CASE STUDY FOR IMPROVEMENT ON LED TESTING EQUIPMENT USING STATISTICAL PROCESS CONTROL AT OSRAM OPTP SEMICONDUCTOR.

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Special dedicated to

my beloved parents and siblings who have encourage, guided and supported me

throughout my study life

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ABSTRACT

In a competitive market environment, service and product quality are very important weapon to enable companies to compete and satisfy their customer requirements. The importance of quality has been recognized in many companies for obtaining higher quality products. In OSRAM OPTO Semiconductor Penang, the equipment linearity and GRR on LED tester testing equipment have not been proposed. This project research actually is to study the LED testing equipment in term of linearity and GRR. Other than that, this project is to proposed improvement for tester capability. One of the method to improve the quality of process output where identifying the causes of defect and minimizing variability in manufacturing is by using Six Sigma. Six Sigma is a measure quality that seeks for near perfection. In order to monitor and control a process, a method called Statistical Process Control (SPC) is taken. According to Measurement System Analysis process, linearity and GRR is the best way to identify and quantify all the sources of measurement error which significant. GRR is a gage repeatability and reproducibility. The definition of GRR is a precision that is closeness of repeated reading to each other, a random precision that is closeness of repeated reading to each other and is a random error of component of measurement system. Whereas linearity is change in bias over operating range and correlation of multiple independent bias error over operating time. This project consist LED testing equipments that are IV tester and PHIV tester. The expected result of this project are LED tester that statistically capable and to improve equipment reliability and reduce error in testing.

ABSTRAK

Dalam persekitaran pasaran yang kompetitif, perkhidmatan dan kualiti produk adalah senjata yang sangat penting bagi membolehkan syarikat untuk bersaing dan memenuhi keperluan pelanggan mereka. Kepentingan kualiti telah diiktiraf dalam banyak syarikat untuk mendapatkan produk-produk berkualiti tinggi. Dalam OSRAM OPTO Semiconductor Pulau Pinang, kelinearan peralatan dan GRR pada LED penguji peralatan ujian tidak dicadangkan. Ini sebenarnya projek penyelidikan adalah untuk mengkaji peralatan ujian LED dalam jangka kelinearan dan GRR. Selain itu, projek ini adalah untuk penambahbaikan yang dicadangkan untuk keupayaan penguji. Salah satu kaedah untuk meningkatkan kualiti output proses di mana mengenal pasti punca-punca kecacatan dan mengurangkan kepelbagaian dalam sektor pembuatan adalah dengan menggunakan Six Sigma. Six Sigma adalah satu langkah yang bertujuan untuk kesempurnaan. Dalam usaha untuk memantau dan mengawal proses, kaedah yang dipanggil Kawalan Proses Statistik (SPC) diambil. Menurut Sistem Pengukuran proses Analisis, kelinearan dan GRR adalah cara terbaik untuk mengenal pasti dan menilai semua sumber-sumber ralat pengukuran yang ketara. Takrif GRR adalah ketepatan yang keakraban berulang membaca satu sama lain, ketepatan rawak yang keakraban berulang membaca satu sama lain dan adalah satu kesilapan rawak komponen sistem ukuran. Manakala kelinearan adalah perubahan dalam berat sebelah ke atas pelbagai operasi dan hubungan pelbagai kesilapan bias bebas dari masa ke masa operasi. Projek ini terdiri peralatan ujian LED yang IV penguji dan penguji PHIV. Hasil yang diharapkan daripada projek ini adalah LED penguji bahawa statistik berkebolehan dan untuk meningkatkan kebolehpercayaan peralatan dan mengurangkan kesilapan dalam ujian.

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SPC	- Statistical Process Control
MSA	- Measurement System Analysis
GR&R	- Gage repeatability and reproducibility
PHIV	- Luminous Flux Conform
IV	- Intensity Voltage
LED	- Light Emitting Diode

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CHAPTER 1

INTRODUCTION

1.1 Background

The manufacturing location in Penang is currently one of the largest and most well equipped Osram Opto Semiconductor manufacturing facility in the world. It has the combined expertise of the world's largest lighting manufacturer and the photonic know-how and technology of the opto semiconductor business. One of the product manufactured in this location is Light Emitting Diodes (LED). To get the quality of the product, a technique that is concerned with monitoring process capability and process stability must take place which is call as Statistical Process Control. Statistical Process Control (SPC) is a fundamental approach to quality control and improvement which is based on objective data and analysis.

This report presents the improvement of LED lighting technology using Six sigma method. Six Sigma has been a popular management philosophy for many years. It is introduced by Motorola and popularized by General Electric in 1980s. Six Sigma provides a structure approach to help manage and improve performance. Not just an improvement but it helps to use the right tools, in the right place and in the right way.

Measurement System Analysis is to qualify a measurement system for used based on its accuracy, precision and stability. It is applicable to all gages and test equipment requiring MSA in engineering and manufacturing of products from front end and back end technology. The techniques of measurement system analysis include calibration studies, Gage R&R, linearity, stability and others. This project is investigated the LED testing equipment in terms of linearity and Gage R&R.

1.2 Problem Statement

Recent years Osram Opto Semiconductor, Penang is constantly challenged by increased demand in quality and product customization, at a lower cost and save time. Quality / Process engineers need a systematic, fast and reliable methodology to make decisions to ensure that the Measurement System Analysis is in good condition. Merely the Measurement System Analysis of the LED tester equipment linearity, GRR in Osram Penang has not been fully determined. Therefore this project is seeking to proposed improvement program for tester.

This is a very powerful relationship between the quality and productivity. Adding improvement building blocks to an ideal industrial system in any arena is possible on an appropriate foundation. Competitive pressures have recently caused in Osram Penang to examine the foundations on which their improvement strategies are based. For this Industrial Company to improve its long term competitive position, it must focus on the process rather than on the product.

With the knowledge and the concept embraced by the SPC and Six Sigma methodology help Osram Penang to maintain this focus and provide guidance for quality and productivity improvement. Hence, this project research will propose to industry whereby nowadays product and service quality are very important to compete the customer requirement.

1.3 Objectives

There are some identifiable objectives of this project. Prior to identify certain objective project need to understand what is meant by Six Sigma, Statistical Process Control and Measurement System Analysis. It is because by understand the definition of Six Sigma, Statistical Process Control and Measurement System Analysis can help more easier to complete this project

This project has two objectives to achieve, the first

i. To improve reliability to achieve uniformity in its output of LED lighting technology using Six Sigma.
ii. To investigate the LED testing equipment in term of linearity and GRR.

1.4 Project Scope

This project involves Linearity and GRR data taken from sample of LED product and LED testing equipment which are IV tester that stands for Intensity Voltage tester and PHIV tester that stands for Luminous Flux Conform tester in OSRAM OPTO Semiconductor Penang. The statistical software called Minitab is used to analyze the data. Minitab is the software package that helps to analyze data which are Linearity and GRR data. It provides a quick, effective required in most Six Sigma project such as Linearity and GRR on LED testing equipment. A proposal will then be drafted to improve tester capability based on Six Sigma strategy that will minimize variability in manufacturing.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Since the 1920s, SPC developed by Walter A. Shewart were widely used during the 2^{nd} World War in Britain and United States of America [1]. Japanese companies had demonstrated which by applying SPC, a company will be able to minimize the cost and satisfying more customers. According to Dr Shewart there are 2 types of variation which are prevailed among all processes which are chance causes variation and assignable cause variation. Any process will certainly contain chance cause variation which this is normal, random variation present in all system. For more than 70 year, the manufacturing discipline has benefited from the tools of SPC to lead decision making process. SPC is a statistical technique commonly used to control processes and reduce variation in order to improve quality [1]. It is a philosophy to nurture continuous improvement activities in an organization. Other than that, SPC is a powerful problem solving technique used for monitoring, controlling, analyzing, managing and improving a process using statistical method. SPC is a type of feedback where information about a process is used to improve and maintain the process. The main goal of a SPC system is to make economically efficient decision concerning the types of actions to take on a process and who should initiate the action [1].

2.2 Theory of Six Sigma

Six Sigma was developed by Bill Smith at Motorola. Its implementation began at Motorola in 1987 and allowed Motorola to win the first baldrige Award in 1988. Motorola recorded more than 816 billion savings as a result of Six Sigma [2]. Some of the major companies in the world have adopted Six Sigma are Texas Instruments, General Electric, Nokia Mobile Phones, Sony, Polaroid, American Express and many more. The goal of Six Sigma is process good services at a Six Sigma level [3]. It is to eliminate defects, reduce production and development costs, reduce cycle time and inventory levels, increase profit margin and improve customer satisfaction. The strategy of Six Sigma is to use a data-driven structured approach to attack defects to improve the sigma level. Six Sigma also drive industries to produce and design product to Six Sigma standard. It is useful in any enterprise that provides products or services for companies [3]. The philosophy of Six Sigma is a process that can be defined. Measure, analyzed, improved and control. It required input and produce output. Generally can expressed as the y=f(x) concept. Six Sigma of a set of tools such as SPC includes all the qualitative and quantitative techniques used by the Six Sigma to drive process improvement.

Other than that, Sigma is the Greek symbol for standard deviation. Six Sigma means six standard deviations from the average. When speaking of quality, it means 99.996 percent out of 100 percent accuracy; traditional quality calls for 99.73 percent accuracy. For some perspective, tradition quality (Three Sigma) means residents have unsafe drinking water for two hours per month. Six Sigma is a continuous quality improvement program that is customer focused and provides a problem-solving methodology using statistical tools. Six Sigma uses steps that lead the organization through the improvement process: define, measure, analyze, improve and control (DMAIC)

2.2.1 Define

Define means to understand who the customers are, what is important to them and what are the inputs and outputs of a process. The tools used during this process are flowcharts, check sheets and cause/effect diagrams. Use flowcharts to provide a visual representation of a process. Use check sheets to record the process data. Pareto analysis employs a chart that shows the frequency of a problem. A cause/effect (fishbone) diagram is a picture of the possible causes of a problem.

2.2.2 Measure

In the measure phase, the goal is to collect baseline data to determine where the process stands as compared to where it needs to be. During this phase, identify critical-to-quality (CTQ) characteristics and estimate current process capability. Identify those characteristics that are most important to the customers and calculate the current sigma level. For example, for call centers, customers may complain that it takes too long for the representative to enter the request. The CTQ name is order entry time. The CTQ measure is average handle time (AHT). The CTQ specification is an order entry time of two minutes or less. The unit of measure is the order and the opportunity is one order per call. The defect is orders entered in more than two minutes. Use the Six Sigma calculator to calculate the sigma. The total opportunities are 5,500 orders and the total defects (orders over two minutes). In this case, the sigma is 3.90.

2.2.3 Analyze

For the analyze phase, It is use to show the amount of improvement necessary to make the CTQ characteristics the best in the industry. Some analysis tools used for this are desciptive statistics and FMEA. Descriptive statistics is analysis that uses methods such as the mean, median and standard deviation to understand the characteristics of a population. FMEA stands for failure modes and effects analysis. Use this tool to identify each possibility of failure and its effect on the process. Incorporate those failure scenarios into the process improvements in order to minimize the occurrence of those scenarios and strengthen the structure of the process.

2.2.4 Improve

Implement the suggested improvements to test their effectiveness. This is the time to test possible solutions to the process problems. Collect data on each of the possible solutions, test each solution on a small scale and run a cost/benefit analysis of implementing the solution. Select the best solution to resolve the problem then create a plan for implementing the solution. Create a contingency plan for any unforeseen circumstances.

2.2.5 Control

In the control phase, measures are implemented to ensure improvements are maintained. Use tools such as statistical process control (SPC) charts to monitor the process improvements. The SPC charts have three lines that represent the upper and lower control limits and the center line for the average. Monitor the process to ensure that the process is not out of the control limits. Look to see if the process begins trending outside of the limits. Begin reassessing the process if there are two or three consecutive observances outside of the limits; if there are five, seven or nine observances getting larger or smaller; or if half or more of the observances are outside of the limits

2.3 Measurement System Analysis

Measurement system analysis (MSA) is an experimental and mathematical method of determining how much the variation within the measurement process contributes to overall process variability. There are five parameters to investigate in an MSA: bias, linearity, stability, repeatability and reproducibility or called it as Gage R&R. A general rule of thumb for measurement system acceptability is:

I. Under 10 percent error is acceptable.

II. 10 percent to 30 percent error suggests that the system is acceptable depending on the importance of application, cost of measurement device, cost of repair, and other factors.

III. Over 30 percent error is considered unacceptable, and you should improve the measurement system. The number of distinct categories the measurement systems divides a process into should be greater than or equal to 5.

IV. In addition to percent error and the number of distinct categories, you should also review graphical analyses over time to decide on the acceptability of a measurement system.