Productivity and Quality Improvement in Telecom Industry

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***Abstract*— In Today's industrial scenario most of the firms are interested in strategic approach for improving productivity and quality in their organizations. Consistent with this thrust, this paper attempts to provide a strategic framework for such efforts. The main focus of this paper is on integrating various functional groups of a Telecom organization and highlighting the role of new ideas in productivity and quality improvement. Comparison of earlier and present practices of production operations signifies the importance of TQM, in improving the integration of various functional areas and alignment between business, productivity and quality improvement strategies. TQM has been recognized as a successful management philosophy in the telecom and service industries. The role of knowledge workers and support services plays a dominant role in improving productivity and quality in Telecom industry.**

Keywords—Productivty improvement, Quality improvement, Jigs, TQM

I. INTRODUCTION

Productivity improvement is to do the right things better and make it a part of continuous process. Therefore it is important to adopt efficient productivity improvement technique so as to ensure individuals and organization's growth in productivity. The aim of this chapter is to introduce and understand productivity improvement, various techniques of productivity improvement, work study and its relation with productivity improvement. A production unit can be defined at any level of aggregation desired: a single facility within a multi-facility organization, an entire firm, a whole industry, a sector of the economy, a country, or a region. There are both challenges and advantages that are unique to each level of aggregation.

In practice, there are many different ways to measure productivity. Each measure has its benefits and drawbacks. Some measures are well suited to analyzing an entire country's performance compared to the rest of the world. Country-level productivity is strongly associated with improving the welfare of the nation. This may be useful for national policy-makers trying to enhance the well-being of an entire population through the development of the national economy. These macro-level measures of productivity will not give any sense of how a particular firm's practices can improve their profitability.

Other measures of productivity are well suited to analyzing the performance of a firm or a branch of a company. Measurement at this level of detail will tend to be inadequate in recognizing the value of interactions between firms or discovering patterns at a regional level.

This report focuses on firm level productivity and productivity improvement tools. Engaging in a process of examining firm productivity drivers is an important step to improving the competitive position of the firm and, by virtue of the firm's position within the community, the entire region. Productivity improvement tools focus on improving the drivers of productivity and removing obstacles to productivity improvements. Total Quality Management (TQM) has proven itself as a way of managing and continuously improving quality. Its successful implementation in Japanese firms has been a major factor not only in their success, but also in establishing the levels of quality that customers now expect in whatever they purchase. What is Total Quality Management? What indeed do we mean by quality? Quality may be simply defined as meeting customer requirements. In fact, given the level of competition in today's market place, we might better define it as meeting and improving upon requirements. Total Quality Management, as the name indicates, regards the continuous improvement of customer-oriented quality as both requiring active management and involving the entire company – and often suppliers and customers as well. TQM can be described in practical terms as customer focus, continuous improvement and teamwork. A great deal has been written about TQM, and more scholarly analyses have identified four fundamental orientations of TQM: systems, customer, learning and change. From this perspective, TQM is seen as a dynamic economic effort by firms to adapt and survive in dynamic environments.

"TQM is a management approach of an organization, centered on quality, based on the participation of all its members and aiming at long-term success through customer satisfaction, and benefits to all members of the organization and to society." In Japanese, TQM comprises four process steps, namely:

1. Kaizen – Focuses on Continuous Process Improvement, to make processes visible, repeatable and measureable.
2. Atarimae Hinshitsu – Focuses on intangible effects on processes and ways to optimize and reduce their effects.
3. Kansei – Examining the way the user applies the product leads to improvement in the product itself.
4. Miryokuteki Hinshitsu – Broadens management concern beyond the immediate product.

TQM requires that the company maintain this quality standard in all aspects of its business. This requires ensuring that things are done right the first time and that defects and waste are eliminated from operations. Total Quality Management (TQM) is a management strategy aimed at embedding awareness of quality in all organizational processes. TQM has been widely used in manufacturing, education, government, and service industries, as well as NASA space and science programs.

II SURFACE COATING PROCESS

Ultrasonic Cleaning

Ultrasonic Cleaning is a highly effective precision cleaning process, which delivers a quick, safe, consistent and exceptional standard of cleaning. The very nature of ultrasonic cleaning ensures it is a powerful force, which can clean both hard to reach areas such as blind holes and complex internals as well as remove ingrained surface contaminants such as paint or wax.

Alkaline Etching

This method is a means for preparation of test specimens for determination of bare dielectric material quality and properties, using an alkaline etching solution for removal of copper cladding.

Desmut

The desmut solution contains strong mineral acids, and when aluminum-silicon alloys are treated, fluoride ions. Both may be selected to uniformly attack the aluminum surface, or the proportions can be varied to preferentially dissolve the silicon (e.g., high fluoride concentration) and/or the aluminum. The aluminum and exposed silicon particles are thereby rendered more active.

Triple-Rinsing

Triple-Rinsing is a 3-stage manual rinsing process that has been proven as the best method for cleaning empty agrochemical containers. Triple-Rinsing means rinsing the container three times. Triple-rinsing can be used with plastic, non-pressurized metal, and glass containers.

Zincating process

The zincating process was conducted at various times to determine the optimal conditions for complete coverage of the sample with a uniform zinc deposit.

Zinc stripping

Zinc stripping is primarily used to protect metals from corrosion effects. Zinc coatings prevent corrosion of protected metal by forming a physical barrier and acting as a sacrificial anode - even when this barrier is damaged. Zinc and iron/steel are joined and placed in an electrolyte; a cell is formed, in which the zinc becomes the anode and the steel the cathode. Then, the zinc is sacrificed, and the steel does not rust.

Electroless Ni Plating

Electroless nickel (EN) plating is a process for depositing nickel alloy onto a substrate by electrochemical reactions [1].This process can effectively and economically improve the surface property and corrosion resistance of iron and steel products because of its high wear and corrosion resistance, good lubricity, and excellent thickness uniformity even in recessed areas [2-10]. In contrast to zinc or cadmium coatings that act as sacrificial coatings [11], Ni-P coatings function as a barrier by isolating the substrate from the aggressive environment.

Electroplating

Electroplating is a process that uses electric current to reduce dissolved metal cations so that they form a thin coherent metal coating on an electrode. The term is also used for electrical oxidation of anions onto a solid substrate, as in the formation silver chloride on silver wire to make silver/silver-chloride electrodes. Electroplating is primarily used to change the surface properties of an object (e.g. abrasion and wear resistance, corrosion protection, lubricity, aesthetic qualities, etc.), but may also be used to build up thickness on undersized parts or to form objects by electroforming.

Electrode Position

The process used in electroplating is called electrode position. It is analogous to a galvanic cell acting in reverse. The part to be plated is the cathode of the circuit. In one technique, the anode is made of the metal to be plated on the part. Both components are immersed in a solution called an electrolyte containing one or more dissolved metal salts as well as other ions that permit the flow of electricity

Silver plating

Silver plating has been used since the 18th century to provide cheaper versions of household items that would otherwise be made of solid silver, including cutlery, vessels of various kinds, and candlesticks. In the UK the assay offices, and silver dealers and collectors, use the term "silver plate" for items made from solid silver, derived long before silver plating was invented from the Spanish word for silver "plata", seizures of silver from Spanish ships carrying silver from America being a large source of silver at the time.

Neutralizer

One common neutralizer is calcite. When properly applied, calcite corrects pH only enough to reach a non-corrosive equilibrium, and does not overcorrect under normal conditions. Upon contact with calcite, acidic waters slowly dissolve the calcium carbonate to raise the pH, which reduces the potential leaching of copper, lead and other metals found in typical plumbing systems.

Tarnish

Tarnish is a thin layer of corrosion that forms over copper, brass, silver, aluminum, magnesium and other similar metals as their outermost layer undergoes a chemical reaction. Tarnish does not always result from the sole effects of oxygen in the air. For example, silver needs hydrogen sulfide to tarnish, although it may tarnish with oxygen over time. It often appears as a dull, gray or black film or coating over metal

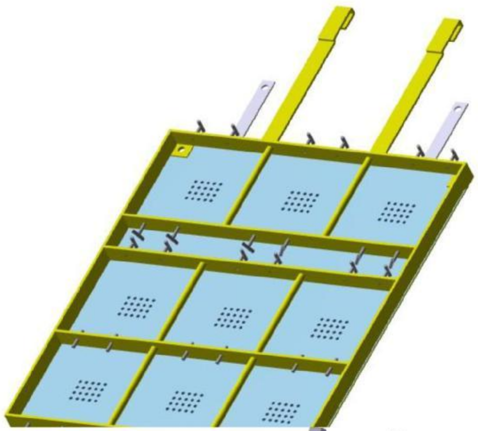
III Jigs

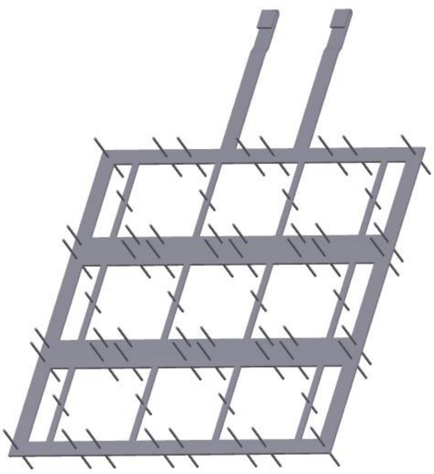
Mass production targets on increasing productivity and increasing accuracy by reducing the setup cost and manual fatigue. One of the common practices to achieve the goals of mass production is to use jigs. Let us consider an example that one gets an order of 1000 product in such a way that three holes are to be drilled in a work piece. In such situations, designer will lay out the position of each hole with the help of square, straightness, scribers, center punch etc. Generally, trial and error method is practiced until the axis of hole is properly aligned with the axis of drill. Thus, a lot of time will be consumed to maintain the accuracy. Ultimately it increases operator's fatigue. Thus, instead of laying out the position of each hole on each work piece with the aid of square, straightness, scribers, center punch etc., the operator uses a jig to position and guide the drill into proper place. Drill jig increases productivity by eliminating individual marking, positioning and frequent checking. Interchangeability is one of the advantages of jigs. There is no need for selective assembly. Any of the parts will fit properly in the assembly and all similar components are interchangeable. In addition, a jig reduces the repetitive nature required for drilling a hole, as the locating, clamping and guiding are done by jig itself. The tool-guiding element helps in

ISSN: 2278-0181
ETDM - 2017 Conference Proceedings

setting of tool in correct position. Hence, skilled workers are not required. Drill jig makes it possible to drill, ream and tap holes at much faster speed and with great accuracy as compared to holes produced by conventional hand methods. The responsibility for accuracy of hole location is taken from the operator and given to the jig.

III Design of Jigs





TOTAL QUALITY MANAGEMENT (TQM)

Total = Quality involves everyone and all activities in the company.

Quality = Conformance to Requirements (Meeting Customer Requirements).

Management = Quality can and must be managed.

TQM = A process for managing quality; it must be a continuous way of life; a philosophy of perpetual improvement in everything we do.

TQM as a Foundation:

TQM is the foundation for activities which include;

· Meeting Customer Requirements

· Reducing Development Cycle Times

· Just In Time/Demand Flow Manufacturing

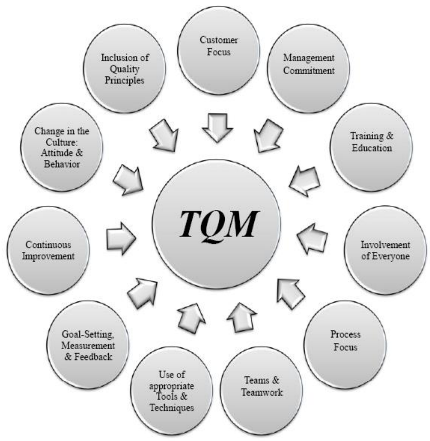
· Improvement Teams

· Reducing Product and Service Costs

Improving Administrative Systems Training

The Ten Steps to TQM are as follows:

1. Pursue New Strategic Thinking
2. Know your Customers
3. Set True Customer Requirements
4. Concentrate on Prevention, Not Correction
5. Reduce Chronic Waste
6. Pursue a Continuous Improvement Strategy
7. Use Structured Methodology for Process Improvement
8. Reduce Variation
9. Use a Balanced Approach
10. Apply to All Functions



The Principles of TQM are as follows:

1. Quality can and must be managed.
2. Everyone has a customer and is a supplier.
3. Processes, not people are the problem.
4. Every employee is responsible for quality.
5. Problems must be prevented, not just fixed.
6. Quality must be measured.
7. Quality improvements must be continuous.
8. The quality standard is defect free.
9. Goals are based on requirements, not negotiated.
10. Life cycle costs, not front end costs.
11. Management must be involved and lead.
12. Management Commitment
    1. Plan (drive, direct)
    2. Do (deploy, support, participate)
    3. Check (review)
    4. Act (recognizes, communicate, revise)
13. Employee Empowerment
    1. Training
    2. Suggestion scheme
    3. Measurement and recognition
    4. Excellence teams
14. Fact Based Decision Making
    1. SPC (statistical process control)
    2. DOE, FMEA
    3. The 7 statistical tools
    4. TOPS (Global 8D - Team Oriented Problem Solving)

Step 1: Define the problem:

1.1 Selecting the Theme :

Increase the customer satisfaction by reducing the customer end rejection and reducing the line stoppage.

1.2 Problem statement

Very high rejection of FFGY filter casting after tuning (20% - 30%) due to RX –IL failure at customer end. Fig 7 illustrates the current status of the problem.

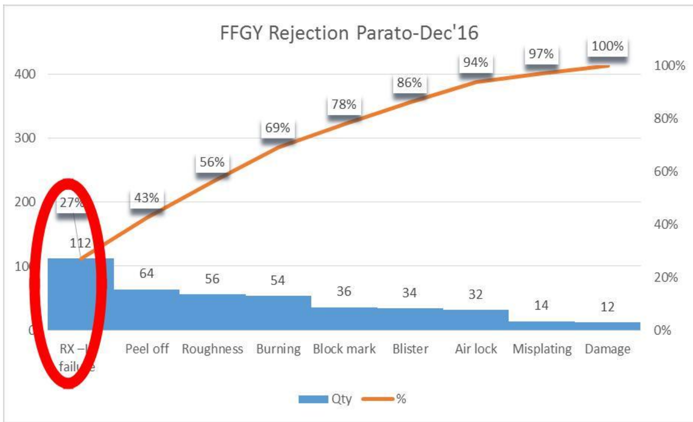
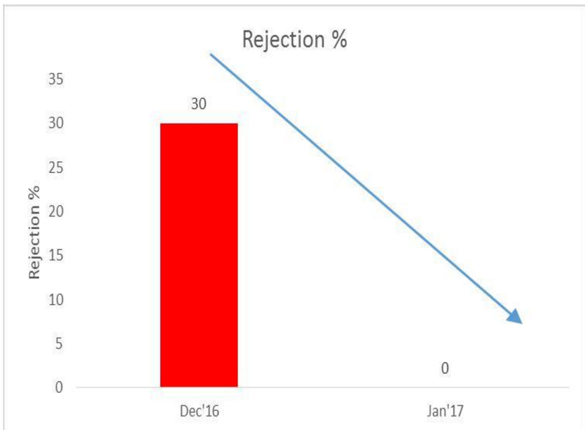


Fig 7. Problem status

Define the Scope

• To reduce casting rejection of FFGY filter Casting from 30 % % to 0 % by Jan’17

Fig 8. Customer desire



WHAT IS Q AND WHY IT IS MEASURED?

The reason for Copper and/or Silver plating is not to have a certain thickness of these metals on the RF filter parts. Primary reason is high frequency surface conductivity. The thickness requirement is a minimum layer thickness required for high RF conductivity, a guide number, how to achieve the required performance for certain product. Thickness itself never guarantees good quality plating, if the conductivity is not at the right level.

Unloaded quality factor [Qu] defines the frequency selectivity of a resonating structure in filters. The higher the selectivity, the smaller RF power losses the cavities will have as a filter. Qu is a bare number, and is defined as a proportion of two frequency values:

$Qu = f_{res} / BW_{-3dB}$, f_{res} = the resonance frequency BW_{-3dB} = Bandwidth for 3dB drop in resonance power

The theoretical upper limit for Qu is defined by mechanical dimensions, surface roughness and the *high frequency surface conductivity of the cavity*. Because of differing sizes and operating frequencies, also Qu requirements vary per product. When samples of the same product are measured, however, the mechanical structure is always the same. Thus, the *differences in Qu are caused* (almost solely) *by variations in the plating conductivity*. That means: the higher the Qu, the better the plating.

Qu limit is the most important performance related quality requirement for the plating, and for final equipment functionality, absolutely essential to fulfill. Furthermore, Q-measurement is an excellent means of measuring plating quality, and thus an invaluable tool for plating process quality control and development. *Plating thickness measurements alone never guarantee a good conductivity*.

II. Q-MEASUREMENT DESCRIPTION, PRECAUTIONS

The Q-measurement is performed on the cavity defined in the filter body technical drawing. A product-specific, silver-plated test cover is used in the measurement. Qu is measured with a precision instrument, a high-performance vector network analyzer. Operator performing the test has to be qualified in using the test equipment.

Network analyzer operational environment

- VNA should be kept in room temperature and normal humidity away from heat sources or direct sunlight, that is, in office environment.
- Analyzer has to be placed on a sturdy, even surface. It should never experience any shock, vibration or strong blows.

Never expose network analyzer to any fumes from plating area.

- While testing, the operator should always ground him/herself and use ESD jacket + wrist strap, as static discharge can permanently harm the analyzer.
- Additionally, the analyzer ports or cable connector centre pins should normally not be touched at all - and never without proper grounding.

Performing the test

The test is always carried out the same way. First, attach the lid and test cables, then use analyzer search functions to find the lowest resonance peak in the cavity. When the resonance peak is found, the view on the screen is modified so that the reading is accurate and reliable (= frequency span is not too wide, and any instability or erroneous behaviour can be seen live on the screen).

1. Use clean cotton gloves during the whole operation. Do not touch the inside surface of the test lid with your fingers.

2. Make sure that the filter body (to be tested) and silver-plated test cover are clean from any impurities visible to the bare eye, completely dry and not hot to handle (approximately room temperature).

- loose particles can be blown away with pure pressurized air. Note that dirty air can contain oil or water and badly contaminate the body.
- if solvents are needed for cleaning, following are acceptable: industrial ethyl alcohole, isopropyl alcohole and acetone. All of these can be used to clean also the test cover connectors.
- A proper time for drying has to be allowed for solvents. The surfaces are not yet dry, when they look like that!

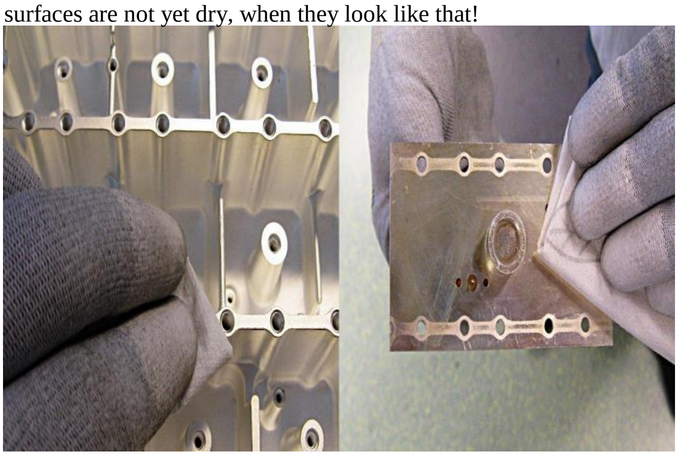
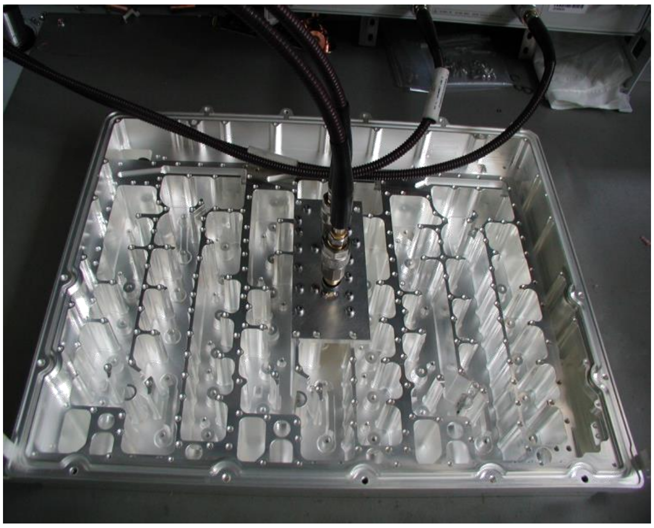


FIG 2. Cleaning the contact surfaces with alcohole. Use clean, lint-free cloth.

3. Attach the clean lid to the body using the right type of pan-head screws and right torque (2.2Nm for normal, 3.7Nm for self-threading). Use all screw positions in the test cover, do not leave even one out.

If uncertain, verify the tightness of the screws by hand.

5. Attach the analyzer measurement cables to test cover connectors.

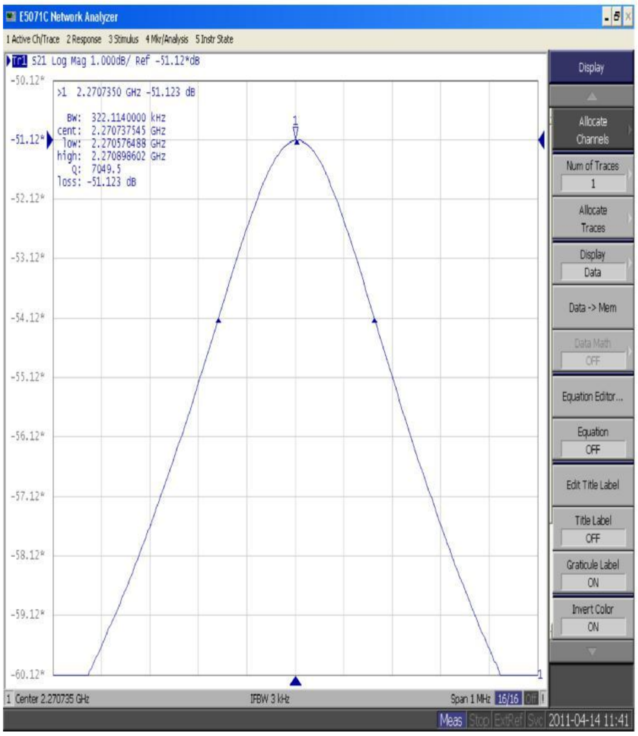


	Process Time			Thickness		
	Nickel (Min)	Copper (Min)	Silver (Min)	Nickel (µ)	Copper (µ)	Silver (µ)
Trial 1	10	45	15	2.5	5.2	0.7
Trial 2	10	45	20	2.7	5.6	1.1
Trial 3	10	60	15	2.4	6.8	0.8
Trial 4	10	75	15	2.6	7.7	0.6
Trial 5	10	90	15	2.5	8.2	0.7
Trial 6	10	120	15	2.8	10.6	0.7

From the table Trial 3, 4, 5 & 6 mets the customer specification & satisfaction.

i) Normality Test for FFGY Filter (One jig - Nine

Conditions	
i) Nickel Process time	10 Min
ii) Copper plating Process time	90 Min
iii)Silver Plating Process time Components)	15 Min

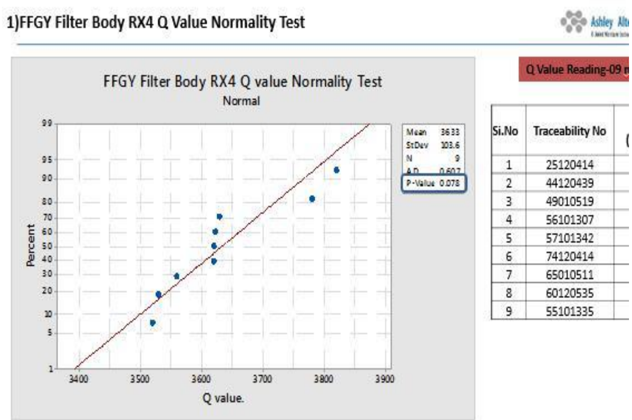


Process parameter Modification:

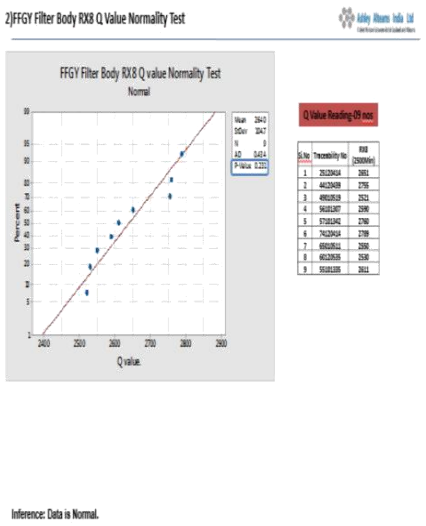
Process parameter modification was carried out with DOE.

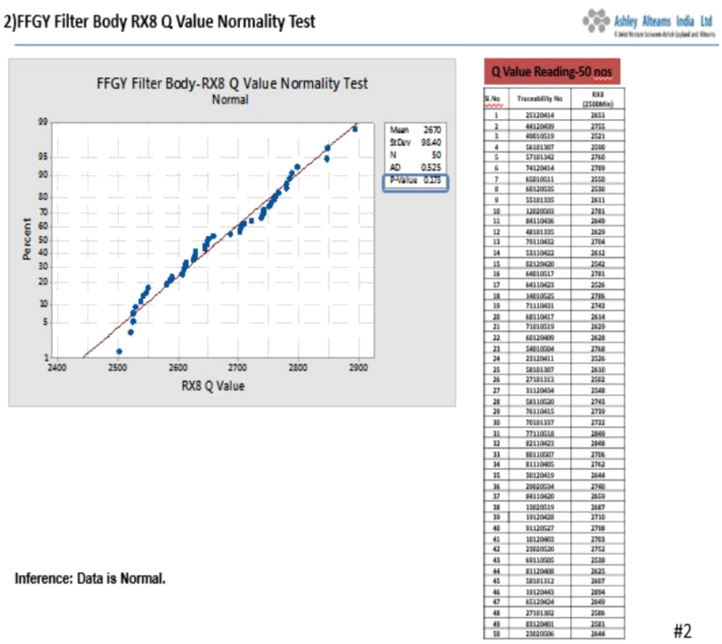
Conduct the Design of Experiments (DOE) to optimize the process parameters

Design of experiments is carried to study the root cause analysis for reducing the rejections



Inference: Data is Normal.





ii) Normality Test for FFGY Filter (Continuous 50 components)

From the experiments indicates that Process was stable with process parameters (Trial 5).

Conditions	
i) Nickel Process time	10 Min
ii) Copper plating Process time	90 Min
iii)Silver Plating Process time	15 Min

IV CONCLUSION

A number of productivity and quality improvement strategies are developed in this paper in line with recent changes in manufacturing environments. Also, from a total strategic view point, a framework has been proposed to improve the productivity and quality by integrating various functional activities. The issues of new manufacturing concepts and technologies while developing strategies for integrating the activities of functional departments in the manufacturing company have been discussed. The cost of quality in terms of profit and loss must be considered because this forms the basis of any effort applied to quality improvements.

While implementing TQM (a) management just does not need to investment heavily into process implementation. Rather the approach should be such that every member of the organization does every task with the aim of giving an error free output even if it means putting in little bit extra effort, or slowing the pace a bit. This higher quality, in turn, will lead to less rework and a more satisfied team and client.

The basic value proposition for quality management is that you will save more cost and time over the life of your project than the cost and time required to set up and manage the quality management process.

Some of the steps given below may be helpful in implementation but actually the TQM for each project will have a different approach to be followed

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