean Six Sigma is an evidence-based, data-driven improvement methodology that places a higher priority on fault prevention than defect discovery. By lowering variance, waste, and cycle time and encouraging the adoption of work standardization and flow, it boosts customer experience and bottom-line results while giving businesses a competitive edge. Every employee should take part in it, and it applies whenever there is variance and waste.

Concepts of Lean Six Sigma:

The eight types of waste that make up the DOWNTIME acronym—defects, overproduction, waiting, underutilization of talent, transport, inventory, motion, and extra-processing—are the main focus of the lean management philosophy. Any technique, measure, or technology that facilitates the discovery and removal of waste is referred to be lean. Tools and methods that are utilized to enhance manufacturing processes are referred to as Six Sigma. The tactic makes an effort to pinpoint and get rid of the causes of errors and inconsistencies in production and business procedures. Lean Six Sigma makes use of the DMAIC phases from Six Sigma. Define, Measure, Analyze, Improve, and Control are the letters in the acronym. It alludes to a five-step, data-driven methodology for enhancing, enhancing, and stabilizing commercial and manufacturing processes. In order to ensure progress in a company's operational processes, a Lean Six Sigma method that combines Lean strategy and Six Sigma's tools and procedures identifies processes that are prone to waste, defects, and variation and then decreases them.

Five Lean Six Sigma principles:

For your LSS project to be successful, experts advise that you bear in mind these 5 essential Lean leadership concepts.

Working for the client: Delivering the greatest possible advantage to the client should be the main objective of any change you intend to execute. Early on, establish a clear level of quality that is determined by what the market or customers want.

Find your issue and pay attention to it: It's simple to become distracted by the desired modifications during the retooling operations and lose sight of the original issue. Obtain information that identifies your specific problem area so you may focus just on improving that part of your company. The LSS procedure will probably be derailed by any attempt to significantly alter the business or the product.

Get rid of variance and obstructions: Once the issue has been located, you should start thinking about how to reduce the likelihood of errors. These gaps are frequently found in lengthy, complex procedures that offer a lot of possibility for error and waste. A good strategy to accomplish quality control and efficiency is by streamlining or eliminating these functions.

Clear communication and team member training: The basics of Lean Six Sigma demand that every team member understand LSS, be aware of the project's objectives, and get regular updates on its status. The Six Sigma process can lead to significant change and calls for management to pay close attention. Advanced Six Sigma certifications are crucial for lowering the risk of project failure and guaranteeing the success of the entire process.

Be adaptable and receptive: Lean Six Sigma and change go hand in hand. It is necessary to improve or eliminate a process or function that has been found to be flawed or inefficient. With LSS, sticking with a failed strategy is not an option. Every business leader aspires for a smaller, stronger, more competitive organization, so while change and change management might be difficult and painful, it's a little price to pay.

Techniques Using Lean Six Sigma

The following approaches and technologies are utilized to achieve the key objectives of the Lean Six Sigma strategy:

1. Kanban workflow management strategies, which increase efficiency and encourage continuous improvement, such as work visualization and limited work in progress.
2. Kaizen techniques that include staff members and encourage a work climate that prioritizes continuing development and self-improvement.
3. Value stream mapping to identify areas for waste reduction and process step optimization.
4. The 5S tool to guarantee an effective, prosperous, safe, and efficient workplace.

Benefits of Lean Six Sigma

Businesses may enhance the work experiences of their staff and the customer experiences of their clients by boosting the efficiency of key procedures. Both inside and outside of a corporation, this can increase loyalty.

Simplified, streamlined procedures can improve control and a business's capacity to seize new possibilities swiftly.They may also result in increased income and sales, decreased expenses, and improved corporate outcomes.Employee participation in group or company-wide efficiency initiatives can enhance their abilities (such as rational skills and project management), their possibilities for professional progress, and their sense of camaraderie.

By preventing faults, businesses can avoid spending the time, money, and resources necessary to find and fix them in the past.In the end, the business process helps all of its constituent parts, including the corporation, vendors, consumers, and employees.

Considering the Lean Six Sigma guiding principles

Lean Six Sigma combines the best aspects of both Lean and Six Sigma to create a stunning set of seven concepts. The fundamental ideas behind each strategy and the combined set doesn't provide any unexpected results. The following are the seven Lean Six Sigma tenets:

The CTQs are the foundation for defining the process measurements you need to determine how well you operate against these important needs. They are written in a manner that guarantees they are quantifiable. Since just 10% to 15% of process stages normally contribute value and often take up less than 1% of the overall process time, it is crucial to concentrate on the client and the idea of value-add. These numbers may surprise you, but they need to get your attention and make you aware of any possible waste that exists inside your own company. You're more likely to earn and keep new business, grow your market share, and meet the CTQs as you perform better.Determine the process and get familiar with it. The value stream outlines each stage in your operation, such as accepting a client order, producing a product or providing a service, and collecting money. You can ensure the process is focused on satisfying the CTQs and providing value by outlining the non-value-added phases and regions of waste on a map of the value stream. You must "travel to the Gemba" in order to complete this procedure correctly. The Japanese term "Gemba" refers to the location of the job, the hub of activity, and the starting point of administration. Process stapling, which is spending time at work to observe how the job really gets done, as opposed to how you would want it to be done. You see the actual process in action and get information about what's occurring. Using process stapling, you may analyse the issues you wish to solve and choose a better approach for your daily tasks.

The value stream displays all of the value-creating and non-value-creating activities that go into bringing your product or service idea to market, as well as the activities that move a client order from conception to fulfilment through the supply chain. The processing of client information and the transformation of the product as it travels to the consumer are examples of these value-creating and non-value-creating operations. Control, enhance, and streamline the process flow. This idea is an illustration of alternative thinking. Use single piece flow wherever feasible, do away with batches, or at the very least, reduce batch sizes. In either case, aim to eliminate the non-value-adding phases from the process and make sure they don't cause delays for the ones that provide value. Pull, not push, is the idea that ties to our knowledge of the process and enhancing flow. Additionally, it may be crucial in preventing bottlenecks. It is wasteful to produce too much or to move things forward too quickly.

Eliminate waste and processes that don't offer value. Another crucial aspect of enhancing flow and performance in general is to do this. Waste is referred to as Muda in Japan, where it is divided into two general categories and two subcategories.

Reduce variance and manage by facts. Utilizing precise data and managing by facts might help you avoid making snap decisions and offering quick fixes. If organisations want to be genuinely successful, they must include people. However, like with so many other Lean Six Sigma concepts, this needs new ways of thinking.Conduct systematic improvement activities. Here, DMAIC—Define, Measure, Analyze, Improve and Control—comes into action. The tendency for improvement action to not be conducted in a systematic and uniform manner is one of the critiques that is sometimes levelled towards "stand-alone" Lean. DMAIC is utilised in Six Sigma to enhance current processes, but the framework may also be applied in Lean and, of course, Lean Six Sigma. The DMADV approach is utilised when a new process has to be developed.

Value

Value is the one idea that has been brought to the attention of the business world the most recently. The client determines value based on how helpful and necessary they believe a certain item or service to be.German and Japanese-built automobiles are both offered in the same markets, although some consumers choose Japanese-built vehicles due to their superior quality, dependability, high resale value, and fuel economy. Some of the same expectations may be met by German-built automobiles, which can provide a sense of pride in the manufacturer.For just these reasons, there is a certain kind of buyer that favours automobiles built in Germany. Customers thereby decide what a thing is worth. Trucks and vans made in the United States are robust enough to tackle difficult duties. Some American automobiles, trucks, and vans rival their Japanese and German rivals in terms of quality and dependability. Additionally, they have ingrained consumer loyalty. A certain kind of customer will purchase cars built in America for just these reasons.

The target cost for the product or service may be established after the notion of value has been grasped. Womack claims that this goal cost is a result of looking at the existing selling prices of rivals as well as studying the removal of waste using lean techniques:

A process step is seen to be value-added by lean experts if:

1. The customer acknowledges the value
2. It modifies (transforms) the product
3. It is completed properly the first time.

The consumer is unwilling to pay for some operational tasks since they do not alter the shape or functionality of the product or service.Non-value-added is the designation given to these operations. Rework is a prime example. For example, the customer expects to pay for the printing of a document but does not wish to pay for adjustments brought on by supplier faults. The identification and removal of non-value-added tasks is a crucial step in making a company leaner. The operative rule while looking for non-value-added activities should be "question everything." Steps that are presumed to be required often provide room for improvement. Team members who are not involved in a process will often provide a new perspective and pose the rude questions.

Of course, there are ambiguous regions where the distinction between value-added and non-value-added may not be clear. Testing and inspection is one such sector.

In certain cases, a process's output has to be reviewed to ensure that no faulty components reach subsequent operations. A case might be made that this examination adds value since the buyer doesn't want faulty goods. The simple answer is to improve the process so that it can function properly without the need for inspections. The majority of authority concur that this examination adds little benefit. On the other hand, in order to meet CSA specifications, a gas furnace manufacturer is required to fire test each furnace.

The CSA listing is something that customers are prepared to pay for, therefore this test stage is a value-added activity. According to studies, a large portion of lead time—much of it spent waiting for the next action—is nonvalue-added. However, attempts to cut lead times have often throughout the years prioritised speeding value-added operations above minimising or eliminating non-value-added services.

Examples of the Best Lean Tools

5S (or 6S or 7S) (or 6S or 7S). A workplace organising technique called 5S helps boost productivity and better manage operations. The environment has an influence on a process, as does the staff's capacity to adapt to changes in the process. Process control is aided by improvements to the workspace's general condition, such as increased hand tool accessibility. Since process control data is filtered by the measurement system, the cleanliness, illumination, and general cleanliness of any space where measurements are taken are very important in this context. As an example, a crowded workstation costs experienced employee’s important time and distracts them from their tasks, which leads to subpar output. Similar to how a messy desk full with papers and files may slow down processing and result in mistakes, one of the first tools to be used on the road to establishing lean enterprise companies is 5S.

The standard 5S procedure is as follows:

Sort. Take away anything extra. We have a tendency to accumulate things that are neither necessary nor even very seldom used, whether at home or at the business. These things build up into a mess over time, which reduces the effectiveness of searching for necessities and may sometimes even present safety risks. Sorting through the objects as needed and tidying up the workspace are the first two steps. Never-used objects should be thrown away right away.Put in the proper sequence. Organize the necessary and seldom used goods for easy access. Drawings, instructions, tools, safety goggles, and other materials that are needed more often are kept in specific, marked areas where they cannot be moved. In other words, everything has its place and is in its place. It is possible to store out of the way goods that are only sometimes needed, such as machine manuals and designs for the shop floor.

Shine. Cleaning the workspace and the tools is required here. As obvious as it may seem, thorough cleaning of the work space reveals several quality problems. For instance, cleaning the floor helps to reduce accidents, cleaning the inspection surface plate improves measurement results, and cleaning the equipment work table improves movement. Cleanliness is required in certain sectors, such as semiconductor production, and is quantified by particle count.

Standardize. To maintain a clean and organised workspace, this entails creating checklists, standards, and job instructions.Sustain. The hardest 5S sequence is this one. The first four phases are often effective for most firms, but maintaining the efforts and carrying them out calls for management support and employee empowerment. The management have to be ready to put the effort in and understand that it is time well spent. The time spent on 5S increases efficiency and production overall while lowering accidents. By giving people control over their workspaces, management should likewise give its staff more authority.

According to the report, the following are the secrets for typical North American businesses:

1. Discuss with management the cost reductions that 5S will bring about.
2. Create clear scoreboards with metrics for cleanliness.
3. After the scoreboards are set up, the organisation should concentrate on beginning with step 4, standardise, so that individuals are aware of how to adjust their scores.

Also take notice that some individuals add a seventh S (oversight) in the healthcare industry and a sixth S (safety).

Andon. A visual feedback system that displays the state of the production at any given moment (usually at the work site, red, yellow, and green stacked lights). It notifies the operators and supervisor that help may be required and gives the staff the authority to halt the process if a problem develops that is deemed to be detrimental to quality.With advances in technology, activities can now be monitored from numerous points inside the operation, and operators are receiving ever-earlier alerts when something may not be operating as it should for regular operations.

A3 paper was initially used to publish this reporting tool in Europe, thus the instrument's original name. Using this method, managers may quickly review the major subjects and problems associated with a project on a single piece of paper.This may be used as a brief update for the team or management, a status report template, or an overview of the project. The CD-ROM contains samples of these types.

Constant Flow. Operations in which there are few (or no) buffers between operation stages and work-in-process moves easily through the system. Many types of waste are eliminated when a continuous flow is created, including inventory, waiting, transport, and over processing.

Heijunka. A production planning method that intentionally produces in significantly smaller batches by combining (sequencing) several product/service variations in the same process. Since each product or variety is manufactured more often, this usually cuts down on wait times and inventory levels (since batches are smaller).Kanri Hoshin Its objective is to coordinate middle management's plans (tactics), the work done on the shop floor, and the company's objectives (strategy), also known as policy deployment or quality function deployment (QFD). Additionally, it guarantees comprehensive progress toward strategic objectives and has the advantage of reducing waste brought on by inadequate communication and unclear guidance.

Jidoka (Autonomation). The TPS procedure is based on the idea of "why have a person do something a machine can do better," particularly for laborious, repetitive operations that over time may injure workers. Between totally manual and fully automated work systems, Shigeo

Shingo has identified 23 levels that are often referred to as "intelligent automation" or "automation with a human touch." Fully automated devices must be able to recognise and fix operational issues on their own, which is presently not economically feasible. He thought that autonomation might provide 90% of the advantages of complete automation.

Just-in-Time (JIT). JIT is a manufacturing technique that was developed by Toyota and is currently used by other companies in an effort to increase company ROI by lowering in-process inventory and related carrying costs. Kanban is one method for achieving this, but JIT applies to all elements of product flow within the firm, including those from suppliers. Basically, the idea is that keeping idle inventory in storage is a waste of resources (regardless of where it is located in the system). JIT inventory systems reveal the hidden costs associated with maintaining inventory and assist the company in developing fresh strategies for dealing with the effects of change.

Kaizen Events: Kaizen, Continuous Improvement. The Japanese concept of kaizen refers to process improvement via tiny, gradual changes. This progressive transformation is sometimes referred to as continuous improvement.Another Japanese word, kaikaku, refers to significant improvement (which Juran refers to as substantial change).In North America, kaikaku is known as a kaizen event or kaizen blitz. As a result, many practitioners often mistakenly use the terms kaizen and kaizen event interchangeably. Kaizen events are utilised in lean implementation to speed up the pace of outcomes. During a kaizen event, a cross-functional team is assembled, and for three to five days, they analyse all potential areas for improvement in an attempt to make a breakthrough. These efforts need the backing of management. If staff members find it difficult to take three to five days off to address a process restriction, either the issue is minor or more fundamental culture change inside the company is needed before applying lean.

Kanban (Pull System) (Pull System). The best way to govern a system is to ensure that data and material enter and exit the process in an orderly and sensible manner. Process inputs that arrive before they are required often result in needless confusion, inventories, and expenditures. If process outputs and downstream operations are not coordinated, delays, unhappy clients, and related expenses might result. By ensuring the timely transfer of goods and information, a well implemented kanban system would enhance system control. Kanban is accomplished with kanban cards, which are visual indicators. When the minimum level is achieved, the card specifies the amount that will be restored.The indication for manufacturing to withdraw materials from the prior stage is an empty bin with a kanban card. During actual implementation, the kanban amount is mathematically estimated and adjusted. Organizations often require some time to master kanban. Kanban is a more sophisticated idea. Before using kanban, it's crucial to implement the other pillars of lean (5S, standard work, total productive maintenance, and variation reduction). If not, the goal of kanban will be defeated by frequent equipment failure and erratic or inconsistent processes, necessitating the use of very large kanban sizes to account for these uncertainties.

Equipment Efficiency as a Whole (OEE). A computation that multiplies process availability, performance, and quality to get a percentage of overall effectiveness of the operation (A P Q = OEE) was created from the 1960s-era idea of gauging how well a manufacturing operation is employed. This is one of several measurements available to assess operation performance, and it serves as a baseline for ongoing improvement initiatives. A perfect 100% would represent flawless production, which would include producing only high-quality components as quickly as possible with no downtime.

Poka-Yoke, often known as mistake-proofing or error-proofing, is a technique used to stop mistakes. The principle of mistake-proofing is used in a variety of ways in everyday life, including electrical plugs and sockets that prohibit incorrect plugging, valves that close when the maximum pressure is reached, fittings that prevent loading components in the incorrect orientation, and more. A glass envelope, which enables users to see the letter sealed with the correct address, is another error-proofing technique. Similar to this, there is mistake-proofing that warns a user right away when an error is committed (to stop more mistakes). An automated measuring machine that alerts when a component is manufactured that is oversize or undersize is one example. Another is a vehicle alarm that sounds when the driver locks the door while the lights are on.

Single-minute Die Exchange (SMED). SMED aims to provide a quick and efficient method of switching an operational process from managing the current product to managing the next product. Reducing production lot sizes and enhancing system throughput both depend on quick changeover.

The ratio of actual production time to change over time, or the amount of time it takes to stop producing one product and begin producing another, is used to determine the economic lot size. The cost of the actual manufacturing itself increases if the switch takes a lengthy time because of the output that is lost.

The term "single minute" refers to a time frame of less than 10 minutes (also known as a "single-digit minute") rather than a time frame of just one minute for all setups and changeovers.

Regular Work. Standard work is essentially a tool that describes the interaction between a machine and a human during the production of a component. Standard time, standard inventory, and standard sequence are its three main parts. Standard work aids in the training of new operators and lowers process variance.

Making manufacturing processes and/or service processes consistent is the underlying notion. By include standard work as part of the regulated documentation, quality management systems like ISO 9001 offer a fundamental framework for lean implementation. Additionally, having standard work reduces process variance since equipment, tools, layout, procedures, and materials are all standardized.

A thorough process work instruction that includes everything mentioned above might be a very helpful standard work document.

Time Takt. This term, which comes from the German word taktzeit, describes the baton that a conductor of an orchestra employs to control the tempo, rhythm, or timing of the performers. Takt time is used to properly balance supply and demand.

It gives a lean manufacturing system its beating heart. In the 1930s, the German aviation industry employed takt time for the first time as a production management tool.

Takt time, which is also known as beat time, rate time, or heartbeat, regulates the speed of industrial manufacturing lines so that production cycle times may be matched to rates of client demand. The rate at which you must create the goods in order to meet anticipated client demand is determined by those customers. The production scheduling department decides what is required when shipping to the client after taking into account the overall amount of consumer demand. The manufacturing processes then determine how quickly those parts, components, and assemblies need to be produced in order to be sent to the customers.

Principle of Constraints.

A technique for addressing issues called the theory of constraints concentrates on the weakest link in a series of processes. The slowest process is often the limitation. The rate at the limit must grow before the flow rate through the system can. Five phases for system improvement are listed by the theory of constraints:

Describe. Identify the procedure limiting the system's efficacy.Work-in-progress (WIP) that has to be completed will often be the limitation if throughput is an issue.

Utilize. To increase the pace of the constraining process, use kaizen or other techniques.

Subservient. Change (or subordinate) the chain's other processes' rates to correspond to the constraints.

Lift up. The limitation may need to be extensively revised if the system rate still needs to be improved (or elevation). This can include spending money on new technology or equipment.

Repetition repeating these processes with the new limitation may increase system rate if the process has been made better to the point that it is no longer the constraint.The advantage of the theory of constraints is that it takes a systems view and emphasises that changes to individual processes will not increase the rate of the system unless the constraining process is also improved.

Drum–Buffer–Rope (DBR) (DBR). A group of soldiers moving in a single line was used by Goldratt7 to represent a series of industrial operations. The first soldier obtains raw material, the new ground, as he advances. Each soldier after them walks on the same terrain and executes a different routine. The terrain is done as soon as the final soldier crosses it. Lead time is the time it takes for the squad to pass over a point, so the individual processes are moving over fixed material rather than the other way around. The lead time tends to increase if each soldier advances as quickly as he can, with the slower troops falling behind and holding up those in front of them since passing is not allowed. The slowest soldier is the system limitation. This soldier can move no quicker than the ground can be processed. The system's overall drumbeat is set by this soldier.

A rope ties the lead soldier to the slowest soldier to prevent extending the lead time.

Now, the squad works together to go forward with the least amount of lead time and ongoing effort (WIP). In the event that a soldier who is behind the slowest soldier drops his gun, he will lag behind a little (particularly if the sergeant observes it), but because he is not the slowest soldier, he will be able to catch up. This is comparable to a small station-specific process issue. The squad won't have to halt until the slowest soldier catches up to the one in front of him if a soldier in front loses his gun. Therefore, the rope has to be longer if the squad has a strong propensity to drop their guns.

The buffer's size is determined by the rope's length. In conclusion, all system operations should be slowed down (through the rope) to the pace of the slowest process (the drum), with the quantity of WIP (or buffer) dictated by the reliability of the individual processes, in order to minimise lengthy lead times and excess WIP. See Goldratt's Critical Chain for a more in-depth discussion of these ideas.

Comprehensive Productive Maintenance The production or service equipment must be dependable if the lean enterprise deployment is to be maintained. A company must do routine maintenance on its equipment in order to have dependable equipment.

Examples of preventive maintenance include changing the oil as needed, tightening loose components, and keeping an eye out for any audible or visual signs of failure. A team of maintenance technicians can be required for a thorough maintenance programme. This may be both costly and unpractical. As a result, a total productive maintenance (TPM) programme brings together line employees and maintenance experts to operate as a team to decrease machine downtime. To cross-train line employees to conduct simple, elementary maintenance and repairs, management assistance is necessary. As a result of the operators' training in frequent failure indications, maintenance personnel get information more quickly, cutting downtime. Metrics like overall equipment effectiveness (OEE), which is a result of equipment availability, performance, and output quality, are used by mature TPM systems.

The state of the information and material is visually identified by the visual factory along the value stream. Examples of a visual factory include displaying the status of the material entering and leaving a raw material warehouse, showing the number of units produced, the number of units left to finish an order, and the total number of units produced by shift or day on a production display board, and displaying red, yellow, and green lights on the machine to indicate its status. Consider the scenario where we need to determine the current status of a work order for a certain client. This is often accomplished by speaking with line supervisors, consulting logbooks, holding internal meetings, and other means.In other words, a workplace is effectively visual if an employee can enter a shop floor and determine which machines are in operation, what product is being produced, how many more must be produced for the client, follow written safety regulations, and report to management.

Waste (Muda)

Waste, or muda as it is known in certain texts, is categorised into seven or eight different types by various writers. Overproduction, excess motion, waiting, inventory, excess material movement, defect rectification (rework), extra processing, and wasted creativity are often on these lists (underutilization of resource skills). The causes and effects of each of these wastes are discussed in the paragraphs that follow.

Overproduction. Excess work-in-process is the primary sign of overproduction, which is defined as producing more than is required or producing it sooner or quicker than is required by the following process (WIP). For a variety of reasons, including lengthy setup periods, an uneven workload, and a just-in-case mentality, businesses engage in overproduction. One business keeps six months' worth of an unstable equipment that makes a certain little item on hand. Sometimes accounting procedures have mandated that machines generate more than necessary in order to amortise their capital expenses.

All WIP should be continually examined for areas that may be cut down or eliminated.

Poor workplace design, particularly difficult supply and equipment placement, may be to blame for this. This causes ergonomic issues, time lost looking for or relocating tools or supplies, and often lower quality standards. Kaizen events may be used to efficiently concentrate a small, temporary workforce on making changes in a specific work area. Individuals with prior experience in the relevant areas as well as those with previous experience in related roles must be a part of the team. Additionally, it is crucial to include those who have decision-making power. In only two to five days of rigorous effort, these teams have achieved astounding results.

Waiting. Waiting wastes money and, perhaps more importantly, demoralises staff. It is often brought on by things like delayed shipments, protracted setup times, or absent individuals. Attempts to reduce setup time and overall productive maintenance are just partial solutions to this issue. In certain circumstances, cross-training employees may help them transition to different professions successfully. Of course, well planned and carried out schedule is very crucial.

Inventory. Costs for environmental control, record keeping, storage and retrieval, and other expenses are incurred when inventories of raw materials, completed items, or work-in-process are kept. The consumer receives no benefit from these functions. Of course, there may be a need for some inventory, but if a rival is able to save expenses by doing so, business may be lost. When a company cycle is in the economic recovery stage, it might be very attractive to allow inventory levels increase. The best course of action is to coordinate output to rise with real demand rather than raising stocks based on expectations. Similar to this, operations that offer little value but utilise excessive amounts of space or other resources raise expenses.

Large conveyor systems, massive forklift fleets, and similar equipment increase the cost and complexity of manufacturing and often lower quality via handling and storage. Typically, poor plant arrangement is at fault. Plants with departments organised around functions (all lathes together, all presses together, etc.) need for a lot of material transportation. A preferable strategy is to group equipment that is utilised for a single product or family of products. This may include having a production cell that uses a variety of tools and calls for workers with a range of abilities. Because they may be staffed in many ways, cells that create a C shape, as illustrated in Figure 3.1, have proven to be successful for many businesses. Six employees, one for each machine, might be assigned if there is a strong demand for the output of the cell. One worker might travel from machine to machine, creating components one at a time, if demand is extremely low.

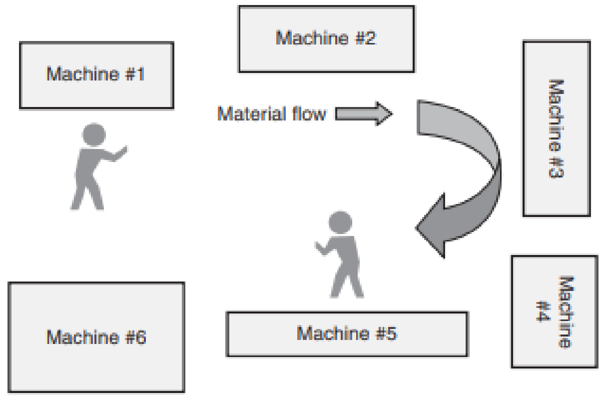

Figure 3.1: C-shaped manufacturing cell.

Correction of Errors. Due to the lost work involved in fixing the broken item, this action adds no value. Bad product design, poor training/work instructions, inadequate quality control, and poor equipment maintenance are typical causes of faults. For the purpose of constantly lowering defect levels, lean thinking necessitates a thorough examination of these and other factors.Overprocessing or excessive processing. This kind of garbage is often hard to identify. Sometimes the complete value chain's stages don't provide any value. Before they are scheduled for painting, a steel stamping process generates a significant number of pieces. In order to avoid rust while the pieces are waiting to be painted, it could be necessary to practise dipping them in an oil solution. The pieces are cleaned and painted as the paint schedule allows. Because the dipping and removing of grease do not improve the goods, the buyer is not prepared to pay for them. The best course of action in this situation is to plan the pre-paint tasks so that they are completed as soon as the components are produced. This could need, among other things, lower batch sizes and better communication processes.

The grinding phase that often follows a welding operation serves to eliminate certain weld flaws. The necessity for grinding may be reduced or eliminated by improving the welding process. Excessive processing would include the unneeded grinding. Both the factory floor and the office may engage in excessive processing. Customer purchase order data is sometimes recorded into a database, and the order itself is stored as a backup physical copy to help with any potential disputes down the road. The physical copies truly serve no use, despite periodically being retrieved from files and initialled stamped, stapled, etc., according to a recent study by one business. Once the information is submitted, the business now throws away the purchase order. These records' filing, storage, and maintenance procedures required one-half of a worker to do non-value-added work.

Additional Ways Lost Creativity is wasted. Perhaps the worst waste is this one. Most workers in manufacturing have suggestions for improving procedures that might be put into practice. Sometimes it seems like traditional organizational structures are intended to stifle such ideas.Divides between labour and management appear almost impossible to cross. Lean thinking understands the importance of include people in teams that value and embrace their opinion. These teams must be given the authority to implement changes in an environment that views failures as teaching opportunities. No accountant has yet assessed how the higher morale and lower staff turnover that follow have an influence on the bottom line. These are lean thinking's intangible advantages. Perfection. In order to eliminate muda, one must strive towards excellence. Additionally, you learnt about several processes' explicit and covert wastes. Your company may work to achieve "perfection" in lean by maximising value-added operations and eliminating waste. This is a sustained endeavour. This involves ongoing learning.

CHAPTER 4

Lean Tools for Process Control

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Total productive maintenance (TPM) enhances infrastructure and equipment maintenance procedures and makes it possible to forecast and/or stop impending breakdown. A portion of the work may be delegated to the operational team members, who can carry out maintenance as part of their continuous process activities, via a coordinated effort combining engineering, operations, and maintenance.

Waste reduction depends on the efficient utilisation of infrastructure and equipment. The combined effort of the following projects is managing these assets:

Preventing decreased, idled, or halted performance as a result of equipment failure.Cutting down on the amount of time required setting up and switching out equipment, which would otherwise stall production and cause bottlenecks. Preventing delays brought on by the processing or detection of subpar goods or services. Making sure that procedures and equipment are working at the rate and speed at which they were intended. If the speed is slower or more delayed, try to identify and fix the cause.

To decrease material waste, scrap, rework, and the requirement for material reviews, increase the output of approved material.To reduce or eliminate faults and downtime, TPM tries to fix flaws in machines. This includes management of people, processes, systems, and the environment in addition to preventative maintenance. Anytime mechanical devices are utilised, how well they are functioning affects how well the process is controlled. The process output may be impacted by equipment deterioration, often in unanticipated ways.

Effective TPM has two advantages:

TPM will provide problem-solving insights that may be used in various phases of the improvement cycle. By merging data gathering, issue reporting, and continuous improvement for integration into the products and projects, this incorporates lean back into the whole Six Sigma programme. TPM will assist in identifying and addressing the many types of waste, or muda, allowing lean systems to detect and eliminate waste more successfully. The wastes may be summed up using the Tim Wood acronym as follows:

Transportation - Inventory - Motion - Waiting - Overproduction - Overprocessing - Defects.

The goal of total productive maintenance is to prevent production interruptions by ensuring that each machine in a production process is capable of carrying out its assigned functions. Along with machine efficiency and first-pass yield, uptime is enhanced.

A lean maintenance approach called TPM is used to increase equipment dependability.

TPM originated from:

1. Breakdown repairs.
2. Remedial maintenance. altering or improving machinery to avoid failures or facilitate maintenance
3. Preventative maintenance. scheduled maintenance tasks carried out to avoid unexpected failures
4. Successful maintenance. A synthesis of equipment engineering economics, preventative maintenance, equipment reliability engineering, and equipment maintainability engineering
5. TPM encompasses a variety of disciplines since workers may check, lubricate, adjust, and even do some basic calibrations on their own equipment. As a result, the technical crew is freed up to do higher-level preventive maintenance tasks that call for greater technical skill.

TPM is based on information on equipment uptime, usage, and productivity.

Under TPM, everyone strives for zero breakdowns, maximum production, and zero defects. TPM coordinates all departments and involves every employee in group activities across the whole equipment life cycle, from product conception through manufacturing to the end of its usable life. Through employee involvement, TPM promotes a culture where initiatives to enhance safety, quality, cost, delivery, and innovation are encouraged. TPM systems include the following components:

Upkeep of infrastructure, aims, and goals

Workflow and controls; Data gathering system (general equipment effectiveness); Training and education

Participation in operations

Overall equipment effectiveness (OEE), which is further discussed in the OEE section below, is the primary TPM statistic. OEE is increased by cutting operational expenses while lowering inventory levels, increasing throughput and quality, reducing lead times overall, and reducing throughput and inventory.

You need a baseline measurement of OEE to comprehend the existing state and assess the success of any improvement activity:

OEE stands for availability, performance effectiveness, and quality rate.

Uptime or machine utilisation are other terms used to describe availability. The machine's unplanned downtime losses are monitored using availability. The actual run time (equipment planned and operational) divided by the net operating time gives the availability rate (scheduled run time). It is important to understand that the scheduled run time is not based on calendar time and does not account for planned downtime for tasks like preventative maintenance or times when the equipment is not required for output.

Whether equipment is operating at maximum capacity (or speed) for certain items is determined by performance efficiency. Performance is used to monitor the machine's speed losses. The performance rate is calculated by dividing the actual production by the desired output. This may also be determined using the formula: Actual operating time divided by Ideal production time equals Actual operating time divided by Actual number of components manufactured.

OEE is divided into several losses. A downtime loss is the reduction in availability. The decline in performance is a decline in speed. A quality loss is a loss of quality. The Six Big Losses include breakdowns, changeovers, idling and small stoppages, decreased speed, scrap and rework, and start-up losses. A TPM programme comprises actions to assist prevent these potential productivity drains.

Although downtime is a frequent metric, the following other data might also be collected and used:

Mean Repair Time (MTTR). The typical length of time needed for repairs to fix a problem. This may be used as a measurement of the overall success of the maintenance procedure in terms of reaction and adjustments.

Additionally, the performance rate may be seen. When crucial information is lacking, there may be small halt and idle periods. Similar to decreased speed losses, they arise as a result of knowledge or training deficiencies.

TPM may be improved by a variety of participants, as seen below.

Operators

Measure degradation via data gathering;

1. Prevent deterioration through routine inspections;
2. Correct deterioration through routine equipment cleaning
3. Take part in group activities as equipment specialists
4. Help with maintenance tasks
5. Maintenance personnel
6. Preventive maintenance via routine inspections and adjustments
7. Planned maintenance actions to minimise production interruption Operators and supervisors should get training on TPM and OEE principles.
8. Equipment design, which helps in removing design flaws;
9. Root cause analysis, which aids in understanding the reasons of downtime
10. Participate in group projects as a resource for maintenance.

Engineer’s Early equipment management—designing for upkeep and long-term viability Root cause analysis—assisting in identifying the reasons of downtime.

1. Take part in group projects as an engineering resource.
2. Avoid contamination throughout the equipment design phase.
3. Administrators and Managers
4. Root cause analysis, which aids in comprehending the reasons of downtime
5. Take part in group activities and provide leadership and guidance.
6. Training – facilitate learning and growth
7. Accountability—ensuring that workbooks and data gathering are finished

It is crucial to convey the benefits of a well implemented TPM programme, such as how it enhances safety and quality, boosts equipment output, and lowers energy and maintenance costs.

Equipment Efficiency as a Whole

In manufacturing, measuring equipment efficiency has long been a common way to gauge productivity. Failure rate, mean time to repair, mean time between failures, and availability have all been used as reliability indicators.However, without a comprehensive understanding of what was included or missing in the assessment, the relevance of these metrics is reduced.The three key components of OEE are quality, performance, and availability. These metrics may be used to monitor the efficacy and efficiency of procedures and equipment.

The goal of OEE is to determine when machinery is producing high-quality output and to compare that time to the whole period during which such production is theoretically achievable (i.e., the volume of output that can be produced without scrap or rework):

The entire theoretical amount of time that the machinery, procedure, workforce, and facility might produce quality goods, or the potential number of hours of operation.

Planned downtime includes all periods when the equipment is not intended to be in operation (for instance, when the facility is closed, during scheduled downtime for maintenance tasks, during lunch breaks, or when customer demand is satisfied and the equipment is shut down to prevent overproduction, and therefore should be excluded from the OEE calculation.

Planned available time, which may be computed as follows, is the amount of time that a process, piece of machinery, worker, assembly line, factory, etc. are anticipated to be working together to produce a quality end product.

Potentially available time minus planned downtime equals planned availability.

Analysis of the inefficiencies and productivity losses that take place during the scheduled free time is the next phase. Three categories of inefficiencies and productivity losses are identified:

1. Loss from unplanned downtime
2. Loss of performance
3. Quality decline

Unplanned downtime loss is the total of all equipment availability losses brought on by unexpected production halts throughout time. The time frame used for calculating prospective available time and planned available time should be utilised as the time frame as well. A few examples include running out of supplies or components, switching over, and having equipment fail.

Actual equipment running time may be computed using unexpected downtime loss:

Actual operating time = Planned available time –Sum of all unplanned downtime losses

The first aspect of OEE, availability, is the proportion of time that machinery, a process, workers, or a manufacturing line are in use as opposed to the time that was anticipated for use, or available time downtime losses.

The total of losses incurred during equipment operation as a result of variables that prevent the equipment from operating at its optimum planned efficiency over time is performance loss, the second category of productivity losses. Wear, operator inefficiency, material variances, part jams, and more examples might be given:

Actual performance time is equal to the sum of all performance time losses minus actual operating time.

Actual performance time is the efficiency level at which the equipment really performs during operation as opposed to actual operating time, which is the planned performance of the equipment as intended (designed performance) (actual performance).

Performance, the second component of OEE, is the ratio of actual performance (net operating time) to the intended performance of operation for each piece of machinery, process, worker, or production line. The efficiency of a process or piece of equipment may also be determined.

The third category of productivity losses, quality loss, is the total of quality losses incurred during equipment operation as a result of flaws and rework. Simply said, this is the yield from a first pass, or excellent output, rate. Equipment first-pass yield, also known as first-pass yield, may be calculated after quality loss has been recorded.

First-pass yield is the third and final component of OEE, which is quality. OEE is a ratio of first-pass yield to projected available time, put simply.

Three components combine to form the OEE measurement (numerical examples are provided for explanatory purposes):

Availability. Percentage of the working day during which the equipment is usable for production.

Efficiency in performance. A factor influenced by the processing time, cycle time, and equipment running time tempo of high-caliber output. Yield for the infrastructure piece, equipment, or gadget

The OEE formula and sample measurement units are as follows:

OEE = Availability (Available hours) × Performance efficiency(Proportion of production flow to operating time) ×Rate of quality products (Percentage yield of acceptableproducts to total units produced)

OEE may be used to monitor labor-intensive processes (such as manual assembly, administrative tasks, and service functions), even though it was originally developed for use in manufacturing operations to monitor equipment, machines, and automated production. OEE may be used as a useful indicator for administrative and service tasks by altering the definitions of each element (availability, performance, and quality) for labor-intensive activities. We might refer to this as total labour effectiveness (OLE).

Visual Factory

The visual factory aims to convey process objectives, alert staff to present operating conditions, and make issues apparent. Charts that are widely displayed at work show trends in a variety of metrics, including quality, delivery, downtime, and productivity. Boards for scheduling and production provide information to workers. Similar actions may be taken to continually update all participants in non-factory contexts (such as services and education).

To prevent negligence and deviations, job instructions must be accessible and well-illustrated. This is particularly true when cross-trained employees adapt to different workstations and mixed-model schedules are used. To further reduce variance, good lines, signs, and labels make ensuring the correct component is present at the appropriate time and location.

Visual Control

In a well-designed 5S (well-organized workplace) setting, visual management employs strategies including colour coding, clear containers for supplies and equipment, enhanced signage, and process indicators. Visual systems provide essential information in an easy-to-understand way to those who need it, when they need it. When anomalies are obvious, adjustments may be addressed promptly, and procedures can resume their usual course.

Simple tools called visual management aids are used as communication tools to demonstrate work standards (examples of excellent and faulty goods) and inspection techniques. The single-point lesson is one kind of visual management tool that is intended to demonstrate how a job should be carried out, how a product or service should be assessed, and what to check for throughout the inspection. The single-point lesson comprises very little, if any, written and is mainly dependent on visual presentations. The idea behind the single-point lesson is to use a graphic to lead the employee through the process and make it simpler to spot flaws before the product or service is given greater value. 6 Visual Office

One approach for continuous process improvement, visual management and the "visible workplace," should be used in combination with other solutions, such as:

1. A decrease in lot size
2. Load balancing
3. 3P (production process preparation) (production process preparation)
4. Complete fruitful upkeep (TPM)
5. Customary work
6. Integrated feedback
7. Business strategy alignment
1. Processes for ongoing improvement are included in 8.
8. Good systems
9. System of corrective action
10. Project administration
11. Process design
12. Pull system

Knowledge exchange

An organisation will be able to identify what and where adjustments are required once these mechanisms are in place. The visual workplace may then reflect and communicate these advancements.Meeting daily performance targets, drastically cutting lead times, and improving quality are all dependent on the visual workplace, which is a compelling operational need.

A visual workplace is a self-organizing, self-explanatory, self-regulating, and self-improving work environment. A workplace changes as it becomes more visually appealing—it becomes safer, better, quicker, and smoother.

A workplace with visuals in particular

With the help of high-impact, low-cost visual aids, it is organised, explains itself, shares crucial information about what to do and what to avoid, when to do it, and how to react if anything goes wrong.

Becomes self-improving as a result of visual devices' ongoing performance feedback

Visual Tools: The Spokesman for Your Operations a visual workplace is made up of a variety of visual tools developed by the workers.In a visual workplace, information is transformed into straightforward, easily understood visual aids that are put as near to the point of usage as is practical throughout the work process. The end result is a workplace that talks plainly and precisely about how to do error-free work in a safe, efficient, reliable, and timely manner. Lack of information is the issue. Production schedules, customer requirements, engineering specifications, operational procedures, tooling and fixtures, material procurement, work-in-process, and the thousand other details that are essential to the operation of the business on a daily basis are all examples of workplace information that can change quickly and frequently. To maintain work current, correct, and timely, literally hundreds of informative transactions are needed every single day.

In quality reports, SPC graphs, management briefings, team meetings, and weekly and yearly reports, data may be found everywhere. Data are everywhere at work. However, we cannot make wise judgments and advance the business and its employees if we cannot comprehend the meaning of the data.

The easiest technique to determine how much of a visual work environment is both lacking and required is to estimate the amount of information deficits (missing answers). The Visual Factory using Lean Tools. Lean is a collection of tried-and-true methods and techniques (shown in the "house of lean" schematic in Figure 4.1) that aim to enhance operations and activities via standardization, fast repetition, and transparency. The visual work environment—also known as the visual workplace or the visual factory increases the efficiency of lean tools by:

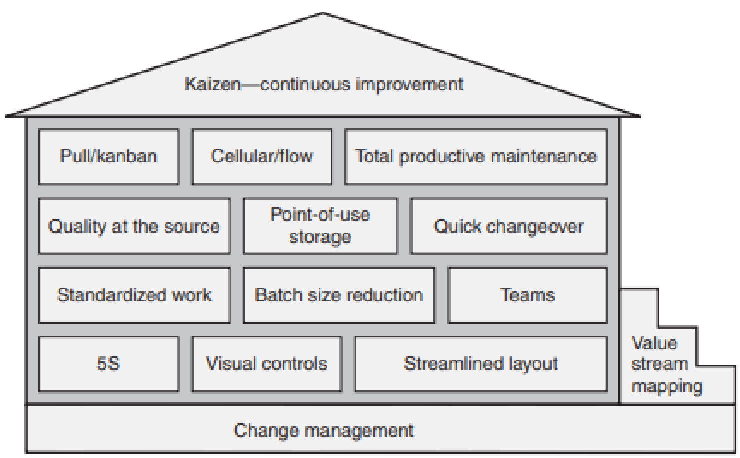

Figure 4.1: The house of lean.

Placing all tooling, components, production operations, and indicators in plain view to enable quick communication and confirmation of system status

Labeling and posting commonly used tasks, workstations, supplies for material storage, and related diagrams and papers

Simplifying and standardizing the workspace design so that team members may access the relevant data without unnecessary detours or pauses in the flow of work.

Lean and Six Sigma methodologies both make use of various visual controls and indicators as a component of the visual factory. In actuality, the techniques are interrelated and only work when they are accessible to the operators and clearly stated where they will be used. Visual controls, a lean technique, are mapped to the control phase of a Six Sigma project in Table 4.1. Dashboards and control charts are two types of visual controls found in the visual factory.

Table 4.1 Lean Six Sigma tools.

DMAIC phases	Six Sigma tools	Lean phases	Lean tools
Pre-project	Project scoping Project prioritization Project plan	Pre-project	Project scoping Project prioritization Project plan
Define	Project charter Team charter Stakeholder analysis SIPOC, cross-functional map Voice of the customer Tollgate review	Analyze	One-piece flow Value stream mapping Spaghetti diagram Teams Run charts Benchmarking
Measure	Data collection plan Identify key metrics Gap analysis Process sigma calculation Capability study Control charts Tollgate review	Plan improvement	Error-proofing Visual controls Total productive maintenance Streamlined layout
Analyze	Pareto chart Ishikawa diagram Five whys Run charts Relations graph Correlation Regression analysis Hypothesis testing Tollgate review	Focus improvement	Visual display 5S Value stream mapping Root cause analysis Five whys
Improve	Brainstorming Mistake-proofing Design of experiments Pugh matrix House of quality Failure mode and effects analysis Tollgate review	Deliver performance	Kaizen Kanban Changeover reduction Point-of-use storage Standardized work Failure mode and effects analysis
Control	Control charts Process sigma Dashboards Balanced scorecards Storyboarding Tollgate review	Improve performance	Visual controls 5S Continous flow and cell design Quality at the source Balanced scorecards

The visual factory initially appears in the early measure phase of the Lean Six Sigma programme, as indicated in the table, and it continuously develops to include the determined metrics, improvements, process controls, and work flows:

An enormous adhesion mechanism. The tens of thousands of informational exchanges that take place at work every day are translated into visible meaning via visual aids.

From simple signage reminders to complex mistake-proofing systems, visual devices can show status (on time, process running, help needed), share work priorities (as in a work priority display board), prevent defects, provide order on the plant floor (through clear borders for WIP and deliveries, along with person-width borders for easy access), and of course do much more.

The use of visual gadgets that are simple to understand and accessible to everybody is the key to a visual workplace. In comparison to a spreadsheet of numbers, a written method, or no information at all, it is simpler and more efficient to immediately perceive and respond to occurrences inside a process when images, colours, forms, and other visual cues are included. Colors are used to readily distinguish between different volumes, statuses, and other conditions.

Visual workspace may be used in everyday life as well as in high-tech industrial and service environments. An employee picture ID badge serves as a visible cue to prevent visitors from entering the workplace, mingling, and endangering employee and data security. The majority of regular work that is recorded employs a visual work flow so that the operators may properly understand the process. A document's watermark feature may be used to tell if it's controlled or uncontrolled, a draught, or an old version.

Inspection tags of different colours indicate whether a product is "good," "junk," "on hold," etc., avoiding the shipment of subpar goods to customers and the overprocessing of already flawed goods.The Toyota andon board is perhaps the most well-known kind of visual workplace. When a process is paused, this visual display alerts the group leader, supervisor, or maintenance with a light that indicates the particular process step and sometimes with an audio alarm. A visual depiction of the state of the production/process is the andon board. Some andon boards include scrolling LED message boards that provide employees with information on the current production rate, total production, production variance, operational equipment efficiency, production targets, and takt time. Large flat-screen monitors are being utilised increasingly often in production and service environments as a result of falling technological prices. On the screen, the displays may be changed in real time. Flat-screen monitors are also replacing the marker boards and grease boards that emergency departments formerly used to keep track of their patients.

The utilisation of stack lights is another kind of visual workspace. The machine-mounted light contains red, yellow, and green LEDs. Green denotes uninterrupted, regular production. Yellow means assistance is needed by the operator. Red means that production has ceased. At any point, the operator may flash yellow to signify attention and request assistance. To fix the problem and stop it from happening again, the line supervisory staff should provide support and document the incidence. As was already said, service firms also use visual management.To represent the material levels of different components in inventory, material planning also makes use of a variety of visual tools. Visual controls may be set up to cause the restocking of components, materials, or processes using the visual signs of green, yellow, and red. On the assembly line, in the warehouse, and in the office, visual controls may be used for material planning to manage reorder points and reduce inventory levels.

A kanban card is used as an efficient visual signal when a pull system is developed to start manufacturing of parts and components of an assembly process when they run out of stock. Another visual management system that can visually warn a subassembly process when to generate components may be made using kanban cards.Visual management may be used in the service sector to show when more resources are required for the task at hand. When a client queue reaches a certain length, systems like this one may be used to add a bank teller, checkout clerk, counter associate, and other employees. Doctor's offices, hospitals, schools, and many other locations employ simple color-coding procedures as a file management tool to speed up information retrieval.

The same color-coding method is used in inventory management systems to help staff members identify certain components and supplies in a warehouse or storage area quickly. A colorful diagonal line may be used to rapidly show if important paperwork or manuals aren't where they belong. Such techniques may be used in maintenance areas or businesses that are required by law to have important documents on hand in case of emergency or audit. Workers who maintain equipment utilize visual controls to indicate whether it is "up," "down," or undergoing preventative maintenance. To avoid accidentally using equipment that, if utilized, may endanger the operator and the equipment, they also employ "lock out tag out" (LOTO) gadgets in high-risk regions. Signs that warn an employee of work dangers are placed in hazardous places.

Visual devices have a wide range of industrial applications. Manufacturing control valves include an image of them facing the right way when they are "open" so that workers can see if the valve has been accidentally closed by someone. Setting limitations on analogue gauges is another common use. This is a sheet of paper that has been cut out that shows the operating range sector of the gages circular. This will assist the operator in remaining within the operating range or determining when maintenance is needed on the device. There are audible alarms and LEDs that may offer a comparable signal for digital gauges. Standard work may demonstrate visible flaws to aid in the training of new inspectors and to validate the goods while being inspected. Visual control using various coloured tags is utilised to separate learners from competent specialists during employee training. In locations where operations are anticipated to have an output rate depending on takt time, visual hour-by-hour charts are used. Particularly in processes where flow has already been established, they are applicable. These graphs show the anticipated output for a certain pitch. Employees may use this tool to rapidly determine if a process is performing as planned and to record the causes of deviations. Color coding may increase productivity by highlighting problem areas (for instance, green for output that meets expectations and red for production that doesn't).

The only restriction on the visual workplace is your creativity. The goal is to make it simple and accessible for all workers to compare actual performance to anticipated performance. The goal is to concentrate on the process and identify areas that need attention.The visual workplace has its drawbacks. Management and staff members are required to react to the visual cue. Any effective visual system will be useless if someone ignores an alarm light, management does not address a lost production issue, warehouse staff does not replenish the depleted stock, an operator ignores a visual defect and moves on to the next process, or employees choose to disobey a safety display and enter the danger zone unprotected.

CHAPTER 5

Design for Six Sigma (DFSS) Methodologies

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Organizations must consider various features and expectations when designing products, going beyond basic functioning and customer demands. This all-encompassing approach to design will provide a more reliable and stable product that not only represents client preferences but is also able to be utilised and applied by the intended user in the designated context. Typically, we refer to using Six Sigma throughout the product development design phase as "design for Six Sigma" (DFSS).

In order to meet the "customer's" expectations of quality and performance, the definition of DFSS includes the following:

DFSS is a business/engineering strategic process that emphasises proactive design quality rather than reactive design quality.

DFSS is a systematic process to create produce-able designs by reducing and managing variation.

The most frequently used acronyms in DFSS are DMADV (define, measure, analyse, design, and verify) and IDOV (identify, design, optimise, and verify). Other acronyms include DCOV (define, characterise, optimise, verify), ICOV (identify, characterise, optimise, and validate), DMEDI (define, measure, explore, develop, and implement), IDDOV (identify, define, develop, optimise, and verify), and GD1 (good design).

These are connected to DMAIC and aid in closing the loop on process or product improvement during the initial design for Six Sigma phase. It is often mentioned that doing IDOV feeds the MAIC of DMAIC when the most popular tools are employed in the different stages. The problem is that before a product really exists, it should be designed utilising the different Six Sigma technologies.

No matter which acronym you choose, scoping projects for DFSS may be difficult, as it is with many Six Sigma applications. Keep in mind the following:

1. Insufficient scope—capture enough control elements to ensure robustness (three or four are not enough).
2. Ambiguous scope—no mention of a subsystem.
3. Using different projects for every ailment.
4. Spending too much time on grading systems for jobs or other things.

Use robust, create robust, and maintain robust.

Being extremely explicit about what might happen to your product in the customer's hands should be one of the main priorities of a DFSS project. Noise is defined as elements of the production process or client use that are beyond your control. To enhance a process, you must allow for a noise strategy. The likelihood that a client may abuse your product increases if it can be done (i.e., voice of the customer [VOC]). The team's deployment of too few control elements is often the primary issue in DFSS failures (around the noise in the systems). Before teams seek for chances for continuous improvement, parts are often already created.

The following are advantages of DFSS for your company:

1. Greater customer satisfaction, as measured by the Kano model;
2. Less variation;
3. Robust design;
4. Lower warranty costs;
5. Improved reliability and durability;
6. Greater market share;
7. Greater revenue and earnings growth;
8. Greater production—less production downtime for defects.

The two primary DFSS methods now in use are described in further depth below.

The four phases of IDOV are identify, design, optimise, and verify, according to IDOV Woodford2. Measure, analyse, improve, and control are the first four steps of the classic Six Sigma improvement approach, or MAIC. The comparisons are shown below.

Determine Phase. The activities in the identify phase connect the design to the customer's voice.

• Identify the needs of the consumer and the product.

Identify technical needs, crucial to quality (CTQ) factors, and specification boundaries. Establish the business case.

1. Responsibilities and roles
2. Milestones
3. Creating Phase. The tasks in the design phase stress the following CTQ variables and attributes:
4. Create a concept design; use failure mode and effects analysis (FMEA) to identify possible hazards; and provide design parameters for each technical need.
5. Use DOE (design of experiments) and other analytical techniques to identify CTQs and their impact on the technical requirements.
6. Plan procurement, raw material, manufacture, and integration (transfer functions)

Optimisation Phase In order to forecast performance and improve design, the optimise phase creates certain design elements:

1. Optimize design to reduce CTQ sensitivity to process factors

2. Assess process capabilities to achieve important design parameters and fulfil CTQ restrictions
3. Design for robust performance and dependability
4. Optimize sigma and cost; establish statistical tolerancing; and error-proof
5. Validation Stage. In the validate phase, the design is tested, validated, and information for design improvements is recorded:
6. Assess performance, failure modes, reliability, and hazards. Prototype test and validation.
7. Iterative design and phase review

DMADV

According to Breyfogle, the DMADV (define, measure, analyse, design, and verify) technique is preferable to the DMAIC approach when a new product or process has to be created. Or maybe the existing, optimised product or process still doesn't satisfy client or/and company requirements.

In the past, it has been discovered that the redesign process is a typical source of waste that may be decreased by improving the initial design process. The process of designing with a certain characteristic in mind is known as "design for Six Sigma":

1. Specify. The Six Sigma team must assess and rank the main design goals for the company before starting a design endeavour. The design efforts will have the greatest potential effect on reaching Six Sigma objectives by focusing on the top priorities.

2. Calculate. This calls for a technical and competitive product management study, identifying the design criteria that the market and the consumer value the most. In addition, authorities, partners, and other stakeholders have expectations that must be met.

3. Examine. Design priorities may be determined with significance and confidence using the statistical and investigative techniques employed in Six Sigma projects.

4. Artwork. The Six Sigma team must work with designers to guarantee that the final design outputs include the necessary qualities after obtaining a clear direction for the design goals. The achievement of Six Sigma design goals will be included into the development and testing processes and entrenched in the overall solution if they are viewed as requirements or specifications.

The Six Sigma design goals would have to be included as a layer without this method, which might be costly and wasteful.

4.1 Consider cost (also known as Design to Cost). Cost has evolved into a key factor in the design process in the majority of markets. This necessitates a continuous search for substitute procedures, components, and techniques. The design team may get help from those with expertise in cost accounting and buying.

4.2 Design for Assembly, Design for Manufacturing, and Design for Producibility

Numerous businesses have discovered that making little design adjustments may simplify and reduce the cost of manufacturing a product. Tolerance design may lead to cost reductions in gauging, tooling, and machining operations. Designers should be conversant with the tools and procedures used in production today and work to create things that don't need any new technology. Some businesses have discovered that a good strategy to save manufacturing costs is to drastically decrease the number of pieces in a product. Generally speaking, a design is more producible the sooner production workers are engaged in the process.

Design for Test (4.3) (also known as Design for Testability). Designers must plan for testing early in the manufacturing cycle for goods where in-process testing is essential rather than only relying on functional tests of a final assembly or subassembly.

Design with maintainability in mind. The process of designing must take frequent maintenance into account. Long diagnostic and repair periods for a product might force the user to miss deadlines and alienate clients. Modularity, decoupling, and component standardisation are all aspects of maintainability.

4.5 Create robust designs. All components, subassemblies, and assemblies must be subjected to life cycle testing throughout the design phase.

The mean time to failure (MTTF) or mean time between failures (MTBF) for each product supplied by a supplier of acquired components should be documented.

For components that cannot be repaired, MTTF is utilised, and for those that can, MTBF. Failure rate and MTTF or MTBF have a fundamental link in this area: MTTF = 1/MTBF and, of course, = 1/MTTF or = 1/MTBF.

4.6 Usability-focused design. A product's quality is assessed via validation, which occurs when it is used for its intended purpose by its intended users in its designated environment. It is possible to gauge and enhance a user's comfort level while using a product, system, or service to get value.

4.7 Design with Extended Functionality in Mind. Many items that are originally created and intended for a specific use might have their features used to create new functionality that goes beyond what the original designers had in mind. Computer software programmes are an excellent example of a product that was first created for rapid mathematical computation and numerical tracking but is now a favoured tool for database administration, visual design, and word processing.

4.8 Use Efficiency in Design. The system or product has to be designed with the least amount of resource consumption in mind. This is similar to design for cost, but the assessment criteria here include time, resources, and crucial component usage. Reliability and cost over the long run will benefit from efficiency.

4.9 Design for Performance, abbreviated DfP. Performance is the constant, aggressive attainment of milestones or breakthroughs. Words like "latest and best" and "cutting edge" highlight the ongoing struggle of delivering at levels that were previously unreachable. Examples from the past include the development of aeroplanes that travel faster than the speed of sound and the ongoing development of microchips' processing capacity.

4.10 Create a secure design. As diseases like computer viruses, identity theft, and product abuse grow in reach and complexity, security is becoming a greater challenge. Protection of users' and designers' privacy as well as the integrity of the product will be ensured through security.

4.11 Create scalable designs. Products or systems introduced for use in a developing market should prepare for growth or quick acceptance. Without this feature, the product's quality will suffer if its user or scope threshold is crossed. During peak times, for instance, the auction website can abruptly go blank because it is unable to manage the strain of 100,000 concurrent visitors at month's end.

4.12 Create with Agility. Many businesses compete on their capacity to provide customised solutions quickly. This calls for a quick-thinking approach to fast development, a solid architecture or structural base, and a ready supply of parts or suppliers that can add distinctive touches to the basic product. As an example, consider a hot tub maker that seamlessly integrates a simple hot tub into the style and architecture of a building or landscape.

4.13 Design for Compliance: Regulations are placed on designers and must be met in order for the product to be commercialized. Compliance requirements might include things like reaching a certain level of product performance or proving that the right design procedures were used and documented. The fines and potential costs of noncompliance may be used to determine the cost-benefit of the DFSS program if it operates in a highly regulated environment. To maintain thorough and accurate documentation, one example of process design is to demand configuration management updates each time the product is altered.

4.14 Confirm: After the design is complete, it is important to confirm that the results achieve the design goals. A traceability matrix connecting the design goals to the design outputs may be used to illustrate this.

Analysis of Basic Failure Mode and Effects

The study of risk, which is at the core of a failure mode and effects analysis (FMEA), has developed into a multidisciplinary area of research with several resultant risk techniques. Risk is all about how unpredictable a situation is. Another way to put this is to say that risk is concerned with potential outcomes, both good and bad, that could have an impact on how things are done at work, with the product or service, how a customer might use or misuse your product or service, or any other problem that management may find to be of concern.Three further ways to characterize risk are effect (severity), probability (occurrence), and event (detection).

The Risk Control Memory Jogger outlines a Risk Road Map for ISO 31000:2009 that includes: Planning risk management Tools for risk identification. Plan risk responses, analyses and assess risks, and monitor and manage risks:

The ideas behind what we now refer to as failure mode and effects analysis have existed for a very long time under many names formerly known as failure mode, effects, and criticality analysis and are consistent with the principles outlined in the Risk Road Map. In the past, product designers and innovators considered potential reasons why a product can malfunction under difficult handling and use. In order to avoid these failure types, they began offering countermeasures throughout the design and production processes. FMEA subsequently began to develop officially.

FMEAs

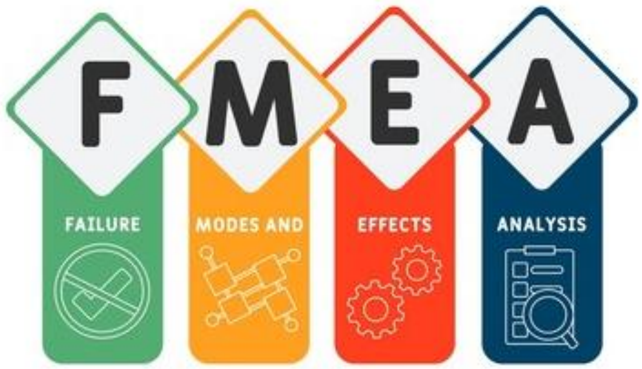

Figure 5.1: FMEA.

The idea of employing a risk matrix to examine a specific issue is not new in many businesses' thinking today (see Figure 5.1). The FMEA technique was pioneered by the automobile industry. The main goal of an FMEA is to identify the issues that are most likely to fail (at the idea, design, process, equipment, or system level). The proverb "a stitch in time saves nine" certainly holds true in this situation. We have a far higher chance of anticipating and preventing events or scenarios that might cause our company a negative problem if we carefully consider the forthcoming process and properly set it down on paper (or in a software system).FMEA was defined by the AIAG as a systematic set of actions meant to:

1. Identify steps that might prevent or lessen the likelihood of the possible failure happening
2. Recognize and assess the potential failure of a product or process and the repercussions of that failure

Understanding the chances of failure and the effects of risks in a product or process design, prioritizing the risks, and taking steps to minimize or lessen their effects are the goals of automotive design FMEA (DFMEA) and process FMEA (PFMEA). A front-end tool is FMEA. Identifying potential failure modes and taking steps to prevent or decrease failure throughout deployment and life cycle are essential for successful product/process development. The product/process design team must regularly evaluate and update the failure modes since FMEA is not a one-time activity. The team identifies the risks in the early phases of the creation of the product or process using data from current, comparable processes, knowledge, and experience. There may be new, unanticipated dangers and failures when the product/process is distributed. Consequently, ongoing FMEA evaluation assures continuous success. The website www.effectivefmeas.com has a variety of FMEA checklists that Carlson included in his book.

FMEA should be recorded, subject to revision control, and integrated into the current quality management system (QMS). FMEA is connected to the deployment of quality functions in the design and process "houses of quality" and to control plans in the production house of quality in a well-designed QMS. The FMEA is thought of as a living document, which means it should be updated as necessary and the revisions regulated to monitor changes over time. As a result, part of this document management procedure is required.The fact that FMEA is not limited to industrial applications is another important component of the utilisation of the FMEA risk management concept. The application of FMEA in service/transactional operations, software development, the medical industry, and other areas has been very successful.

Following the completion of the FMEA, you should observe some of the following advantages or uses:

1. Considered the impact on all clients (internal and external)
2. Assists in analyzing needs and options

Assists in validating the intended design, manufacturing, or assembly process; Documents the results of the design, manufacturing, or assembly process; Identifies confirmed special characteristics requiring special controls; Identifies potential design, manufacturing, or assembly cause issues that need to concentrate on controls for reducing occurrence and/or increasing detection; Develops a prioritized list of actions (ongoing as a living document);

FMEA is known as design FMEA (DFMEA) and process FMEA, even though it is often undertaken to address possible failures in product design and process design (PFMEA).

FMEA Tables and Forms

The conventional FMEA structure is a straightforward matrix that is easy to replicate using a spreadsheet tool. As your team completes the procedure, specialized software tools are also accessible to aid in the creation of the form. If you are not acquainted with this tool, speaking with your organization's quality manager or quality engineer may be helpful. Specific forms may be needed depending on the industry in which you operate. Today, the column headings for design FMEA and process FMEA are two examples of commonly used headers.

Performance of an FMEA

Since a team approach has been shown to be the most efficient way to carry out an FMEA, it is covered here. Form a multidisciplinary team with expertise in the process, the product or service, and the demands of the consumer. Design, production, quality assurance, reliability testing, maintenance, buying (and suppliers), shop floor operators, sales, marketing (and clients), and customer service are often involved. Both process and design expertise should be present when conducting a design FMEA. The team should consist of five to seven members for efficient interaction. Subject matter specialists are added to the team if more expertise are required to provide feedback on safety, regulatory, or legal problems.

The FMEA flowchart is a diagram that depicts the fundamental steps of the FMEA process. This demonstrates a straightforward three-step method for organising your thoughts while you work on an FMEA. This flowchart's placement on a standard FMEA form. One important thing to keep in mind as your team completes the various columns of the form is that there are no absolutes. If disagreement occurs, think about finding a middle ground for the time being (possibly making a note for additional research later on) to prevent the team from getting bogged down in the process as a whole.

Amount, Frequency, and Detection

A score determination must be made for each of the three main areas of severity, occurrence, and detection as the probable failure modes are identified by the cross-functional team. In accordance with what each phrase means, you must assess each failure mode according to the score table you are employing (such tables may be found in the J-1739 or PFMEA-4 standards, online, and a few are on the CD-ROM disc). Some tables that are used in manufacturing organisations may be rated from 1 to 10, while others can be scored from 1 to 10. Having tables that are tailored to your particular organization's and industry's demands is important in this situation. This might necessitate reliability engineers or quality engineers creating business-specific tables for your requirements using warranty data and other information from inside your firm.

The team has to choose the from the identified table that most accurately represents their expectations. This might include a problem that, if utilised poorly, would hurt employees or customers; the severity of such a problem would then range from 9 and 10, depending on how severe the injury would be. You often look at previous instances when the problem may have arisen, and bigger numbers are produced by more frequency. Therefore, an event that occurs every day may have a number between 8 and 10. The numbering in detection often follows severity, with the lowest probabilities of actually detecting anything producing the highest numbers. Therefore, if an operator can clearly notice the mistake every time it may occur, the score would be low.

Number Priority of Risk

The risk priority number (RPN), which is created by multiplying the severity, occurrence, and detection (S-O-D) three values together for a certain failure mode, is then determined by the team. Since some organisations want the severity number to take precedence over the total RPN, this number serves as the starting point for determining which failure modes should be handled first (you will need to study the regulations for your industry about how to apply the RPN). A Pareto diagram of the different RPN values may be made after the full FMEA is finished to determine which failure modes have the most potential to cause problems in your firm. The cross-functional team should utilise the far right column on many FMEA forms to indicate when steps have been made to address a specific failure mode in order to lower the overall RPN as part of the team's ongoing effort to identify potential problems before they arise. The FMEA should be seen as a live document as the team continuously works to avoid difficulties in the design/process using the FMEA as their guidance. As a result, a road map of continuing work for constant improvement initiatives may be established. As a result, the team should come together frequently to update data in the FMEA and determine where extra efforts may be focused to enhance the process as a whole.

Process FMEA and Design FMEA

The FMEA approach has several applications the compatibility and interoperability of many of these manufacturing processes (idea, design, process, machinery, and system). To this number, which is contained in the ERM systems already mentioned, we may also add "management". All of this comes together to form risk management, which is what your organisation must do in order to be registered to one of the ISO management system standards (9001, 14001, 45001, and 50001).crucial point to keep in mind while differentiating between the design and process FMEA. You should think about producing a concept FMEA first, then a design FMEA, and finally a process FMEA. In a manufacturing environment, it's common for there to be neither a concept FMEA nor a design FMEA, thus the engineer or management must make do with what they have to produce a process FMEA without fully understanding the design purpose.

Designers and process engineers should utilise design FMEA to consider potential problems with producing designs or drawings in a certain approach as opposed to other options. Design FMEA is about the product design. Additional injuries may arise if we build a tyre jack that is prone to slipping while a flat tyre is present and being utilised by the vehicle owner. As was previously said, your company can save a tremendous amount of time and money by going through the design FMEA in these early phases before tooling is cut and final processes have been developed. Design FMEAs may be performed at many levels, such as the system, subsystem, or component levels.The development of the manufacturing process layout, whether for the production or assembly of parts or components, should start with a Process FMEA, which examines the shop floor manufacturing process. We may also observe manufacturing or assembly at several levels in this case, such as system, subsystem, or component levels.

FMEA for Design and Process: Differences

It is important to first take notice of what the header block states about the sort of FMEA you are looking at while examining an FMEA to better comprehend the process.The kind of FMEA, such as design, process, or another system-level document, should be explicitly stated in the heading. The techniques for examining and finishing the forms are comparable, as was previously mentioned. The way the FMEA is used inside the company will vary between design and process FMEAs.With the exception of the name in the header block and the spacing of some of the columns, the overall formats used by AIAG PFMEA-2 and SAE J-1739 are extremely similar to one another. On the CD-ROM disc, examples of each are provided for further reference. There are several software programmes available for going through the FMEA process, and many individuals utilise an Excel spreadsheet to build their FMEA forms.The majority of the DFMEA and PFMEA debate, which is applicable to any service business, was focused on a manufacturing firm.

CHAPTER 6

Managing Value with Design for Six Sigma

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Design's primary motivating factor is value. What a fascinating idea. This seems like a straightforward principle to follow when creating new features or products. It's one of the most challenging regulations for a business to adhere to. Every corporation that places product and service designs at the core of its long-term business should adopt this heuristic. It is not because obtaining value from the customer's voice is difficult or overly ambiguous.In actuality, the procedure is effective and efficient thanks to a variety of processes. An exceptional comprehensive design that speaks to client wants with weight and importance may be created by good marketing and design experts by extracting that voice. For a variety of reasons, including lack of time, pet projects, politics or corporate culture, inadequate processes, and funding, businesses struggle to extract value as a driving function. Although I'm sure there are more, they are the ones I encounter most commonly.

Taking Value Out

Value extraction is not a science of engineering. Value extraction is not only a marketing science.

The type of value analysis that would place their items in the market is not even performed by many marketing departments. The corporate marketing machinery that succeed in the market game are often the winners. They control the market with items that gain market share and have an impact on their standing. Utilizing an analytical value model will at the very least enable a company to position itself in the market using criteria other than share and volume. Share is the benchmark for market acceptability, but in our data, it often appears late or not at all.Real winners use value metrics to determine market acceptability, identify gaps in the market's perception of the offering, and guide their companies in making the best judgements on market performance and product modifications. Sometimes gauging consumer value judgements prompts a business to pursue new design.

Value Assessment in the Market

In the value formula, we've established value, quality, price, and dimensions of quality. In order to compete effectively against rivals, we must do it at a level that we can measure. In reality, our goal is to fully comprehend the value proposition in the market so that we can build or develop around it. That is the objective and the point at which Six Sigma's statistical measures start to matter quite a bit. We'll then approach these ideas abstractly and start working toward a quantifiable understanding of them. To perceive each of them as relative elements of the big value formula, we shall abstract them all. Now, we will base our business and R&D decisions on the value and quality of our goods and services.

Identifying the Design's Objectives

Let's discuss the kinds of designs we may strive towards in order to better understand this idea. In a quality-based market, I will outline three different sorts of intrinsic motivations for our designs. Fit to standard quality comes foremost. It is linked with the calibre of quality consumers anticipate receiving when they purchase a product. When you purchase a candy bar, you anticipate that it will be sweet. When you purchase a vehicle, you anticipate that it will have tyres. The transaction is often lost when clients are shocked by a flaw in a product's ability to meet standards.Fitness to use quality is the next tier of quality purpose. Fitness for use refers to a standard of quality that the consumer has expressly requested. Customers often see or imagine a product they like and ask for it in that particular version. Customers obviously don't anticipate having power seats in a car, but they often ask for the feature since they have seen it in other cars.To remain competitive, all businesses continue design efforts for this level of excellence. The other manufacturers hurried to provide a comparable solution when Ford released cruise control in the US a couple of years ago in order to remain competitive.

Every designer strives for the degree of quality purpose that is the highest.

Every design engineer aspires to work on projects of this kind. Each and every buyer looks for this calibre of product. Fit to latent expectation is the term used to describe this collection of elements, which are often referred to as "surprises" and "delighters". Most businesses have confirmed to me that user-friendliness and standard compliance take up between 85 and 95 percent of their design time. They invest considerably more time in fitness to standard efforts alone when the market is mostly commodity-based. Unfortunately, the more time a company spends concentrating on fitness to standard, the more probable it is that it will continue to do so and permanently be concentrating on margin.

Those design efforts may just as well be referred to as "fitness to margin." In this scenario, the technical teams' morale starts to decline, followed by the marketing teams' morale, and eventually the firm starts to slowly deteriorate toward being a lifelong business in managing margins. The car maker described previously is a perfect illustration of this. Many businesses succeed in this role for many years, but they seldom leave it without a resolve to increase the quality of both their current offerings and the quality of their future creations.On the basis of their value proposition, these sorts of designs may be successfully sold. A recent and excellent illustration of this reality are palmtop computers. The first really functional and durable palmtop computers were the outcome of its efforts. While the modem industry often descends into generic competitive conduct, it continues to flourish. By improving these designs and emphasising their worth to the client, Palm Computing keeps improving the value proposition it offers to its market.

By not just increasing margin on cost-related problems but also adding value by including quality that consistently satisfies customersmore power, more fuel economy, cleaner emissions, and fewer repairsCummins continues to retain a solid connection with its industrial purchasers.With a robust R&D strategy, testing facilities, and a continual awareness of the market environment, Cummins oversees its design efforts.By enhancing the chicken's quality, meat-on-the-bone content, colour, and brand recognition, Frank Purdue of Purdue Chicken fame generated value in the market for his chicken many years ago. As a consequence, the consumer had a higher sense of quality.

More chicken was offered at a greater price by Purdue. That is something usually stress: More chicken at a greater cost!

Using the customer's voice to influence design

The first step is to initiate a conversation about capturing the voice of the customer (VOC) and transforming those demands into significant design requirements. The consumer must always be at the centre of the effort while doing this. The responses would be rather diverse if we were to ask the various departments of a corporation what was crucial to a new product design project. Sales is concerned with features, service, and support; R&D is focused on functionality and performance; finance is concerned with cost; production may be unduly focused on the assembling of a new product.

Let's first think about where these views came from. Because they develop functionality as their job, R&D personnel value functionality. Sales may earn more commission on service contracts than on the actual product, while finance is concerned with the cost of scrap, rework, and warranty claims. This is only an illustration, but it illustrates the point that, despite our desire to believe that the company's design is united, each department is motivated by distinct factors. We need a method for controlling and balancing all the crucial variables that are active.

If we pay attention to client feedback, it will meet all internal voices' needs if it is effectively mined from the customer base. Whether they are aware of it or not, those in charge of a design project always want the best outcome for it, and they want a list of design concerns (requirements) to be prioritised and weighted. Because it is frequently necessary to make trade-offs and difficult choices in order to meet these criteria, financial and resource limits often come into play.

The design team is forced to concentrate on what is important by constraints including time, money, human resources, manufacturing capability, and competitive pressures. A weighted and prioritised list of the design criteria is essential since we can't achieve everything. The design requirements should mostly come from customer feedback. The many additional groups and stakeholders that help the design team act as encouraging outside voices. Although we must pay attention to the internal opinions of the company, the most pressing question is whether we also consider the opinions of our exterior customers.

On a side note, it's still important to moderate the excitement for completing internal departmental goals from the perspective of value and growth. We cannot disregard the fact that these internal divisions are responsible for and have important influence on the product, whether it is in the design stage or the stage after launch. The What/Who Matrix is an easy-to-use tool for handling these obligations. This sophisticated method aids in internalizing through departmental responsibility the value criteria outlined in the value/quality analysis. The criterion might be any set of criteria, or we could utilise Garvin's eight dimensions.

Utilizing Concept Engineering

The important challenge is choosing an approach for promoting these concerns while identifying the most feasible, market-conscious, and inventive ideas we can after value, quality, and consumer voice have been established as the guiding principles for our work. In reality, we must make sure that our procedures are well-documented and demonstrate a careful and deliberate approach to the market, the client, and the objectives of the business simultaneously.

The process of product development, as a whole, regulates this. Concept engineering is one of the finest methods I've ever seen for incorporating client feedback into the product development process. I have probably seen a number of "revolutionary" techniques that "unleash originality" and "add enthusiasm" to new designs only in the last year. I detest describing design methods with these types of terms.

People who claim to be thus enthusiastic about teaching others their "ways" often have doubts about the effectiveness of their own methods. Because they haven't truly seen their own process through to completion on anything big, they exaggerate it. For one and only one reason, many techniques seem hollow to me: They prominently emphasise market research after the design is finished as proof that the client has been taken into account. They apply the build-test-fix paradigm. In other words, the most effective method of gathering voice is to show a model or concept to clients for feedback after initial design. That is attempting to convince clients to support an internally focused design, not voice extraction.

A case study on satellite/cellular hybrid phones was just given to me. As you undoubtedly already know, in 1999, the biggest corporation in this industry filed for bankruptcy. The firm was informed internally that many business personnel would be happy to have a mobile phone.n this expensive project, the client and the market were hardly taken into account. It's still fair to say that "it's not that we manufacture such awful automobiles; it's simply that they are such lousy consumers," according to a car industry executive from the 1930s. With the intention of selling them to commercial customers, the corporation created this system of satellites, phones, and beepers. Along the way, it overlooked the fact that business customers on mobile phones don't care how their calls are connected just that they are.

Cellular tower construction was significantly simpler and quicker in most industrialised nations than satellite construction. In comparison to, instance, Siberia, the satellite/cellular corporation was far more interested in positioning satellites over the United States. In actuality, the market was in Siberia, a region devoid of both tower-based cellular networks and phone lines.

These phones were crucial for use in distant regions, offshore oil rigs, and ships.

In contrast to New York, where you had to be outdoors and in clear view of a satellite, there, you could request and get $7 a minute for satellite calls. On a pricey day, tower-based cellular airtime costs less than 50 cents per minute. In its last days, this manufacturer began hearing remarks such, "Analysts worry whether [Company X] forgot to flesh out its marketing plan in its drive to deploy satellites in space." The most revealing criticism is ultimately the one that many design-based businesses have heard when they fail: "What they didn't do was concentrate on, evaluate, and pay attention to the market they could serve. Both significant (technical) successes and spectacular (voice of the customer) failures were experienced by. (Clarissa Bryce Christensen, consultant to the space industry). The voice of the market and the consumer would have made all the difference.

This example shows the value of idea engineering. This methodology's care in ensuring that customer voice is honoured at all stages and checkpoints of the product development process is what I enjoy about it. In the 1980s, it was developed by MIT in collaboration with Polaroid, Bose, and other companies. By putting the needs of the customer at the centre of the endeavour, it has undergone an evolution of adjustments and enhancements since that time (by virtue of its goal, it is ever self-improving) that have made it a reliable and solid approach for discovering design requirements. It applies the techniques covered in this book, which will only briefly describe here.

1. Methods for Concept Engineering
2. Getting ready for client interviews
3. team interviews with customers
4. Image KJ
5. Requirements Translation of the KJ Requirements
6. deployment of product-level quality functions (QFD)
7. Idea generation
8. Pugh Concept Choice
9. Deployment of lower-level quality functions

The two techniques that are most often used by businesses are QFD and Pugh Concept Selection. Concept engineering (CE), a methodical and well-considered approach, places these tools in a bigger framework. In fact, since it is so thorough, several engineers have informed me that they believe it is overkill because "most" of the information derived from the process is already known to them. The goal and benefit of CE is to ensure that all necessary requirements for the design project are covered in full. Additionally, it guarantees that you evaluate market worth using the logical, high-quality data you've worked on. I'm not sure why, but design engineers, production engineers, and other R&D employees often shy away from speaking with customers. I propose two broad explanations. The first is a widespread aversion to wasting important "design" time by asking clients for this information. Second, there is a culture that permeates every business where someone, usually a leader or a dominating member of the design team, declares, "I know what the client wants. Since we have been doing this for so long, we don't need to undertake all of this customer-focused work. Additionally, I am in command since I am already aware of the demands of the client and because I have some fresh ideas that I am certain the client would like. You could nod in agreement that this occurs to some extent in your business.

Being careful with your clients has a quality component that you cannot overlook. Because of this, CE begins with loosely organised, Likert-scale-based consumer interviews. Instead, they are concentrating on gathering details, use photos, and emotional information from the client. Following a thorough set of customer interviews, this data may be used in KJ analysis to create a meaningful collection of weighted customer concerns. Jiro Kawakita, a Japanese anthropologist, is known by the initials KJ. He asserted that if mathematicians can organise and prioritise variables' data, we should be able to do the same with characteristics' and languages' data. Some individuals envision an affinity diagram when they examine the KJ diagram's findings. It is much more than that, in fact. The thing that makes the "product" special and distinctive is the process that leads to it. There isn't enough room to fully describe the process here, but I will say that it is highly rational and intuitive, and by the time you get to the conclusion of a KJ, there is never any disagreement. The KJ connects the crucial customer goals to team comprehension and agreement, making this organisation of VOC data crucial to a team working on a design project. The benefit is that if someone wants to modify the project's course three months into the design process, the KJ acts as the customer-focused milepost that keeps the team on course.

The Picture and Conditions KJ combines the sounds and visuals of user wants that were spoken by clients and recorded by designers during client interviews. The pictures (and context). As a supporting component that confirms customer need, usage and need) are included to the Requirements KJ. The design team transforms the customer's "expressed requirements," which now have weight and importance, into language and descriptions that the product development organisation can understand when the KJs are completed. We often use translation worksheets that combine the declared need context with the imaged usage and need context. Utilizing Quality Function Deployment, the important (ordered by weight and priority) client demands are finally translated into technical requirements.

The significance of maintaining comprehensive CE self-documentation and the data collection cannot be overstated. If the documentation for a CE project is thorough, no one will be able to approach the team and undermine the work in favour of their "expert" judgement of what is required without a customer-championed struggle. I've made my case enough to maintain thorough records for a finished CE project. The secret to getting it right and keeping the team focused on what is factual rather than what is opinion is data, genuine consumer data.

Once the customer's needs have been translated, we can begin the process of concentrating on the most important criteria, matching them up with the value analysis we conducted previously, and searching for parallels to other companies who have achieved superior quality in the same field. We will continue to employ Quality Function Deployment to accomplish this aim (QFD). With an additional study of the internal capacity to fulfil, QFD is a complete method for harmonising the aforementioned metrics and changing the needs from "generic and weighted" to "specific and weighted."

A solid QFD application should show us our present delivery capabilities as well as what we need to accomplish to meet the specific technical needs. For a visual representation of this application, see Figure 6.1.

Effectively combining market data, customer input data, and internal capability data, QFD creates a practical set of key needs that are both precise and specific. We often restrict the scope of QFD to those challenging, novel, and innovative needs. We may utilise concept ideation as a creative method to come up with a variety of ideas to satisfy the criteria after we have a viable set of specific, important requirements—both those that are common and those that are novel, tough, and fresh.

The aim of concept ideation is to generate a large number of creative design bases, evaluate them against the specific requirements list, and then, using the Pugh Process of concept selection, combine the best aspects that exist within them. The graph in Figure 6.2 shows what we are attempting to do by coming up with a lot of beneficial notions and then narrowing them down to the most practical one or two to present to our clients to see whether we are on the right road.

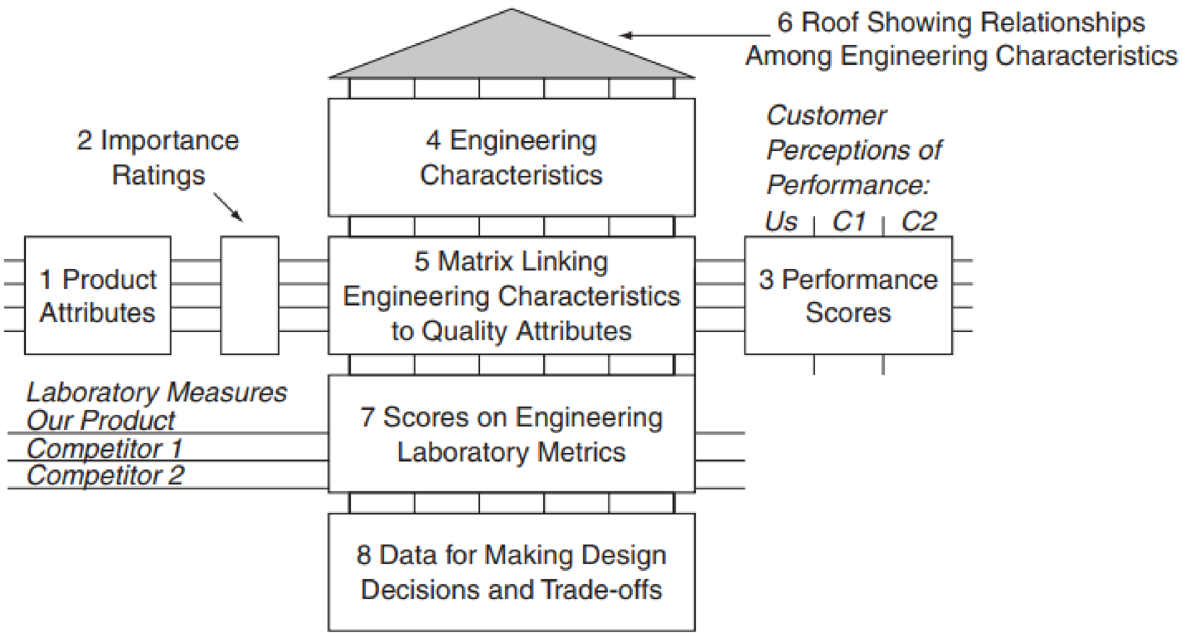

Figure 6.1: QFD: The House of Quality

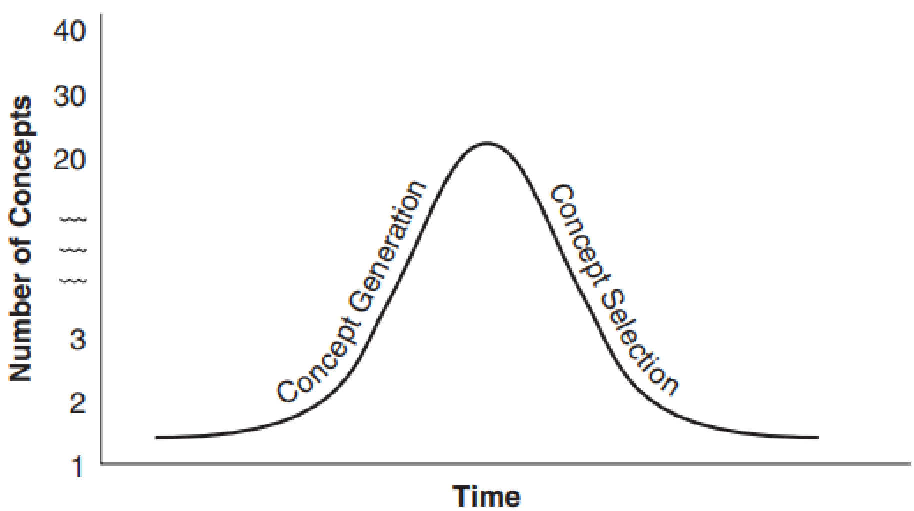

Figure 6.2: Concept Engineering Cycle

Concept ideation, defined simply, is the process of sitting down with the needs and creatively coming up with several approaches to satisfy each requirement. You begin combining the possibilities into a notion once you have many answers to each condition. You continue doing this until you have a number of ideas to compare to an already-available best-in-class product or an earlier design. With the Pugh Process concept selection, you may combine all these cutting-edge design ideas into the greatest and most practical option. We may choose a second round of QFD from the Pugh Process to ensure that the particular, comprehensive client needs that were translated into design requirements are fully translated into the chosen, better design. The emphasis is on practical specifications that the design team can comprehend.

CHAPTER 7

Introduction to DMAIC

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Access to a wide range of methods for solving business problems. Professionals with experience in problem resolution will each have a preferred approach. Some early instruction could be necessary for those with less operational excellence or continuous improvement experience. The information that follows should be helpful to you if you fall into the latter category, but it is still worthwhile to explore all your choices. The well-known five-step procedure known as DMAIC is one prominent strategy used expressly for project-based process improvement. Define-Measure-Analyze-Improve-Control is represented by the letters DMAIC. As seen in the Figure 7.1 below, DMAIC is a data-driven improvement cycle or framework that divides problem solution into five parts. Key tasks, tools, and templates are utilized to set up and carry out a problem-solving activity at each phase. Although DMAIC is utilized as the basis for GO Productivity's Lean Six Sigma Greenbelt training, this framework may be seen as a standalone Six Sigma technique.

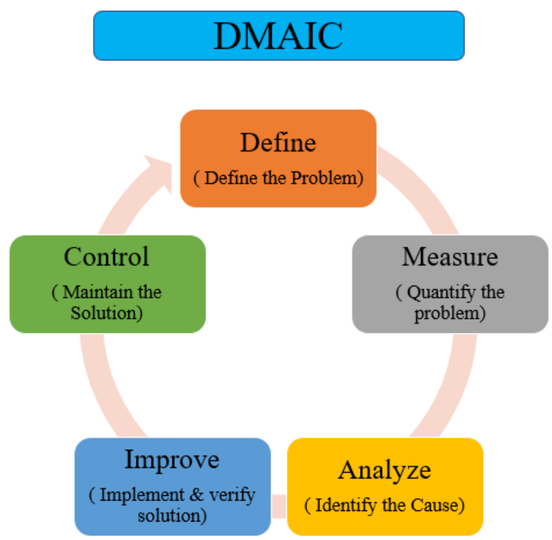

Figure 7.1: Representation of the DMAIC Process.

Define: Describe the issue, the client base, the objectives, and the desired procedure. Tools for DMAIC Define Phase:

1. Stakeholder analysis
2. Voice of the customer to critical to quality translation

3. Voice of the customer matrix
4. Measurement
5. High-level process map (SIPOC diagram)

Measure: Choose the parameters that need to be quantified, determine the best method for doing so, gather the necessary data, and conduct the measurements through experimentation. The tools for the DMAIC measure phase:

1. Juran's pareto analysis
2. A data collection plan
3. Detailed process mapping
4. 6s
5. Value stream maps

Analyze: Identify discrepancies between actual and desired performance, ascertain their reasons, ascertain how inputs into processes affect outputs, and priorities improvement opportunities. DMAIC Analyze Phase Tools:

1. Sigma Level Calculation
2. Graphs and Charts
3. Stratification
4. Histograms
5. Box Plots
6. Scatter Diagrams
7. Cause and Effect Diagrams
8. Failure Mode and Effect Analysis
9. Impact Control Matrix
10. Brainstorming

Improve: Create prospective solutions, determine the best options to use, test speculative solutions, and put improvements into practice. By this time, the group will: Come up with alternate remedies, create the solution (including plans for culture and control), establish the solution's efficacy and Put the solution into practice. The tools for the DMAIC Improve Phase:

1. Brainstorming
2. Solution Matrix
3. Barriers
4. Aids Chart
5. Pugh Matrix
6. Pilot Study
7. Error Proofing
8. Benchmarking

Control: Create a thorough solution monitoring strategy, monitor successfully implemented changes, regularly update plan records, and keep a functional employee training schedule. In order to do this, the team must: Identify control subjects, create a control measurement, create performance standards, measure actual performance, compare actual measured performance to standards, and act on the difference. Tools for DMAIC Control Phase:

1. Control Charts
2. Process Control Plans

Six Sigma DMAIC methodology's effects:

A framework is provided by the Juran Roadmap and the Lean Six Sigma DMAIC approach to help organizations achieve high quality, long-lasting results, and financial gains. They achieve this by:

Ensuring that quality thinking becomes the norm in business, putting the customer first, and cultivating client loyalty.Making use of tried-and-true quality tools to enhance products and services and reach ground-breaking results. Establishing performance indicators for quality processes that relate to company objectives.Establishing a quality culture that is enjoyable and offers a practical means of enhancing process quality. Finding initiatives to drive development that will produce high-caliber outcomes that are sustainable.

The DMAIC methodology serves as a roadmap to keep the group and project progressing effectively. The DMAIC phases are frequently referred to as the "boss of the project." Despite having a team leader, the steps ultimately rule because they must be followed in order to finish the job. Skipping a phase could result in financial waste, unneeded culture conflicts, and unsuccessful solutions for the organization. Process improvement can be carried out in a way that is systematic, long-lasting, supported by data, and in line with stakeholder and customer quality expectations by adhering to the Six Sigma DMAIC approach.

Define Phase

Project outlines: The Six Sigma Project Charter, which is depicted in Fig. 6.1, provides a summary of the project's official plan and authorization. A contract between the project team and its sponsor is contained in the project charter. Therefore, any modifications to the crucial components of scope, objectives, or timetable need to be approved by the sponsor and agreed upon by the team. The following components are included in the project charter, which outlines the why, how, who, and when of a project:

a. Problem statement
b. Project objective or purpose
c. Addressing the business need
d. Scope
e. Deliverables
f. Sponsor
g. Stakeholder groups
h. Team members
i. Project schedule
j. Other resources required

These things are mostly connected; as the scope grows, so do the timeline and the deliverables. Many initiatives start off with a too broad scope, whether they are recommended by operational staff or started by management. The tangible costs of project deployment, such as those related to labour and material use, will rise as the project cycle time grows. The Define phase is the first stage of the Six Sigma DMAIC cycle. Project definition or, as we might say, the establishment of the project's overall framework occurs at this phase. In this phase, the team is established, stakeholders are determined, and consumer voices are recorded. The main objective of this phase is to make sure that the project team members are concentrating on the business issues. The project managers seek to define the goal and parameters of the project during this phase. In order to increase output quality, Six Sigma is applied in five high-level processes. Define is done initially. Four main tasks are carried out in the Define phase.

1. Project Team is Being Formed
2. Carry out two tasks
3. Decide who should join the team

Choosing the right team members can be challenging, particularly if the project spans a wide range of disciplines. It might be a good idea to divide such projects into manageable chunks and work toward completing a number of staged projects.

Customers' Core Business Processes Documented:

Each project has clients. The target audience for process improvement is a consumer who receives the good or service. Every customer has a single need or a number of demands from their supplier. There are prerequisites for each demand that is addressed. The qualities of the need that determine whether the consumer is satisfied with the good or service offered are known as the needs. So, note consumer wants and pertinent specifications. There is a documented list of business procedures. In order to satisfy the needs of the client and address any Critical to Quality issues, these steps will be put into action.

Create the project charter:

This document identifies the project, provides a concise statement outlining the business case, and lists the project's scope and objectives. The following elements make up a project charter:

a. Project title
b. Business argument
c. Project horizon
d. Project objectives
e. Milestones
f. Specific conditions
g. Unique presumptions
h. Project team roles and responsibilities
i. Create a SIPOC process map.

A process is characterized as a sequence of actions that accept inputs, add value, and provide an output.

The SIPOC process map identifies each of the following project components:

Supplier: A person who supplies inputs to a process.

Input: Materials, data, and other resources required to carry out a process are known as inputs.

Process: The organized actions that turn inputs into outputs

Outputs: Outputs are the goods or services produced by the process.

Customer: Receiver of the outputs is the customer.

For locating, the SIPOC process map is crucial. With the use of the subsequent steps, SIPOC is a table that records the process, output, client, input, and supplier in a table format.

Specify the procedure: Determine the procedure for which SIPOC will be developed. As a group, identify the procedure.

Specify the procedure steps: A process is a planned series of steps that typically adds value to the inputs in order to produce outputs for the consumers. A high-level process flow should only have up to 7 phases; any more makes it difficult to understand. Use an affinity diagram to condense complicated procedures into a handful of essential steps.

List off the results: Products, services, and/or information that are beneficial to the customers are considered outputs. This encompasses anything that is delivered to the customer, such as goods, materials, or services.

Identify your customers: Customers are the people who use the products that the process produces. Customers may also be internal stakeholders; they are not always external to the company.

Determine the Inputs required for the process: Identify the materials, services, and/or information needed for the process. Inputs are what the process uses to create the outputs. An input is essential because the output is impacted by the variation in the inputs.

Identify the Suppliers: Suppliers contribute to the process by providing inputs. Internal suppliers are also covered, in addition to external ones.

Validate the diagram: before going on to the process improvement step. Once it is finished, share it with all pertinent stakeholders.

Measure Phase

Based on the project inputs, the Measure phase takes between two and three weeks to complete. The participation of all important stakeholders, in particular, is crucial for obtaining high-quality data. The measure phase focuses on gathering data, validating the measuring system, establishing a baseline for the present process, and assessing the process capabilities. The Measure phase of six sigma offers a variety of concepts and tools.

Process Defined & Fundamental Tools:

Process map: A process map is a tool that visually depicts the inputs, steps taken, and outputs of a process in a step-by-step flowchart. The flowchart shows how inputs (X) and outputs (Y) are related (Y). Make a process map of all the steps needed to transform raw resources into output (Y), after which you may pinpoint the aspects that are crucial to quality (CTQs). Process maps make it easier to spot process waste or inefficiencies. This aids in identifying the crucial procedures for data collection.

Value stream mapping: Value stream mapping gives the movement of resources and information throughout an organization a visual depiction. All the non-added and added values needed to produce the product are included in value stream mapping. It consists of the steps taken to get the product from the raw ingredients into the customer's hands.

Spaghetti Diagram: A spaghetti diagram, commonly referred to as a spaghetti chart, illustrates the fundamental movement of people, goods, and paperwork during a process.

Matrix of Cause and Effect: During a root cause analysis, a cause and effect matrix establishes the relationship between the process input variables and the customer's outputs.

Data Collection: Actually, the measure phase is all about gathering as much information as you can to gain a clear picture of the issue. The team must therefore make sure the data collecting method for measurements is reliable and exact.

Data Types: A set of values for qualitative or quantitative variables is referred to as data. Numbers, measurements, observations, or even simple descriptions of objects are all acceptable. The categories of quantitative data are listed below.

Discrete data: If the measurements are counts or integers, the data is discrete. For instance, the quantity of customer complaints, statistics on weekly faults, etc.

Continuous data: Data is continuous if the measurement can take on any value, typically falling within a range. Stack height, distance, cycle duration, etc. are a few examples.

Data Coding: Data can sometimes be coded more effectively by adding, removing, multiplying, or dividing it by a factor.

Data coding techniques include

1. Substitution
2. Truncation

Data Collection Plan: This focused strategy aids in avoiding collecting data merely for the sake of collecting it.

1. Develop operational definitions
2. Specify data collection objectives
3. Design a sampling strategy
4. Choose and validate data gathering techniques

Prepare for and start the data collection process.

In general, a data collection form is a technique to document how the data needed for the study were obtained. The information should also be gathered using a calibrated device, a consistent data collection form, and trained operators.

Checklists for data collection: A check sheet is a technique for gathering data that typically pinpoints the locations and frequency of faults in a good or service. It was created especially for the kind of process being looked into.

Measurement System: This section's goal is to help you recognize and comprehend the components of variation resulting from the measurement system so you can utilize the right tool for the job, based on the sort of data you have.

Data Types for Measurement System Analysis (MSA): The Gage Repeatability and Reproducibility (R&R) studies are performed for continuous data type, and examine the following:

a. % Tolerance
b. % Contribution
c. % Number of Distinct Categories

The Discrete Data Analysis (DDA) for discrete data is performed for accuracy, repeatability, and reproducibility.

Phase-by-process capability measurement

The inherent variability of a process, when there are no unfavorable special factors and the variability is caused by common causes, is what is meant by a process's capacity.

Two categories can be used to classify process capability:

Short-term Capability: A process's potential performance that is currently under control. Calculated without the effect of other factors using data collected during a brief period of time (i.e. temperature change, shift change, operator change etc.). The true process capability is short term capability. Short-term capability describes the process's technology.

Long Term Capability: The process's actual performance over time. Calculated using data collected over a sufficient amount of time for outside influences to be possible. Long-term capability is a combination of your controls and your technological capabilities.

Measure DMAIC Deliverables Phase

a. Process capability and sigma baseline.
b. Process capability and sigma baseline
c. Detailed process map
d. Data collection strategy
e. Obtained data

f. Results of measurement system analysis
g. Graphical analysis of data

Analyze Phase

The phase entails examining the issue to ascertain its underlying cause. This enables the Six Sigma project team to address the issue more deeply and permanently. This entails looking into what causes product failures, for instance, in a manufacturing process. This is also referred to as variance, and it is something the customer does not desire.

Tools for Finding Potential Causes:

During the analyze phase, all potential reasons are sought out. The good news for teams is that this is Six Sigma. They can employ methods to eliminate the element of speculation when identifying plausible causes. The most popular equipment for performing this is listed below:

Process map: This flowchart displays the process as it is right now. This indicates that all the steps, actions, inputs, outputs, and other information are depicted exactly as they are for a better understanding of the process. By observing the process changes, the team is able to envisage potential causes.

Fishbone diagram: The team can organize likely causes into relevant categories using a fishbone diagram, also referred to as a cause-and-effect diagram or an Ishikawa diagram. The fish's head represents the issue that is now being encountered. Each spine bone stands for a particular group. The potential causes are then put as lines to each bone.

Analyze Phase Data and metrics are analyzed using a variety of techniques:

Trend Evaluation: This statistical technique sheds light on the quantity of clients or things concerned throughout time. It is employed to forecast upcoming trends and modifications in consumer behavior.

Comparison: To determine how well you're doing, compare your process to that of another business or an industry standard.

Histogram: A histogram is a graphical display of data that makes use of bars to show how values for a specific variable have varied over time or space. It can be used to spot outliers and other irregularities in your data set that could affect the outcomes of your analysis.

Scatterplot: A scatterplot is a type of graph that displays the relationship between two variables by charting them on an X-Y axis system, where X stands for one variable and Y for another. This makes it easier for you to find correlations between two sets of data and predict things using those correlations. However, it only works well when the two variables plotted together have a distinct link.

Causation and Effect: This approach entails determining all potential causes of an issue then ranking each one in order of likelihood. After you have identified all of your potential causes, you may choose which candidates based on their likelihood and their potential impact on your business processes are likely to benefit from improvement initiatives.

Survey Technique: Poll customers and stakeholders to learn what they believe needs to be improved. This will assist you in choosing a starting point or a course of action.

Methodology Utilize in the Analysis Phase:

Prior to the adoption of Six Sigma, it was customary for businesses to first identify their problems before rapidly launching into finding solutions. However, the Six Sigma strategy is data-driven and process-focused. First, a statistical problem is created from the business problem. The statistical problem is subsequently solved, leading to a statistical conclusion, using the data gathered during the measure phase. This statistical finding directs the proper course of action, which is subsequently implemented in a very controlled way.

Sources for the Analysis Phase

Identification of the potential few crucial inputs to the process under improvement is one of the inputs received by the analyze phase. For instance, if a process for maintaining automobiles is being improved, key inputs that can make it to the analysis stage include worker technical expertise, the location of the service, the amount of time needed for the service, and so on. These facts serve as the basic data.

But more information is required than just this list. Six Sigma experts are limited to simply looking at such lists. The measurements gathered when the process was in operation must also be accessible for each input that has been designated as crucial. The Six Sigma team will be able to demonstrate the crucial inputs quantitatively as a result.

Results of the Analysis Phase:

The results of the analyze phase are as follows:

1. A list of the statistically supported confirmed key inputs.
2. A list of the important inputs that were rejected along with the supporting statistics

Six Sigma is more effective than any other quality tool because of the meticulous, methodical methodology it uses to identify problems. The Analyze phase's and Six Sigma's fundamental characteristic is their reliance on facts.

Stage of DMAIC Goals analysis:

1. Use measure data to determine the likely reasons of the issue.
2. Use brainstorming, the five-why method, and other strategies to determine the true root cause.
3. Determine the critical root cause with the greatest impact on CTQ.
4. Use appropriate statistical methods, such as hypothesis testing, to confirm the root causes.

Improve Phase

The Improve phase is the final stage of the DMAIC cycle. The team now begins addressing the issues that were first identified in the first three stages' underlying causes. It is regarded as the most creative stage of the cycle because no statistical analysis is done during this time; instead, people try to come up with innovative ideas to solve problems. By implementing workable solutions to the problem's underlying causes, its main goal is to eliminate variability in the process. After the answers are found and put into practice, the target performance is improved while reducing variability. The 'Improve' phase activities include: Identifying particular inputs that are affecting the process' outputs.

1. Coming up with remedies to get rid of the problem's primary causes.
2. Validating the important inputs and solutions.
3. Improving crucial inputs and evaluating the solutions put in place.

Improve Phase Tools

The following are some tools and methods that can be helpful during the Improve phase:

Failure Mode and Effects Analysis: The 1940s saw the introduction of Failure Mode and Effects Analysis (FMEA), which instructs teams to list every potential point of failure for a process. The majority of organizations give special consideration to mistakes or flaws that affect the client. It aids in identifying process flaws that may have gone unnoticed in the past. Teams can use it to manage risk while they examine potential solutions during.

Stakeholder Analysis: The team must be ready for resistance to some of its solutions from employees and managers as they get closer to the moment where they will present them to the company. As crucial to success as any technical aspect of the process is getting buy-in. The team assigns each stakeholder a ranking based on their position and attitude toward change during the stakeholder analysis process. It gives a brief outline of the individuals they should spend the most time teaching about the significance and advantages of making data-driven changes.

Kaizen Event: A Kaizen Event is a practical method for quickly putting the best solutions into practice. For a limited period of time, stakeholders and subject matter experts come together to concentrate solely on selecting the best options from those generated by the project team. These occasions typically last three to five days.

Poka-Yoke: As fixes are implemented, error-proofing controls, or Poka-Yoke, can either stop mistakes from occurring or catch them as soon as they do. This enables adjustments to be made before a mistake results in more severe harm.

5S: The 5S cycle is employed in Japanese enterprises to get rid of wastes that cause mistakes and accidents at work. The five stages of the cycle, all of which start with the letter S in Japanese, are referred to by the abbreviation 5S. Seiri, seiton, seiso, seiketsu, and shitsuke are their Japanese names, and when translated into English, they mean:

Sort - go through your belongings and keep only what you need while throwing away the rest.

Straighten- Everything in its place, and everything in its place.

Shine: Cleaning frequently serves as a pre-inspection step that reveals anomalous and early-failure situations that could compromise product quality or result in equipment failure.

Standardize: Create systems and procedures to uphold and keep track of the first three Ss by standardizing them.

Benchmarking: An additional tool for the Improve phase is benchmarking. This method compares several aspects of a particular process to the best practice in order to calculate various attributes of that process. This enables the team to create strategies for putting such best practices into practice, usually with the goal of improving some performance-related traits.

Benchmarking can take several forms: Process benchmarking is when a company bases its interpretations and analyses on business processes, utilizing the best practices of one or more benchmark firms as a point of reference. It will be necessary to analyze the activity in order to scale efficiency and cost.

Financial benchmarking: It is the process of conducting an economic study and comparing the findings with the outcomes in an effort to assess the overall level of competitiveness.

Performance benchmarking: It is comparing a company's product and service to those of a rival.

Product benchmarking: Finding a product's strengths and limitations in order to develop a new product or provide a new service.

Strategic benchmarking: It involves keeping an eye on how other market participants compete. This style doesn't focus on any one individual business but rather takes a broad view of the industry.

Functional benchmarking: A company will focus its benchmarking on a single function in order to enhance the operation or procedure for that specific task.

DMAIC goals' phase of improvement

a. For the discovered root cause(s)
b. Determine workable solutions.
c. Using statistical tools,
d. Choose the optimal option.
e. To assure demonstrable changes in the process
f. Perform a cost-benefit analysis
g. Test the solution
h. Evaluate its efficacy.

DMAIC Phase Improvement:

Based on the time needed to implement the solution and the resources available, the Improve phase lasts about 8 to 10 weeks. Support from top management is especially important for allocating funds and resources for putting solutions into action. The list of improvements has to be identified and given a priority during the Improve phase. Developing an implementation strategy, carrying out a test project, and assessing the success of the adopted solution. The Improve phase of six sigma offers a variety of concepts and tools.

Control Phase

The Six Sigma DMAIC model's final step is called "Control." The major goal of this phase is to make sure that all the things developed and the advances made in the DMAIC cycle's "Improve" phase are kept long after the project is complete. Through the usage of the Define phase, one gets a clear understanding of the process and where it requires modification before this phase starts. Data are gathered in the "Measure" phase, then evaluated to identify the underlying reasons in the "Analyze" step. A workable solution is also discovered in the "Improve" step. The team's journey and the DMAIC cycle both come to an end at the 'Control' phase. In compared to the DMAIC cycle's earlier phases, this one does not require as much statistical analysis, but it is still crucial to the success of the project. The following activities take place during the Control phase:

1. Setting up SPC and other controls, such as quality assurance.
2. Retaining composure.
3. Maintaining advancements.

Several tools are used in this stage. The following are the tools that are most frequently utilized at this phase:

1. Total Productive Maintenance (TPM),
2. Total Productive Maintenance (TPM),
3. Statistical Process Control (SPC) and Visual Factory
4. Lean Tools (5S, Kanban, Kaizen, Poka-yoke)

Based on the presumption that all processes are subject to fluctuations of some kind, the SPC is used. These variations' primary causes can be divided into two groups:

Common (chance) causes of variation: They are usually on a small scale and are inherent or natural to a process. It is challenging to locate and eliminate from the process.

Particular causes of variation: These variations are primarily of a big magnitude and are brought on by some special causes. It is simple to recognize and eliminate from the process [1].

Charts for variable (continuous) controls

Utilize a continuous scale to measure the output. The qualities of a product's quality can be evaluated.

X bar: R Charts for X Bar (when data is readily available) The X bar R chart is used to track the efficiency of a continuous data process and the data that will be gathered in subgroups at predetermined intervals.

Run Diagrams: A run chart shows the changes in observed data over time. Simple graph that shows data values in chronological sequence.

MR Charts for X: When data is continuous and not gathered in subgroups, an individual moving range (I-MR) chart is utilized.

X bar: S Charts when the subgroups have a high sample size and the S chart offers a better grasp of the dispersion of subgroup data than range, X Bar S charts are employed.

EWMA Graph: The Exponentially Weighted Moving Average (EWMA) chart is used to track variables that utilize the whole history of an output.

The four methods applied to process control plans:

1. Standardization
2. Documentation
3. Monitoring plans
4. Response plans

Standardization: To ensure that everyone who is responsible for execution has the same understanding, the "should-be" process steps must be standardized.

Documentation: By having it recorded with appropriate work practices, documentation ensures that the learning obtained via improvement is institutionalized and disseminated across the team. Live processes frequently have a propensity to develop haphazardly. Most of the time, it is up to the individual how to complete each process activity, therefore a large portion of organizational knowledge is only held in the collective thoughts of all those in charge of execution. A procedure is the written list of the steps and other instructions required to complete an activity for a procedure.

Monitoring Strategy:

Monitoring: It aids in the detection of process changes as they happen and ensures that advancements continue to hold for us to be able to satisfy customer requirements throughout time. As a process is being observed, a monitoring plan aids in defining:

Important process and output metrics for continuing evaluation of the enhanced procedure

Define the process for acquiring, storing, and reporting on the measures, including the timing and frequency of data collection.

Response Plan: If a change in the process is seen during monitoring, a response plan can help determine the necessary next steps.

DMAIC Control Phase Objectives:

1. Create a control plan
2. Validate the solution implement it

3. Conduct a cost-benefit analysis
4. Formally close the project
5. Celebrate success
6. Thank the team.

DMAIC Control Phase Overview

The Control phase lasts for about two to three weeks. The creation and updating of standard works or work instructions is done during the control phase. Calculate the savings in dollars and acquire the financial controller's approval. Utilizing control charts, devise and deploy a process monitoring system. Prepare a control strategy and response next so that it can continue to function as a process control and monitoring mechanism. Obtain management permission, update lessons learned, officially close the project, and then turn the process over to the process owner. There are numerous concepts and tools accessible in the Control phase of six sigma.

CHAPTER 8

Introduction to DMADV

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The client and their CTQs are the main emphasis of the DMADV framework. The voice of the client must be heard and understood whenever feasible, but in order to improve our ideas, we may sometimes need to go beyond it. In keeping with the concepts of Lean Six Sigma, management by fact and not assumption, like with DMAIC, ensures that new designs reflect client CTQs and provide genuine value to the customers. Projects using the DMADV framework often focus on bringing about radical transformation inside an organisation. To support the transition, a well-thought-out change management program is essential. Elements of Change Model offers a framework to handle and manage the numerous people concerns that are crucial to the project's successful completion.

DMADV is a Design for Six Sigma (DFSS) methodology that focuses on customers and on developing the ideal product or procedure the first time around. To develop an objective specification that produces a solution that satisfies the needs of the client, the needs must be quantified. There is a precise technique to monitor progress: by developing an objective specification with quantifiable characteristics. The DMADV approach, which stands for "Define-Measure-Analyze-Design-Validate," as shown in the Figure 8.1. The approach initially adheres to DMAIC's first three steps, but deviates in the final two steps by adding Design/Redesign and Validate steps to achieve the desired changes. This strategy avoids issues by utilizing strong and high-quality design principles.

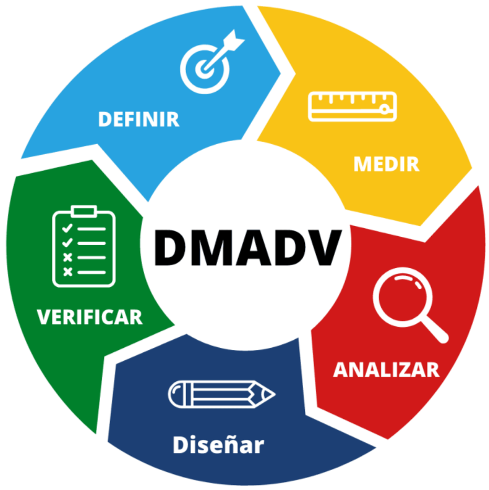

Figure 8.1: Representation of DMADV Process.

Define: The demands and wants that project managers believe clients value the most are identified. The historical data, consumer reviews, and other information sources are used to identify wants and needs. Teams are formed to lead the process, and consumer input is used to build metrics and other testing.

Measure: The second step of the process involves using the established metrics to gather information and document requirements in a way that can be used to guide the remaining steps.

Metrics are allocated to each procedure necessary to successfully manufacture the good or service in the future.

Technology teams evaluate the metrics before using them.

Analyze: Internal teams test the finished product or service produced by the manufacturing process to establish a benchmark for improvement.

Leaders use data to pinpoint process adjustments that will result in improvements to the final product's or service's production process or quality. Teams implement final procedures and make necessary revisions.

Design: Customers' demands and needs are compared to the findings of internal tests. Any further modifications are made as necessary.

Before the finished product or service is widely distributed, the improved production process is evaluated and test groups of customers provide feedback.

Verify: The methodology's final step is ongoing. The procedures might be changed as the product or service is launched and client feedback starts to flow in.

Metrics are improved in order to monitor ongoing client feedback on the good or service

Since there may be more modifications brought about by fresh data that need to be addressed, the original procedure might result in new DMADV applications in related fields.

DMADV utilizes the following techniques:

1. Promotes efficiency and effectiveness
2. Eliminates interchangeable designs
3. Adopts the six-sigma rule
4. Sets priorities in accordance with client requirements and services
5. Examines and assesses the processes' design in light of the product's service.
6. Monitors outcomes and upholds performance

DMADV's primary benefit:

1. It maximizes customer happiness.
2. Increases revenue.
3. Reduces the number of errors.

DMADV's drawbacks include:

1. Six Sigma employee training takes time and can occasionally be pricey as well.
2. The biggest drawback is that invention and originality are prioritised over.

Identifying What Requires Design:

Defining, organising, and planning your project's path are all part of the Define phase. Understanding the goal, justification, and business case is crucial, as is understanding who you may need to turn to for assistance and how you intend to manage the situation. Therefore, it's crucial to comprehend the project's limits, including the procedures, market(s), consumers, and stakeholders involved.Making sure that you and your team have a clear grasp of why the project is being done and what it is aiming to accomplish will be a crucial component for success. Making ensuring that such understanding occurs is the main goal of the Define phase.

Make sure the appropriate departments and roles are represented when you first gather the proper personnel. All too often, this isn't the case, and the project's definition and scope suffer as a result. Starting a DfSS project by using the affinity and interrelationship diagrams may be very beneficial. These methods provide a means of assembling the team and eliciting their varied concerns, concerns, and agendas before assisting in the identification of the essential areas for the project's success. Importantly, completing the two approaches gives the team members a sense of engagement and ownership in the project.

Obtaining the design's measurement

Since it establishes the framework around which the design may be constructed and the foundation for the design choices required in subsequent stages, the Measure phase is crucial. This phase concentrates on identifying and comprehending client wants, and it's crucial to comprehend the various customer groups. A thorough grasp of these is a crucial starting point for DfSS initiatives since they often aim to optimise the design of goods or processes across numerous client needs.

The next stage is to convert these demands into quantifiable qualities (CTQs), which constitute the general specifications for the product, service, or procedure. The objective is to completely comprehend the client needs, provide the appropriate metrics, and establish goals and specifications for the CTQs.When creating new goods or services, you must ensure that the design can be produced using current processes or that new processes can be created to support the new design. A distinguishing feature of DfSS is that process capability is taken into account now, rather than after the design is finished.

Examining the plan

The goal of analyse phase is to create high-level designs and functional specifications. The detailed design is then created and tested throughout the design process.

The process of going from the "what" to the "how"—from the demands of the client to potential solutions—begins with analysis. In order to do this, internal functions must be mapped onto the CTQs, and alternative design ideas must first be considered.This study entails determining the core functionalities for a service and the important component qualities for a more physical product. Typically, the sub system components (parts) are established first, then the sub system characteristics.

Functions are the things a product, service, or method has to accomplish to fulfil the CTQs that were discovered and specified throughout the design process. Functions are best understood as important high-level operations to take into account in a service context. So, for instance, a telephone ordering service with a design objective of an order placement in five minutes may be the product or service being developed. The tasks at hand can include, for instance, "answer the phone," "check requirements," "check stock," and "put order." You must do an examination of the functions to comprehend their performance potential and guarantee that they are appropriate for the task at hand.

The production, analysis, and evaluation of a high-level design as well as alternative design ideas are heavily emphasised in DfSS projects.The best design idea is chosen and further developed in the second phase of analysis, which incorporates analysis and selection. High-level design criteria should be established for each design component after carefully considering each one in turn. The fit and interaction of the various components will also need to be taken into account.Typically, this process involves the creation of multiple high-level designs, evaluation of each one's appropriateness, and selection of the best match.

To determine how competent the design is of fulfilling the CTQ, you must evaluate performance and create design scorecards.When appropriate, assessments may be conducted using simulations, field testing, or pilots while including customers to get their comments.Design scorecards provide a methodical way to incorporate requirements into the design and evaluate the potential of a new design. At each level, they record the crucial performance indicators and keep track of the measured indicators as the design changes.

Designing the Project

There are two sections to the design process as well. It starts by elaborating on the "how" thinking. The goal is to gradually increase the amount of detail in the different components of the high-level design. The focus is on creating designs that will fulfil the process outputs' CTQ criteria.The design process is iterative; the high-level design was formed in the Analyze phase, and it is now described at a level of detail sufficient to be used for the creation and testing of a pilot. Although the degree of granularity is substantially less, the detailed design activities are comparable to those in the high-level design phase.

In this process, all the design components are combined into a single overall design.

The lowest-level specification limitations, control points, and measurements are then decided upon. These will serve as the framework for the control strategy that must be in place after deployment.

However, you must pilot the design before putting it into action. By creating a pilot in the second stage of the design process, enough information ought to be available at this point to test and assess the design's viability. You must carefully and realistically plan your pilot.

Confirming the design's functionality

The design is tested and evaluated during the Verify phase, and implementation and deployment follow, subject to any changes made after the pilot. Similar to DMAIC, the cycle's last stage involves evaluating the successes attained and the lessons gained.

The outcomes are checked against the initial CTQs, objectives, and specifications.

Only once the solution has been standardized and moved into operations and process management is the project declared complete.Make sure the handover to the process owner or operational manager doesn't have any gaps in it. For a shift that is well-planned and well-documented, you must collaborate closely with your team.

A comparison between DMAIC and DMADV

It is conceivable to begin a project using the DMAIC approach, only to find yourself switching to DMADV later on. The potential turning moments in switching from one strategy to the other.Many of the Lean Six Sigma tools and procedures that you are already acquainted with from DMAIC are required for DMADV projects. However, quality function deployment (QFD), a method that is sometimes referred to as the "House of Quality" due to its look, is perhaps the most crucial strategy (see Figure 8.2). QFD deserves its own book, much as DMADV, thus here we merely present an overview of this technology.

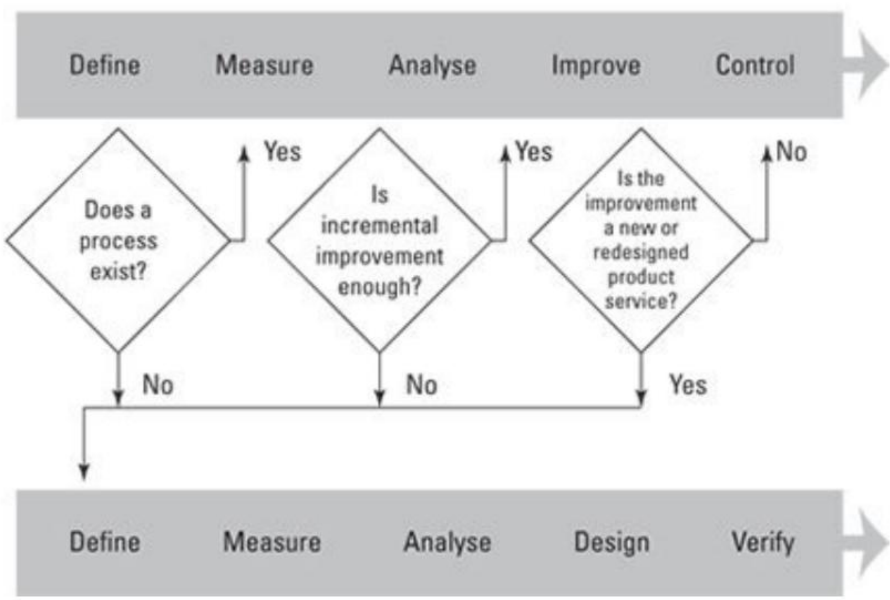

Figure 8.2: selection between DMAIC and DMADV

Taking Quality Function Deployment into Account

The voice of the consumer is ascertained via customer research. Research on competitors enables us to hear the voice of the consumer. Quality function deployment (QFD) assists in converting both voices into high-level requirements, and the CTQs, and in giving these requirements quantitative definitions, specifications, and objectives. In order to satisfy the high-level customer CTQs, QFD is also used in the Analyze and Design stages to provide specifications for the planned product, process, or service's lower-level features.

DMAIC and DMADV similarities

1. Employ organized techniques to lower variation and address issues
2. Gather information and analyses it to help you make decisions.
3. Having a customer focus, working in teams to solve challenges, and using a lot of the same tools (brainstorming, FMEA, DOE)

Distinctions between DMAIC and DMADV:

DMAIC focuses on the current process, whereas DMADV is concerned with the design process.

DMAIC (reactive) reduces/eliminates defects; DMADV (prevents defects) (proactive).

DMAIC contains particular solutions, and DMADV is a step in the process of designing solutions.

DMAIC has controls to maintain gains, whereas DMADV contains validation and verification of the final design.

A well-structured approach for improvement is offered by DMAIC and DMADV. They can assist assure the success of your LSS projects, which can lower costs and boost customer satisfaction, when used appropriately with the relevant improvement tools.

CHAPTER 9

Project Management Using DMAIC and DMADV

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As the project develops, information should be gathered continuously.The project manager should promptly share the information with sponsors and stakeholders since they often assist in maintaining or regaining the schedule.A formal, written report is one of the key tools for providing feedback. It gives context for recurring reporting to different stakeholder groups:

Status updates

formal, recurring written reports—often in a predetermined format—that describe the project's progress in relation to the strategy stated in the most recent widely published iteration of the Charter. The reports provide information on the root of the issue and remedial steps to bring project performance into line with the plan when it does not. Remedial action may sometimes include changing the strategy, pending sponsor approval. The status report will ask for senior management assistance if the project is not progressing according to schedule because of challenges that the project team is unable to solve.

Management reviews: These are planned meetings where the project manager will have the chance to speak with important management team members. Management has primary responsibility for these meetings.The goal is to update management on the project's state, go through the project charter and the team's objective, talk about management actions that might affect the team's development, etc. The team's experience with system hurdles calls for discussion in this forum:

While the team must operate within the current processes, management is empowered to make changes as needed. Sometimes a little system modification may significantly improve the team's capacity for growth.

Budget reviews: Although budget reports are included in each status report, a budget review is a formal assessment of actual resource use relative to budgeted usage. Budget revisions, either upwards or downwards, may also be part of the budget review process depending on changes after the first budget approval. There is a regrettable propensity for people who are not trained in the science of statistics to respond to each random tick in budget variations as if they were caused by a unique source of variation. To avoid meddling with the budgeting process, Six Sigma managers should train finance and management staff on the principles of variation (see Project Budgets for more information on budgets).

Audits of customers

In this context, the term "customer" refers to the project's primary stakeholder group's senior management. The client should actively participate in ensuring that the project stays on course to accomplish its stated goals since the project deliverables are created to satisfy their needs.

Changing schedules and plans:

Feedback's main objective is to provide information that may be used to change future behaviour. The project plans and schedules, which include information about that behaviour, must be modified in order to guarantee that the proper course of action is performed.

Resource redirection entails either raising or lowering the amount of resources allocated to the project, or speeding or decelerating the timeline for resource usage, depending on the changes made to the plans and timetables. Management should assess how these resource reallocations may affect other initiatives in light of the organization's overall goals.

Project Costs

Budgeting is the practise of allocating resources for use in the future. The term "project budget" refers to a list of project expenses that is segmented into several areas.The following project-related budget categories are listed by Ruskin and Estes (1995):

Typically, direct labour budgets are created for each task in the project plan, then added together for the whole project. To guarantee that the overall budget allocation is not exceeded, control is often maintained at the work element level.

Budgets may be expressed in terms of money or another kind of value, such the number of hours of direct work auxiliary services Budgets must be created since, in the absence of budgets, support services often bill according to real expenses, without making provisions for mistakes, rework, etc.

Making and sticking to budget projections imposes a discipline that often results in increased effectiveness and better standards.Budgets for bought things include spending on goods, tools, and services. Budgets may be based on agreed-upon pricing or market rates. Here, the same problems that apply to support services do.

Resources are set aside in budgets for future use. Nobody can accurately foretell the future. Tracking actual spending after the budgets have been created is therefore a crucial step in the budgeting process. Project managers are in charge of periodically assessing expenses, often in collaboration with their contacts in finance. Variance reports are often created to compare actual and planned spending. (The word "variance" employed here refers to accounting, not statistical, variance. The discrepancy between the budgeted and actual amounts is known as a variance in accounting. Statistical methods are needed to determine whether or not an accounting variance points to a unique source of variation.)

Variance reports may be presented in a number of ways. Simple tables that display actual against budgeted differences by line item, overall for the current period, and cumulatively throughout the project are the most typical. An allowance is often granted, for instance, 5% above or under is given without justification since it is doubtful that variations would be zero. To determine allowances and/or identify patterns or trends, it is preferable to plot historical data on control charts.

The project manager has to look closely at the variance data for any patterns that provide important information. The pattern should ideally have both modest positive and negative deviations. This pattern suggests a reasonable budget, that is, an accurate forecasting of expenses, assuming that it is accompanied by a project that is on track.Variances (direct labour, materials, etc.) should be assessed independently for each kind of budget. The key source of information on the project's resource usage status, however, is the variance report for the whole project.Overspending poses a major danger to the project and even the organisation itself since allotted resources are often limited. The resources available for other activities and projects are depleted when a project goes over budget.

The monitoring systems should be created by the project team, team leader, and sponsors in order to identify and address overspending before it becomes a danger to the project or the business.Overspending is often a sign of underlying issues with the project, such as paying more to "catch up" after running behind schedule or incurring more costs for rework, etc.

Spending too little may be just as harmful as spending too much. If the project budget was appropriately created, the spending should represent a certain timetable and degree of quality. Underspending could signify "shortcutting" or giving suppliers wiggle room for delayed deliveries. Any substantial deviation from the plan should be supported by an explanation.

Project Documents

Project records include information that is helpful both during and after the project. Project records are essential for three things: cost accounting needs, legal obligations, and educational objectives.Even if it isn't practicable to preserve all of the records in one place, they should be structured and kept as if they were a single database. There should be just one "official" copy of the documentation, and someone assigned to look after it while the project is ongoing. The project documentation must be sent to the organization's archives after completion. Large-scale quality improvement initiatives need a lot of effort and money. The procedure is intricate and often perplexing. However, researching the "project process" when data is there may teach us a lot. It is possible to find trends and issues that are present across several projects by looking through the archives of such projects. Project timetables, for instance, could be constantly too optimistic or underly pessimistic.

The following documents need to be preserved:

Statements of Work, Plans and Schedules for Projects and Subprojects, Written Agreements, Correspondence (Written and Electronic), Budgets and Financial Reports, Cost-Benefit Analyses, Status Reports, Presentation Materials, Documentation of Modifications to Plans and Budgets, Followed Procedures, Developed Procedures, and Notes of Important Lessons Learned.The project team should gather one last time to do a "post mortem" of the undertaking. The meeting need to take place as soon as the project is finished, when recollections are still recent. The discussion will go through the project's lessons learned and suggestions for process improvement. Project managers should learn from the minutes of these sessions. Low-cost Software for document control and project management may automatically catalogue the data and provide fast and simple database searches.There doesn't appear to be much of a justification for not permanently storing all project data.

Team Six Sigma

The main method for implementing Six Sigma and achieving the objectives of the organisation is via Six Sigma teams working on projects. Six Sigma teams are sometimes led by Black Belts, although other qualified Green Belts or Six Sigma champions with a passion for the project may also serve as team leaders. In these later situations, a Black Belt is required on the team to supervise the data analysis since this is not included in the Green Belt and Champion training.

Teams of people who offer authority, expertise, talents, and other personal qualities to the project make up six sigma teams. When compared to other work teams, Six Sigma teams are not particularly unique. They are individuals with various backgrounds and skills who are working for a same immediate objective.

If the team's objective is to be completed, its dynamics, like those of other groupings of people, must be understood. This section discusses the methods that sponsors, champions, facilitators, Black Belts, Green Belts, and leaders may use to make sure that Six Sigma teams are effective. It focuses on: the stages of learning to work as a team; the distinction between group maintenance roles and group task roles; the identification and encouragement of productive roles necessary for team success; the recognition and dissuasion of counterproductive behaviour on teams; the facilitation of team meetings; the resolution of conflicts in a constructive manner; and the evaluation, recognition, and reward of teams.

Team Participation

The division of labour is the foundation upon which contemporary organisations are built.The majority of corporations nowadays are divided into many departments, each focused on a different area of expertise. The fact that various functional divisions have a tendency to maximize their own operations often to the expense of the organization as a whole is a basic concern.In reality, traditional organizations erect walls between departments. Departmental managers often have to fight for a limited number of budgetary allocations; in other words, they are engaged in a "zero sum game" where one manager's success is seen as the department's failure. People who participate in zero sum games think in terms of win-lose, according to behavioural study. Self-destructive and ruthless conduct results from this. It will need better departmental coordination and communication to overcome this trend.

Teams of individuals having the necessary expertise to provide the required value are known as interdepartmental teams. The team develops processes to provide value in an effective and timely way. The organization's management must ensure that the necessary talents are there.

Management of Team Dynamics, Including Conflict Resolution

The Six Sigma project team leader often has responsibilities for conflict management.

If there is a facilitator on the team, they may help the leader by making sure that creative disagreement is welcomed rather than suppressed. Examine the conflict's basic causes. Set up one-on-one meetings with the participants and attend the sessions to assist mediate if "personality issues" threaten to derail the team meeting.

Create a consensus decision rule for the group, such as: No judgement may be included in the group decision unless it has at least tacit consent from every member of the group. This is the first step in forming an effective group.

The following actions may help to promote this prerequisite for collective movement:

Refrain from defending your own stance; instead, explain it as clearly and rationally as you can, taking into account the group's responses in any future presentations of the same issue.

Prevent "win-lose" deadlocks in the exchange of ideas.

Reject the idea that there must be a winner and a loser in the conversation; in situations when there is no way forward, find the next best option for all parties.

Refrain from making decisions just to resolve disputes, achieve consensus, or promote harmony; resist pressure to comply with demands that lack any basis in reality or logic. Aim for enlightened flexibility; yet, refrain from complete submission.

Steer clear of conflict-resolution strategies including majority voting, averaging, negotiating, coin-flipping, trading out, and similar ones.

Consider disagreements as a sign that someone hasn't fully shared all important information, whether it be regarding task-related concerns, emotional information, or intuitive feelings.

Treat disagreements over ideas as normal and beneficial rather than as a roadblock to decision-making. In general, the more ideas that are stated, the more likely disagreements will be, but there will also be a wider variety of resources available.

Treat any first agreement with suspicion – Investigate the justifications for any apparent accords; before adopting any viewpoints into the group decision, ensure that everyone came to them for the same fundamental reasons or for complementing ones.

Refrain from using subliminal means of persuasion and decision-making modification, such as feeling that a member who had been refusing to agree should be rewarded by getting their way on a later issue.

Refrain from predicting the worst for your group's potential and be open to the idea that it could genuinely succeed in achieving all the aforementioned goals.

The aforementioned actions used together are frequently referred to as the "consensus strategy." 75% of the groups who were taught this strategy significantly exceeded their best individual resources in tests, it was discovered.

Group Development Phases

Groups of several distinct sorts often develop in a similar manner. Knowing that the process of forming an efficient group is going normally is often helpful. According to Tuckman (1965), a group goes through four phases as it develops: forming, storming, norming, and performing.A group usually places more emphasis on formalities when it is still formed. Interaction among groups is highly cautious and courteous. The decision-making process is dominated by the leader, who is crucial to advancing the group's goals.Forming is followed by the storming phase. This stage is characterised by conflict between members and between members and the leader. When it comes to the goals, organisation, or processes of the group, members challenge authority. The group often fights against the leader's efforts to nudge them in the direction of independence. The group's members are attempting to clarify their positions.The leader must handle the disagreement in a productive manner. There are various methods for doing this:

Avoid tightening the reins or attempting to pressure members to follow the policies or guidelines set during the formation period. Guide the group toward new processes based on a consensus within the group if disagreements over current procedures occur.

1. Look into the real causes of the dispute and seek a more agreeable resolution.
2. Act as a go-between for the group's individuals.
3. Confront ineffective conduct head-on.
4. Keep pushing the team toward autonomy from its boss.

The group starts to take ownership of its objectives, processes, and behaviour during the norming stage. The goal is to collaborate effectively. The group itself imposes group norms on the group.The performance phase is the last. Members now feel proud of the organisation, its successes, and their individual contributions. Members are comfortable asking for or offering help since they are confident in their abilities to contribute to the organisation.

1. Roles and duties of members
2. Roles for Effective Groups

Task roles and group maintenance roles are the two fundamental categories of responsibilities that group members often take on. The responsibilities involved in guiding and organising the group's efforts to choose, identify, and resolve a specific issue are known as group task roles. The responsibilities for group tasks listed are widely accepted.The group maintenance roles are another sort of position used in small groups. The objectives of group maintenance roles are to promote group cohesion and group-centered behavior. They consist of the actions.The process of forming a team must include the formation of task and maintenance roles. The process of teaching a group to work as a unit rather than as a collection of individuals is known as team building.

Ineffective group dynamics

Recognizing and addressing individual responsibilities that can obstruct the formation of a cohesive and successful team is equally crucial to establishing productive group-oriented behavior. The function of the leader also include process observation. In this role, the leader keeps an eye on how people are acting and the environment in group meetings. Identification of unproductive conduct is the goal. Naturally, after being recognized, the leader must politely and gracefully provide the group and its member’s criticism. The effectiveness of groups has a significant impact on the success of Six Sigma.

Management's Function

Giving a group time to develop its effectiveness is maybe the most crucial thing management can do for it. In order to do this, management must, among other things, focus on maintaining steady group membership. Members of the group cannot be removed from it without a very good cause. Additionally, the group shouldn't constantly have new members that are just there on a temporary basis. It will take a lot of discipline from the group and management for a group to go through the four phases outlined previously to the important performance stage.Making the workplace a place where groups may work effectively is another area in which management must provide assistance.

Facilitating methods

When to Employ a Third-Party Facilitator

A team or group does not always need to be facilitated by an outsider. Although they often provide benefits, facilitators may also bring costs, therefore their usage should be carefully examined. If outside facilitation is required, the parameters listed below may be utilised to make that determination:

Mistrust or prejudice—Groups should engage an impartial outsider to assist (and maybe convene) the group in instances when distrust or bias is visible or suspected.

Intimidation—The participation of those who would otherwise feel intimidated might be encouraged by the presence of an outside facilitator.

Rivalry—The presence of an outside facilitator may help to lessen rivalries between people and organisations. A group is defined as a collection of people who have one or more things in common. The individuals' geographic proximity to one another at the same moment may be the only common attribute. It's possible that the group has a family-like shared ancestry. There are many distinct sorts of groups in contemporary life. Of course, our family is the first group we join. We also participate in PTAs, sports leagues, churches, and social clubs. The groupings diverge in a variety of ways. They include various numbers of individuals and serve various goals over various time periods. However, all successful organisations have a few things in common. The following characteristics of a successful group are listed by Johnson and Johnson (1999) in their book Joining Together:

Group members must properly and effectively express their thoughts and emotions. Group objectives must be understood clearly, be relevant to the requirements of group members, and inspire a high degree of commitment from each member to their completion. The foundation of all group functioning and member engagement is effective, two-way communication. Leadership and participation must be shared among the group's participants. Everyone should take part, and everyone should be heard. Members should all feel accountable for assuming leadership responsibilities as they emerge. All members will be engaged in the group's work, dedicated to carrying out the group's decisions, and satisfied with their membership thanks to the equality of participation and leadership. Additionally, it guarantees that each member's resources will be used to their best potential and improves group cohesion.

If appropriate decision-making processes are to be matched with the situation's requirements, flexibility must be applied. The technique of decision-making employed must be in harmony with the time and resources that are available (such as the members' talents). Consensus decision-making is often the best method (see below). Power and influence should be distributed fairly among the group members in order to foster distributed participation, the equalisation of power, constructive conflict, cohesiveness, engagement, and commitment.They need to be founded not on power but on knowledge, skill, and information access. Members of the group should build coalitions based on their interdependence and mutual influence in order to further their own aims.

Disagreements brought on by divergent viewpoints (controversy) should be supported. Disputes encourage participation in the group's work, quality, originality in decision-making, and dedication to putting those choices into practise. Minority views need to be respected and used. Conflicts brought about by competing interests, incompatible wants or objectives, a lack of a resource (such as money or power), or rivalry must be resolved amicably in order to preserve the interdependence of the group members.

There should be strong group cohesiveness. Members' fondness for one another, their desire to stay in the group, their contentment with being a member, and the degree of acceptance, support, and trust amongst them are all factors that contribute to cohesion. It is important to promote group norms that foster psychological security, individuality, creativity, intellectual conflict, development, and change.

A high level of problem-solving capacity is ideal. Problems must be fixed permanently and with the least amount of effort possible. There should be processes in place for identifying issues, creating and putting into practise solutions, and assessing the efficacy of those solutions. The capacity of the group to solve issues effectively increases, creativity is fostered, and group effectiveness is enhanced. Members must have strong interpersonal effectiveness. The degree to which the results of your conduct match your objectives is a measure of your interpersonal effectiveness.These qualities of successful groups hold true regardless of the task the group is working on. It hardly matters whether the organisation is organising a prom dance or studying air defence. The shared characteristic is the existence of a team of people working together to achieve common objectives.

Assisting with group task facilitation

The two categories of team activities are task-related and maintenance-related.

The purpose of the team's formation, its charter, and its clear objectives are all included in task tasks.Before the team is created, the facilitator should be chosen. He or she should help create the team's charter and identify possible team members and leaders.

The facilitator is crucial in assisting the team in creating precise objectives based on their charter. The art of goal-setting makes it common for team objectives to have little in common with the real intentions of management when the team was founded. Goals that are excessively ambitious, too narrow, or that imply a cause-and-effect link without supporting evidence are common difficulties. A team tasked with reducing scrap may, for instance, assume that Part X had the biggest scrap loss (perhaps based on a week's worth of data), and set that part's scrap reduction as its objective. The team and management may be able to communicate via the facilitator.

A realistic timeline for the team to achieve its objectives may be created with the help of facilitators. Chap. 6 addresses the topic of project scheduling.

The team's initiatives should be well documented, according to facilitators.

Information about the project's current state should be available in records. Records should be made so that management may easily create recurring status reports. The facilitator should set up clerical assistance for duties including creating paperwork, scheduling meetings, finding meeting locations, procuring audio visual equipment, and acquiring office supplies.

The facilitator is also required for the following tasks:

Meeting management

Set a time for the meeting well in advance. Make sure important individuals are invited and intend to attend. Set a schedule and follow it! Start promptly. Clearly state the meeting's goal at the beginning. Take a moment. Summarize sometimes. Actively seek out the opinions of individuals who are less chatty. Stop the members who speak too much. Deal with conflicts. Make tasks and responsibilities clear and precise. Finish on time.

Communication

It is widely acknowledged that it is impossible for "the quality department" to "guarantee" or "control" quality. The facilitator needs a lot of help and collaboration from those outside the team in order to produce quality. The team's written and vocal communications with other members of the organisation may be relayed by the facilitator. Even in the age of rapid technological communication, spoken communication has value. When compared to exchanging emails and faxes, a five-minute phone conversation may provide you the chance to ask questions and get responses that might otherwise take a week. The team meeting is just one arena for communication; the facilitator may help team members communicate outside of meetings by setting up one-on-one meetings, mediating disputes, etc.

Making the Group Maintenance Process easier

Examine the group dynamic. A rare opportunity exists for the facilitator to step back and watch the group in action.When these issues are noticed, the facilitator has to provide the team feedback and direction. Consult the more reserved members to get their opinions. Find out whether there are any objections to the team's direction.

CHAPTER 10

Process of Product

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A process is a group of actions, processes, or activities that are carried out, often in a precise sequence, and produce an end product, such as the delivery of a service or a physical commodity. A firm uses a variety of procedures to accomplish its objectives. Technically speaking, the company or organisation itself may be thought of as one very large process. For instance, a criminal defence legal company employs a vast, intricate procedure to carry out its business. The procedure begins with the defendants and their cases. The procedure' output is the outcome of the case, which might be a plea agreement with the prosecution, a victory or defeat in court, or an early charge dismissal.There are hundreds, maybe thousands, of lesser procedures included inside the massive process that takes the defendant through to his or her conclusion. Processes inside processes exist. The negotiating process may be handled by a paralegal team and an attorney, while the scheduling of meetings might be handled by a legal secretary. Processes include things like taking depositions, copying papers, writing letters, and submitting legal paperwork. Even a simple task like picking up the phone or composing a letter may be thought of as a process. A Six Sigma team required to identify the processes that were connected to a process improvement or project in order to establish and maintain correct scope. In the hypothetical law practise, a project to speed up the scheduling process would probably not include a procedure for submitting a legal brief. To understand it, however, you must be aware that the appointment setup procedure and the legal brief process do not share any elements. The components of processes and a structure for mapping those components known as a SIPOC will both be covered in this.

Definition of the Process in Four Layers

Processes may be quite complicated, as you'll discover when you go through the rest. Our straightforward definition is as follows: Basic. Let's peel back the layers of this idea known as "a process" before we define the components of a process.

A Steps

Every process, whether it be physical, digital, or ideological, consists of a number of stages. You may record such processes using a process map, a visual diagram, or written instructions, which are both known as standard operating procedures in formal corporate training or policy documents. Most workers and members of the Six Sigma team can easily understand a process map created using standardised forms and linkages.

Processing Time All processes have a certain amount of time required, and this time may vary depending on a number of variables. Only average processing times or measurements of processing time variation may be recorded in process maps and documentation. This information is often recorded in these papers because it gives teams useful information, but actual process observation nearly always yields more accurate processing time information.

A retail chain may design a process diagram for replenishing a specific region. According to the process paperwork, it typically takes two hours to completely refill all of the shelves in the designated area. A Six Sigma team spends two weeks observing workers doing their jobs in real time at different times of the day to get additional information about the process. Following from those observations are a few notes:

Stocking throughout the day is delayed by client movements; stocking in the evening merely takes a few minutes.

Typically, stocking tasks completed during busiest shopping times take the longest.

With only this knowledge, it should be clear how to cut down on stocking time in the given scenario: wherever feasible, shift stocking responsibilities to off-peak hours. You need to collect information regarding process timings in addition to process phases in order to fully understand the process.

Interdependencies

In a company, almost every operation is reliant on one or more other processes. Keep in mind that the company itself consists of a number of interconnected processes aiming to achieve the same objective or aims.

On process maps, interdependencies are sometimes mentioned. Interdependencies may also be resource-related.Think of a relatively simple situation involving a passenger train. Passengers are transported by rail from station A to station B. The engineer must be on board and ready to run the machinery before the train may depart. Before the train departs from the station, many procedures must be completed, including safety inspections, clearance from the rail yard, and the shutting of all doors. The conclusion of various steps is necessary for the process of the train conveying people.

Teams in Six Sigma improvement projects need to be mindful of interdependencies while dealing with processes. The first is crucial because, while making adjustments, you could require assistance from individuals or processes downstream from your process. The second is crucial because you need to understand how changes will affect people and downstream processes. Improving the performance of one process won't benefit the firm or organisation as a whole if it impairs the performance of another.

Assignment and Resources

Resources are needed by processes. A process needs resources like power, people, money, digital bandwidth, computer equipment, machinery, supplies, components, and even talent to operate, much as a motor vehicle needs fuel or energy to work. Project teams must comprehend the resources involved, their costs, and the owners of the processes and resources in issue in order to properly seek extra resources since someone within an organisation must authorise and pay for resources.

Important Process Elements

Events, tasks (activities), choices, inputs, outputs, and events are some of the elements that make up a process. When a certain event happens, inputs enter the process; tasks and choices are then carried out using or in response to the inputs. An output is created at the process's conclusion. The concept of process components is often explained using a straightforward factory-based example: raw materials of a certain kind enter the factory, work is done there, and completed commodities depart the factory. For instance, materials like sugar, water, plastic, and electrical power enter a factory that produces hard candies. The inputs are used by the machinery and the workers. The finished product is a wrapped confectionery item that is prepared for sale.

Using the example of a pizza store, the picture below demonstrates the concept of process components. The process starts with an action, in this case, ordering a certain pizza. The graphic shows every component, and the section that follows will go into further depth on each one.

Inputs

Anything that enters a process or is necessary to enter a process in order to generate an output is referred to as an input. The inputs in the aforementioned pizza example are all the ingredients required to produce the pizza. You may also think of the process' inputs as things like the oven's temperature, model, and cook's level.

Six Sigma emphasises the need of comprehending all process inputs since they are often causative or connected to causal elements for a process. Process mistakes or flaws may be caused by inputs or by the outputs of those inputs. When the oven gets too hot, the cookies burn. When the circuit boards are defective, the factory-built computers are inoperable. If a lawyer's information is inaccurate, they won't win their case. The circuit boards, the oven temperature, and the lawyer's knowledge are all inputs into processes that are themselves producing issues.

Understanding the resources needed for a process to execute, identifying unnecessary inputs that are not necessary, and understanding the process' expenses are other reasons to define inputs while dealing with a process.

Recognizing the relationship between the process and processes that precede it. Keep in mind that in a company, procedures are connected to achieve a final objective or goals. The outputs exiting process A might be the inputs going into process B. A.

Outputs

The service or item utilised by the process's client is the output of a process. In the case of the pizza, the output is the cheese pizza that the consumer will consume. The hard candy produced by the hypothetical candy factory is what the retail establishment will sell.The end customer who buys a product or service is not necessarily the process customer. Internal or external customers may exist. A corporate office that employs a receptionist to take phone calls is an example of a procedure servicing an internal customer. The person on the other end of the phone and the one receiving the call or message are both served by the receptionist taking messages or transferring calls.

Sometimes a process's client isn't even a real person. Many processes provide energy to others. The procedure of inputting information about a prescription at a pharmacy feeds the one that invoices an insurance company for the drug.

According to the Six Sigma methodology, an output is usually always more valuable to the final process than an input. The procedure itself entails giving the inputs some kind of value. A bakery will bake uncooked bread dough to enhance value, creating a delectable end product that customers are more inclined to buy or pay more for.

Events

Events are certain, predetermined requirements or behaviours that trigger a process to start operating. A well-functioning process reacts to an event in the same way as a lightbulb reacts to the action of a switch being pulled. In order to understand why a process is being carried out and if it is being carried out when it is not necessary, Six Sigma teams must ascertain what events create a process.

Take the case of compliance audits at a business in the banking industry. Perhaps a business has a unique audit procedure that begins when warning signs are detected with accounts; the audit procedure is extensive and typically requires 80 labour hours. It seems sense that the procedure would be costly to maintain. When a clerk notices a mismatch in an account, the compliance procedure is launched. A Six Sigma team recognises this incident throughout the investigation.

When the team looks into it, they find that this is true regardless of how little the shortfall was—a few dollars or less—or if the clerk was able to make up the difference later in the day. The team can argue that there is an issue with how the procedure and the event are related. The process is active when it may not be beneficial for it to be.

Tasks

The core of a process is comprised of tasks or activities. The jobs in a process pump the inputs through, converting them into the outputs, just as the heart pumps blood through your body. The actual, automated, or computerised steps that make up a process are called tasks. The following are some examples of tasks: • A machine welding two metal components together

An email is being written, a piece of computerised work is being routed via a workflow system, a chef is cutting ingredients for a dish, and a person enters data into a software programme.

Decisions

Chores and decisions are intimately intertwined, and decisions may also be tasks. In addition to chopping the components for a soup dish, the chef must determine how much of each item is required. The recipe and the amount of people he has to serve will probably influence his choice.

Usually, a process's decisions are guided by a set of rules. When making choices, staff expertise and experience are used together with informal guidelines that are sometimes explicitly written. Even when all staff members are skilled, processes that are regulated by unwritten norms might have challenges with consistency since they may all do tasks differently. Additionally, variety may result in a drop in quality and additional potential for flaws.

Here are some instances of choices in a process using the task examples from above:

When inputting data into a software programme, a user may choose a particular drop-down option based on the software's rules or training.

When a report's outcome is a number greater than a certain threshold, a computer delivers the report to a human.

Because it is customary to do so when sending this kind of email, a person decides to add certain information while composing an email, such as an order number or customer number.

You're undoubtedly realising that interactions between all the components and processes may be exceedingly complicated. Both inputs and outputs from one process may be used as inputs in another. A choice may cause an action that initiates a new process, but it may also determine which job gets started.

Six Sigma teams get to grasp the links between the components as they engage with processes, watching, drawing, and measuring them. This knowledge helps the teams in making judgements about potential adjustments and improvements.

Procedural Owners

Teams must comprehend who the process owners are as they seek to enhance processes. The individuals having the authority to authorise modifications might vary depending on the corporate organisation. The lowest-level owner may not have veto power or decision-making authority over all modifications in certain businesses, but he or she is nevertheless held accountable for the process's success.

An executive-level person who is likely in charge of many processes in his or her division may be a process owner as well as someone in charge of a much specialised process or function, a team supervisor, or a department manager.

The architecture of a particular organisation may often determine the duties of a process owner, but typically, a process owner will: Monitor the performance of the process, typically using one or more metrics or regularly provided data items. Recognize how the process fits into the entire company, why the process' output is essential to achieving business objectives, and what processes' inputs are.

Ensures that standard operating procedures (SOPs) are used to record the process and that the documentation is maintained up-to-date and correct.Assures that process operators have the tools and training necessary to do their duties.Process owners may also make sure a control plan is in place and frequently assess the process for potential for improvement in a Six Sigma setting.

Data

Last but not least, all operations produce some kind of data. Information is part of every process, even if data isn't currently being collected. The number of items in work queues, the number of items worked that day, the amount of time items have been waiting in queues, the number of items transferred, and the destination of those items are just a few of the statistics that a computer programme that automatically routes work in a workflow may produce. Data from a process for filling bottles with liquid might include how much liquid is put in each bottle, how many bottles are filled every hour, and even differences between bottles.

Because data is often used to determine if a process is under control and effective, data is of utmost importance to Six Sigma teams.

Process Component Definition:

The SIPOC

The define stage of a Six Sigma project often includes the SIPOC diagram as a key component. The SIPOC diagram, however, may be used whenever you want to know more about a process or comprehend how a process in a corporate setting is connected to other processes.Suppliers, Inputs, Process, Outputs, and Customer are all referred to as SIPOC. Inputs and outputs for a SIPOC adhere to the same principles outlined in earlier sections. Suppliers are the individuals, businesses, and other entities that provide the inputs for your process. Customers are the individuals, groups, and entities that utilise the products of your process. The stages that transform inputs into outputs make up the process itself.

Reasons to use a SIPOC diagram

Due to its effectiveness and simplicity, the SIPOC diagram is one of the most often used tools for comprehending process components and process relevance. Although good diagramming often requires the participation of a process owner and one or more SMEs who are acquainted with the process on a daily basis, teams may build SIPOC diagrams in a single brainstorming session.

Additionally endlessly scaleable are SIPOC diagrams. Teams may use SIPOC to map out processes at the most granular level as well as a complete company. To demonstrate scalability, we'll go through how to create a SIPOC diagram and then provide several instances of SIPOCS at different levels.

SIPOC Diagram

A SIPOC diagram may be made either alone or in a group setting. SIPOCS may be made using a computer and software programmes like Word or Excel, but they can also be hand-drawn on a piece of paper or a whiteboard. Because teams may rapidly change the rough draught of the diagram as they debate a process, freehand diagramming is an effective brainstorming tool. Since they have already been typed and corrected, they seem tidy. Your own process diagrams may first seem jumbled due to revisions, arrows, scratch-outs, and inserts. The thoughts and information that flow during the brainstorming process might be restricted by "editing" or imposing restrictions. When you are done brainstorming, you may always make a clean duplicate of the diagram for use in presentations.

Step 1: construct swim lanes.

Swim lanes are the basis of a SIPOC diagram 10.1. You may use swim lanes to demonstrate how cross-functional resources and activities connect to your process. One lane each for Suppliers, Inputs, Process, Outputs, and Customers is allocated in a SIPOC diagram. The final product will resemble the illustration below.

Suppliers	Inputs	Process	Outputs	Customers

Figure 10.1: The finished item will look similar to the illustration below.

Step 2: Define Your Process and Set Boundaries

Define the start and end points of your process or duty before the SIPOC session starts. Your SIPOC session may go amok or result in a diagram that is unhelpful for your project if you don't grasp the breadth of your process.

Naming your process makes it easier for the team to relate to a particular area of the company. One process that may be examined by a team looking to enhance procedures at a medical office is "Gathering New Patient Information." The team has established certain scope restrictions by identifying the procedure; as a result, they will only discuss matters pertaining to collecting data from patients. The method by which staff members collect data from new patients is another restriction on the scope. You may go back to the name and the scope you've specified as you go through the SIPOC diagramming exercise to keep the team's conversation on track.

Step 3: Finish the swimming lanes

While SIPOC swim lanes may be completed in any order, it's generally considered best practise for teams to input data in the following sequence:

1. Process
2. Customer
3. Outputs
4. Inputs
5. Suppliers

In reality, teams will have ideas as they go through the process, so you'll need to go back to the swim lanes a lot to rearrange material and add new information. Keep teams high-level while finishing the process swim lane since a SIPOC isn't often a low-level or detailed map of the real process. In that part, you may either provide a few of the process's high level phases or only the name of the procedure. If teams are unsure about outputs and inputs, listing stages is a valuable exercise. Starting to picture the process generally encourages ideas to emerge about how the process is related to other processes and resources inside the firm. Ask the group to explain the process in no more than five to seven stages in order to prevent the meeting from devolving into a thorough process mapping exercise. Limit process stages to brief verb-noun combinations like "Enter information," "Collect money," or "Place labels" to keep things simple.

Name of Outputs and Clients

Once you have a basic concept of the process, start with the inputs or outputs. Ask the group "What results from this process? What results from this procedure?" These solutions are placed in the outputs swim lane. Then, ask the group, "Who or what utilizes the results of this process?" Put those responses in the swim lane for the consumer. In terms of automation, keep in mind that clients might be either internal or external, and another process can act as the customer.

Name Suppliers and Inputs

Ask the group "What tasks must the process complete? What raw resources or products fuel the process?" Enter the responses in the inputs area. If you like, you may split the concept of inputs into two categories. The first thing you have are the actual inputs, which are the products and services that the process transforms to produce the outputs. Then there are those who make the process possible. Although they are necessary for the process to operate, they aren't strictly inputs since they don't enter the process or change as a result of the process. A facilitator is machinery. The machine that cuts the steel sheet into metal components is an enabler in the process. It's not necessary to separate enablers on your SIPOC, but doing so might help you clarify the process and provide you more information for later in the project. Ask the group, "Once we have a list of inputs, "What are the sources of the inputs? Who or what provides these items to the process?" Suppliers might be internal or external, much like consumers. The factory's raw sugar may be supplied by a vendor, and the leads used by the sales department to generate orders may come from the marketing division. In an automated system, suppliers may also be other processes, and a raw SIPOC diagram might include a list of several providers for a single input. For instance, the Information Technology (IT) division receives support requests. The automated system that directs the ticket to the proper work queue as well as the end user who submits the ticket might both be considered the provider of the ticket. If you are recording enablers, you may list the automated process as the enabler and the end-user as the provider.

Step Four: Verify the Data

By verifying your diagram, you can make sure that your knowledge of the process at this high level is correct. If you've assembled a thorough team that includes SMEs, the group can verify the majority of the data on its own. However, it's always a good idea to get a second opinion on any issue the team is unsure about. Invite other SMEs or the process owner to quickly evaluate the diagram with the team and provide input.

A Few Pointers for a SIPOC Brainstorming Session

On huge sheets of paper or a whiteboard during a team session is one of the finest methods to draw the first SIPOC diagram. Draw swim lanes on the whiteboard or put a sheet of paper for each lane on the wall to create swim lanes. Sticky notes and markers should be made available to the team; instead of writing directly on the board or paper, use sticky notes. As you navigate the diagram, you can swiftly shift components around thanks to this.

SIPOC diagram examples

These SIPOC diagram examples are provided. The first diagram represents the company at its most fundamental level: the process. The second illustration shows an automated procedure. The third figure shows an industrial process that is driven by humans and incorporates enablers.

Diagram of a business-level SIPOC

The SIPOC for a mid-sized printing firm is shown in this figure 10.2. This SIPOC illustrates how consumers and suppliers provide information and goods, which the printing firm subsequently transforms into finished goods like printed business cards. Individuals, companies, and marketing specialists who made the purchase get the finished output.

Suppliers	**Inputs**	**Process**	**Outputs**	**Customers**
Paper vendor	Orders/customer specifications	Receive order	Business cards	Individuals
Ink vendor	Paper	Layout designs	Brochures	Business owners
Copy and print machine provider	Ink	Print designs	Banners and signs	Marketing departments
Customer	Designs	Deliver printed product	Mailers	
			Letterhead	

Figure 10.2: SIPOC for a mid-sized printing firm is shown.

A business-level SIPOC diagram is often not dealt with by a Six Sigma team. Starting with a high-level graphic, however, may help others outside of the business grasp the overarching aims of the organisation if the team includes members from outside the division or company, such as suppliers or consultants helping with an upgrade.

An automated process' SIPOC

A mail-order pharmacy's automated procedure is shown in the figure 10.3 below. The method in issue involves labelling bottles that will later be filled with the appropriate drugs. Only the labelling of the bottles is within the purview of the procedure.

Suppliers	Inputs	Process	Outputs	Customers
Bottle sorting machine	Unlabeled bottles	Choose bottle size	Labeled bottle	Bottle-filling station
Label machine	Data for labels	Print label		
Prescription software	Labels	Affix label		
Ink and label vendors	Ink for printing			

Figure 10.3: A mail-order pharmacy's automated procedure is shown.

Almost all of the parts are machines, procedures, and stuff since this process is one in a series of automated processes. A machine separates bottles by size before labelling. Whenever necessary, that machine feeds the labelling station. Another station fills the bottles when the labelling is finished.

SIPOC with Noted Enablers

The SIPOC graphic below shows in the Figure 10.4 how enablers for your process might be documented. A worker affixes legs to a barstool on an assembly line during the procedure, which takes place at a furniture factory.

For the purposes of this illustration, the leg attachment station serves as the final stage of the product's completion before it is ready for packing and shipping.

The individuals involved in this process would have to move the items manually if there were no conveyor machine. Although not entirely necessary, the conveyor helps the process of adding legs to the stool go more quickly.

Although the drill isn't necessary either screws can be installed by hand it is unquestionably what makes the process move at the pace necessary for mass production. A Six Sigma team would already have some idea of where variation may be hiding, what motivates process efficiencies, and how the process relates to the overall business with just this basic SIPOC diagram of a process.

Suppliers	Inputs	Process	Outputs	Customers
Upholstery station (provides final top of stool)	Stool top	Align legs	Barstool with legs attached	Packing station
	Legs	Attach legs with screws		
Warehouse (provides legs, screws, and protective cover)	Screws	Place protective cover		
	Protective cover			
Enablers:				
Conveyor machine that moves products				
Drill for application of screws				

Figure10.4: The SIPOC diagram below demonstrates how your process' enablers could be recorded.

Create a SIPOC diagram on your own

Pick a process you are familiar with and practice drawing your own diagrams whether you are working alone or in a team. Choose a procedure related to your line of work or a successful business model. Start by utilizing the following templates.

CHAPTER 11

Voice of the Customer (VOC)

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Any project should always begin with this inquiry, and in many situations, a strategy is required to go meet with those people. Customers may be either internal (those who are involved in the project's study process) or external (those who are not project participants), thus the names internal customer and external customer. Establishing the project's boundaries will make it simpler to distinguish between internal and external clients. We may refer to people as stakeholders if they are not what we would classify as internal or external customers.Please consider stakeholders who may not be in your immediate company while reading the list of external customers. These could include your company's board of directors, businesses that use your company's goods or services, people who live close to your business's physical location(s), as well as regional, state, and federal governments. Examining your company's ethical obligation to society as a whole is one way to make sure that you have identified your external consumers. You might learn more about this subject from your safety manager or lead.

It's critical to recognise and comprehend the consumers for a project or process.

The consumers may be known depending on the product or process's level of maturity. It is always a good idea to identify the clients using some of the strategies in this book, even if they are known. Customer identification techniques include:

1. Idea generation; SIPOC; data from marketing analysis
2. Monitoring a delivery of a product or service

When appropriate, internal and external customers should be noted. Customers may be divided into segments, and these segments are often made up of the following subcategories:

1. Both indoors and outside
2. Age groupings, particularly when it comes to consumer goods

Geographical region, including climatic conditions, language, ethnicity, and other factors; industry type (for example, construction, agricultural)

A client list inside a segment should be created whenever feasible.

Customers, both internal and external, must be engaged when a project team makes modifications of any kind, or at the very least, their concerns must be conveyed.

Client Data

There is a wealth of research-based information available on how to build up efficient customer communication systems. The most important thing to keep in mind is how do you know you really understand what the consumer needs or want. To find out, all you have to do is ask.The fact that many managers and engineers assume they know what the client wants just because they are the best at what they do is a fascinating occurrence. This is evident when computer software developers create new programs or fixes without thoroughly verifying the results of their work. To correct the new software, additional patches and rework are always required.

As the Green Belt for a project, speak with the workers to learn what they are doing and what may make their jobs simpler after obtaining your benchmark process data on the system. Building support for the project you'll be working on might start here by looking at what can be done to enhance the local job. Talk to people who are both upstream and downstream of the project's target region next. Understanding the needs, desires, and expectations of the consumer comes next after the first identification. Some of the most significant statistics are unknown and unknowable, according to one of W. E. Deming's most well-known quotes. He was making reference to topics like the monetary worth of consumer goodwill. The client will, in Deming's words, "tell all his friends and some of his foes" if a supplier or employee let him down. Of course, his main argument is that it is simple to undervalue the importance of anticipating and meeting consumers' wants. We would not exist without customers.

The collection of consumer data may be done using a variety of technologies. The tools with the most use are:

1. Surveys;
2. The voice of the consumer (VOC);
3. Interviews; Quality Function Deployment (QFD)
4. Discussion boards

According to statistics, selecting consumers at random from a sizeable group and obtaining comprehensive and precise data on each of them is the most reliable method for gathering customer information. There are numerous cases when this approach is not feasible, hence several other ways are used. Each approach typically includes one or more "statistically valid" steps.

The information gathered need to be factual and made with the needs of the consumer in mind. It is crucial to get this information from a variety of different sources. It is possible to compare the outcomes to find patterns of conclusion contradiction or reinforcement. After client information has been gathered, its correctness and consistency should be checked; it's crucial to address any disputes or ambiguities.You may get valuable insights on potential barriers in the present system by taking the time to have honest conversations with individuals about what you can do to aid them (in the context of your project).

The needs of the client:

The design and redesign of goods and processes is one of Six Sigma's most significant applications. The optimum design is cost-effective and satisfies or surpasses client expectations.

To achieve this goal, it is important to: 1. Connect client requirements to product and process features.

The quality function deployment (QFD) method offers a useful strategy for this operation.

Create a product and manufacturing procedures that will provide the required quality at the lowest feasible price.

Use design tools to create completely original methods of problem-solving.

The QFD process (sometimes referred to as the "house of quality") offers a method for organising client needs and wants so that they may be linked to specifications when developing new or revised goods and services. The customer's voice serves as a process input (VOC). A team must research their customer's requirements and wishes as well as the organization's reaction to them as part of the QFD process. The relationship between the VOC and the ensuing technical needs is made clearer by the QFD matrix.

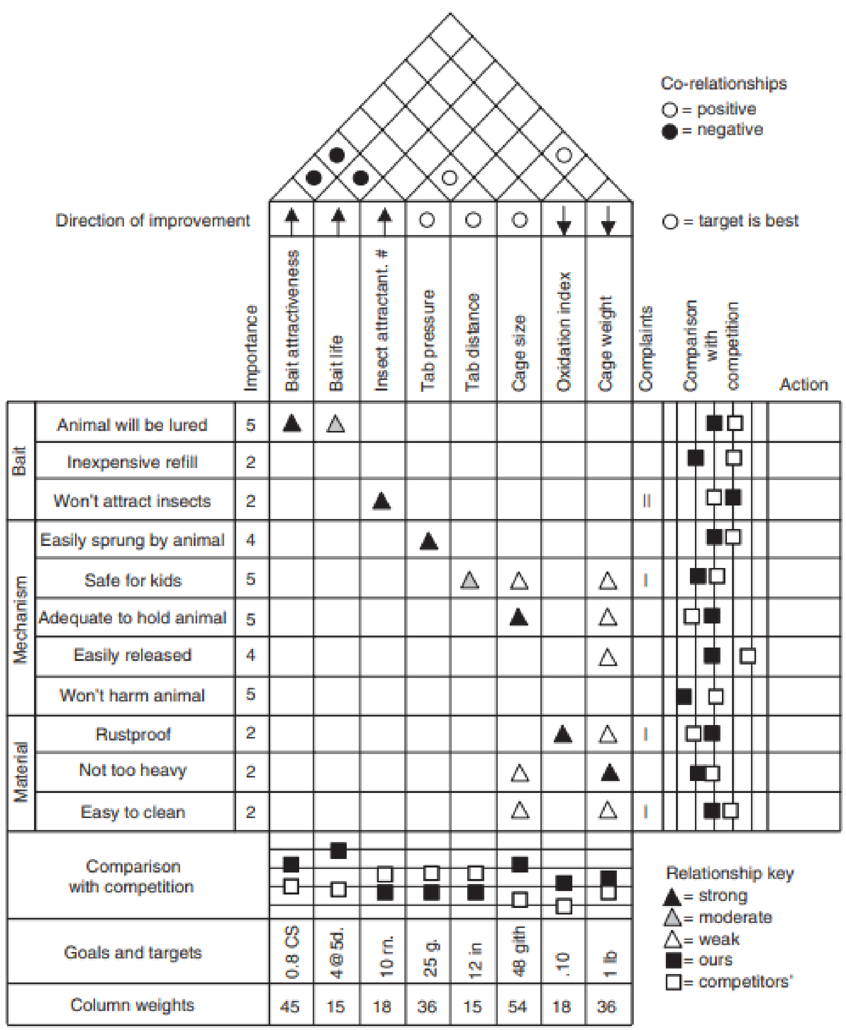

Figure 11.1: A QFD matrix example for an animal trap.

A quality function deployment matrix is divided into several sections. Although there isn't a standard format matrix or key for the symbols, the illustration in Figure 11.1 serves as an example. Figure 11.2 displays a diagram of the different components of Figure 11.2.

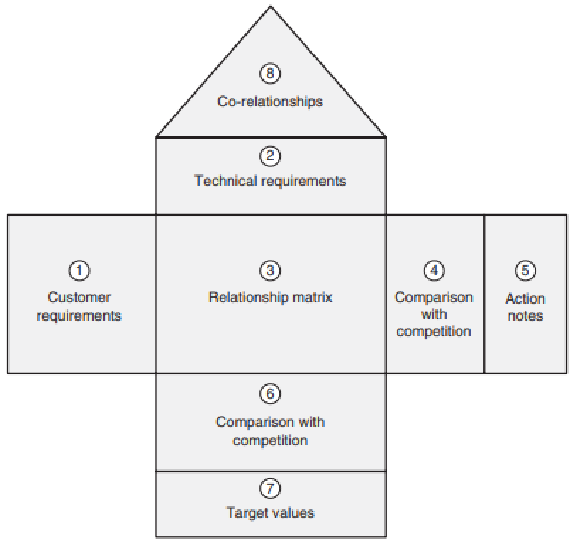

Figure 11.2: A map of the QFD matrix elements is shown.

The consumer needs are initially included into the matrix once they have been developed via analysis of the customer voice (VOC). Frequently, a scale indicating the relative significance of the various elements is included in this section. In area, the technical requirements are created in response to the customer's needs. Whether lower (â) or higher (á) is preferable is indicated by the symbols on the top line of this section. The target is better if it has a circle around it. The relationship section shows how the technical requirements and the customer needs are related. Here, a variety of symbols may be utilised. Not all QFD matrices display the area. It compares the consumer needs to those of the competitors. An index of the documentation pertaining to improvement efforts is available in area.

Not all QFD matrices display the area. It compares the technological requirements to those of the competitors. The goal values for the technical criteria are listed in Area. The relationships between the technical criteria are shown in Area. An advantageous co-relationship suggests that both technical needs may be enhanced simultaneously. If two technological needs are negatively correlated, then addressing one will worsen the other. Column weights are optional and are shown at the bottom of the figure. They highlight how crucial the technical specifications are in fulfilling the needs of the consumer. The value in the "importance" column of the customer requirements section is multiplied by values allocated to the symbols in the relationship matrix to produce the value in the column weights row. These numbers are arbitrarily set; in the example, a strong association is given a score of 9, a moderate score of 3, and a poor score of 1.The finished matrix may be used as a database for product development, as a foundation for planning product or process changes, and as a way to identify opportunities for introducing new or updated products or processes. The technical needs portion is frequently referred to as the "how" area, while the customer requirements section is sometimes referred to as the "what" information.

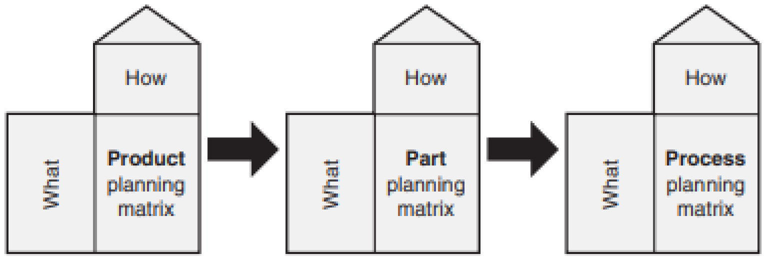

Figure 11.3: Planning for products, parts, and processes using a series of QFD matrices.

Similar matrices to the fundamental QFD product-planning matrix may be used to plan the product's components as well as the processes that will create those components (see Figure 11.3). An unmanageable matrix usually contains more than 25 consumer voice lines. In such a case, the list may be streamlined using a convergent tool like the affinity diagram.

Application

In order to ascertain whether customer desires are associated with a certain design strategy, relationships are recorded and the crucial ties are identified. These connections are rated in order to choose the technical priorities for improvement or innovation, as well as the targets of opportunity.The finished matrix, as shown in Figure 11.4, may be used as a database for product development, as a foundation for planning product and/or process improvements, and as a way to identify possibilities for the introduction of new or updated products and/or processes.

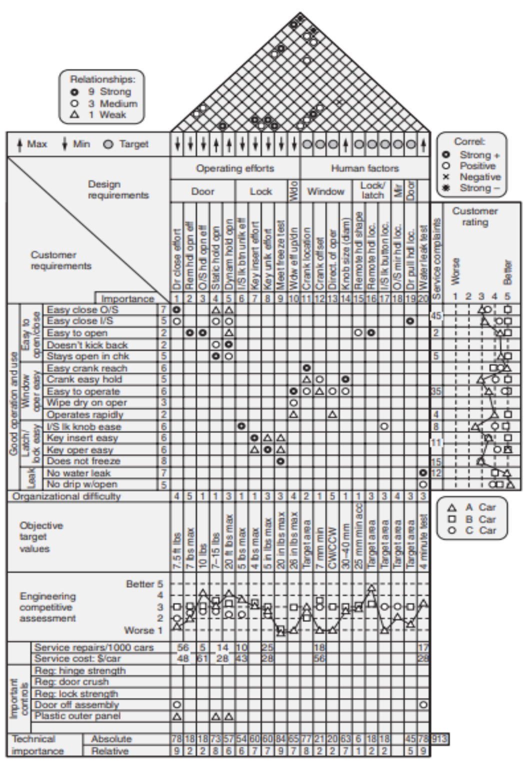

Figure 11.4: A finished QFD matrix example.

To raise the calibre of other processes, QFD may be used. As shown in Figure 11.5, in a staged environment, the outputs of one stage serve as the inputs for the stages that follow. In order to guarantee that there are no gaps in the customer's pleasure, QFD is a valuable strategy for including the customer needs into the very first stages and allowing the knowledge to cascade to subsequent stages.

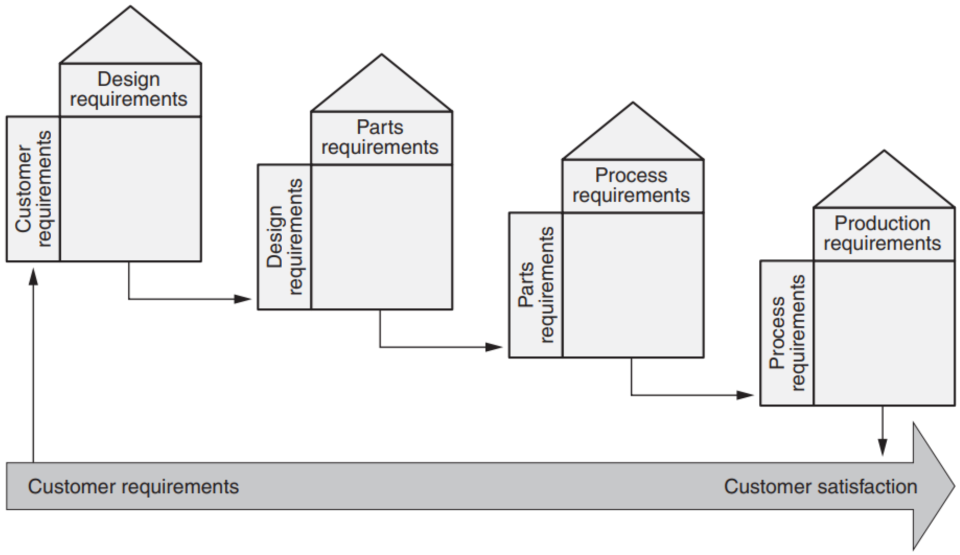

Figure 11.6: shows the linkages and stage flow for QFD.

To increase customer happiness at a reasonable cost, QFD is used. The input-output matrix captures the fundamental connection (see Figure 11.6). Whats may be described as essential (expected to have), optional, and required (must have) (nice to have). Technical specifics, or "hows," should be described to at least take into account the client's particular needs (Figure 11.7).

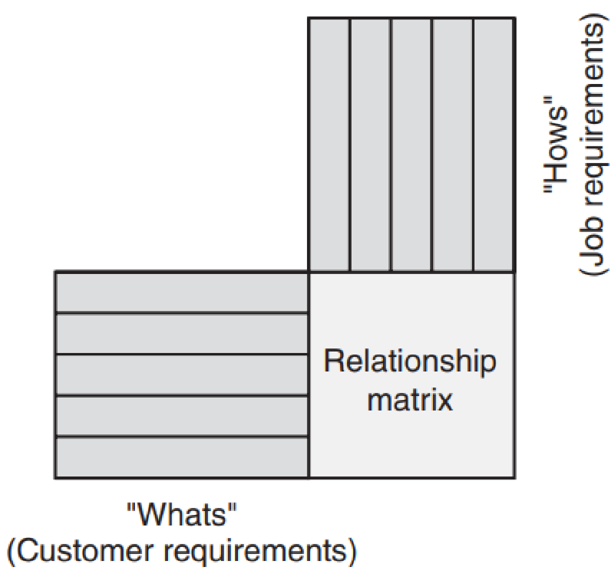

Figure 11.7: Matrix of the QFD input-output requirements.

Implementing quality functions helps the product include consumer value. Characteristics of product and service value are shown in Table 11.1.

Table 11.1: QFD value characteristics

Product value characteristics	Service value characteristics
Performance	Responsiveness
Benefit relative to cost	Reliability
Durability	Competence
Safety	Access
Serviceability	Communication
Usability/ease of use	Credibility/image
Simplicity of design	Confidentiality/security
Functionality	Understanding the customer
Availability	Accuracy/completeness
Performance	Timeliness

By offering an objective and traceable matrix connecting consumer wishes and expectations to technical specifics and acceptance criteria, QFD promotes customer-driven quality and the whole customer experience. This improves the design's resilience and clarifies the conditions for the creation, distribution, upkeep, and fulfilment of the product.

CHAPTER 12

Data-Driven Management

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A crucial part of a Six Sigma endeavour is making management choices based on factual information. Six Sigma projects provide a way to analyse process data to accomplish process improvements on a project-by-project basis. These process changes are started in the bigger organisational perspective so that the organisation may accomplish its organisational aims. The requirements and desires of important stakeholders, such as the customer, shareholder, and employee groups, are analysed in order to determine the priorities. By assessing stakeholder groups' requirements or desires in relation to present baselines and acting on the data to close those crucial performance gaps, data-driven management enables the achievement of organisational goals.

Qualities of Effective Metrics

The selection of what to measure is essential to the organization's performance. When measurements are picked incorrectly, employees may behave poorly and may move away from rather than toward the organization's objectives. Three system-wide performance indicators are suggested by Joiner (1994): overall customer satisfaction, total cycle time, and first-pass quality. Total cost of poor quality is a useful statistic for estimating first-pass quality. The metrics must be explained to the organization's members after they have been selected. It must be evident exactly how the employee's performance affects the measure for it to be meaningful, and the employee must be able to impact the metric via his performance.

Rose (1995) describes the qualities of excellent metrics as follows:

They measure performance across time, which shows trends rather than snapshots; they are customer centred and focused on indicators that provide value to customers, such as product quality, service dependability, and timeliness of delivery; or they are associated with internal work processes that address system cost reduction, waste reduction, coordination and teamwork, innovation, and customer satisfaction To ascertain meaning, no more processing or investigation is necessary.

1. They are connected to the organization's goals, plans, and initiatives. They provide organisational control and direction.
2. Teams of individuals who supply, gather, analyse, and utilise the data work together to build them.
3. Rose also provides an eight-step performance measuring model

Step 1: Performance category.

This category is the core subset of organisational performance and provides the answer to the question: What do we do? The strategic vision, key competencies, or mission statement of a company are all good places to start when deciding on performance categories. Numerous performance categories will likely be identified by a company. The organisation is defined by these criteria at the level where it is being evaluated.

Step 2: Performance Objective:

An operational description of the intended state of the performance category is provided in the goal statement. It serves as the performance category's aim, thus it should be articulated explicitly and with a focus on taking action.

An original objective statement may be exactly what is needed, be very complex and need additional performance category separation, or be too specific and require a mixture of performance categories. Before a good outcome is obtained for both, it may be required to switch back and forth between the performance objectives in this step and the performance categories in step 1.

The most crucial step in the model is Step 3

Which is a performance indicator, since it is at this point that the performance goal's progress is shown. If a metric does not support an organisational aim, it is disregarded here. The crucial metrics—those that convey what matters and chart the road for organisational success—are developed here.

Each objective will have one or more indicators, and each indicator must have an operational description outlining its purpose and how it will help the goal be achieved. Different levels of the organisation may have different perspectives on the indicator's scope.

Step 4: The components of measurement

The organization's success against the performance indicator is largely determined by these fundamental characteristics.

They are the sources of measurement data—what is really measured—and are within the organization's control. Because the organisation is unable to act on the data acquired, making an effort to measure things that are out of its control is a pointless waste of time and effort. The best way to manage this is in the subsequent step.

Step 5: Parameters

These are the outside factors, such as context, constraints, and boundaries that have some bearing on the components of measure.They are not within the organization's control, but they have a significant impact on how the parts of measure will be used. A policy modification action might be produced if measurement data analysis shows that these external concerns seriously impede organisational advancement.

Step 6: Measuring instruments

Out all the previously mentioned parts, this step makes logic. The application of the elements of measure and their corresponding parameters to establish the degree of success in the performance indicator is described in a broad, how-to action statement. Although the length of this sentence is not crucial, it is necessary to make the intended point clear.

Step 7: Hypothetical metrics

This stage involves developing conceptual descriptions of potential metrics that may emerge from the preceding processes. This stage enables everyone to come to terms with the general idea of how the data gathered in the earlier processes will be used to gauge organisational effectiveness. It offers a foundation for the process' validation and the subsequent development of particular metrics.

Phase 8: Specific Metrics

In this last step, the metrics that will be used are given an operational definition and a functional description. The data are described in the definition and description together with how they are gathered, utilised, and, most importantly, what the statistics imply or how they impact organisational performance. Additionally, a descriptive scenario that illustrates potential actions that may be performed as a consequence of the measurement and a prototype presentation of actual or hypothetical data are developed. The true test of any statistic comes at this stage. In order to facilitate further improvement measures, it must specify what needs to be done and expose circumstances in sufficient detail.

Balancing Scorecard

Given the stark contrast between Six Sigma and the conventional three sigma performance standards, choosing to pursue Six Sigma performance plainly necessitates a fundamental transformation of how things are carried out. Making this pledge will change the company forever. It is essential that Six Sigma projects and activities be connected to the organization's high-level objectives since a significant amount of time and resources will be spent. It is crucial that they be the correct objectives. An company that employs Six Sigma to pursue the wrong objectives will only move more swiftly in the wrong direction. The groups that the business serves—customers, shareholders or owners, and employees—must ultimately determine the organization's aims. Long-term harm to all of these groups may result from excessive attention being paid to the interests of just one of them. For instance, businesses that see shareholder profitability as their primary important purpose risk losing both staff and clients. Senior management must convert these stakeholder-based objectives into measurements in order to employ the balanced scorecard. Then, a plan of action is linked to these objectives and metrics. To present the metrics for each constituency or stakeholder, dashboards are created. Last but not least, Six Sigma is used to either close gaps in crucial metrics or assist in the development of new procedures, goods, and services in line with the strategy of top management.

By giving a succinct presentation of performance data in four categories that approximately correlate to the primary stakeholders—customer, financial, internal processes, and learning and growth—balanced scorecards assist the business in maintaining perspective (Kaplan and Norton, 1992). Local suboptimization, a prevalent phenomena where performance in one area of the organisation is enhanced at the cost of performance in another area of the organisation, is prevented through simultaneous assessment from many viewpoints. This results in the well-known feedback cycle wherein this year's quality-focused approach raises prices. The cycle time will suffer next year as we put more emphasis on expenses. People cut corners, which lowers quality, when cycle times are considered. On a broader scale, this also occurs when we alternatively prioritise our customers, workers, or shareholders at the cost of the stakeholders who are not the present priority. There is no doubt that such "firefighting" is unpleasant for everyone. Balanced scorecards are something that we really need.

Statistical assistance is included in well-designed dashboards to help comprehend the results. These rules, which are most often take the form of statistical control limits. Limits are operationally defined parameters based on statistical calculations that indicate when action is required. Generally, the process should be left alone while measurements are within the bounds. A metric, however, suggests that something significant has changed and needs attention when it deviates from the bounds. These broad guidelines are deviated when an intentional intervention is taken to accomplish a task. In this scenario, the intervention is expected to cause the measure to react by moving in a favourable direction. Leadership will be able to determine from the limitations if the intervention had the intended effect. If so, an improvement will be shown by the measure going over the appropriate control limit. The limitations should be revised such that they can identify slippage after the measure has stabilised at the new and better level.

Causing and Effects Evaluation

Dashboard metrics are evaluations of the outputs of complex systems and processes. These outcomes are, in a way, "effects" of what happens throughout the processes. For instance, a top-level dashboard measure would be "cost per unit".This in turn is made up of the price of the materials, labour, and so on. A "cause" of the cost per unit is the cost of the materials. The price of materials may be further broken down into, for example, the price of raw materials, the price of acquired subassemblies, and so on. We eventually arrive at the "root cause," or the most fundamental explanation for an outcome. To assist them in identifying these core problems, Black Belts and Green Belts acquire a variety of tools and strategies. However, the quest's beginning point is the dashboard.Results and underlying causes are referred to as "Ys" and "Xs," respectively, in Six Sigma work. Technical roots may be seen throughout Six Sigma's history, and most of its founders were engineers.

Customer viewpoint

Starting with the consumer, let's examine each of the key views on the balanced scorecard in more detail. The balanced scorecard mandates that management convert their nebulous company mission "Acme shall be #1 in delivering customer value" into precise metrics of characteristics that are significant to consumers. How do our consumers see us is answered by the customer scorecard.You must ask yourself two linked questions in order to respond to this: What factors do customers take into account while judging us? How are we aware? Although talking to actual customers is the only method to get the genuine answers to these questions, it is commonly known that consumers often place the following four broad categories of variables at the top of their lists when evaluating a company:

Quality – How successfully do you follow through on your commitments to provide error-free services or defect-free goods? Have I gotten what I ordered? Is it unharmed? Are the delivery times you guaranteed reliable? Do you settle claims promptly or uphold your warranties?

Timeliness—how quickly do you provide service? How long will it take to deliver my order? Do improvements happen when they should?How do your goods and services benefit me in terms of performance and service? Are they trustworthy?

Value – How much does purchasing and maintaining your item or service cost? Does it merit it?

Finding out exactly what clients take into account while assessing your business is the first step in the translation. This may be achieved by speaking with customers directly or via focus groups, surveys, chat rooms, forums, and other channels.

The words that consumers use to define their opinions of the business, its goods, and its services should be seen by management. Management must express their client objectives in terms that are important to them after they have a good understanding of their target market. For instance, management may promise:

1. We will be the best in the industry for on-time delivery
2. We will closely include our customers in the creation of our next big product.
3. We will decrease the time necessary to launch a new product from 9 months to 3 months.

These objectives must be put into practise by choosing measurements to serve as stand-ins for the objectives. Consider the objectives as constructions that are latent or concealed. The purpose is to find measurable, observable items that are closely connected to the objectives. These are signs that point you in the direction of your objectives. Examples of how the aforementioned objectives could be operationalized are provided.The leadership of the company sets important needs such as plans, budgets, objectives, and targets. Ineffective implementation might result in conduct that falls well short of what the leadership wants or expects. Employee performance is evaluated using key criteria, which is connected to promotions, salary raises, incentives, and many other things that matter a lot to employees.

Setting objectives that are only desires and hopes is the most prevalent goal-setting error. The leadership muses on what constitutes "excellent" performance for a certain statistic after looking at it. If there are enough nods at the conference, this will be the goal for that measure.Examining the metric's real historical development through time is a better method to establish targets for important needs. A process behaviour chart should be used to plot this information. The procedure is regarded as predictable if the measure mostly falls within the estimated limitations. In most cases, the objective for predictable processes will be to preserve the previous levels unless the measure is operationalizing a differentiation strategy. The dashboards that the leadership regularly examines will not include these indicators. However, process owners keep an eye on their performance, and if the process behaviour changes, the leadership is notified.

View of internal processes

The relationship between internal process excellence and customer perceived value is indirect and unreliable. When internal issues arise, it is often able to conceal them from consumers by devoting more resources to them, such as greater testing and inspection. Additionally, elements other than internal processes, such as pricing, competitor products, etc., have an impact on how customers perceive value. Similar to how external activities use resources, internal operations have an effect on shareholders. Again, the connection is faulty and indirect. For instance, there are instances when it serves the organization's strategic interests to raise prices in order to satisfy urgent short-term client needs or to fend off competition in the market. Therefore, leadership may not always get a strong sense of how well internal processes are doing by merely looking at the shareholder or customer dashboards. For this, a separate dashboard is required.

Operational managers may get the internal guidance they need in this portion of the scorecard to concentrate on client demands. Internal metrics should be selected with an understanding of what consumers need from internal operations in order to support the leadership's customer strategy. Process maps demonstrating the connections between suppliers, inputs, process activities, outputs, and consumers should be developed (SIPOC). SIPOC is a flowcharting approach that assists in determining the processes that have the biggest effects on customer satisfaction.Businesses must determine and assess their key skills. The business must succeed in these areas. Their competitive advantage stems from that. Goals in these areas need to be tough and ambitious. This is your chance to "Wow" your client. Other important sections will seek objectives meant to please consumers, possibly by keeping performance levels competitive, how customer value propositions could be influenced by core capabilities. Although the indicators for the various firms may be comparable, the objectives will be quite different. For instance, Company A would put more focus on how long it takes to create and roll out new services. The internal activities of Companies B and C would not be ignored, but their objectives would be less lofty than those of Company A. The industry standard for innovation is set by Company A.

Of course, it's conceivable that your rival may attempt to surpass you in your area of expertise, setting a new standard and taking your clients in the process. Or you could see that the market for your specific competencies is contracting and your client base is eroding. Leadership must be ready to respond promptly and be vigilant for such events. As long as there is a sizable market, the majority of businesses will battle to keep their place as the industry leaders. Strategically speaking, Six Sigma initiatives are often short-lived, and Black Belts provide a resource that can be promptly redeployed to the areas where they are most required.

Perspective on Innovation and Learning

We construct measurements in the Balanced Scorecard's Innovation and Learning Perspective area to assist us determine if we can keep improving and adding value. Success is an elusive goal. What was successful yesterday can be disastrous tomorrow. The indicators that the leadership believes are most critical for success in the immediate future have been selected in earlier parts of the balanced scorecard. However, the company has to be ready to handle the new and evolving demands that the farther-off future always brings. The intrinsic value of a firm is the discounted worth of the cash that can be taken out of the business throughout its remaining existence, and is particularly reliant on the company's capacity to innovate, develop, and learn (Buffett, 1996). A company's capacity to develop new products and processes, raise operational effectiveness, find and grow new markets, and boost revenues and margins are all directly tied to intrinsic value. Companies who can accomplish this successfully will generate more revenue in the long run than those that can't. The owners have the option of withdrawing the money or investing it back into the company.

The continuous improvement (CI) projects of the past focused on innovation and learning. CI devotees will be pleased to find that it is still in use in the Six Sigma community. Contrarily, the majority of Black Belt Six Sigma initiatives are cross-functional whereas CI projects are often local in scope. Numerous 'Green Belt' initiatives include elements of earlier CI projects. Additionally, whereas Green Belt initiatives encompass a wider spectrum of business processes, goods, and services, CI tends to concentrate more narrowly on work processes.

Various business and local process improvement concerns will be addressed by a combination of Green Belt and Black Belt projects in a well-designed Six Sigma programme.

The three key areas of employee capabilities, technology, and corporate culture are often addressed in dashboards created to track success in the field of innovation and learning. There are several methods to operationalize them. The average rate of sigma level improvement for an organisational unit is one metric. An organisational Six Sigma plan to eliminate mistakes, errors, and defects may aim for a factor of 10 improvements every two years, or around 17% every month, as stated A statistic of the real rate is an excellent option for the Innovation and Learning dashboard since this breakthrough rate of progress is often not reached immediately. The Six Sigma initiative's overall maturity is gauged by the pace of progress. Candidates for additional Innovation and Learning metrics can include things like:

Responses to employee input; R&D cycle time; closure of training requirements gaps audit.

Financial Viewpoint

Numerous reform initiatives have failed as a result of an obsession with financial indicators. Senior executives often overlook the reality that a complex network of interconnected processes that effectively and efficiently create value for consumers generate those outcomes when they focus simply on the end product. A business can only make sales by offering clients value they are prepared to pay for, and it can only turn a profit for its owners by producing these values at a cost below what they are worth. The impact of focusing primarily on short-term financial gains has been a long-term decrease in company performance for many firms. Numerous businesses have completely stopped operating.

Due to this terrible past, many detractors have argued that the practise of utilising financial measurements to direct leadership action should be completely abandoned. The reasoning goes something like this: if we put our attention on these variables, financial success will eventually follow because financial outcomes are influenced by a mix of customer happiness and how the firm manages its internal operations. Throwing away the baby with the bathwater is what this is. The issue in the theory is that it implies managers and executives are fully aware of how internal operational excellence and high customer satisfaction translate into positive financial performance. This haughtiness is unwarranted. Too often, we discover after the fact that our priorities were off track when the expected financial gains didn't occur. For instance, we may diligently work to increase the throughput of a process that already has a tonne of spare capacity. This attempt just increases our surplus capacity. Because management does not take the essential actions, such as decreasing superfluous inventory, shrinking excessive workers, selling off unnecessary equipment, etc., even well-managed improvement initiatives will not have an effect on the bottom line. According to Toyota's Taiichi Ohno, it is meaningless if 0.9 of a worker is saved as a consequence of labour savings. Before a cost reduction happens, at least one person has to be saved. We must thus achieve worker saving.

Beyond Mass Production: The Toyota Production System

In actuality, it's incredibly difficult to fire individuals, and it's a bad incentive for anybody who helped make the change. Most managers agree that this is the most difficult aspect of their work. The wisest course of action isn't to ignore the problem, however. Before beginning a project, preparations must be taken for adapting to the results of success. The project shouldn't be started in the first place if there won't be any financial effect since there are no plans to turn the savings into genuine reductions in resource needs. On the other side, preparations may often be developed at the organisational level to cope with the benefits of Six Sigma, using strategies like hiring freezes, early retirement programmes, etc. Plans to boost sales or expand the company to take use of the additional capacity are preferable yet. Frequently, this may be done by altering the client value offer to include more dependable items, cheaper costs, quicker deliveries, shorter cycle times, etc. The Six Sigma advancements have made it feasible for these improvements.

Failure to keep an eye on financial outcomes has several risks. We can naively invest money in enhancing customer happiness that is incorrectly assessed by a flawed or insufficient survey. In other instances, the rivals could develop a fresh innovation that renders ours outdated. There are a plethora of problems that might possibly sever the relationship between internal strategy and financial success. Metrics of financial success provide the information required to test hypotheses.

There are several actual measures for assessing financial success. Metrics for increased efficiency (e.g., cost per unit, asset utilisation) or increased effectiveness (e.g., revenue growth, market share expansion, profit per customer) are often included in the top-level dashboard. These expenses may often be divided into operational quality cost categories, sometimes known as the Cost of Quality (or, more accurately, the Cost of Poor Quality).

Price of Subpar Quality

The initial publication of Juran's QC Handbook in 1951 is where the history of quality costs begins.Quality cost accounting systems and many quality standards are now a component of every contemporary organization's quality improvement plan. The internal potential for return on investment are found through quality cost systems. As a result, quality costs emphasise preventing flaws and other actions that lead to customer discontent, but they provide little insight into the characteristics of the product or service that thrill or please consumers. It is possible for a company to reduce quality expenses to zero and yet fail.

Any expenses that would not be made if quality were flawless are included in the cost of quality.This covers expenses that are evident, such scrap and rework, as well as less obvious ones, including the price of replacing faulty material, the cost of rushing shipments of new material, the cost of the personnel and equipment needed to handle the replacement order, etc.

Businesses that provide services also have quality costs. For instance, a hotel has a quality cost when room service brings a visitor a lost item. Quality costs, or expenses related to achieving or failing to meet product or service quality, are a measure of all product or service criteria set by the business and its contracts with clients and society.

The definition of a product or service can be affected by a number of documents and customer needs, including marketing specifications, end-product and process specifications, purchase orders, engineering drawings, company procedures, operating instructions, professional or industry standards, and governmental regulations.

Quality costs, in more precise terms, are the sum of the expenses associated with (a) investing in the avoidance of nonconformances to requirements; (b) evaluating a product or service for conformance to requirements; and (c) failing to satisfy requirements.

Quality expenses are often hidden expenditures for companies. Few accounting systems provide for the identification of quality expenses unless particular attempts to do so have been made. Unmeasured quality expenses thus likely to rise.

Lower client satisfaction and increased costs are two ways that poor quality affects businesses. Poor revenues are the outcome of lost sales and pricing pressure brought on by lower customer satisfaction. A crisis that might endanger the company's very survival finally results from the combination of increasing costs and decreasing revenues. One method of avoiding this issue is to monitor the cost of quality rigorously.

As the detection point ascends the manufacturing and distribution chain, quality expenses often rise as well. When mistakes are avoided altogether, the cost is often the lowest. It is often least costly to identify nonconformances as soon as feasible after they occur. Beyond that, extra effort that could be lost results in loss of money.

Customers' discovery of nonconformances results in the highest quality charges. In addition to the cost of replacement or repair, a firm suffers reputational harm when a consumer tells others about his negative experience and loses customer goodwill. Extreme circumstances might lead to lawsuit, which would incur more costs and harm reputation.

Early detection also offers the benefit of more insightful feedback that helps in determining underlying problems. It is exceedingly challenging to link a failure in the field to the process condition that caused it because of the lag between production and failure in the field. Field failure monitoring is helpful for assessing a "repair" in the future, but it often adds nothing when analysing a problem in the past.

It is not necessary for quality cost measurement to be precise to the penny. To give broad recommendations for management decision-making and action, such costs are measured. Such precision is unachievable due to the very nature of expense of quality.

In certain circumstances, it may only be feasible to acquire sporadic approximate estimates of costs such those associated with lost consumer goodwill, reputational harm to the business, etc. Special audits, statistical sampling, and other market research may all be used to get these estimations. Teams of marketing, accounting, and Six Sigma professionals might work together to carry out these tasks. These estimates must be obtained since these expenditures are often quite high. They do not have to be acquired every month, however. Usually, annual studies are enough to show trends in these indicators.

Quality Cost Bases

The following rules should be followed when choosing a basis to analyse quality costs:

a. The base should be meaningfully connected to quality expenses.
b. The managers who will get the accurate expense reports need to be familiar with the basis.
c. The base should reflect the size of the market in which quality cost metrics will be used.
d. It is sometimes required to combine many bases to fully understand the relative magnitude of quality expenses.
e. According to Campanella (1990), some typical basis include:
f. A cost basis; or, alternatively, a labour base (such as total labour, direct labour, or applied labour) (such as shop cost, operating cost, or total material and labor)
g. A sales base (such as the value of completed items sold or net sales billed); (such as the number of units produced, or the volume of output)

Although actual dollars spent are typically the best indicator for identifying where quality improvement projects will have the greatest impact on profits and where corrective action should be taken, it will not give a clear indication of quality cost improvement trends unless the production rate is relatively constant. Since the cost of quality programme seeks to improve over time, it is vital to account for other time-related changes in the data, such as changes in production rate, inflation, and other factors. Total quality cost in relation to a relevant base result in an index that may be plotted and examined using control charts.

Net sales is the basis that is most often utilised for presentations to upper management for long-range assessments and planning (Campanella, 1990). The quality cost analysis may be carried out for very short periods of time if sales remain mostly consistent across time. To account for significant fluctuations in the revenue base, this statistic must be estimated over a longer time period in other sectors. For instance, in sectors like shipbuilding or satellite manufacture, there can be periods with no deliveries and others with significant sums. It's crucial that the quality expenses be proportional to the sales for the same time period. The "potential" for the quality expenses to occur may be seen in the sales. Gives the following as a few instances of the expense of high-quality bases:

a. The percentage of manufacturing expenses attributable to internal failure costs
b. External failure costs as a percentage of net sales on average
c. The procurement appraisal costs as a share of the overall cost of the materials acquired
d. The percentage of operations expenses that make up the overall cost of manufacturing
e. Total quality expenditures as a share of production expenses

Plan for Strategy Deployment

Balanced scorecards are focused on strategy, in contrast to conventional measuring methods, which have a bias toward control. Utilizing a collection of related tactics, the goal is to fulfil the leadership vision. Metrics put these ideas into practise and link the leadership's vision to the organization's operations. These guidelines for a fictional company, whose metrics are represented by the rectangles on the left side of the diagram. The relationship between the measurements and the most important topics of interest is clearly shown in the strategy deployment plan.

These latent or unseen structures are inferred from the metrics and are represented by ellipses. This viewpoint enables leadership to see both the significance and limits of measurements. The dashboard measures are plainly insufficient and need revision if, for instance, all of the indicators relating to shareholder perceived value are very positive yet shareholder satisfaction surveys (Voice of Shareholder) show displeasure.The company is focusing on certain dashboard metrics that are shown in bold text and is following a certain strategy. To set this company apart from the competitors, extremely high goals will be established for these indicators. To sustain competitiveness, objectives for other metrics (key needs) will often be defined by preserving the previous levels for these indicators.

The company's executives consider technology and customer service to be its main skills. They want their clients to see them as the source for the greatest items, fully crafted to satisfy the most exacting requirements.But take notice that the company's unique selling points are:

1. Unit price

2. Income from fresh sources

3. Relationships with customers

4. Product launches and (new product) sales

5. When to utilise your research

It would seem that item 1 is at odds with the leadership vision since obtaining benchmark status for items 2 to 5 would be at odds with a goal for item 1 that is comparable. The plan suggests that this organization's productivity approach needs to be reevaluated.Item 1 should probably be a critical criterion maintained at historical levels unless the firm is losing its market owing to uncompetitive pricing or losing its investors due to poor profitability. Cost per unit may get more attention than usual if expenses are really out of control in order to bring them down to acceptable levels. On the strategic dashboard, it shouldn't be shown as a differentiator, however. In the viewpoint of consumers or shareholders, the corporation has no ambition to become a cost leader.

By offering the tools required to promote change where it is needed, Six Sigma plays a crucial part in realising the leadership vision. Entails determining the projected effect of the project on a dashboard measure. This links Six Sigma projects to dashboard metrics. Although the measurements for Six Sigma projects are normally shown on a lower-level dashboard, there is an explicit correlation since the data for the top-level dashboard flow down to the lower level. For each top-level dashboard measure, the procedure starts by determining the difference between the actual state and the desired state; Master Black Belts often help with this task. The best candidates for Six Sigma initiatives are measurements on the differentiator dashboard that reveal significant gaps. Master Black Belts are often the ones who make this judgement. The choice of applicants for the Black Belt rank benefits greatly from this knowledge.

Metrics shown on dashboards operationalize dashboard design strategies. Information on dashboards is intended to be consistent throughout the company. Any process owner should be able to rapidly understand the significance of the dashboard data and quicken the learning process. The deployment strategy plan is only an assumption. In order to take action or modify the strategy deployment plan, science-based management involves testing the hypothesis to see whether it is reasonably consistent with the facts.The guidelines for excellent measurements outlined earlier should be reflected in dashboard metrics, specifically:

1. The evolution of display performance.
2. Provide statistical principles to assist in distinguishing between signal (variation from a recognisable source) and noise (variation similar to random fluctuations).
3. When known, display the sources of variance.
4. Determine what performance is acceptable and undesirable (defects).
5. Be connected to lower-level dashboards (drivers) or higher-level dashboards (goals and strategies) to direct organisational strategy.

The first two issues are addressed by the statistical process control charts that are described. They are the right tool for analysing the metric over time and include guidelines (i.e., statistical control limits) to distinguish between actual process changes and the random variation anticipated within a stable process. SPC software may include more sophisticated capabilities that enable drilling down to show and quantify the sources of excessive variation as well as drilling down between higher and lower level measures.

The software programme window's top-left tabular dashboard offers a rapid view of top-level metrics with status (either reliably under control or prone to unanticipated out of control signals) and sigma level over a specified time period. For instance, the Service Time measure has a relatively low Sigma level of 1.115, which equals an about 13% fault rate. The process must be fundamentally altered to lower the error rate from 13%, as further shown by the process's In Control status, which shows that the mistake rate is inherent and not the result of unforeseen fluctuations.

Drilling down on each of the major dashboard metrics will illustrate how they have changed over time, as shown in Fig. 3.6 for the Service Time measure. The control chart in this illustration shows the process behaviour that was really observed over a 30-day period. As was earlier stated in the dashboard, there are no data over the statistical Upper Control Limit (UCL) of 18.375 and Lower Control Limit (LCL) of 0.234, indicating the process is steady at this time. Near the centre of the figure, a period with less volatility is interestingly highlighted. The wide circles surrounding the data points show that this very low variability period is statistically significant; additional research into this time may lead to a better knowledge of process design, which might lower total variance.

The graphic neatly displays the process objective (also known as the Upper Specification Limit) as 8 minutes. It is clear from the visual representation that 19 observations surpass this criterion. Three boxes, three triangles, and three full circles make up the plot of 13.The customer service staff has correlated each of these sign kinds with a likely reason found during data entry: boxes are related to "System Slow," triangles are related to "Required Approval," and full circles are related to "Customer Information Lacking." The control chart's time-ordered structure reveals that these non-conformances are more evenly dispersed throughout time than they are in one particular time period.

One of the many potential Pareto diagrams connected with the data is shown after further drilling. The product related with each of the excessive service times (i.e., service times longer than 8 minutes) is illustrated in the Pareto diagram of Fig. 3.6, which is further divided by stacked boxes within each product category depending on the customer service problem code. According to this drill-down, Product C has the most mistakes (58%) followed by Product A (an additional 26%), with Product D having the remaining problems. These percentages generally correlate to the proportion of all goods handled, according to another Pareto that can be readily constructed by drill-down (and is not displayed). In other words, given that Product C accounts for 60% of the overall product handled, everything else being equal, we could anticipate that it will contain around 60% of the faults.

The "Customer Information Lacking" problem is connected to every Product D issue, the "Required Approval" error is connected to most of the Product A failures, yet none of these errors happened for Product C. Although not statistically significant on their own, these potential problems might be helpful for project-focused process changes. In order to eliminate mistakes caused by "Customer Information Lacking," for instance, a project may be created. To identify the specific goods for which this error occurs, more analysis of data from related datasets over a longer time frame might be employed.In this approach, the dashboard first offers a mechanism to keep track of the organizational transformation's progress toward the strategic plan's objectives. Drill-down features on the dashboard provide a much deeper source of data to learn more about the potentials and difficulties of the processes. Designing an information management system that can gather and distribute information reflective of the constantly changing organizational demands is undoubtedly advantageous.

CHAPTER13

Prerequisites for Information Systems

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Top-level measures are used first in balanced scorecards. Dashboards will only show a select few metrics at any given level. This enables the dashboard user to concentrate on important information, but it may make it more difficult for them to comprehend the most significant problems brought on by a particular process modification. The "drill down" functionality mentioned in the previous part of information systems (IS) aids in resolving this problem.To drill down, dashboard measurements must be broken down into their component elements. Decomposition of a cost-per-unit metric, for instance, may be done by division, plant, department, shift, worker, week, etc.

At lower levels of the organisation, these elements of the higher-level statistic may already be on dashboards, in which case the response is given beforehand. Other exploratory dig downs can be needed, nevertheless, if the problem cannot be explained by the existing lower-level dashboard indicators. Drill down queries place a burden on the IS; however, online analytical processing (OLAP) cubes often reduce this burden.

In Six Sigma companies, the IS has to be accessible to a lot more individuals, which brings up an essential issue. The data systems belong to us, is how many IS departments feel. Make a formal request for the data you desire. This perspective is utterly outdated in a Six Sigma organization. When Six Sigma is implemented, the demands on IS significantly rise. The Black Belts and Green Belts often use IS in their projects, in addition to producing a large number of dashboards, along with the attendant drill downs and issue investigations. More requirements are placed on the IS by the Six Sigma "show me the data" emphasis. Companies must choose a high-level champion to supervise the transformation of IS to the new Six Sigma realities as part of their preparation for the success of this methodology. While preserving data security and integrity, it is intended to make access as simple as feasible.

The majority of Six Sigma data analysis don't need immediate access to data, even if timing is crucial. It's often sufficient to use data that is only a day or a few days old. For Six Sigma team members and Belts to do off-line data analysis, the IS department may wish to offer the necessary infrastructure. When doing data mining techniques like clustering, neural networks, classification, and decision trees, a small number of powerful workstations that can handle massive amounts of data or complex computations may be quite helpful.Technical leaders in Six Sigma seek to retrieve useful information from an organization's information warehouse. Six Sigma operations should be carefully connected with the organization's information systems (IS) to ensure access to the necessary information. It goes without saying that an investment in software and hardware is necessary to supplement the knowledge and training of Six Sigma technical leaders.

1. Using Six Sigma in the Integration of Other Information Systems Technologies
2. Three information systems subjects have a tight relationship with Six Sigma activities:
3. Online analytical processing (OLAP), data mining, and data warehousing

Data warehousing refers to the data that is stored by the company and hence accessible for usage in Six Sigma projects. It has an influence on data storage, which has an impact on Six Sigma analysis accessibility. People who may not have the technical experience of a Six Sigma technical leader may analyse massive datasets thanks to OLAP. Utilizing cutting-edge technologies and methodologies, data mining entails a retrospective review of data.

Smaller firms may benefit greatly from establishing adequately scaled systems, even as bigger organisations unquestionably need an advanced approach to data warehousing, OLAP, and data mining. Simply said, the longer-term data management and analysis needed by Six Sigma teams cannot be accomplished with one Excel spreadsheet, or more likely, a proliferation of these spreadsheets. In comparison to spreadsheet data storage, relatively simple database designs with MS Access or SQL Server backends offer significant advantages, especially when combined with user interfaces that make it simple to drill down into the database or query related databases like Laboratory Information Systems (LIMS) or Manufacturing Resource Planning (MRP) systems.

Database Management

Data warehousing has advanced significantly. In 1990, data warehouses were almost nonexistent; now, nearly every significant firm has at least one, and some have several. Data warehousing solutions are provided by hundreds of suppliers, ranging from software to hardware to whole systems.

There are as many data warehousing implementations as there are data warehouses, and there are few standards in place. The multitiered method to data warehousing looks to be gaining popularity, and recent technological advancements and price drops have increased the allure of this option for business users.The purpose of the data is the main emphasis of multitiered data warehousing architecture. Although data summarising into various departmental warehouses may be necessary for access and storage reasons, it is ideal for Six Sigma analysis if the warehouse retains all of the data's granularity for historical analysis. According to Berry and Linoff (1997), this architecture's principal elements are:

The sources of the data are known as source systems.

The primary store for the data warehouse is the central repository, and the metadata explains what is accessible and where. Data transit and purification transfer data across multiple data stores.Data marts provide end users and applications quick, customized access.End users are the reason the warehouse was built in the first place, and operational feedback incorporates decision support back into the operational processes (Figure 13.1).

Each data warehouse has at least one of these components. The data comes from the source systems and travels via the different parts to the end consumers. The parts may be divided into three categories: networks, software, and hardware. Delivering information serves as the catalyst for the generation of new knowledge, which is subsequently used to enhance corporate performance. In other words, a decision-support system's data warehouse is a key component.

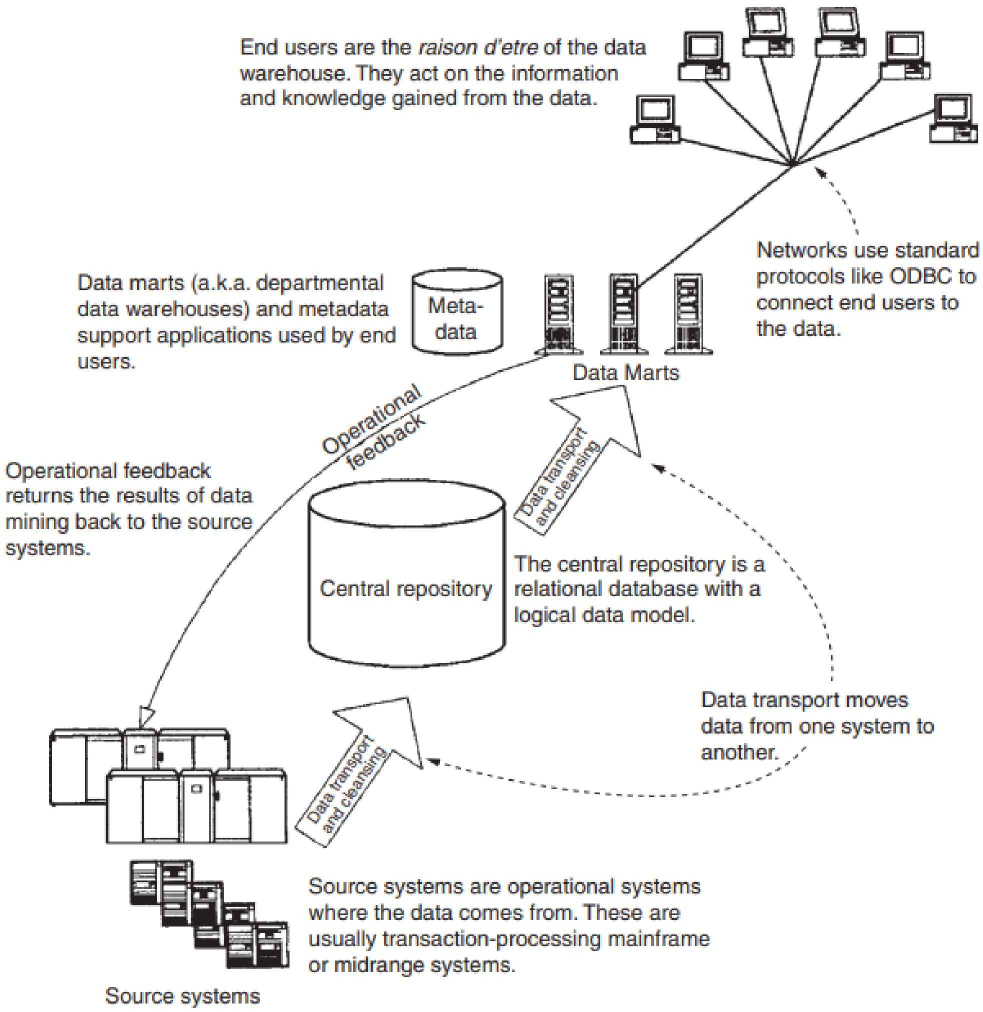

Figure 13.1: The multilevel strategy is shown.

OLAP

Online analytical processing, sometimes known as OLAP, is a group of technologies created to provide common people a way to extract helpful information from large databases. A data warehouse may or may not hold these databases. If they do, the user will have the knowledge that the data has already been cleaned up, and access will probably be quicker. The components of OLAP are client-server programmes with cutting-edge graphical user interfaces that access data organised in "cubes." The cube is perfect for queries that let users manipulate the data anyway they see appropriate. OLAP technologies are very helpful when huge data warehouses are queried since they have extremely quick response times compared to SQL searches on conventional relational databases.

The cube is OLAP's fundamental data type. Data from one or more databases are compiled into an OLAP cube using subcubes. Multiple dimensions that correspond to various database fields make up each cube. For instance, as illustrated in Figure 13.2, an OLAP cube may include warranty claims organised by months, items, and location.

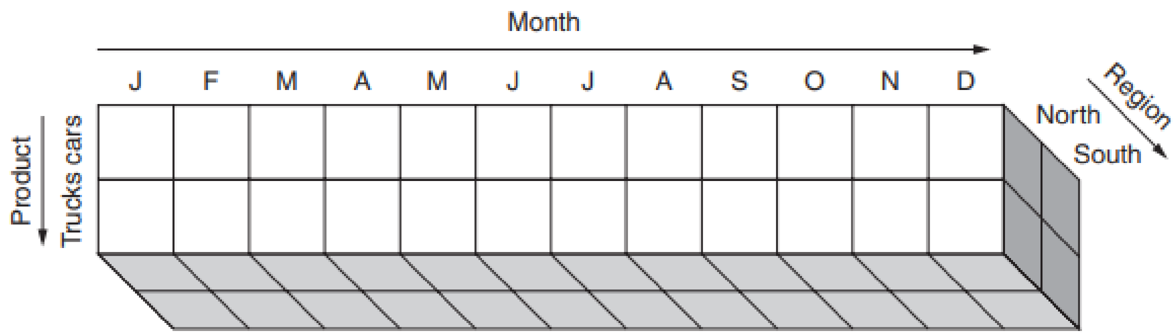

Figure 13.2: An Olap Cube

Data Mining

Data mining is the exploration and analysis of massive amounts of data using automated or semiautomatic methods in order to find relevant patterns. These patterns are investigated in order to create performance guidelines, or new and improved procedures. Six Sigma's use of data mining aims to increase quality, decrease cycle times, cut costs, and increase customer happiness.

Data mining is a mash-up of methods taken from numerous fields. Data mining, like Six Sigma, alternates between developing questions via knowledge discovery and testing hypotheses through planned experiments. When analyzing data, both Six Sigma and data mining search for similar things: classification, estimate, prediction, affinity grouping, clustering, and description. However, data mining often employs a different set of tools than conventional Six Sigma tools, offering an additional method for searching for improvement potential. Data mining also tends to focus on marketing, sales, and customer support, while Six Sigma tends to concentrate on internal company operations. The external emphasis of data mining offers both feed forward data to the Six Sigma programme and feedback data on its effectiveness, since the ultimate goal of Six Sigma is to increase customer satisfaction.

Data mining is a method for looking back and investigating corporate data. The stages of such a process are increasingly well understood, and any disagreements are limited to the specific activities that go into each stage.

Goal definition: Definition of the project's purpose or objective is known as the "goal definition." This should be a business purpose or goal that typically corresponds to a business event, such as mortgage payment defaults, customer attrition (churn), process energy use, etc. The creation of the actions that will follow the identified patterns and result in business improvement is also a part of this step.

Data selection: Data selection is the process of determining the data sources and the data that will be used in the data mining project.

Data purification: joining or merging of data sources, and the creation of additional columns (fields) in the data through aggregation, computation, or text manipulation are all examples of data preparation. The final product is often a flat table that is prepared for the data mining itself (i.e., the algorithms used to find patterns). Usually, two data sets are created from such a table: one for pattern discovery and the other for pattern verification.

Data exploration: it is the process of looking further into the prepared data before finding patterns and validating the outcomes of the data preparation. Typically, this entails analyzing the frequency distribution of several data fields as well as descriptive statistics (minimum, maximum, average, etc.). To comprehend the interdependence between fields, scatter plots of one field vs another are frequently used.

Pattern discovery – This phase involves using the algorithm for pattern discovery to produce patterns. The use of the pattern discovery process as an exploration process with the aid of the discovery algorithm yields the best results.

Business users may collaborate with the discovery process in this way and contribute their business knowledge. For instance, while building a classification tree, users may review and investigate the data filtering that led to a particular branch, look at the algorithm's suggestion for the data field to use for the next branch, and then use their business judgement to choose the data field. The capacity to forecast the recurrence of the event in data sets other than those used to create the model is examined during the pattern discovery stage.

Deploying patterns—at this step, the business purpose of the data mining project is resolved by using the patterns that have been found. Various variants of this exist:

Pattern presentation—A document or presentation includes a description of the patterns (or the graphical tree representation) and the data statistics that go along with them.

Business intelligence – To create business intelligence reports, the patterns that have been found are employed as queries on a database.

Data scoring and labeling—using the patterns that have been found, each data entry in the database is scored and/or labelled with the likelihood and the label of the pattern to which it belongs.

Decision support systems—the components of a decision support system are made using the patterns that have been found.

Alarm monitoring: A business process uses the patterns that were found as norms. Monitoring these trends will make it feasible to spot changes from the usual as soon as possible. This may be done by including the data mining tool as a monitoring component or by using a traditional strategy, such control charts.

Monitoring of pattern validity – As a business process evolves over time, so will the validity of patterns identified from historical data. Therefore, it's critical to spot these changes as soon as they occur by keeping an eye on trends with fresh information. The requirement to identify new patterns from more current data will be indicated by significant changes to the patterns.

Data mining, OLAP, and Six Sigma

Data mining is still necessary in addition to OLAP. Data mining is the process of looking for hidden patterns in data, whereas OLAP tools are effective for reporting on data.

By instantly providing data to support or refute ad hoc ideas, OLAP assists users in exploring current notions. In essence, it is a semiautomated analytical method. The conventional toolkit of methods and procedures utilised in Six Sigma is complemented by both OLAP and data mining. Retrospective studies employ both OLAP and data mining to build hypotheses by analysing historical data. Contrarily, designed experiments evaluate the hypotheses produced by OLAP and data mining, which aids users in creating prospective research. Combining OLAP, data mining, and Six Sigma results in a potent set of business improvement capabilities.

Benchmarking

Six Sigma is often interested in the subject of benchmarking. As a result, the topic at hand extends beyond just using benchmarking for project management.

A common technique for creating requirements and establishing objectives is benchmarking.

Benchmarking, as it is more commonly known, is the process of comparing your company's performance to that of best-in-class organisations, figuring out how they attain those performance levels, and utilising that knowledge as the foundation for your own company's goals, plans, and execution.

Benchmarking entails looking at the best practises at the company, process, and industry levels. Benchmarking goes beyond figuring out what the "industry standard" is; it dissects a company's activities into processing processes and seeks for the best-in-class in each one. For instance, Xerox Corporation researched retailer L.L. Bean in order to enhance their parts distribution method.

Setting objectives is just one aspect of benchmarking. It focuses on methods that result in excellent performance. Setting up alliances that enable mutual learning is an aspect of benchmarking. Competitors may benchmark as long as they stay clear of proprietary problems.

Just like any other big project, benchmarking initiatives are similar. To guarantee that comprehensive and accurate investigations are successfully carried out, benchmarking must have a defined process. But it must be adaptable enough to take into account fresh and creative approaches to compiling information that is hard to come by. It is a journey of discovery and education. It compels the organisation to look outside of itself and from an external perspective.

According to Camp (1989), the benchmarking process includes the following steps:

1. Organizing
2. Identify the benchmarking criteria
3. List comparable businesses
4. Select a data collecting strategy and gather data

Review

Determine the "gap" in current performance

Predict performance levels in the future

Fully incorporated practises within the process

Choosing what to benchmark is the first stage in the benchmarking process. Start by determining the process outputs that matter most to the consumers of that process in order to concentrate the benchmarking campaign on essential concerns (i.e., the key quality characteristics). Since every organisational function includes outputs and clients, this step is applicable to all of them.

Activities related to benchmarking are naturally preceded by the QFD/customer requirements assessment.

Introduction to Benchmarking

Information gathering is at the heart of benchmarking. Finding the process to be benchmarked is the first step in the procedure. The procedure used need to have a significant influence on the company's achievement.

Once the procedure has been determined, get in touch with a business library and ask them to do a search for any relevant information. The library will point out content from various other sources, including periodicals, journals, special reports, etc. Additionally, you need to use the Internet and other electronic networking tools while doing your study. However, be ready to narrow down what will presumably be a very lengthy list of options (for instance, a search on the phrase "benchmarking" on the Internet returned 20,000 results). The internal resources of your company should not be overlooked. Use the "Intranet" if your business has one to carry out an internal search. Call a meeting with representatives from important divisions, such R&D. Utilize the knowledge of those employees in your business who often deal with clients, rivals, suppliers, and other "outside" businesses. Frequently, the board of directors of your organisation will have a wide network of connections.

Of course, the search is not entirely random. Search for the top-tier companies rather than the typical ones. The elites may be determined from a wide variety of sources. One strategy is to compile citations of excellence and business awards that firms have won for business process improvement. A few sources to take into account are the Industry Week Best Plants Award, the Malcolm Baldrige Award from the National Institute of Standards and Technology, the Quality Cup Award from USA Today and Rochester Institute of Technology, the European Foundation for Quality Management Award, the Occupational Safety and Health Administration (OSHA), the Federal Quality Institute, the Deming Prize, the Competitiveness Forum, Fortune magazine, and the United States Navy's Best Manufacturing Practices. You could choose to pay for a subscription to an "exchange service" that gathers benchmarking data and makes it accessible. The names of other subscribers will be available to you after you sign up, making this a fantastic resource for connections.

Don't disregard the informational value of your own providers. Contact the top suppliers identified by your company's programme to ask them if they would be prepared to share their "secrets" with you. Cooperation between suppliers and consumers comes naturally to them; it is a door opener. Contact your clients as well. Customers are motivated to assist you in improving your business. Your clients will gain if you perform better in terms of quality, pricing, and delivery. Customers could be prepared to provide some insight into how you stack up against their other vendors. Once again, learning about your immediate rivals is not required. There won't often be any problems with confidentiality if you keep your attention on the process level. Finding possible benchmarking partners via your customers has the benefit of providing a recommendation, which will make it simpler for you to launch the collaboration.

Academic research is another resource for comprehensive information about businesses. Companies often provide universities access to comprehensive data for research needs.

Even while the published study often leaves out particular company names, it frequently offers comparisons and in-depth analyses of what sets the best apart from the others. You may often save tens of thousands of hours of effort by using this knowledge, which is offered by subject-matter experts whose work has undergone thorough peer review.

The next stage is to choose the top three to five targets from the list of probable prospects. On the basis of the following factors, a candidate who seemed promising early on in the selection process can be disqualified later (Vaziri, 1992):

Unskilled performer

1. Lack of availability and shaky trustworthiness of candidate information;
2. Reluctance to share information and practises (i.e., does not see the benchmarking process as a mutually beneficial learning opportunity);

The features of the most ideal candidates will be continuously improved as the benchmarking process progresses. This happens as a consequence of a better grasp of the essential qualities and success elements of your firm as well as a better comprehension of the competition and the market.

The activities that follow from this understanding greatly improve an organisation.

Why Efforts at Benchmarking Fail

The same factors that contribute to other unsuccessful initiatives also contribute to failing benchmarking efforts (DeToro, 1995).

Lack of sponsorship—A team should provide management with a one- to four-page proposal for a benchmarking project outlining the project's goals and probable expenditures. It makes little sense to go on with a project that is not understood or appreciated or that is unlikely to result in remedial action after completion if the team can't acquire clearance for it or find a sponsor. The same people who own or are employed by the process should also be engaged in benchmarking. A team can't solve challenges in industries it doesn't understand or in which it has no power or influence.

Teams don't fully grasp their work – There can't be an efficient transfer of methods if the benchmarking team didn't map, flowchart, or record its work process, and if it didn't benchmark with firms that likewise documented their processes. Every benchmarking effort aims to help a team fully comprehend their own process and compare it to the procedure of another company. Performance improvement requires the sharing of process stages.

Teams take on too much—Teams often take on tasks that are too big for them to handle. This vast region has to be divided into smaller, easier-to-manage tasks that may be tackled methodically. Making a functional flowchart of an entire region, such as manufacturing or marketing, and cataloguing its operations is one proposed strategy. The benchmarking approach may then be chosen based on criteria that best supports the goals of the company.

Lack of long-term management commitment—Managers sometimes underestimate the time, money, and effort necessary to properly finish a benchmarking project because they are less acquainted with particular workplace difficulties than their workers are. Managers should be made aware that, while though it's hard to predict how long a normal benchmarking project would take in advance, it often takes a team of four or five people five months to finish a project, or a third of their time.

Prioritize metrics over processes – Some businesses prioritise performance measures over procedures while doing benchmarking. Even though a competitor may have a higher return on assets, this does not necessarily mean that the competitor's performance should become the new benchmark (unless it is known how the competitor uses its assets differently and an analysis of its operations reveals that it can be imitated or outperformed).

Benchmarking is one of several Six Sigma methods, including problem resolution, process improvement, and process reengineering, used to decrease cycle time, costs, and variation. Benchmarking should be positioned within a bigger plan. For the greatest benefit, benchmarking should be used in conjunction with these tools since it is compatible with them and complements them.

A lack of knowledge of the organization's purpose, goals, and objectives—Management should always start benchmarking activities as part of a larger plan to achieve the organization's mission and vision by first achieving the short-term goals and then the long-term ones.

Assuming that every project needs a site visit—in many cases, the public domain has enough information to avoid the need for a site visit. This expedites benchmarking and significantly reduces expense.

Failing to keep track of progress—Once benchmarking for a particular area or process has been finished, benchmarks have been developed, and process improvements have been put into place, managers should examine the outcomes of implementation and progress. . By properly planning and controlling the project from the start, you can avoid them in the best possible manner.

Use this list as a checklist to assess project plans; if they don't explicitly rule out these issues, they aren't comprehensive.

Why Benchmarking Is Beneficial

Competitive benchmarking has the following advantages:

1. Fostering an environment that emphasizes constant improvement in order to attain greatness.
2. Increasing innovation by minimizing the impact of the not-invented-here syndrome

Increasing the company's sensitivity to environmental changes and changing its corporate mindset from one of relative complacency to one of a strong feeling of urgency for continuing improvement

1. Aligning resources with performance goals determined with feedback from employees
2. Establishing priorities for areas that need development and exchanging best practises with benchmarking partners

A Few Risks of Benchmarking

Instead than creating new and better methods, benchmarking is focused on learning from others. Benchmarking cannot provide a company a sustainable competitive advantage since the procedure being researched is open to public scrutiny. Benchmarking is useful, but it should never be the main method of development.

Many businesses employ a strategy for goal formulation called competitive analysis. This strategy is basically a kind of industry-specific benchmarking. Competitive analysis is common, but it almost ensures worse quality since the company will continually be emulating its rivals. Using this strategy will result in stagnation for the whole industry, positioning them to be eventually replaced by outside innovation.

Questions for Practices

1. Why is Six Sigma used?
2. What is the difference between the Six Sigma DMAIC and DMADV methodologies?
3. **What is Lean Six Sigma?**
4. How would you decide the project level, whether it should be a Black Belt or a Green Belt project?
5. What is your ultimate purpose in developing the FMEA document?
6. How can a design team reconcile divergent viewpoints if it is split on the crucial questions for a product?
7. What is the foundation of any process you are developing?
8. What is the role of a process owner?
9. Which internal procedures are essential to achieving customer and shareholder goals?
10. What ways can you get the Voice of the Customer Six Sigma?
11. Who makes up the ideal benchmarking team?

Reference Book for Further Reading

1. The Certified Six Sigma Green Belt Handbook
2. Statistics for Six Sigma Made Easy! Revised and Expanded Second Edition
3. Six Sigma Demystified, 2nd Edition
4. A Guide to Six Sigma and Process Improvement for Practitioners and Students: Foundations, DMAIC, Tools, Cases, and Certification (2nd Edition)
5. Six Sigma for Powerful Improvement: A Green Belt DMAIC Training System

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