Research Paper Engineering

Development of Quality Circles in an Organisation (A Case Study in the Areas of Design for Manufacturing and Design for Assembly In Machine Shop of Tool Room, Indore)

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ABSTRACT

The present paper deals with various aspects of quality circle and how the productivity is to be improved by adopting quality circle in tool room, machine shop, assembly and related industries. The paper describes a case study of development of quality circle in the areas of design for manufacturing and design for assembly and how the time factor is reduced and at the same time the quality of the product is to be maintained. The paper also presents the problem solving techniques in the areas of DFM and DFA in Machine shop of Tool room, Indore

KEYWORDS: Quality circle, Design for manufacturing, modular design, tolerances, shapes and dimensions, self locating, joint monitoring, motivation, 'top-down' assemblies, Design for assembly, fish-bone diagram, common axes, surface finish

1.Introduction

Quality Circles known as Quality Control circles came into existence in the Japanese industry in the early 1960'SThe QC circle was formally organized in Japan in 1962 by Japanese Union of Scientists and Engineers (JUSE) and the man who initiated the idea is Dr. Kaoru Ishikawa.

Quality circle is a small group of 6 to 12 employees doing a similar work and voluntarily meet together on a regular basis to identify quality improvements in their respective areas Quality Circle is based upon the, Human Resource Management and Improvement of product quality and productivity

2. REVIEW OF LITERATURE

1947: General Douglas McArthur requested US Govt. to send experts to help Japanese rejuvenate their industries. Dr Edward Deming was sent [1]

1949: An Overseas Technical Research Committee was organized by the Union of Japanese Scientists and Engineers (JUSE) [1]

1950: Dr Deming invited to eight day Quality Control seminar organized by JUSE

Management seminar organized by JUSE [1]

2.1 Quality Control Circles (Japan)

1962: First QC Circle was registered with QC Circle Head Quarters [1]

1964: Regional chapters of QC Circles were organized in four different districts [1]

3 OBJECTIVES

a) To develop quality circle in the Design, Manufacturing and Assembly areas
b) To identify all problems of the work order PT0012-15 related with Design For Manufacturing and Design For Assembly
c) To analyse the problems in design for manufacturing and design for assembly
d) To select appropriate solutions in design for manufacturing and design for assembly

It implies the

a) Creates and sustain their motivation and commitment towards work excellence
b) Implies the creation of facilitative conditions and environment of work
c) Cumulative process of Education, Training, work experience and participation
d) Development of Skills ,Capabilities, Confidence and Creativity of the people

2.2 Quality Circles (India)

1981: Quality Circle concept was first introduced by BHEL, Ramachandrapuram , Hyderabad in India [2]

1982: Quality Circle Forum of India (QCFI) was founded [2]

1983: Tata Motors (formerly Telco) started Quality Circles, by 1985 they had more than 400 Circles [2 & 3]

1985: BHEL had 1411 Circles covering around 13362 members [2 & 3]

2.3 Developments in Mfg and Assembly

M. Anderson explained about how to design the products for manufacturing [4 & 5]

G. Boothroyd explained how to design for assembly process [6 & 7]

2.4 Team building and Employee involvement

Dale H Basterfield explained about product, production planning and process planning [8]

Fig-1 Organisational Structure of Quality Circle

Eugene L. Grant explain the employee involvement and team building [9]

Charantimath explain the participative management and continuous improvement [10]

2.4 The seven basic tools of quality
Leonard A. Doty explained the importance of quality tools[11]

5. DEVELOPMENT OF QUALITY CIRCLE IN THE M/C SHOP OF TOOL ROOM
Steering Committee
Manager (production)

Manager (Design.)

Manager (Purchase)

Co-ordinator
Sr.. Engineer (PPC)

QC Facilitator
Sr. Engineer (Design)

Circle Leader
Sr. Engineer (Assembly and Try out)

Circle Members
Engineer(Production)
Engineer(Assembly)
Engineer (PPC)
Engineer(Purchase)

6. Definitions of DFM and DFA
6.1 Design for Manufacturing (DFM)
a) Concerned with reducing overall part production cost
b) Minimize complexity of manufacturing
c) Use common axes and common processes

6.2 Design for Assembly (DFA)
a) Concerned with reducing product assembly cost
b) Minimize number and complexity of assembly operations
c) Individual parts may be more complex in design

7. Principles of DFM (Guidelines for DFM)
a) Simplify and reduce the number of manufacturing operations
b) Standardize materials and use common parts
c) Design for efficient joining
d) Open tolerance as much as possible
e) Allow over-travel in part design
f) Avoid special tooling and frequent tool changes
g) Select materials for best manufacturability
h) Specify 'acceptable' surface finish for functionality
i) Machine for one primary axis whenever possible

8. Principles of DFA (Guidelines for Assembly)
a) Minimize part count
b) Design parts with self-locating features
c) Design parts with self-fastening features
d) Minimize reorientation of parts during assembly
e) Emphasize 'top-down' assemblies
f) Standardize parts
g) Encourage modular design

9. THE PROCESS OF OPERATION OF QUALITY CIRCLE
9.1 PROBLEM IDENTIFICATION
The Circle Members identify a number of problems that need to be solved

a) For Work Order PT0012-15
Time to be reduced both manufacturing (conventional and CNC machining) and assembly process and improve the product of the quality

9.2 PROBLEM SELECTION
a) Manufacturing of punch and die in CNC machining
b) Assembly of tools
c) Frequent failure of tryouts in in house

9.3 PROBLEM ANALYSIS
Why this process are taking more time for manufacturing, assembly and tryout failures? Due to complicated projections , curves and closer tolerances for manufacturing , non availability of raw materials , fasteners and special cutting tools are required The consumer cannot afford the cost of machining and require close tolerances

9.4 GENERATE ALTERNATE SOLUTIONS
The solutions may be
a) Identify the higher accuracy machines specially for the work order
(The QC team identified Hauser made jig boring machine , Koming Made CNC milling machine, Charmiles EDM ,DMG made CNC lathe and Charmiles wirecut machine)
b) With permission from customer ,the complicated projections, shapes and dimensions , close tolerances where ever required and will not affect the quality of the product
(customer accepted to corner radii from 0.2 to 0.5mm both in punch and dies and accordingly design department has changed the design and it is helpful to manufacturing process)
c) Well inform to purchase section regarding non standard materials , special cutting tools and fasteners
(purchase section raised the indent in advance and purchased the raw material from abroad and special cutting tools purchased from Sandvik Asia Ltd , Pune and SECO Cutting Tools, Pune)
d) Design drawings should be understandable to the Engineers/ Sr. Engineers and the team of the work order
(Each component drawing , sub assembly and assembly drawing is provided to every members of the quality circle team for this work order for transparency to complete this work order)
e) Offload the polishing operations and honing
(offload to SSI Industries those who are expert in the fields (sent to the some of the parts to be chrome plated and for polishing operations) to reduce the time and get the quality product in time

f) Change the mechanical press to hydraulic press

For tryout put highly experienced technicians for carrying the trials and use hydraulic press

9.5 SELECT THE APPROPRIATE SOLUTION

a) Each and every stage of the tool the QC team should meet and discuss the problems and solutions (monitoring)
b) Fair and necessary communication is to be done at all stages (may be manufacturing or assembly or in purchase)
c) Specific expertise people will be deputed for this work order

9.6 PREPARE PLAN OF ACTION

a) To identify the right people for right job
b) To procure the materials / find out the indigenous material as much as possible
c) To co -ordinate with customer and joint monitoring can be done at wherever and whenever possible

9.7 PRESENT SOLUTION TO MANAGEMENT

Put up to top management and get final approval from the management and start the work order

9.8 IMPLEMENTATIONS OF SOLUTION

The final process is implementing the solutions to get the fruitful results. It will require support from top management and the team members

10. BASIC PROBLEM SOLVING TECHNIQUES

The following techniques are generally used to solve the problem in the quality circle

a) Data Analysis
b) Brain Storming
c) Cause and Effect Analysis/Fishbone Diagram
d) Pareto Diagram
e) Data Collection

PROBLEM ANALYSIS

After brainstorming meeting with the team members and all related committees , it is concluded that cause and effect diagram is the optimum problem solving technique for design for manufacturing and design for assembly areas.

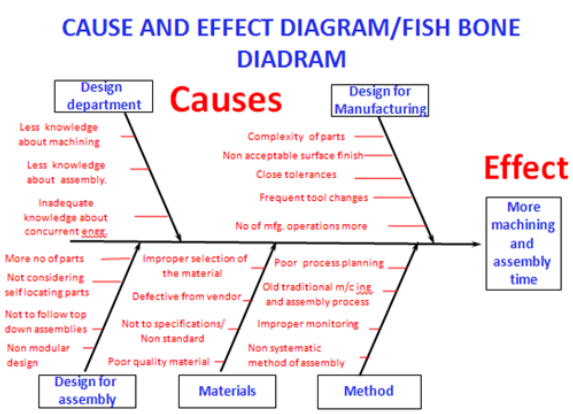

Fig-2 Cause and Effect diagram for reducing the time factor and sustain the quality in the areas of DFM and DFA areas

11. REMEDIES FOR THE PROBLEMS RELATED TO THE WORK ORDER

11.1 For design department, orientation training was given to the design department personnel regarding manufacturing and assembly areas and concurrent engineering and the QC team identified the highly experienced personnel for the work order regarding machining and assembly process

11.2 For design and manufacturing, parts should be simple, acceptable surface finish, open tolerances and reduce the no of operations is to be done.

11.3 For design for assembly, less no of parts, self locating parts, follow top down assemblies and modular design is to be done.

11.4 For machines, QC team identified the right m/c for right job and decided for preventive maintenance is required to get accuracy and good working condition to get accuracy

11.5 For materials, QC team insisted that standard materials (with shape and size) procured from only standard vendors and immediate communication is to be made to purchase department for any requirement.(imported materials, special cutting tools, fasteners, consumables and etc)

11.6 For method, traditional methods are to be modified and stage inspection was carried about with sub assemblies to reduce the time for main assembly. Proper process planning is required and close monitoring and follow up action is to be done at all stages

12. RESULTS AND DISCUSSIONS:

Before Design for Manufacturing, the motto was "I designed it; you have to build it!" and the design engineers worked alone and they are having their own concept without understanding the problems of manufacturing and assembly process while executing the Work Order PT0012-15.

12.1 RESULTS:

The Production Planning Control department planned to complete / execute this work order within 27 days. By formation / developing quality circle, the team identified the experienced personnel for this work order, machines to be required, simplify the manufacturing and assembly process and continuously monitoring / follow up action with everybody those who are involved this work order , the Work Order PT0012-15 was completed within 19 days i.e. the time is reduced by 30%

After developing the quality circle in the DFM area, the Quality Circle team realizes that manufacturability can be assured by developing products in multi-functional teams with early and active participation from Manufacturing, Marketing, Finance, Industrial Designers, Quality, Service, Purchasing, Vendors. The Quality Circle team works together to not only design for functionality, but also to optimize cost, delivery, quality, reliability, ease of assembly, testability, ease of service, shipping, human factors, safety, customization, expandability,

Now the Quality Circle team understands that modular design concept, avoid right/left hand parts, design the parts with symmetry wherever possible, minimize tooling complexity, minimize setups and minimize cutting tools in the manufacturing areas.

After developing the quality circle in the DFA area, the Quality Circle team realizes about design for assembly, importance of integrated parts, ease of assembly process, design parts with self-locating features, design parts with self-fastening features, emphasize 'top-down' assemblies and the view from customer assembly.

12.2 DISCUSSIONS:

QC members are understanding that where to maintain close tolerances, and arrange alternate materials which will not affect the quality of the product. QC members are self motivated and actively participating the overall process by reducing the cost of machining, less time in assembly and improve the productivity and at the same time how to sustain the quality maintaining. QC members perceive their company/organisation as a good place of work which is a sign of job satisfaction. They also accept the values of the organization and show the willingness to expand effort to achieve organizational goals and job commitment.QC technique proved that this is the most effective and efficiency tool for solve the quality problems in design for manufacturing and design for assembly.

13. CONCLUSIONS:

In this case study, the quality circle process is used as an effec-

tive tool to find the quality related problems in the Design For Manufacturing and Design For Assembly areas. Development of quality circle in the m/c shop of tool room has identified the problems related to the DFM and DFA and reducing the manufacturing and assembling time of selected Work Order PT0012-15.

Now everybody concludes that Quality Circle is important at each and every section/department for getting benefits of motivation, development of skills, confidence, participation and commitment towards work and the Quality Circle must be present at each and every organization.

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