"Built In Quality"- New Trend in Automobile Industry For Quality Improvement.

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Abstract— "Quality is what the customer perceives to be acceptable to achieve his/her enthusiasm". For every successful organisation Quality is the most important aspect and any non conformance cannot be tolerated in its product. As automobile industry is one of industrial sector which totally depends on the quality.More quality provided by industry more customer satisfaction and ultimately higher profit earning. To achieve customer satisfaction and increase profit ratio now a days some automobile industry develop their own quality techniques in which one technique is "Built in Quality" used by one of the leading automobile manufacturing industry. This paper highlights the basic methodology and requirements of BIQ (Buil in Quality).

Keywords : Built in Quality, Global Manufacturing system (GMS), five principles of GMS, levels of BIQ, elements of BIQ, requirements of BIQ level III.

I. INTRODUCTION

Fig. 1: Global manufacturing System

Built in Quality is one of the priciple of global manufacturing system. Global Manufacturing system is followed by the company to frame their business standards . GMS is the combination of five different principles such as ;

- Continuous Improvement
- People Involvement
- Standardization
- Short Lead Time
- Built in Quality

Through GMS comapany wants to improve their quality, quality standards, customer's satisfaction.

A. Continuous Improvement:
Reduction in variation stabilizes the process so that Continuous Improvements can take place.

B. People Involvement:
Everyone is responsible for Quality (All the People, All the Time) . Well Trained, Well prepared, Well treated People make great Quality

C. Standardization:

Absolutely necessary pre-requisite for achieving quality

D. Short Lead Time:

Drives first time quality, thereby, enabling shorter lead times to deliver vehicle to the customer.

E. Built in Quality:

The BIQ Model defines 5 Steps that describe organizational development for building quality into the manufacturing process, moving from Detection/ Containment to Prevention.

This paper mainly focuses on 5th principle that is Built-in-Quality. Basically built-in-Quality also refer as BIQ which is very vast concept but can be simply stated as a value chain in the production process which involves different parties as shown in figure below.

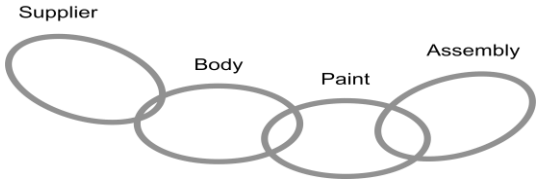

Fig. 2: Built in Quality

In the above figure, Every Process Has at Least One "Customer" and One "Supplier".

Which means for supplier, body shop is a customer & likewise for body shop, paint shop is a customer and so on. Each supplier has to satisfy its own customer as per their requirements and quality standards.In BIQ there are 5 levels to accomplish these standards which are as follows:

1) BIQ Level 1- defects, don't leave the plant
It is inspection based process in which defects are tracked in plant & contaminated in the plant itself rather than at the end user side. This is the initial phase of BIQ which means avoid the defect or poor quality inside the plant itself, avoid them to reach at customer end.

2) BIQ Level 2- defects, don't leave the shop
It is process of detection & contamination of downstream processes on the shop floor. As already stated in BIQ each shop or sector is linked in chain as supplier and customer relation so as to satisfy respective customer is the main challenge in BIQ level II.

3) BIQ Level 3- defects, don't leave the team
This process takes care of prevention & continuous improvement to increase team efficiency. If company achieve the second goal of BIQ form third level the complexity and effectiveness of plant must be increase and maintained is the main purpose of next three level. In level III defects which are going to built in the team should be eliminated at respective team only.

4) BIQ Level 4-defects don't leave the station
In this process preventive measures are taken care to eliminate in process repaires. As the criticality goes on increasing the level IV is aiming to avoid to pass on the defects to next subsequent station.

5) BIQ Level 5- defects are not created

The goal of zero in process waste can be achieved through this level. This is the final phase of BIQ which utilizes full plant capacity with zero defects.

These BIQ levels are important in order to reduce the defect and increase the productivity.

As the BIQ is very vast technique but the methodology follows some principles of existing techniques such as Kaizen, Poka-yoke and total quality management etc. which discuss as follows.

II. LITERATURE REVIEW

Built in Quality majorly uses the principles of kaizen, poka-yoke and TQM. In this kaizen is the major part. kaizen means continuous improvement. BIQ itself step wise task or methodology to achieve quality at world class state. Therefore the history and basics of kaizen methodology is to be understood which is as follows.

A. Kaizen:

In the decade of 1980, management techniques focusing on employee involvement, and empowerment through teamwork approach and interactive communications and on improving job design were not new, but Japanese companies seemed to implement such techniques much more effectively than others .The business lesson of the 1980's was that Japanese firms, in their quest for global competitiveness, demonstrated a greater commitment to the philosophy of continuous improvement than Western companies did. For such a philosophy the Japanese used the term Kaizen.

Kaizen means improvement, continuous improvement involving everyone in the organization from top management, to managers then to supervisors, and to workers. In Japan, the concept of Kaizen is so deeply engrained in the minds of both managers and workers that they often do not even realize they are thinking Kaizen as a customer-driven strategy for improvement. This philosophy assumes according Imai that ''our way of life – be it our working life, our social life or our home life – deserves to be constantly improved''. There is a lot of controversy in the literature as well as the industry as to what Kaizen signifies.

Kaizen is a Japanese philosophy for process improvement that can be traced to the meaning of the Japanese words 'Kai' and 'Zen', which translate roughly into 'to break apart and investigate' and 'to improve upon the existing situation'. The Kaizen Institute defines Kaizen as the Japanese term for continuous improvement. It is using common sense and is both a rigorous, scientific method using statistical quality control and an adaptive framework of organizational values and beliefs that keeps workers and management focused on zero defects. It is a philosophy of never being satisfied with what was accomplished last week or last year. Improvement begins with the admission that every organization has problems, which provide opportunities for change. It evolves around continuous improvement involving everyone in the organization and largely depends on cross-functional teams that can be empowered to challenge the status quotient.

B. Poka-yoke:

In the recent years intensifying competition in the international economy caused a major change in approach to quality management. The quality action should therefore include its reach the whole product life cycle, starting from customer identification requirements and expectations, by the customer's service. The organizations by focusing on quality process approach should improve the existing quality management system, the defined processes and also their products by implementing the available philosophy (Kaizen, TQM, Zero quality defects), rules (W.E. Deming, J. Juran), quality tools and methods of quality management. "Process approach" to management of organization is a field developing dynamically. This concept is universal, it works for all companies, because it integrates in transparent way all key mechanisms which result from requirements for quality management system and quality processes.

Poka-yoke is a Japanese improvement strategy for mistake-proofing to prevent defects (or nonconformities) from arising during production processes. Poka-yoke is a preventive action that focuses on identifying and eliminating the special causes of variation in production processes, which inevitably lead to product nonconformities or defects. This concept was initially called Idiot Proofing but it was understood that this name may heart workers so term Mistake Proofing was coined by Shigeo Shingo. Poka-yoke gives a strategy and policy for preventing defects at the source. These solutions are not only cost-effective but also easy to understand and apply. It is one of the important tools to add to any organization's Continuous improvement. In short poka-yoke is a continual improvement strategy that offers a way to move the QMS (quality management system) towards a higher level of performance.The poka-yoke concept was generated in the mid-1960s by Shigeo Shingo who is Japanese industrial engineer. Shingo was working for Toyota and other Japanese companies, where he developed entire production systems focused on achieving zero defects in production and gave birth to this revolutionary work. The basic concept behind poka-yoke is that it is not acceptable and allowed to produce even a small amount of nonconforming product. To stay in market and to become a world-class competitor, an organization must go with new philosophy and technology along with side by side practice of producing zero defects. Poka-yoke methods are the very easy and simple concepts for achieving this goal and are a key component of the continual improvement strategy in many leading Japanese companies on this moment. Poka-yoke is one of the presentations of "good kaizen", or superior continual improvement because of its preventive nature. A poka-yoke device or solution is any mechanism or idea that either avoids the mistake from being made or makes the mistake easily detected at a glance. The ability to find mistakes at a glance is important because, as Shingo states, "The causes of defects lie in worker errors, and defects are the results of neglecting those errors. It follows that mistakes will not turn into defects if worker errors are discovered and eliminated beforehand. He also adds to this that "Defects arise because errors are made; the two have a cause-and-effect relationship. Yet errors will not turn into defects if feedback and action take place at the error stage"

During actual manufacturing of any product there are too many very simple and monotonous steps which are carried out by operators. These monotonous work operations result in to mental fatigue and lack of interest in work which ultimately causes silly mistakes of operators and we know that human is prone to errors even though he doesn't want it. To avoid these simple mistakes poka yoke concept play important role. By implementing some simple solutions we can avoid mistakes. The long term success of poka yoke gives output of saving time and we release the work pressure on mind of worker. We can use creativity and special skills of workers for more creative operations instead of increasing pressure for monotonous activities This involvement of everyone in organisation is basic need to rise roots of quality culture in the organisation.

C. Total quality management:

The introduction of total quality management (TQM) has played an important role in the development of contemporary management. Quality, considered a key strategic factor in achieving business success, is more than ever required for competing successfully in today's global market place and it has become the key slogan as organizations strive for a competitive advantage in markets characterized by liberalization, globalization and knowledgeable customers

Following Millar's (1987) predication that there will be two kinds of company in the future – companies which have implemented total quality and companies which are out of business, companies worldwide, large and small, both in the manufacturing and service sectors, have adopted quality strategies, and made TQM a well accepted part of almost every manager's 'tool kit' The relationship between TQM and organizational characteristics Many previous studies reveal that the size of a company and principal ownership are related to management practices in implementation of TQM. For example, organizational culture refers to attitudes, beliefs, and situational interactions. It has been influenced by different types of ownership. As a result, the degree of TQM use is different.

Some researcher had also defined TQM as managing the entire organization so that it excels on all dimensions of products and services that are important to the customer. We often think of features when we think of the quality of a product or service; TQM is about conformance quality, not features. Aims of TQM are such as

- Meeting Our Customer's Requirements
- Doing Things Right the First Time; Freedom from Failure (Defects)
- Consistency (Reduction in Variation)
- Continuous Improvement
- Quality in Everything We Do

All these principles and technique are combined in BIQ technique for effective and efficient utilization of plant capacity.

As the organisation has already implemented first and second levels of BIQ hence this paper primarily focuses on implementation on BIQ level III.

III. METHODOLOGY

The goal of BIQ level III as already stated that defects should be eliminate in team itself for this purpose their certain 29 requirements are designed by the organisation which are as follows:

- Developed and Common
- Communicated and Understood
- Processes Failure Mode Analysis(PFMEAs)
- PFMEAs - Risk Reduction & Annual Review
- Bypass Management
- Change Control - Process & Product Validation
- Change Control – PTR
- Process Control
- Process Control Plan Implemented
- Contamination/Handling Requirements
- Capability Monitoring and Measuring Equipment
- Capability Review
- Preventive Action
- Error proofing Validation/Verification
- Error proofing Reaction Plan
- Verification Station/CARE
- In Process Control & Verification
- Alarm and Escalation
- Quality Focused Checks
- Rework / Repair Confirmation
- Nonconforming Material / Material Identification
- Component Traceability
- In Process Measures
- Feedback / Feedforward
- Fast Response
- Product Engineering Support
- Resource Plan
- Strategic Quality Plan
- Quality Management System Compliance

To achieve BIQ level III these requirements organisation must have to fullfill. Some of the requirements are discussed below:

A. Communicated and Understood:

Product quality standards are used for the quality check and ensure worker about their process and give guideline about task performing on the station. It includes Inprocess product quality standards (IPQS) and Complete vehicle inspection sheet (CVIS). Standard operation sheet and Job Element Sheet are used by the worker while performing the operations.

Standard operation sheet is basically a sequence of operations to be perform by the worker and in job element sheet every operation which is mentioned in the SOS is explained in detail by which error during the operation can be eliminated.

In CVIS instructions regarding product quality which has attain by the worker when operation performed. CVIS contain the necessary product quality standards such as fitment, gap specification etc. With picture copy to understand worker easily and this CVIS are maintain and control by manufacturing engineering.

Inprocess Quality standards (IPQS) are maintained and controlled by quality department which is used for inspection process. The necessary deviation approved by the design and research engineering department (DRE) are included in IPQS.

VDS displayed at each station which gives idea about the process to worker and also VDS to be linked in JES so that new worker can understand the location and function of VDS in relate to JES.

1) Action Plan:

JES, CVIS, SOS updation taken place as plant production per hour changes from 25 job per hour to 20 job per hour. Also as per BIQ auditor's instruction torque value should not be mentioned JES is also executed. Regular audit is taken to ensure each and every JES. New addition of process is also communicate and changes done in SOS and JES.

SOS, JES and CVIS are must placed at work station board to easy access to worker which is already implemented.

Fig.3: Work Station Board

Visual Display Sheets are the pictorial instruction given to worker which has a specific VDS number which should be linked with JES is the requirement of BIQ. Therefore wherever their is VDS the number associated with that VDS is now included in JES.

B. Bypass Management:

As the name suggest Bypass or Backup is that function when the actual process or machine get failed or in break down. Such type of operations and machines are taken in to consideration as bypass to avoid production line stoppage. Generally bypass used in GA shop for key processes and machines which causes major effect on production during the process.

There are 15 Bypass elements are reported in GA shop

1) Action Plan:

Bypass processes as the requirement in BIQ must be well establish and standardize means full proofing of bypass processes and processes action plan must be specified. Instruction regarding using the bypass process is documented in Task Instruction Sheet (TIS). TIS is placed near the bypass process to easily access and guide to worker. The standard TIS format has been developed and regularized in GA shop

Fig.4: Task Instruction Sheet

The format of TIS is shown in the picture. Also regular audit and check is now done by production team and maintenance team to ensure that the bypass process is working properly or not.

C. Change Control – PTR (Part Trial Run)

Part trial run is the process used in General Motors as there are various sub-assemblies which are imported from China and Korea which are consuming high transportation and installation costs hence to eliminate these costs, localization of sub-assemblies means finding out local supplier and taking trial on sub-assemblies which are received from the suppliers and regularize it in production. This will eliminate the transportation and installation costs of imports.

There are various PTR conducted regularly in GA shop in which processes change is also included. For PTR there are 2 types of number given to each PTR:

- Temporary Work Order (T.W.O.)
- Engineering Work Order (E.W.O.)

Temporary work order is used as a first trial sample and Engineering work order is used for final implementation of that sample.

1) Action Plan:

In BIQ requirements for change control the necessary conditions must be understood by everyone for PTR. Therefore PTR should be discussed in morning session by every associate person. For that reason Production Change Point Management board is established in Nerve Centre where regular meetings are conducted. Also separate crib which is already present in GA shop called PTR crib where all PTR materials are stored.

Fig. 5: Change Management Board

D. Capability Monitoring and Measuring Equipment:

In GA shop there are various equipments and tools are used for assembly. Calibration of all these tools are comes under capability monitoring and measuring equipment requirement of BIQ. As specified in this requirement, equipments and tools should be certified and calibrated, the tools and equipments which are used in GA shop are already certified and periodically calibrated. There are various tools used in GA shop like torque wrench, power tool (impulse tool, battery tool, direct current tool) and equipment such as ACTA, Belt tension meter, etc.

Torque wrenches are calibrated within an interval of 14 days and tools are calibrated within an interval of 120 days and other equipments (DC tools, Torque meters) are calibrated within an interval of 365 days.

Fig.6 : Tool Calibration Board

1) Action Plan:

All calibration records are maintained in GA shop by various departments such as torque wrench calibration is done and maintained by in-process department and tool calibration is done and maintained by manufacturing engineering department.

Tools calibration schedule and status is maintained in tool crib for the information of operators in tool calibration status board.

IV. CONCLUSION AND FUTURE SCOPE

This paper provide an opportunity to study the new methodology, Built-In-Quality and its various levels, standards, processes and techniques. Various factors to be considered for implementation of BIQ- level 3 were analyzed. As a part of the live implementation process of BIQ- level 3 practical knowledge of all these activities is being imbibed. Apart, from the specific implementation, various aspects and qualities required for successful working of a global automobile company is also being studied.

The issues faced by the GA Shop are still under observation by the BIQ Team, being a part of which also a hands on idea of problems faced during actual implementation of a project.

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