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Research paper

Effects of zero defects approach-a case study at an Indian industry

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Abstract

Quality is free when reaches zero defects, quality is measured various aspects. The rework is carried out when the product finish not up to the standard, which added additional expenditure. On other side if there is no chance for rework the cost of raw material and value added cost up to that non conformity is lost. This work shares a success story and reveals a systematic scientific approach to reach zero defects. The case study conducted in the leading supplier who focuses on climate and energy efficient solutions. The traditional powerful quality tools employed to focus, understanding and analyse the problem. The Decision support system preferred and adopted to solve the problem with affordable cost. The outcomes of this work measured in terms of modern Total Productive Maintenance style that is in terms of Productivity, Quality, Cost, Delivery, Safety, Motivation and Morale (PQCDSM). The results in all the way found more significant.

Keywords: *Powerful quality tools, decision support system, modern total productive maintenance, motivation and morale (PQCDSM).*

1. Introduction

Zero-defect manufacturing strategy bring the enormous business prospect to firm like higher productivity, better quality, high-return of investment and innovation etc. [1] The organizational and operational decision making are recently supported by specially designed information system called Decision support systems (DSS) which provides interface to decision maker. Boshkoska et al. [2] addressed quality ranking related issue and suggested DSS with integration of quality standards of the concern and expectation of experts. Another interesting case is deduction of faults and activation of auto recovery without human intervention that is real time quality control capability, discussed. by Ozgur and Wendel [3]. The fuzzy logic used for space application was discussed for fault deduction under uncertainty by Ribeiro [4]. [5] proposed about fuzzy logic based intelligent DSS which detects, analyses the root cause and rectifying the problem and validated with real coal mill data. [6] presented a case study to achieve zero structural defects in press shop of a sheet metal industry. [7] reviewed about condition monitoring in machining process with neural networks. Saravanan et al [8] discussed importance of measurement for improvement and achieved zero defects in drill holed products by Total Productive Maintenance approach and suggested to review the result in terms of PQCDSM. In this paper valve manufacturing unit considered. the powerful tools and renowned techniques were used and results are measured in terms of PQCDSM [9].

2. Materials and methods

Problem background

The organization is a leading supplier which focuses on climate and energy efficient solutions. Wide range of products includes the valves, filters and regulators. This study focuses on refrigerator valves in particularly shut-off valve –STC manufacturing (Figure 1). Specific application (Cold Room) of such valves is depicted in Figure 2.

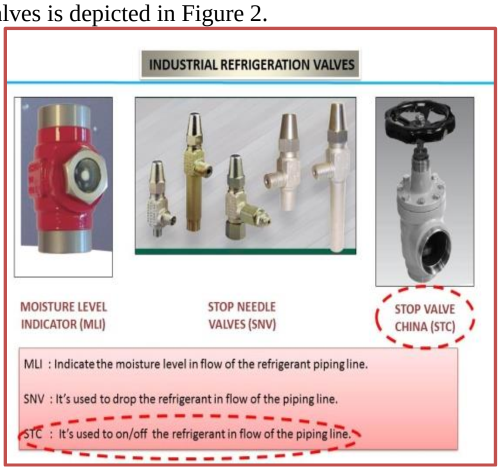

Figure 1: Product and its purpose

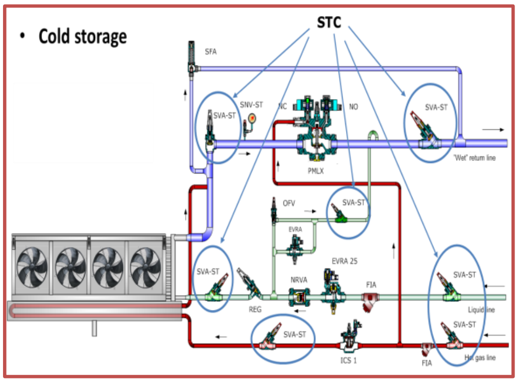

Figure 2: Sample application of the Product

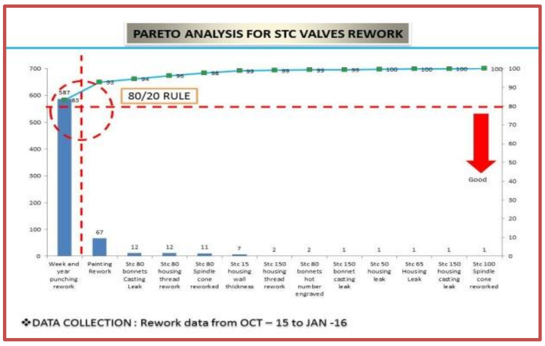

Figure 3: Pareto analysis

Problem identification

According to Six Sigma, the Rework is one of the eight major losses. Hence the Problem identification was carried out with help of rework history of STC valves and analysed by means of Pareto analysis. The self explanatory analysis has furnished in Figure 3. The week and year Punch reworks encountered many times (587). The phenomenon wise week and Year punch defects were analysed and furnished in Figure 4. Week and Year of manufacture information is mandatory for the customer claims. It usually punches on the part as week followed by year. For example, the punch mark is 0716 means seventh week of the year 2016 (Refer Figure 5). It provides traceability of finished goods that is helps to track back on their production records. It is essential easy identification for any customer complaints on the specific valve. So its quality has very high priority. The existing method is manual and it is sequentially depicted in Figure 6.

Problem analysis

The brainstorming study session was conducted and prepared Ishikawa diagram (Cause and Effect Diagram). The possible cases were encircled with green (Refer Figure 7). The root cause analyses were carried and they are diagrammatically depicted in Figure 8 to Figure 10 for the phenomenon uneven punching, punching with less visibility and missing of Punching respectively.

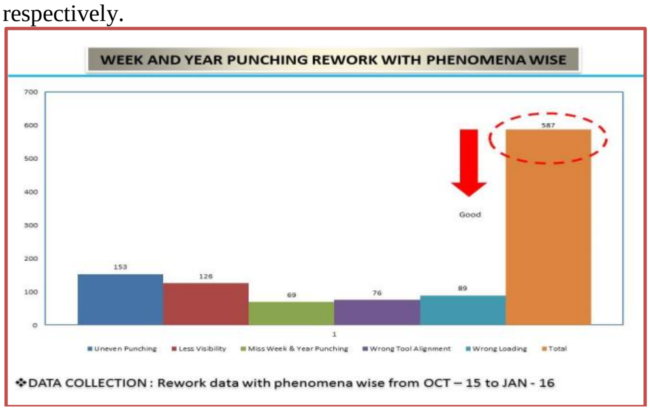

Figure 4: Contribution of different phenomenon for the defect

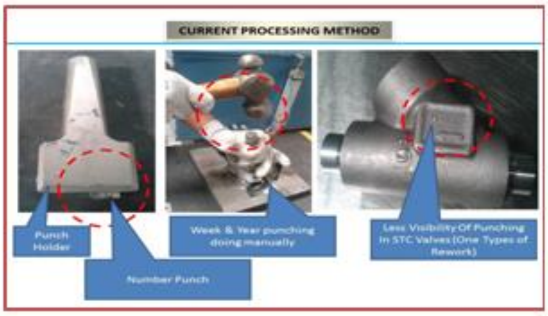

Figure 5: Punch mark of week and year of manufactured

Figure 6: Traditional method & defect

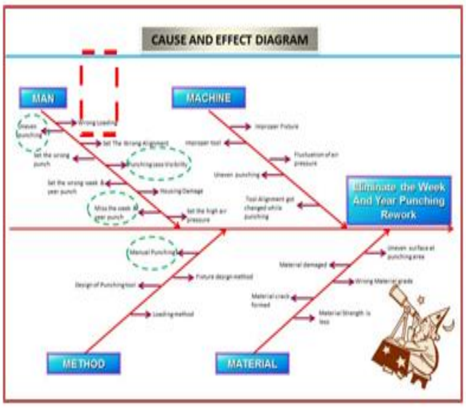

Figure 7: Results of brainstorming

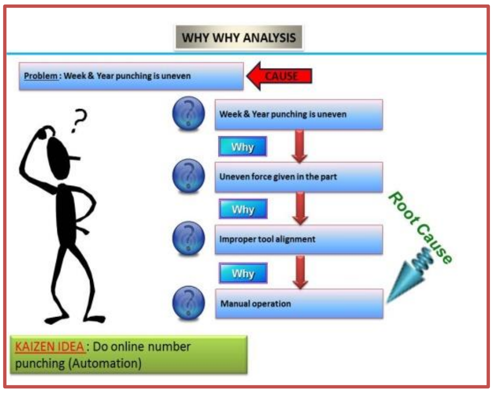

Figure 8: Root cause analysis (a)

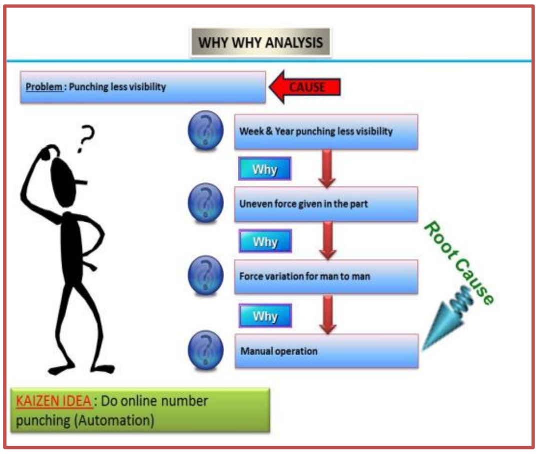

Figure 9: Root cause analysis (b)

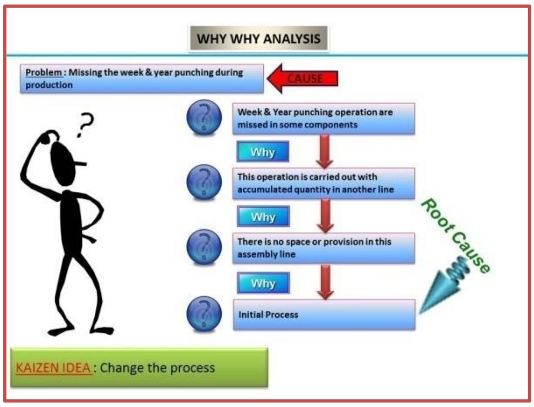

Figure 10: Root cause analysis (c)

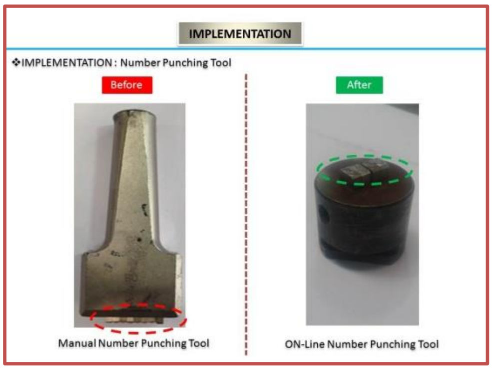

Figure 11: Tools for traditional and new method

Solution to the problem

An on-line punching system is designed and implemented. For better understanding the details are comparatively discussed with illustrative diagrams from Figure 11 to Figure 17.

3. Results and discussions

Saravanan et al (2001) the validation is carried out in various ways that is PQCDSM. The results of the proposed method measured and presented in Figure 18. The solution effects in Productivity, Quality, Cost, Delivery, Safety, Motivation and Morale wise measured and compared. The details are diagrammatically illustrated from Figure 19 to Figure 23.

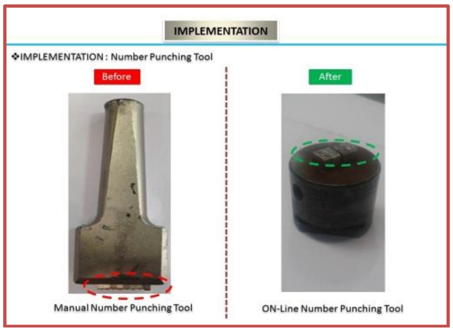

Figure 12: Punching tools

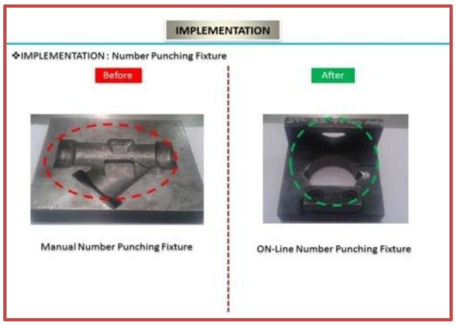

Figure 13: Punching fixtures

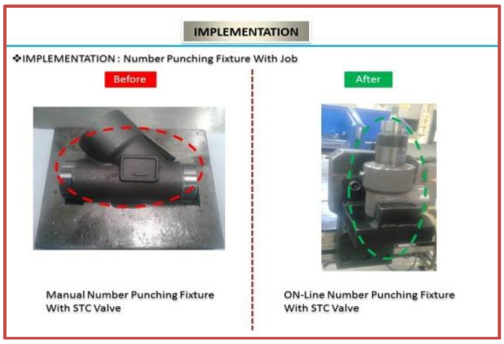

Figure 14: Punching fixture with housing

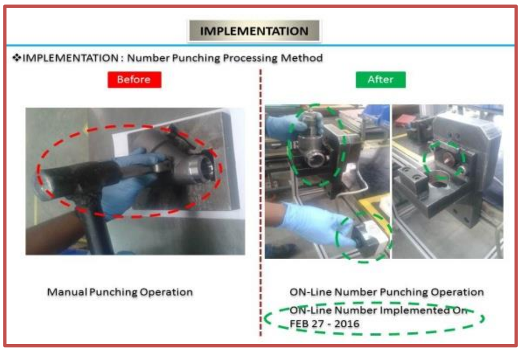

Figure 15: Punching operation methods

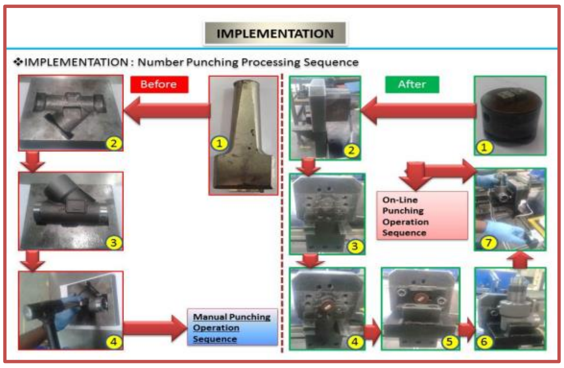

Figure 16: Punching operation sequences

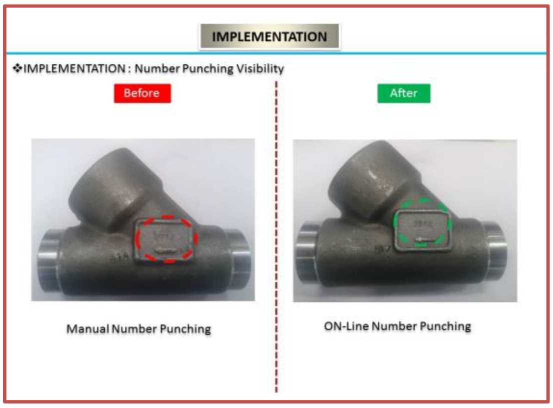

Figure 17: Punching visibilities

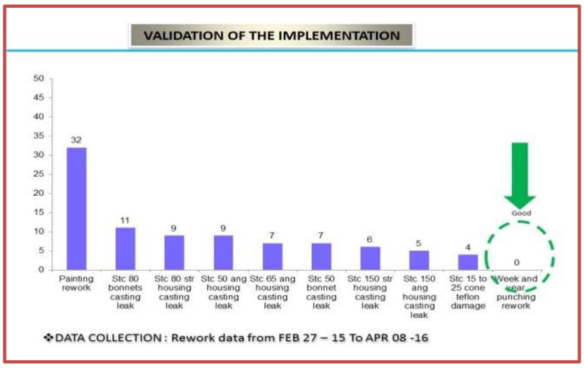

Figure 18: Zero Rework achieved in punch of week and year of manufactured and other quality defects

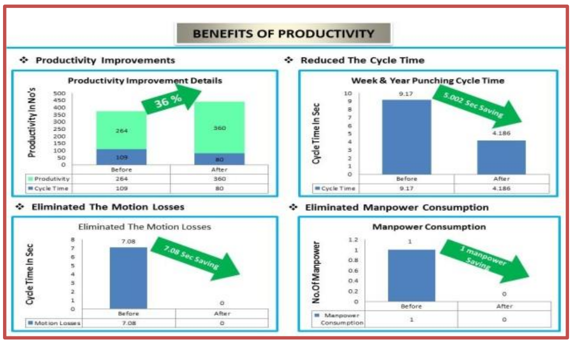

Figure 19: Productivity benefits

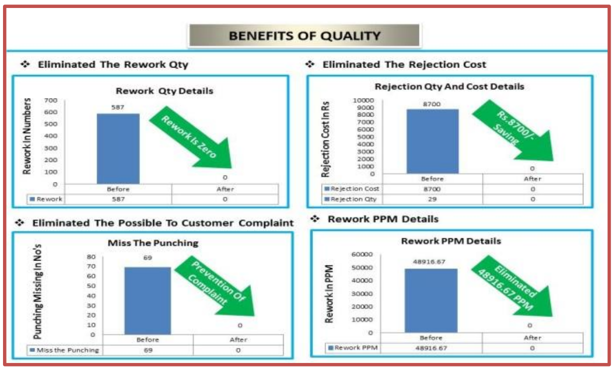

Figure 20: Benefits on quality

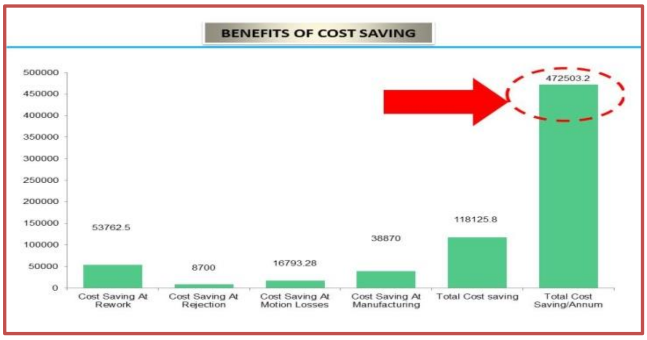

Figure 21: Benefits by cost saving

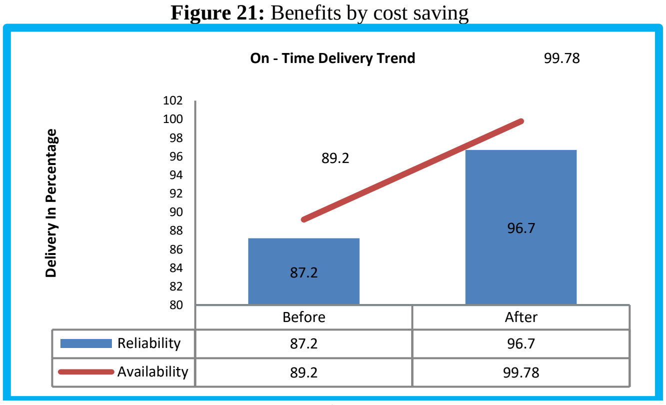

Figure 22: Benefits on delivery

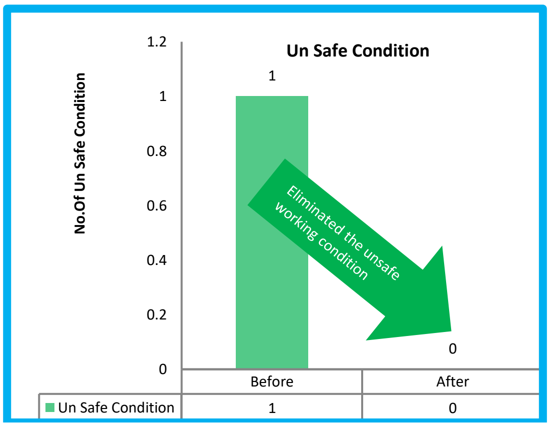

Figure 23: Benefits on safety

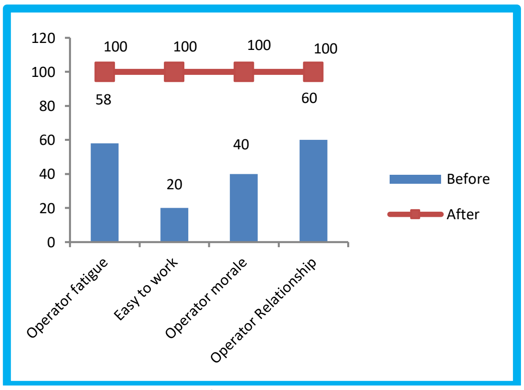

Figure 24: Benefits on motivation and morale

The productivity benefits measured in terms of number of pieces completed and total cycle time and achieved 36% improvement, the cycle time per piece is reduced from 9.17 seconds to 4.18 seconds, the motion losses and man power required are completely eliminated (refer Figure 19). According quality aspects, the rework completely eliminated, and rejection reduced to zero and cost saving Rs.8700/- achieved. The most important defect of missing of Punch was reduced to zero from 69. The rework PPM achieved zero from 48916 (refer Figure 20). The cost benefits measured in terms of rework elimination, rejection elimination, achieved zero motion loss and manufacturing point of view. The cost saving per annum Rs.4,72,503/- (refer Figure 21). The delivery achieved to highest value and presented in terms of reliability and availability in Figure 22. Due to automation of punching 100% safety ensured (Figure 23) and the operator motivation and morale were measured in terms of operator fatigue, work nature, morale and operator relationship and ensured 100% in all categories by implementing on line punching system. The benefits are consolidated in the Table 1 for easy reference.

Table 1: Benefits summary comparison for before and after

S.No	Description	Benefits Summary	
		Before	After
1	Assembly cycle time	109 Sec	80 Sec
2	Production Qty	264 No's	360 No's
3	Productivity	Less than 36%	36% Improved
4	Punching cycle time	9.17 Sec	4.18 Sec
5	Operator motion losses	7.08 Sec	0 Sec
6	Rework Qty	587 No's	0 Sec
7	Rejection Qty	29 No's	0 Sec
8	Punch Missing	69 No's	0 Sec
9	Rework PPM	79216.83 PPM	48916.67 PPM
10	Rejection Cost	Rs.8700/-	Rs.0/-
11	Manpower consumption	1 Manpower	0
12	Rework Cost	Rs.87428.32/-	Rs.53762.5/-
13	Motion Losses	Rs.19842.21/-	Rs.16793.28/-
14	Manufacturing Cost	Rs.49686/-	RS.38870/-
15	Availability	89.20%	99.78%
16	Reliability	87.20%	96.70%
18	Unsafe working condition	Yes	No
19	Operator fatigue	58%	100%
20	Easy to use	20%	100%
21	Operator morale	40%	100%
22	Operator relationship	60%	100%

4. Conclusion

Zero defect approach discussed with case study. The use of traditional powerful tools and modern measure of project outcomes (PQCDSM) also illustrated well. Lot of pictures included for easy understanding. The tangible results achieved and presented. This work made attempt on one product only and suggested to extend other products to continue the journey of success.

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