

# Quality Improvement for LED Lights using Six Sigma

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**Abstract** - Today, manufacturing industries are highly impacted by the fast changing economic conditions. In this scenario, manufacturing industries are facing global competition due to globalization. The major problems those are being faced by these industries are declining profit margin, customer demand for higher quality product and product variety. Six Sigma is a comprehensive and flexible system for manufacturing products or service achieving, sustaining and maximizing business success. Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data and statistical analysis and diligent attention to managing, improving and reinventing business processes. This is the definition that will provide the foundation for our efforts to unlock the potential of Six Sigma for our organisation. The types of business success you may achieve are broad because of the proven benefits of Six Sigma i.e., Cost Reduction, Productivity Improvement, Market-share Growth, Cycle time reduction, Defect reduction etc.

**Key Words:** Six Sigma, Quality Improvement, 5S.

## 1. INTRODUCTION

Over recent decades, the quality of services has become an area that is relevant to managers and researchers due to its strong impact on customer satisfaction and loyalty and company performance and profits. The quality of service can be defined as the result of the comparison between the customers' expectations and his perception of the manner in which service was provided. Cost of Quality can be defined as "the cost of carrying out the quality functions so as to meet the quality needs of the customers." It includes market research costs of discovering needs of customers, product research and development cost of creating product concepts, design cost of translating product concepts into specifications, cost of manufacturing planning in order to meet quality specifications, cost of inspection, cost of quality insurance, complaints, field service and such other functions to improve quality. The competitive advantages and improvements of services can be obtained through the application of quality management techniques and, particularly, through Six Sigma. Six Sigma is an organized and systematic methodology used to improve processes or products' performance with impact on customers, and is based on scientific and statistical methods. This methodology is applied to repetitive, systematic and well known processes. The use of methodologies for quality improvement fits in the competitive environment where companies operate. The selected company for the case

study is a private ltd company from the power sector that uses six sigma projects to improve quality. This project is a typical Six Sigma project since the customer complaints handling process is a core production process highly stable and repetitive. Six Sigma seeks to improve the quality of the output of a process by identifying and removing the causes of defects and minimizing variability in manufacturing and business processes.

### 1.1 Problem Statement

1. Various products manufactured by the company are defective in operation. Supply and demand are not Seeing Eye to eye in regards of quality.

2. Hence, by using Six Sigma tools, the quality build of the products such as LED bulbs, LED street lights, LED floodlights, household surface lights etc can be improved and boost daily production.

3. Based on feedback from customers and changes in various steps of production this problem can be resolved to achieve defect free production which is ultimately the goal to be achieved by Six Sigma deployment. Furthermore, implementation of 5s methodology can be done to help maintain it.

### 1.2 Objective

1. To improve Quality of Street lights which are manufactured in the organisation.

2. To improve Quality of Flood Lamps which is the product of Eco-luxe.

3. To improve and boost daily production target.

## 2. Methodology

### 2.1 Six Sigma

The name Six Sigma refers to the variations that exist within plus or minus six standard deviations of the process outputs. It seeks to reduce variations in the processes that lead to product defects. Like every classic TQM tool, six sigma has a direct link with profitability by reducing the cost of poor quality, which the firm has to spend through rework, rejects & lost customers. In fact, what six sigma really does, is add Octane to your TQM fuel. The difference between Six Sigma and other quality tools is that the others measure your ability to meet quality. Six Sigma actually measures the output of your process. So it

is less theoretical and more real. We have been using quality control tools for a number of years, but six sigma introduces a certain rigour and robustness, which is not there in TQM. It is found that the harder your targets are, the more difficult it is to use conventional TQM tools to meet them. Both six sigma and TQM are effective tools for quality management, but a thin line of difference does exist between them. Six Sigma is newer concept than TQM but not exactly its replacement. The basic difference is that TQM delivers superior quality manufactured goods, whereas six sigma gives more better results. The main focus of TQM is to maintain existing quality standards, whereas six sigma primarily focuses on making small changes in the processes and systems to ensure high quality. TQM is less complicated process than six sigma. Six sigma involves specifically trained individuals, whereas total quality management does not require extensive training. Six sigma is known to deliver better and effective results, as compared to TQM as it is based on customer feedback and more accurate and result orientated. Six Sigma seeks to improve the quality of process outputs by identifying and removing the cause of defects. Six sigma is a collection of managerial and statistical concepts and techniques that focuses on variation of processes and preventing deficiencies in the product.

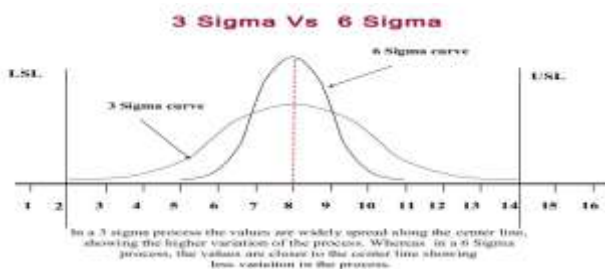


Chart -1: Difference between 3σ & 6σ

## 2.2 DMAIC Approach

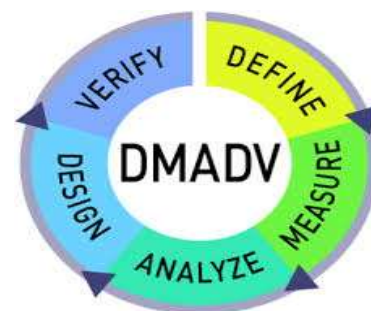
The DMAIC model refers to five interconnected stages (i.e. define, measure, analyse, improve and control) that systematically help organisations to solve problems and improve their processes. DMAIC resembles the Deming’s continuous learning and process improvement model PDCA (plan-do-check-act). Within the Six Sigma’s approach, DMAIC assures the correct and effective execution of the project by providing a structured method for solving business problems. Pyzdek considers DMAIC as a learning model that although focused on “doing” (i.e. executing improvement activities), also emphasizes the collection and analysis of data, previously to the execution of any improvement initiative. This provides the DMAIC’s users with a platform to take decisions and courses of action based on real and scientific facts rather than on experience and knowledge, as it is the case in many organizations, especially small and medium side enterprises (SMEs). The DMAIC project methodology has five phases. • Define the system, the voice of the customer and their requirements, and the project goals, specifically.

This stage within the DMAIC process involves defining the team’s role; project scope and boundary; customer requirements and expectations and the goals of selected projects. The primary aim is to identify, within each sub-process, the possibilities for quality problems, through the use of different statistical tools.



## 2.3 DMADV

DMADV is a Six Sigma framework that focuses primarily on the development of a new service, product or process as opposed to improving a previously existing one. This approach – Define, Measure, Analyse, Design, Verify - is especially useful when implementing new strategies and initiatives because of its basis in data, early identification of success and thorough analysis. The DMADV methodology should be applied: 1. When a non-existent product or process needs to be developed at a company and 2. When an existing process or product already exists but still needs to meet a Six Sigma level or customer specification. DMADV methodology consists of 5 phases- • Define: Design goals that are consistent with customer demands and the enterprise strategy. The goals of the first phase are to identify the purpose of the project, process or service, to identify and then set realistic and measurable goals as seen from the perspectives of the organization and the stakeholder(s), to create the schedule and guidelines for the review and to identify and assess potential risks. A clear definition of the project is established during this step, and every strategy and goal must be aligned with the expectations of the company and the customers. The company will identify the demands and needs of the customers through historical information, customer feedback and other information sources. This will define the goals of the project.



## 2.4 Quality Management Systems

Quality management system is a collection of business processes that are focused consistently on meeting consumer requirements and enhancing their satisfaction. It is defined in the terms of organisational structure, policies, procedures, processes, resources needed to implement the quality management. It ensures that an organisation, product or service is consistent. It has four main components: Quality planning, quality assurance, quality control and quality improvement. Quality management is focused not only on product or service quality, but also on means to achieve it. Therefore, quality management uses quality assurance and control of processes as well as products to achieve more consistent quality. Of QMS regimes, the most widely recognised standard is ISO 9001, a basic quality management system that can be used in industries of any size, anywhere in the world.. ISO stands for International Standards Organisation. Registration to ISO 9001 (or other quality/management standards) provides objective proof that a business has implemented an effective quality management system, and that it satisfies all of the requirements of the applicable standard. An external, impartial expert called a registrar or CB (Certification Body) conducts an on-site audit to determine whether or not a company is in conformance to the standard. If they are found to be in conformance, they will be issued with an ISO 9001 certificate showing their address, scope of operations and the seals of the accreditation bodies that give the registrar its legitimacy

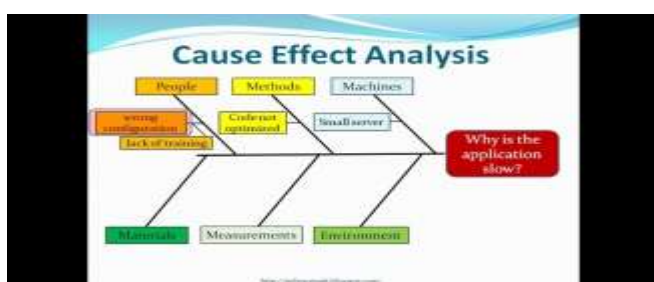
## 3. Experimentation

### 3.1 DMAIC Approach

**Define:** To improve the quality of street lights of 40W, so the defect rate will be minimised as low as 5 defects per 3000 pieces.

**Measure:** Survey was carried out in order to identify the areas of problem. The outcome was following things were identified. Raw material, Improper manufacturing process, poor quality parameters, and voltage fluctuations on site and lack of training skills for workers were the areas where improvement was needed.

**Analyse:** Using cause-effect diagram we analysed the flaws in process and focused on the areas to work.

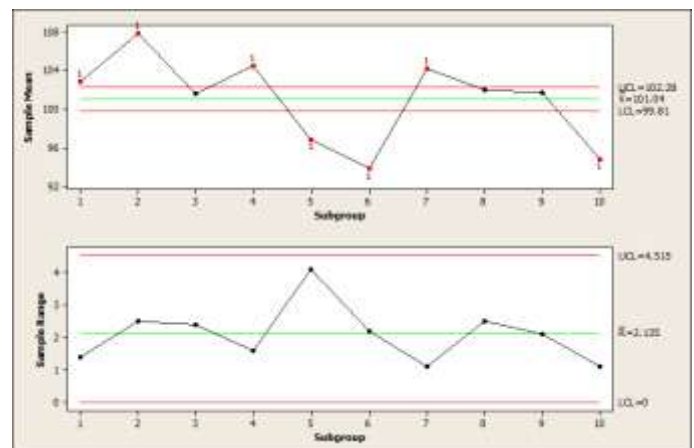


**Improve:** We have studied about the production process going on in the company for the manufacturing of the LED-lights. The process processed as follows: 1. Raw materials will be collected from the authorized vendors according to the customer specifications. 2. In the next step inward quality control test will be conducted by two processes:

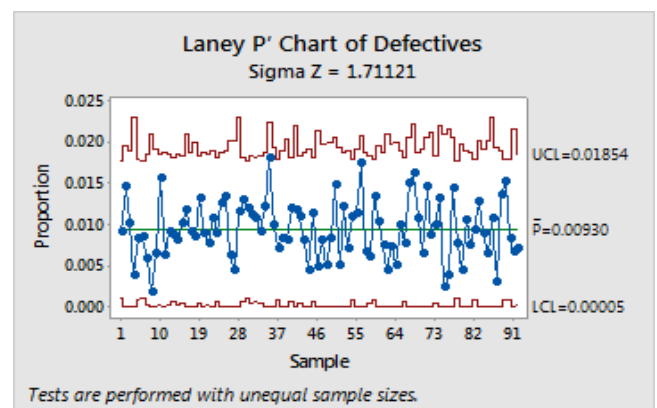
- Physical inspection and
- Functional inspection.

**Control:** The following data is obtained during the process as we control the defect rate and improved the quality.

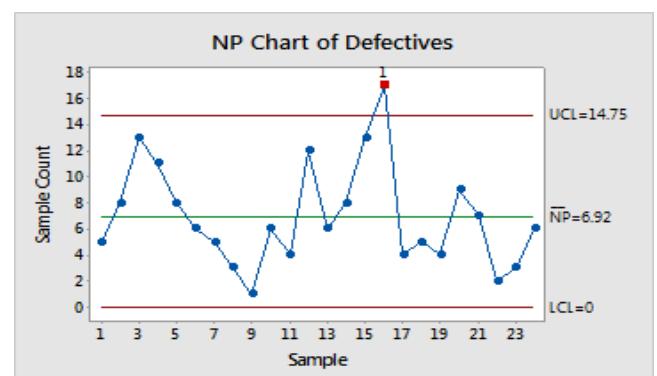
### 1. X bar S chart analysis



### 2. Laney Chart



### 3. NP chart





### 3.2 Implementation of 5S

With the ever changing economic climate, many organizations are periodically adjusting their resources to align with business strategy. This often results in the need to achieve more work with fewer resources. In order to remain successful, businesses must become more efficient, reduce waste and thereby reduce cost. We must find ways to do what we are currently doing in less time and at a lower cost. One way we can accomplish this is through the use of 5S Principles. The 5S Principles are very effective at identifying and eliminating waste and increasing efficiency. The philosophy of 5S represents a way of focusing and thinking in order to better organize and manage workspace, specifically by eliminating the 8 Wastes as defined by the Lean Manufacturing system. It is one of the most widely used and fundamental components of Lean Manufacturing. It's simple, common-sense application is highly effective and reliable as a stabilizing force in Lean strategies.

The 5S list goes as follows

1. Seiri (Sort)
2. Seiton (Straighten, Set)
3. Seiso (Shine, Sweep)
4. Seiketsu (Standardize)
5. Shitsuke (Sustain)

**Sort (Seiri)** – Distinguishing between necessary and unnecessary things, and getting rid of what you do not need. Remove items not used in area – outdated materials, broken equipment, redundant equipment, files on the computer, measurements which you no longer use.

**Straighten (Seiton)** – The practice of orderly storage so the right item can be picked efficiently (without waste) at the right time, easy to access for everyone.

**Shine (Seiso)** – Create a clean worksite without garbage, dirt and dust, so problems can be more easily identified (leaks, spills, excess, damage, etc).

**Standardize (Seiketsu)** – Setting up standards for a neat, clean, workplace. Standardization of best practices through 'visual management'.

**Sustain (Shitsuke)** – Implementing behaviors and habits to maintain the established standards over the long term, and making the workplace organization the key to managing the process for success.



### 3.3 Before 5S

Before 5S implementation, there was haphazard manner of procuring and storing of raw materials as well as resources. As shown in the fig there is no proper stacking done for the boxes, raw material are not properly containerized to form a single unit. Stacking is done in a very careless way causing harm and damage to the material inside. This has resulted in early breakage and failure of many of the final product after assembly resulting in defective production. Proper sorting of boxes and units is not done. Cleanliness is not properly maintained so as to spot the problems easily. There are no proper workplace standards, in short the work area is not fit for optimal usage of space, inventory, and motion.

### After 5S

Upon taking the decision of improving quality via increasing productivity, came the need to implement 5S in the workplace. To minimise waste and damage from the very first stage of production i.e. procurement and storage of goods to handling and assembly, we have educated the workers so as to create a mindset of continuous improvement and clean and efficient way of working.

Before sort



after sort



#### 4. Conclusions

- The Project has been completed successfully with the co-operation of the company and significant results were obtained.
- All the data was shared by the company and based on the data the Quality Control Goals were analysed.
- The term “sigma” is used to designate the distribution or the spread about the mean of any process.
- Sigma measures the capability of the process to perform defect-free work.
- A defect is anything that results in customer dissatisfaction. For a business process, the sigma value is a metric that indicates how well that process is performing.
- The initial quality was below average and after successful implementation of Six Sigma the significant improvement is achieved.
- By implementing this process over a period of time all quality goals will be achieved. The led lights are now under control quality and all production targets are achieved.
- The data was analyzed in the minitab and compared with before and after process. The term “sigma” is used to designate the distribution or the spread about the mean of any process.

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