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Case Study

Quality Circle Implementation in Industry in India-A Case Study

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Abstract

Quality Circle is a team of employees of various relevant departments which emphasis on providing opportunities of reducing in house or customer complaints in Final Inspection Department through effective analysis of Final Inspection data which results in cost reduction through achieving zero defect or defect free manufacturing in all aspects of organization. The methodology gives platform and opportunity to individuals to identify scope of improvements which result in ease, effective and efficient work and work culture. There are several steps to implement quality circle methodology to achieve the desired results. Quality Tools such as Pareto chart, line and arrows diagrams are used for improvement in any organization in which Pareto Diagram is studied as a prime source to identify and selecting problem for improvement in any industry. Quality Circle Methodology can be applied to any industrial culture more than one time to a process until it reaches to its optimum capacity reduce quality cost in any of the industrial process.. The implementation of Quality Circle Methodology helps in achieving efficient production by analysis of data of various products and processes. It involves improvement in process through the process of finding route cause and implement corrective and preventive action to any process. It also improves the quality through reduction of PPM to certain level in a process and improves the quality standard through provide proper system to final inspection area which results achieving zero defect level in certain defects. Although this approach uses existing quality management system and problem solving tools, its application is to provide more thorough approach to improve work conditions, reducing or eliminate waste or non-value added work during any job change over or regular production.

Keywords: *Quality Circle, PPM etc.*

1. Introduction

Maintenance is undertaken to preserve the proper functioning of a physical system so that it will continue to do what it was designated to do. Its function and performance characteristics not only take account of output, unit cost and effectiveness of using energy, but also such factors as end product quality, process control, comfort enhancement and protection of the employed personnel, compliance with environment protection regulations, structural integrity and even physical appearance of the productive system. Maintenance is often wrongly regarded as a cost centre, since the costs are visible, while the benefits are difficult to estimate. (Gray, G. R. S. A. M., 1993)

2. Background to the Study (K. Ganapathy *et al* 1994, S K Dey *et al* 1997)

2.1 Definition

Quality Circle is a small group of 6 to 12 employees doing similar work who voluntarily meet together on a regular basis to identify improvements in their respective work areas.

2.2 Philosophy

Quality Circle is a people – building philosophy, which provides self-motivation and improves work environment. It represents a philosophy of managing people specially those at the grass root level.

2.3 Concept

The concept of Quality Circle is primarily based upon recognition of value of the worker as a human being, as someone who willingly put efforts to improve the job, his wisdom, intelligence, experience, attitude and feelings.

2.4 Objective

The objectives of Quality Circles are multi-faced– Change in attitude; self-development; development of team spirit, improvement in organizational culture.

2.5 Organisational Structure

The basic structure of a Quality Circle is shown in fig. 1.

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Fig.1 Organisational Structure of a Quality Circle

2.6 Launching Quality Circles

The launching of Quality Circles involves the following steps:

- Expose middle level executives to the concept.
- Explain the concept to the employees and invite them to volunteer as members of Quality Circles.
- Nominate senior officers as facilitators.
- Form a steering committee.
- Arrange trainings
- A meeting should be fixed preferably one hour a week for the Quality Circle to meet.
- Formally inaugurate the circle.
- Arrange necessary facilities for the Quality Circle meeting and its operation.

2.7 Process of Operation

Fig. 2 exhibits the operation of quality circles:

Fig.2 Operation of Quality Circle

2.8 Characters of QC

1. Circle membership: It is more or less homogeneous group of people usually from the same work areas. However, whenever required experts may be invited for guidance or advice.
2. Circle size: Usually a group of 6 to 12 members seems quite effective; however, it depends upon the people employed in a particular section.
3. Voluntary participation: The main objective of QC is attendance and participation in meetings voluntarily without any compulsion.
4. QC meetings: An hour's duration is usually quite adequate for a meeting. Whatever may be the frequency, regular meetings should be ensured.
5. Autonomy: An important ingredient of a QC is the sense of autonomy experienced by its members.

2.9 Phases in QC Development

Once a QC is formed, it has to pass through the following distinct phases of development:
1. Problem to be identified analyzed and solved.
2. Solutions to be implemented in due time.
3. Monitoring to be carried out.
4. Higher management to encourage QCs to innovate problem solving methods.

2.10 Basic Problem Solving Techniques

The following techniques are most commonly used to analyze and solve work related problems.
1. Brain storming.
2. Pareto Diagrams.
3. Ishikawa diagram (Fishbone diagram).
4. Cause & Effect Analysis.
5. Data Collection.
6. Data Analysis.

The tools used for data analysis are:
1. Tables.
2. Bar Charts.
3. Histograms.
4. Circle graphs.
5. Line graphs.
6. Scatter grams.
7. Control Charts.

2.11 Causes for Failure of QC

Some of the common causes for failure are:
1. Low morale of employees due to autocratic management and lack of trust.
2. Lack of training.
3. Incompetent leadership.
4. Lack of management support.

Quality circle concept succeeded in Japan, South Korea and a few other Asian countries, but it was a different kind of experience in Europe and USA. In Europe and USA, it became very popular from middle of 70s to middle of 80s, and subsequently, started its journey of

Table1 Description of Case Industry Description

S. N.	Description	Specification	Remarks
1	**Name and Address of the Industry**	Devki Auto Industries (P) Limited, Old IDC, Rohtak (Haryana) - 124001	Situated at Hisar Bypass. The plant acquires 6000 square feet work area for industrial purposes.
2.	**Types of Industry**	Manufacturing of Automobile parts	Shaft Rocker Arm, Axle (Front Wheel & Rear Wheel) Sprocket, Plain Coller, Spindle, Spindle Kick starter, gear selector and all types of fasteners such as nut, bolt, screw, stud
3.	**Customers Details (Domestic)**	Maruti, Honda, RICO	Quality Policy towards achievement of customer satisfaction through system implementation and improvements.
4.	**Total Number of Machines & Manpower**	450 no's with 1500 no's employees working in three shifts of 8hrs each	CNC, Traub, Drill, Milling, Cylinderical Grinding, Header & Boltformer, Rolling machines
5.	**PPM Level of Industry**	Total Quantity = 143108 Piece in the end of Month April 2014 of all Products	Quality Management System Implemented to reduce the level of PPM result in reduction in cost of Quality.
6.	**Motivation**	Kaizen& Lean Manufacturing	Working towards achieving continuous improvements through Product improvements, Process improvements, and employees' skill enhancement.

declining from there onwards. The reasons can be attributed to:

• In Japan, it was mainly considered as a development process of grass-root employees, and organizational improvement was given secondary importance, whereas in Europe and USA, the focus was given to organizational improvement and no proper attention was paid to improvement of people.

• Work associated to QC is totally carried out as an internal process in Japan, whereas in Europe and USA, it was left to the external consulting agency. In India too, these reasons are equally valid and applicable.

2.12 QC Success Story in India

QC took birth in India in 1982 and some of the industries to launch QC first were Bharat Electronics Limited, Bangalore and Bharat Heavy Electricals Limited, Trichy. However, with the progress of time, QC achieved success in a number of industries in India. To name a few are TATA, TELCO, Reliance Industries Limited, Kirloskar Brothers Limited and so.

3. Case Study of Quality Circle

M/s Devki Auto Industries Private Limited, **ISO 9001:2008, ISO/TS16949:2009 certified** is a well renowned and reputed organization situated at Rohtak. The company owes its success to its Kaizen operations and dedication to quality at every step. The passion to serve its customers with the best has successfully translated to significant market share. Description of case industry is as shown in Table 1.

4. Objective of the Study

The case study has following objectives:

1. To provide a sound discussion on quality circle implementation and see how this strategy fit in with quality improvement and operational excellence initiatives in manufacturing industries.
2. To analyze the tangible and intangible benefits of quality circles implementation over manufacturing industries.
3. To justifies the significant role of quality circles implementation for quality improvement and analyze shop floor results after implementation of quality circle.
4. To improve production by brainstorming for reduction in non-value added work through implication of continuous improvement.
5. To encourage and motivate company employee to provide valuable suggestion for improvement in any of the working area.

5. Application of Quality Circle Methodology

The study includes application of Improvement made by the Quality Circle Methodology (QCM) throughout various processes in industry which gives comparatively better results in form of quality improvements, cost reduction etc. The process is described by the method which is described as follows in form of Before QCM and After QCM activities.

5.1 Studies before Implementation of Quality Circle Methodology

A study is done to understand the various processes to produce products of the industry before implementation of QCM. This data has worked as a data base for finding out ideas of improvements in various processes.

Table 5.1.1 PPM Trend of All the Products of Industry before Implementation of QCM

Month Name	Jan'14	Feb'14	Mar'14	Apr'14	Sep.'14
P.P.M	153612	164324	150211	143808	143808
TARGET	0	0	0	0	0

Table 5.2.1 Product Wise Data Analysis of Final Inspection Area

S. No.	Item name	Qty.	Cumm. Qty.	%age	Cumm.%age
1	Spindle Kick Starter (284)DH111012	2382	2382	30	30
2	Shaft Rocker Arm (606) (DS101336)	1835	4217	23	54
3	Axle front wheel (52DJ0105)	1172	5389	15	69
4	Axle rear wheel (52DJ0105)	884	6273	11	80
5	Coller sprocket (695) (DK101245)	488	6761	6	86
6	59050008	459	7220	6	92
7	DK151008	298	7518	4	96
8	DK151009	84	7602	1	97
9	DK171003	75	7677	1	98
10	DK171006	69	7746	1	99
11	DH171012	69	7815	1	100
12	59050002	34	7849	0	100
13	Rack (162) DH101141	0	7849	0	100
14	Assly. Tie rod (DK 101180)	0	7849	0	100
15	Shaft clutch (160)	0	7849	0	100

Table 5.2.2 Defect Wise Data Analysis of Products

	Devki Auto Industries limited	Defect wise perato analysis graph of M.T CHAKEN PLANT				
S.No.	Defect name	Qty.	Cumm. Qty.	%age	cumm.%age	Main contribution of item in related defect
1	O.D O/SIZE	2375	2375	29	29	52DJ0105 FRONT & REAR(1607), SKS(284)
2	O.D. U/SIZE	1479	3854	18	48	52DJ0105 FRONT & REAR(1607), SKS(284),DS101336(233)
3	Dent and Step on diameter	1009	4863	12	60	SKS(284), DS101336(233)
4	CHEMFER NOT O.K	560	5423	7	67	SLEEVE DH111012 (410) , DS101336 S.R.A (110)
5	U' PROFILE NOTO.K	463	5886	6	73	COLLER SPROCKET DK 101245 (463)
6	WRONG THREADING/CROSS THREADING	432	6318	5	78	59050008 (410) , 59050002 (22)
7	PLATING NOT O.K	323	6641	4	82	DK151008 (173) , 52DJ0105 FRONT (84)
8	DENT ON SURFACE	299	6940	4	86	
9	BURR IN I.D	220	7160	3	89	
10	TURNING PATCH MARK ON O.D	193	7353	2	91	
11	TURNING MARK IN GROOVE	185	7538	2	93	
12	THREADING DAMAGE	172	7710	2	95	
13	DENT ON O.D	172	7882	2	98	
14	O.D U/SIZE	104	7986	1	99	
15	MIX UP	83	8069	1	100	
16	SURFACE NOT O.K	5	8074	0	100	
17	GRINDING SURFACE DAMAGE	3	8077	0	100	
18	LENGTH O/SIZE	2	8079	0	100	
19	GROOVE NOT O.K	1	8080	0	100	

Table 6.1 Selected Quality Circle Team Members

Quality Circle Team						
S.No.	**Quality Circle Team Description**	**Position in Industry**	**Deptt.**	**Work Experience**	**Understanding of Concept**	**Remarks**
1	**Narender Kumar (Me)- Team Leader**	Facilitator	Project Mgmt	02	Yes	
2	Team Member 1	Production Supervisor	Production Deptt.	10	Yes	
3	Team Member 2	Quality Supervisor	Quality Deptt.	08	Yes	
4	Team Member 3	Maintenance Supervisor	Maintenance Deptt.	11	Yes	
5	Team Member 4	Store Keeper	Store Room	05	Yes	
6	Team Member 5	Operator 1	Cylendrical Machine Deptt.	08	Yes	
7	Team Member 6	Operator 2	CNC Deptt.	06	Yes	
8	Team Member 7	Operator 2	Heat Treatment Deptt.	04	Yes	

5.1.1 PPM Trend of All Products

The study is done to carry out information provided on the basis of previous performance of industry in year 2014. The data available is of four months i.e. Jan 14 to Apr 14 which shows the progress of programs installed by the industry in this period of time. The progress is slow and need motivation of improvement. The PPM Trend of all the products before the implementation of QCM is shown in Table 5.1.1 and Chart 5.1.1 provided below:

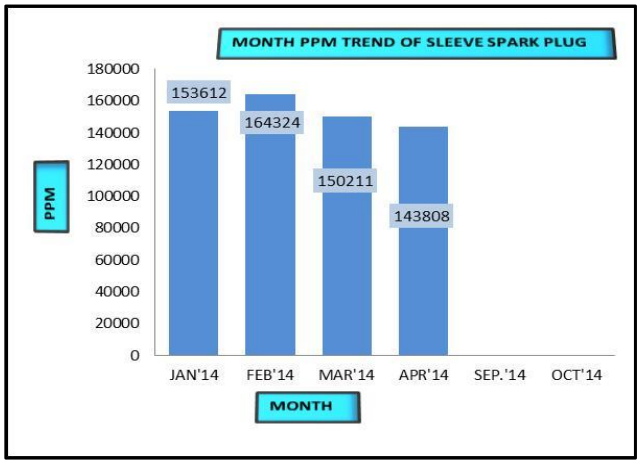


Chart 5.1.1 PPM Trend of All the Products before Implementation of QCM

5.2 Study after implementation of Quality Circle Methodology

A study is done to understand the various processes to produce products of the industry before implementation of QCM. This data has worked as a data base for finding out ideas of improvements in various processes.

The Product-wise analysis and Defect-wise analysis of Final Inspection Data is done as shown in Table 5.2.1 and Table 5.2.2.

5.2.1 Pareto Chart to identify severe problems

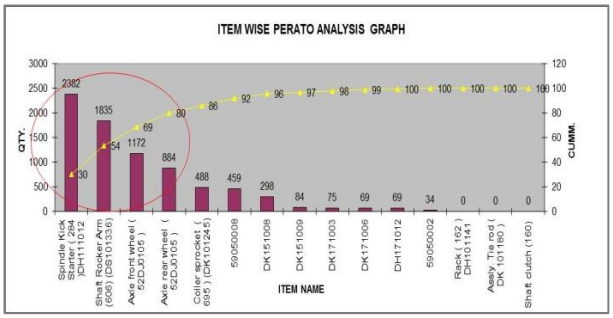
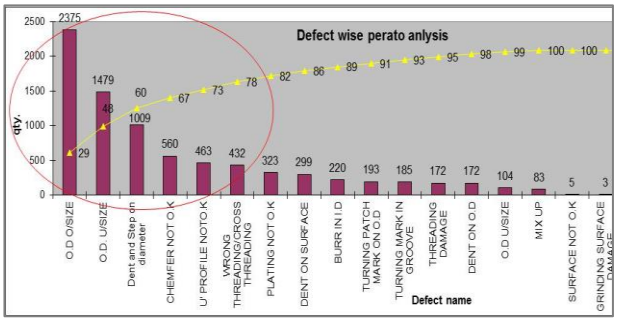


Chart 5.2.2 Product Wise Pareto Chart Analyses



5.2.1 Mark the Identified Problem

It is clearly seen from the above Table and Chart that Sleeve Spark Plug, Shaft rocker Arm, Front Wheel Axle and Rear Wheel Axle with Outer diameter oversize and Length undersize problems is the major contributor (around 80%) to the overall problems produced to the finished product. Thus the problem is marked as major problem to solve by Quality Circle Methodology.

6. Quality Circle Formation

A steering committee which is a group of volunteers is formed. A Team leader and team members selected

Table 7.1 List of Selected Kaizen by Quality Circle Team during Brainstorming Session

List of Selected Kaizen							
S.No.	**Product**	**Description of kaizen idea**	**Problem Faced**	**Location**	**Benefit of kaizen idea**	**Status**	**Requirement**
1	Axle	To protect the face damage problem & step on OD , we provided the dial on slide in cylinderical machine for proper location of grinding wheel after wheel dressing.	Wheel touch on face &step on dia	cylindrical grinding m/c	No wheel touch after wheel dressing.	Feasible	Observation and Marker
2	Axle	To eliminate the wheel touch & step on O.D.	OD Under Size and Step on face	cylindrical grinding m/c	Problem eliminated from final inspection stage.	Feasible	Skilled Operator
3	SKS	Stopper provided both side on centering & facing m/c	OD Under Size and Step on face	On centering & facing m/c	Problem eliminated from final inspection stage.	Feasible	Skilled Operator
4	SKS	TO Eliminate the face unclean problem in In-process & final inspection.	Dent & damage	On shaper m/c fixture	To prevention of the face damage & dent	Feasible	Fixture and Dial Indicator
5	SRA	To Eliminate the mix up of OK and Not OK product	Mix Up	On CNC machine	Problem Mix up eliminated	Feasible	Work Instruction on Machine

from supervisor of that department. All workers of the industry are invited to join the quality circle team to improve the performance of industry by reducing no. of defects of selected problems. This team is responsible for reducing defects to zero level through training to all employees of industry. The selected Quality Circle Team Members are shown in table 6.

Brain Storming Session

Now a meeting is conducted for healthy brain storming session with a view to find the solution of the identified problems of products i.e. Sleeve Spark Plug, Shaft Rocker Arm and Axle (Front & Rear). The problem is defined preciously and everyone is invited to provide their valuable suggestion or ideas regarding permanent solution of these problems.

7. Implementation

The following Table 7.1 shows the list of selected Kaizen to be implemented by Quality Circle Team reducing defects or PPM to zero level. The implementation of Kaizen is done by Quality Circle Team as follows.

Kaizen No. 1

- **Product Name:** SKS
- **Problem Description:** Wheel touches on face & O. D. Undersize and Oversize problem
- **Present Status**
  - Wheel dashed on component face.
  - Steps on O.D. on Cylindrical Machine
  - O.D. Undersize/ Oversize problem
- **PPM Level: PPM=25816**
- **Why-Why Analysis**
  - Why 1:In component slot width variation occurred.
  - Why 2: In customer drawing tolerance in slot width has already given upto 0.2 mm so we maintain the slot width as per drawing.
- **Root Cause of Problem**
  - Due to variation in slot width.
- **Corrective and Preventive Action**
  - Serration bush to be replaced after 25000 pieces.
  - Clamping on Serration is shown in Figure 4.1.

Before

Component clammed on slot side

After

Component clammed on serration side.

Figure 7.1 Component Clamped from Serration after Kaizen 1

- **Result Analysis:**
  - Eliminate the wheel touch on face & step on O.D.
  - Easy to clamp the piece
  - Detect the dent &damage pieces with the help of serration bush clamping

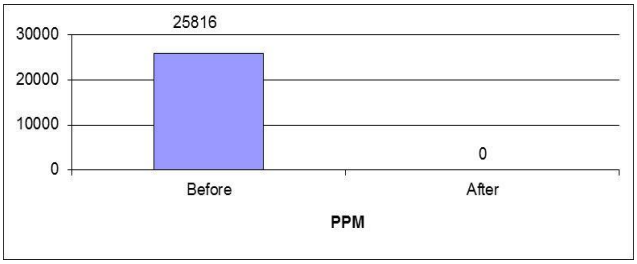


Chart 7.1 PPM of Axle Before and After Kaizen 1

- **Benefits**
  - Eliminate the wheel touch on face
  - Eliminate the step on dia.
  - Time saving

Kaizen No. 2

- **Product Name:** Axle (Front and Rear)
- **Problem Description:** O.D. Under Size and Step on face
- **Present Status**
  - O.D. Under Size
  - Step on O.D.
- **PPM Level: PPM=22816**
- **Why-Why Analysis**
  - Why 1: Face touch & step on diameter created due to uneven gap between grinding wheel face & component face.
  - Why 2: Gap uneven because the operator set the gap between grinding wheel face & component face by own judgment after the wheel dressing.
  - Why 3: No facility provided on machine.
  - Why 4: Because no idea on that time related to this problem.
- **Root Cause of Problem**
  - Gap uneven because the operator set the gap between grinding wheel face & component face by own judgment after the wheel dressing, Because there was no facility provide on machine.
- **Corrective and Preventive Action**
  - Dial provided on grinding machine slide, to set the proper location of grinding wheel after the wheel dressing as shown in Figure 4.2.
  - By monitoring the In-process inspection Quality status.
  - By monitoring the Final inspection Quality status
- **Result Analysis**
  - Eliminate the wheel touch on face
  - Eliminate the step on diameter
  - Reduce the setting time.
- **Benefits**
  - Eliminate the wheel touch on face
  - Eliminate the step on dia.
  - Time saving

Before

After Dressing of grinding wheel, wheel location manually set by operator

After

Dial provided on grinding machine slide to set the proper location of grinding wheel after the wheel dressing

Figure 7.2 Dial Provided on Cylindrical Machine after Kaizen 2

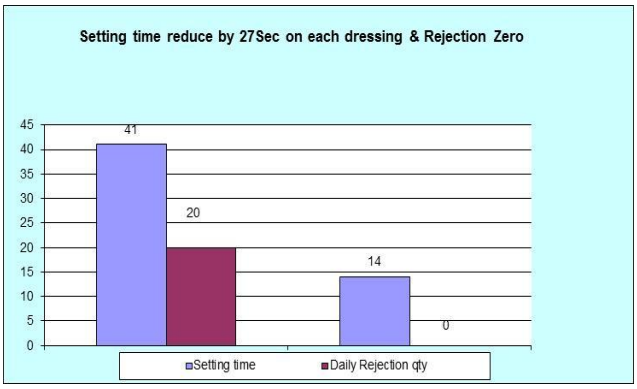


Chart 7.2 Setting Time (Sec) and Rejection (Qty) Before and After providing Dial on Machine

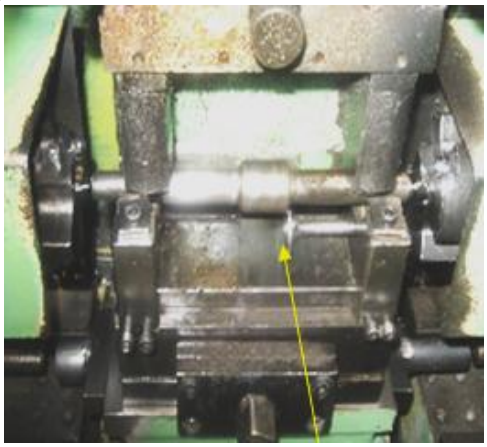
Kaizen No. 3

- **Product Name:** SKS
- **Problem Description:** To Eliminate the face unclean problem in In-process &Steps on OD in final inspection. O. D. undersize problem
- **Present Status**
  - O.D. Under Size
  - Step on O.D.
  - Face unclean pieces occur in In-process & Final inspection.
- **PPM Level: PPM=24519**
- **Why-Why Analysis**
  - Why 1: Face unclean in C.N.C Turning operation.
  - Why 2: During centering & facing operation operator was not properly rest the component face with stopper face.
  - Why 3: Due to operator negligence.
- **Root Cause of Problem**
  - Due to operator negligence.
- **Corrective and Preventive Action**
  - Provided both sides stopper in the fixture as shown in Figure 4.3
  - By monitoring the In-process inspection Quality status.
  - By monitoring the Final inspection Quality status

Kaizen 3

- **Result Analysis**
  - Eliminate the face unclean problem during C.N.C Turning operation.
  - Eliminate the operator negligence during centering & facing operation.

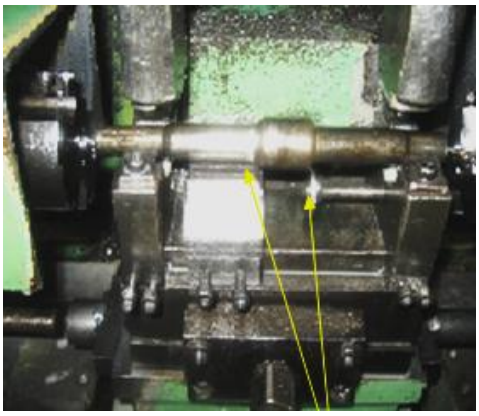
Before



One side stopper fixture

Daily rejection qty-5 pieces approx. and qty-1500 approx.

After



Both side stopper provided in

Daily rejection qty-Zero

Figure 7.3 Both Sides Stopper Provided in Fixture After

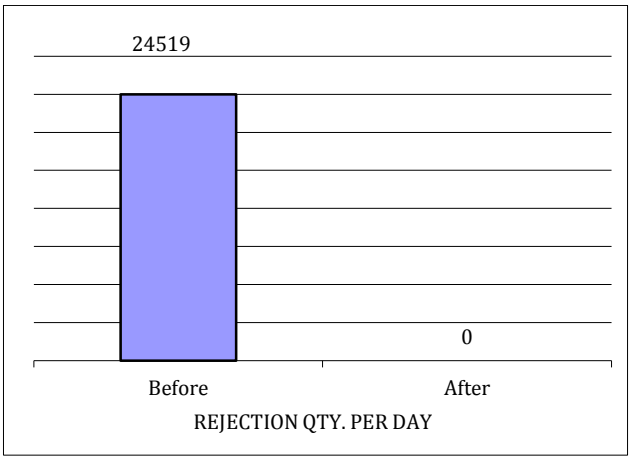


Chart 7.4 PPM Before and After using both sided fixture

- **Benefits**
  - Component face rest properly with stopper face.
  - No chances of failure by operator during centering & facing operation.
  - Unclean problem eliminate during CNC operation.

Kaizen No. 4

- **Product Name:** SRA
- **Problem Description:** To reduce the dent problem on face.
- **Present Status**
  - Dent on face arrested in Final Inspection.
- **PPM Level: 40 PIECES Not Good IN 3600 PIECES /DAY**
- **Why-Why Analysis**
  - Why 1: Dent occurred due to chips between the component resting face & fixture resting face.
  - Why 2: Resting diameter of fixture was more than the component resting face
- **Root Cause of Problem**
  - Fixture design was not correct.
- **Corrective and Preventive Action:**
  - To prevent the chips we modified the fixture design by decreasing the resting face dia of fixture & also cavity provided in fixture resting face
  - Modified Fixture is displayed as shown in Figure 4.4.
  - By monitoring the In-process inspection Quality status.
- **Result Analysis**
  - Reduce the dent on face.
  - Increase the fixture life.
- **Benefits**
  - Dent problem has been reduced.

Before

After

Figure 7.4 Modified Fixture of SRA After Kaizen 4

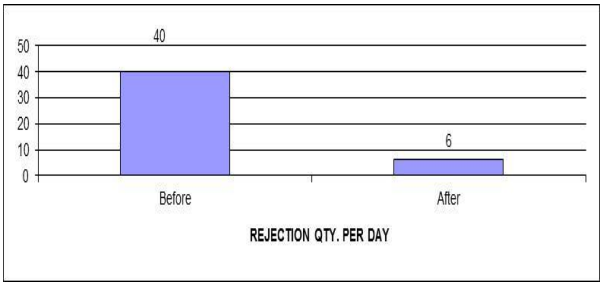
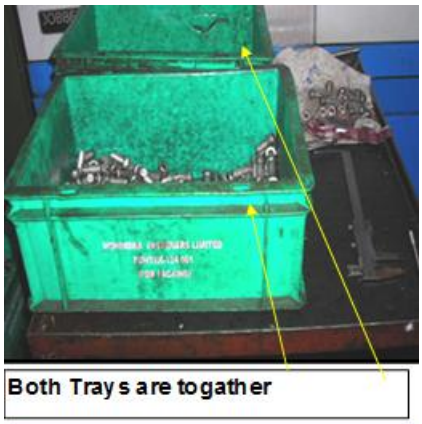


Chart 7.5 PPM Before and After using Modified Fixture of Product

Kaizen No. 5

- **Product Name:** SRA
- **Problem Description:** To Mix Up and Dent Problem on the surface
- **Present Status**
  - Mixed OK and Non-Conformity in Next operation
- **PPM Level: PPM=30212**
- **Why-Why Analysis**
  - Why 1: Both Trays are together.
  - Why 2: Lack of Training about work on machine
  - Why 3: Due to operator negligence.
- **Root Cause of Problem**
  - Due to operator negligence.
- **Corrective and Preventive Action**
  - Trays are separated as shown in Figure 4.5
  - Proper Training given to the operator.
  - Work Instructions are displayed on the machine

Before



After

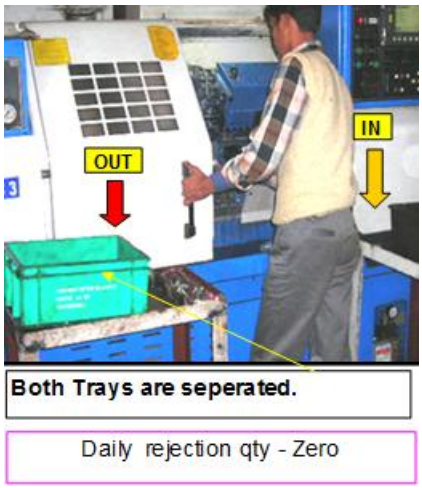


Figure 7.5 Separated Trays on CNC machine Before and After Kaizen 5

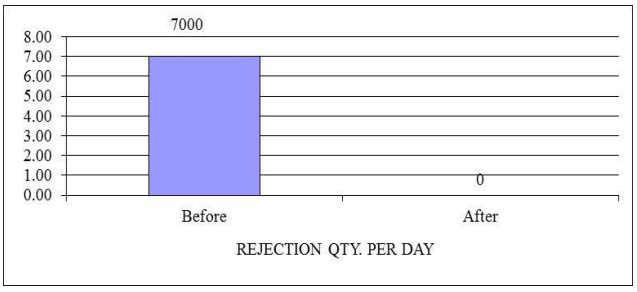


Chart 7.6 Chart 7.6 PPM Before and After using Separated Trays on CNC

- **Result Analysis**
  - Eliminate the mix up problem during C.N.C Turning operation.
  - Proper Training to the Operator

- **Benefits**
  - Eliminating possibility of any mixup.
  - Better process control.
  - Better single piece flow
- The result analysis is done on the basis of effectiveness of QCM by reducing PPM Level of all the products from a huge quantity of total 145808 to a minimum quantity of total 235 which expected to become zero in the next month. The QCM eliminated the major contributor of problems i.e. SKS, Axle and SRA contribute in form of O.D. undersize/oversize, dent and mix up problem which are found in Final Inspection Area. These problems result in increasing the cost of quality to the industry in terms converting the non-conformities to Good Product by sorting, rework and repairing process. The reduction trend of PPM Level of six months (from May 14 to Oct 14) is displayed as shown in Figure 5.1.
- The reduction in PPM level to approximately zero level reduced the cost of industry as follows:
- Overall PPM Reduction (Qty) = 143808-235 = 143575 no's
- Average Rate of the product including Raw Material Rate of each product = Rs. 7.80 / Product
- Cost Reduction of industry = 143575 x 7.80 = **Rs. 11,19,885**

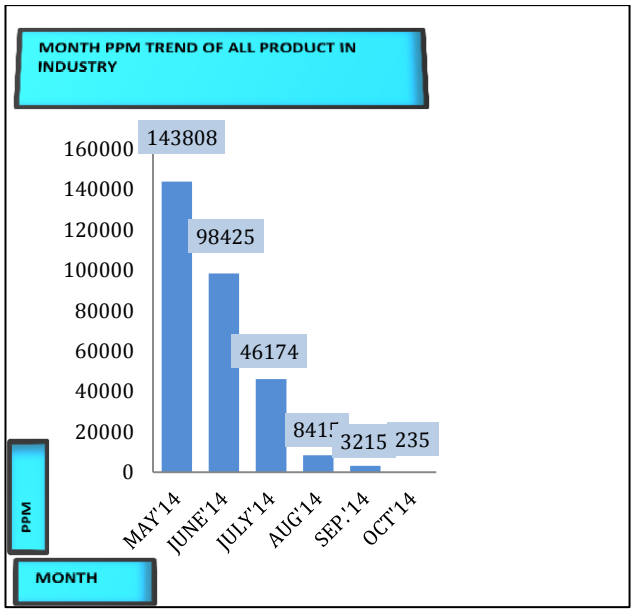


Figure 5.1 Reduction Trend of PPM Level from May 14 to Oct 14

Conclusions

- In the present research work, an initiative has been taken to apply Quality Circle Methodology in a small organization manufacturing of automobile industry. The results of the study showed that Quality Circle Methodology empower employee to achieve zero defects in all possible ways and has a lot of potential to pioneer quality system.
- In manufacturing industry, successful implementation of Quality Circle Methodology has been carried out. In the present study, an attempt has been made to implement Quality Circle Methodology in achieving zero defects in production in a small manufacturing industry.

- The results show that implementation of Quality Circle Methodology implementation has led to a remarkable profit by reducing the cost of quality by eliminating the production of not good products. This method recorded elimination of 80% major problem related to product by successful and effective implementation of concept of Quality Circle among the employees. This method improved work culture by providing opportunities to all employees work towards achieving objective of industry. It provided platform to manpower to give suggestions in improvement in concern areas. It found reliable and suitable in regards to reduce the cost of training to new or existing employees by providing permanent data that can be used in repetitive manner to understand training topics. It provided a comprehensive and flexible system for maximizing business success.

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