

Research Article

Minimizing the Rejection of Lever Combination Switch by removing the problem of Erratic continuity in Assembly line using Continuous Improvement Process

Anil Kumar^{†*} and Vijay Mittal[‡]

[†]H.U., A.P., India, [‡]G.I.E.T., Sonapat, India

Accepted 25 May 2015, Available online 27 May 2015, Vol.5, No.3 (June 2015)

Abstract

Company Mindarika had reported poor quality of particular products in the Assembly department which results in increasing cost, lead time, and customer complaints. The purpose of this study is to help Company Mindarika to improve the product quality and to manage the data for a continuous improvement plan by using Continuous Process Improvement and the Quality Control Techniques. Methods and procedures of this study include a review of literature relevant to Continuous Improvement, Quality Control Techniques, Root cause Analysis, Seven Tools of Quality and Assembly process of a specific automotive product (Lever Combination Switch). After the causes of defects were identified, solutions and procedures were recommended to the Company to eliminate defects in the assembly process of Lever Combination Switch.

Keywords: Minimizing rejection, C.I. Methods, Lean Manufacturing.

1. Introduction

1.1 Background

Quality is now involved in every kind of business: manufacturing, hospital, school, food industry, public utility, etc. This is not focused only in production areas but in service areas also. It has turned out to be a core competency for many companies to improve their competitive advantage. Why is quality important? High quality products or services are leading to business success, improved competitiveness, higher customer loyalty, and lower costs.

Competitors are not only from domestic companies but also from international companies. Therefore, customers have the right to choose companies that can satisfy their needs the best. Examples of customer needs are high quality products, low prices, fast delivery, good services, etc. Continuous Improvement Theory is one of the strategies that can help organizations to satisfy customer needs and help organizations to have greater performance.

1.2 Project/Concerned Place Introduction

1.2.1) Introduction

Mindarika Pvt. Limited, with Rs.1.30 billion (USD 32.12 million) in revenue, is India's largest 4 wheeler

automotive switch manufacturer. Mindarika Pvt. Limited has consciously evolved into a complete design and development centre for four wheeler automotive switches. It offers customized solutions to the automotive industry in the realm of product improvisation and new product development and has very strong localization capabilities. The core strengths at Mindarika are skilled manpower, adherence to the highest quality standards and providing cost effective solutions.

N K Minda Group has 23 manufacturing plants in India, Indonesia and Vietnam, and sales offices in Japan, Europe and China. They are continually looking to increase their global footprint. At the same time, they are building their core strengths in the existing markets. Over the past fifty years, they have grown consistently and rapidly through a carefully controlled and well managed expansion of their portfolio of products, and have thereby experienced consistent growth.

The group employs nearly 6000 people and is headquartered in Manesar, Haryana, India. They have engineering, research and development centers in Bangalore, Manesar, Pantnagar, Pune and Sonapat. The group has joint ventures and technical agreements with world renowned manufacturers such as Tokai Rika- Japan, Soft Italia- Italy, Kyoraku –Indonesia and Emer-Spa, Italy.

Mindarika is consistently winning accolades across categories of products in the automotive switch

*Corresponding author Anil Kumar is a PhD Scholar and Dr. Vijay Mittal is working as Prof. & Principal

segment. The belief is to offer innovative solutions for clients' problems and to serve them better through customer-centric solutions. The focus of company is on collaborative designing with the OEMs. The group has capability to improve existing products as well as cost effective solutions for products already available in the market. With strong focus on research and development, the company has been constantly evaluating and employing technologies to benefit its customers. It provides its customers with all the facilities under one roof be it design and development, prototyping, testing, validation and quality, or manufacturing the final product.

NK Minda group spends 3% of its annual turnover on research and development efforts with the aim being to increase it to 5%.

1.2.2) Mindarika's Engineering

The focus at the NK Minda Group is on **collaborative designing** with the OEMs. The Group has the capability to improvise existing products as well as offer cost-effective solutions for products already available in the market. With strong focus on R&D, the company has been constantly evaluating and employing emerging technologies to benefit its customers. It provides its customers with all the facilities under one roof be it design and development, prototyping, testing, validation and quality, or manufacturing the final product.

1.2.2.1) Production Engineering

Production Engineering enhancements ensure that the manufacturing process is smoother, quicker and has seamless movement right from design & development to producing the final products. This includes emphasis on Process Design, JIG / Equipment Design, Jig / Equipment Manufacturing and Assembly Line improvements etc.

1.2.2.2) Product Validation



Figure 1.1 Product Validation

Each NK Minda Group component goes through voltage drop & high voltage tests, insulation test, operating torque and operating load test to ensure that electrical problems cannot hamper its performance. Environmental tests like Dust resistance, water

shower, corrosion resistance, dry and damp heat tests, cold and rapid temperature change tests, ensure that the external conditions also do not impede the functioning of the component. NK Minda Group has advanced product quality planning through FMEA, QFD, MSA, and Product & Process Validation activities. The company also emphasizes on statistical process control for minimizing defects.

1.2.3) Mindarika's Quality

Quality of automotive parts and customer service has been the focus of the company to gain market share and to satisfy their customers.

The company's business has been increased dramatically within the past couple years. Mindarika Private Limited is producing a larger variety of automotive parts products than before. They do have not enough time to experiment before producing to attain suitable settings for each product like they had in the past. This affected the product quality, increased both internal and external failure cost, and increased customer complaints.

Due to its continuous Quality Improvement Techniques Mindarika has achieved various certificates and awards.

Various Quality Initiatives include:

Business Excellence

The group has collaborated with CII on a well defined 3 years business excellence program titled BEST (Business Excellence Through Simple Techniques).

Quality Circles

50 Quality Circles are actively involved in the improvement projects across the group. Inter Unit Quality circle competitions are held quarterly to honor their efforts.

Kaizen

Involvement in Kaizen activities from all the levels

5 S

Emphasis is laid on 5S principles.

The various certificates and awards achieved by Mindarika are explained below

Table 1 Quality certificates awarded to different units of Mindarika

Name of the unit	Certifications
Mindarika Pvt. Ltd.	TS: 16949:2002, ISO 9001 : 1994 , QS 9000 : 1998, ISO 14001 : 2004
Minda Industries Ltd. Switch Division	ISO 9001: 2000, ISO 14001 : 1996 OHSAS 18001, NABL - LAB Certification
Minda Industries Ltd. Lighting Division	ISO 9001 : 1994, TS 16949 : 2002

1.2.4) Mindarika’s Research

The reason that Minda has consistently been on top in its product categories is because it is constantly offering innovative products that it develops in association with its clients. The idea of customer delight comes into play here, where the design engineers anticipate future requirements, design and develop prototypes and offer potential winners. NK Minda group spends 3% of its annual turnover on R&D efforts with the aim being to increase it to 5% .



Figure 1.2 Automatic Control Unit

Advanced R&D activities are going on for initiatives like LED based Automotive Lighting, Combination lever Switch, Electronic Cell, Automatic HVAC Control Panel, Body Control Module, Contact Less Switches and Grain Sensor.

Table 2 Details of Various Patents and Copyright with Mindarika

	2003-04	2004-05	2005-06	2006-07
Patents	1	2	1	-
Designs	11	-	-	1
Trade Marks	1	3	1	4
Copyright	2	-	-	2

1.3) Statement of problem

Recently the Mindarika Private Limited has reported poor quality of a product (Lever combination switch) in the automotive parts department which results in increasing cost, lead time, and customer complaints.

1.4) Significance of the Study

Quality problems in automotive parts processes are the main problem for Mindarika Private Limited at the moment. Therefore, the results of this study will be applied to the automotive parts processes to improve quality performance and establish the continuous improvement plan for the company in order to increase quality of product, increase productivity, reduce costs, and satisfy customers.

1.5) Definitions

Continuous improvement. A management philosophy that views quality improvement as a never-ending process that will always lead to incremental improvements.

Customer satisfaction. A gauge on how well customer requirements are designed into product or service.

Quality. A subjective term for which each person or customer may have their own definition. Characteristics of a product or service that impact its ability to satisfy stated or implied needs. A product or service that is free of nonconformities.

2. Literature Review

This chapter will discuss concepts of quality including continuous improvement, lean techniques. Moreover, this chapter is devoted to the review of literature which includes the concept of automotive parts manufacturing and processing.

2.1) Continuous Improvement

It is impossible for organizations to survive without changing or improving. The organization's ability to survive in a highly competitive business world depends on how the organization manages and adapts to demands of a changing environment. The change in a business environment comes from many resources-

- Competitors create new products;
- Competitors reduce products' prices and
- Competitors use new technology to improve quality of a product.

Customer expectations are always changing. Therefore, many companies have had to improve in terms of products or services to satisfy customers' needs.

Continuous improvement is an ongoing effort to improve products, services, or processes. It is more focused on customer service, process improvement, higher product quality and long-term strategies. Table-3 shows additional differences between companies that apply continuous improvement theory and traditional companies. There are different approaches to support continuous improvement theory.

Table 3 Continuous Improvement versus Traditional Orientation

Company Oriented Toward Continuous Improvement	Traditional Company
Customer Focus	Market-Share Focus
Cross-Functional Teams	Individual
Focus on What &How	Focus on Who and 'Why
Long-Term Focus	Short-Term Focus
Continuous Improvement Focus	Status Quo Focus
Process Improvement Focus	Product Focus
Problem Solving	Fire Fighting

2.2) Seven Tools of Quality

Kaoru Ishikawa developed seven basic visual tools of quality so that the average person could analyze and interpret data. The seven tools of quality are used for improving processes, identifying problems, seeking root causes of problems, and solving problems. These tools are incredibly simple so all levels of workers can use them easily. These are-Histograms, Pareto Charts, Cause and Effect Diagrams, Run Charts, Scatter Diagrams, Flow Charts, Control Charts.

2.3) View of Product under consideration (lever combination switch)



Figure 2.1 Lever combination switch

3. Objective

To remove the problem of Erratic Continuity of Lever Combination Switch.

4. Research Methodology

4.1) Introduction

The purpose of this study is to help Mindarika Private Limited to improve product quality and manage the data for a continuous improvement plan, then provide feedback to the company for the future improvement.

4.2) Define

The problem will be then defined.

4.3) Data Collection

Data related to production will be collected. It will include the total produced quantities, rejected quantities, and type of defects in the specific product.

4.4) Data Analysis

The various Quality and Lean tools will be used to analyze data, identify problem, seek root causes of problem, and solve problem. Then the solution will be applied to the problem and the final results will be calculated.

5. Results

5.1) Definition of Erratic Continuity

The lacking of continuation of Current Flow in the switch due to which Lever will not work properly



Figure 5.1 Erratic Continuity

5.2) Analysis & Finding out causes of High Significance

A Failure Tree Analysis has been drawn to find out the causes of Erratic Continuity.

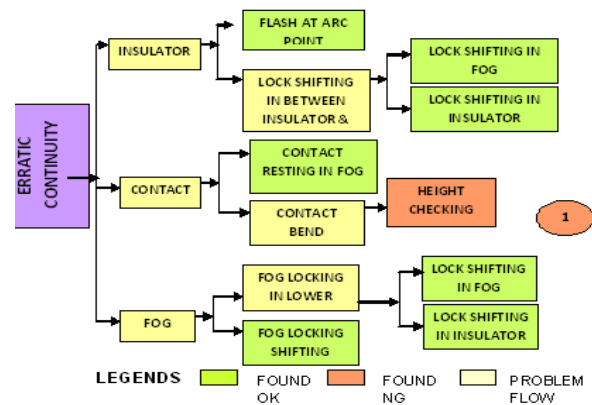


Figure 5.2 Failure Tree Analysis for the problem of Erratic Continuity

From the failure tree analysis it has been found that the Erratic Continuity is due to problem in the contact bend. This is due to the fact that because of **No Proper Height checking**.

5.3) Confirmation of Root Cause

For determining the root cause of this problem we will analyze a diagram taken from the process line. Simultaneously we will make a Why Why Analysis of Height Checking Not Good Factor.

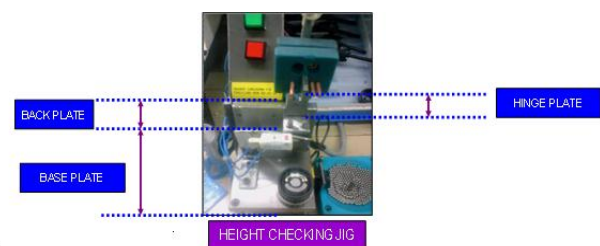


Figure 5.3 Root Cause confirmation of Erratic Continuity

Why -Why Analysis of Height Checking not Good

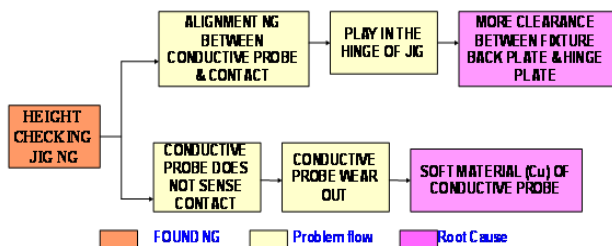


Figure 5.4 Why-Why Analysis of Height Checking not Good

From the above diagram and the Why Why Analysis of Height Checking we found that the problem is due to the two reasons

1. Jig for Height Checking is not appropriate
2. Soft material (Cu) of conductive probe wears out.

5.4) Developing solution for problem Erratic Continuity

For removing the first cause i.e. **More Clearance between Fixture and Back plate**, we can use two solutions

1. Alignment of hinge plate with back plate
2. Convert existing hinge type Jig to Pneumatic Height Checking Jig.

But the first type of solution is not appropriate because of 2 reasons given below

- 1) Chances of error in alignment during maintenance
- 2) Hinge plate is supported with base plate by spring loaded pins.

So the second solution will give an appropriate solution of the problem of the Erratic Continuity which is Convert existing hinge type Jig to Pneumatic Height Checking Jig.

For removing the second cause of problem i.e. **Soft Material (Cu) of Conductive material**, we will exchange the softer material of conductive material with a comparatively harder material. This will not let the material to wear at faster rate.

5.5) Trial Implementation

These solutions are then implemented on the assembly line for resolving the problem of Erratic Continuity.

The first solution (Convert existing hinge type Jig to Pneumatic Height Checking Jig) is implemented to the first problem and it's Before and After condition are explained below in the diagram

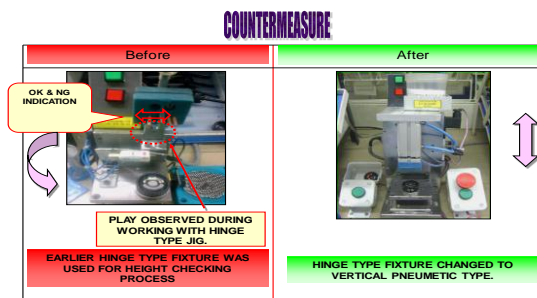


Figure 5.5 Trial Implementation of Ist Solution

The above comparative diagram of Before and After conditions taken from the assembly line explains that

- a. In Before condition we find that a play exists during working with Hinge type Jig which is used for Height Checking Process.
- b. The After condition explains that when we change the fixture to Vertical Pneumatic Type fixture the play problem resolves.

The Second solution (exchanging of softer material of conductive material with a comparatively harder material) is implemented to the second problem (Soft Material (Cu) of Conductive material which gets wear at a faster rate) and it's Before and After condition are explained below in the diagram.

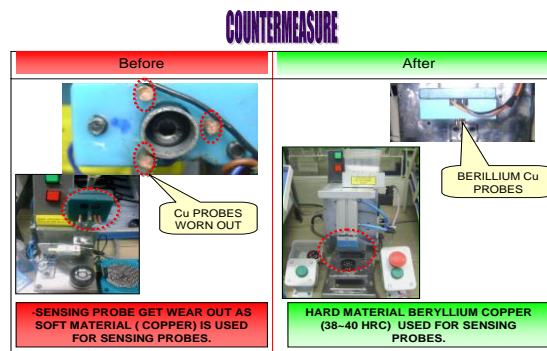


Figure 5.6 Trial Implementation of 2nd Solution

The above comparative diagram of Before and After conditions taken from the assembly line explains that

- a. In Before condition we find that the sensing probe get wear out as soft material (Copper) is used for sensing probes.
- b. The After condition explains the solution of this problem. This condition explains that if we will use a harder material (Beryllium Copper, 38-40 HRC) we can get rid of problem of wear out of sensing probe.

Conclusion

For removing the problem of Erratic continuity the following suggestions can be used-

1. Convert existing hinge type Jig to Pneumatic Height Checking Jig.
2. Exchange the Soft Material (Cu Probe) of Conductive material with a comparatively harder material (Beryllium Copper Probe).

Recommendation for further study

This study provided the procedures and solutions based on the Continuous Process Improvement to solve problem of Erratic Continuity. This study can be applied to other assembly lines, which are facing similar kind of problems, for minimizing the rejection of some particular product.

References

- Dale H. Besterfield (2006) Total Quality Management, Prentice Hall
- Narongsawas Chongwatpol (May, 2006) Implementing Continuous Process improvement methods in a Mid Size Plastic Company, PP. 25-29.
www.mindagroup.com/mindarika.htm
- Colin Herron and Paul M. Braiden (2006), A methodology for developing sustainable quantifiable productivity improvement in manufacturing companies, International Journal Production Economics 104 pp143-153.
- Andrew Crowley (1998), Construction as manufacturing process: Lessons from the automotive industry, Computers and Structures 67pp 389-400.
- P. Kuhlman, T. Edtmayr, W. Sihn (2011), Methodical approach to increase productivity and reduce lead time in assembly and production-logistic process, CIRP Journal of Manufacturing Science and Technology 4 pp 24-32.
- Robert V. Hogg and Mary C. Hogg (1995), Continuous Quality Improvement in Higher Education, International Statistical Review, pp 35-48.
- He Zhen Qi Ershi Liu Zixian, A Study on continuous quality improvement strategies and methods, <http://www.paper.edu.cn>.