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REDUCING THE DEFECTS AND IMPROVING THE QUALITY OF MANUFACTURING PRODUCT (CT WHEEL/CRAIN PART) USING 8D PROBLEM SOLVING TOOL

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Abstract*:* Customer satisfaction is the key element for survival in the industry/market because quality is the big challenge for manufacturers. Aim of this research is to explore the utility of selected (8DS) problem-solving tools and techniques in root-cause analysis to demonstrate their practical application. Eight discipline method (8DS) is used to sort out the problem and to increasers' the quality of manufacturers. It can be followed out on product as well as system and process as well. This method is used as a tool for regular improvement and corrective measure to rectify the minor and major issue. The primary use of 8D method for both internal and external conformity i.e. client complaints as well as inter plant complaints. This tool also applied for better understanding the problem and finding the solutions. Main/ Basic advantage of this method is, it is an easy and legitimate to find out problems according to occur. Its main basic tools and technique is to attacks on the PDCA (PLAN-DO-CHEACK-ACT) cycle. The methodology of 8D is a team oriented problem solving (TOPS). The present work offers a direction to examine the 8D philosophy with the utilization of quality improvement thinking in producing high quality products and zero defects too. Quality plays an important role and that should be more efficient and effective in the global market. Now it is requirements to problem solving process using standardized methodologies, according to International standards. 8D methodology has become very popular because it is effective to use. The aim of this paper is to apply the 8D methodology and to analyze its effectiveness. In order to analyze its effectiveness of 8D methodology a case study was conducted and results can be used by them to improve their quality. This paper is based on two objectives. The first objective is to study the 8D methodology and second objective is to apply the 8D methodology and to analyze its effectiveness. In order to apply the 8D methodology and to analyze its effectiveness a case study was conducted in an ISO certified manufacturing industry.

Keywords: 8 D Tool, Defects, Quality Improvement

Introduction*:* Authors who have had their paper submission The Health State Values Derived from People with Multiple Sclerosis Impact Scale Eight Dimensions Patient Version (MSIS-8D-P) which help to inform resource allocation within ring-fenced budgets for MS and individual-level treatment decisions. Originally, the 8Ds method was developed at Ford Motor Company; it was introduced in 1987 to a manual entitled "Team Oriented Problem Solving" (TOPS) (Goodwin et al., 2019). Ahmed et al., 2020 explain Campbel Measuring the health-related quality of life (HRQoL) in Australians with multiple sclerosis using the Assessment of quality of life-8-dimension (AQoL-8D) multi-attribute utility instrument. 8-D method implemented in the manufacturing company shows a comparison about the frequency of each defect before and after implementing the 8Ds method of inverted cables (Vargaes et al., 2020). Pacheco-Pacheco sought to optimize delivery times of alteration clothing products in a tailor shop by implementing the 8Ds method and found that production times decreased by 2.46% in two mix products (Pacheco-Pacheco et al., 2018). Zasadzie´n, (2017) employed the

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8-Ds method to reduce machine downtimes that is caused by bottlenecks. Since the method has been applied mainly in automotive industries to solve product and service-related problems, such as customer complaints, deviations, returned purchases, poor machinery maintenance (Saad et al.,2016; Stjepandi et al.,2016). According to him the 8Ds method is popularly applied to solve quality problems but at least one of the following events are presented the company receives customer complaints, Safety or regulatory issues have been discovered, Internal rejects, waste, scrap, underperformance, or test failures occur at abnormal levels (Bremmer and Update, 2015). The 8Ds method implemented to solve the problem of an LED diode that did not perform its function in a circuit board; they reported a decrease of operational defects after its implementation (Mitreva et al., 2015). As per business perspective, the 8Ds method is able to find out the main problems' root causes, identify their possible solutions (Saad et al., 2013). In the months of 2011, the research was conducted and mainly was carried out in a large scale organization operating in metal processing field throughout the time, the organization has continuously being upgrading the 8D method in terms of methodology and information technology. Since 2005, The Company has had the 8D method integrated in its business information technology. After 2005, neither the method nor the information support has undergone any further changes. The two methods Qualitative Method and Quantitative Method were used (Problem Solving Methodology, 2012). Carlos A. The 8Ds is a teamwork-oriented problem-solving method that aims at identifying the root cause of a problem to solve it through a corrective-action-guided procedure within a hard atmosphere (Cheng et al,.2010). This case study describes the problems associated with the quality of manufacturing product in a company that uses the 8D methodology to reducing the defects and improving the quality. Based on such problems a quality improvement program is put in practice to improve the performance of such process, by studying the problem root causes and describing the changes made to the process. The performance was assessed by the timeliness and the Quality dept. to customer complaints. According to Chelsom and Vargas the 8Ds method can be applied to any type of problem as its role in supply chain management (Chelsom et al,. 2005).The 8-Ds method was first developed for Ford Motor Company in **1987** as manual entitled "Team Oriented Problem Solving" (TOPS). Since then this method has been applied mainly in automotive industries to solve product and service-related problems, such as customer complaints, manufacturing process deviations, returned purchases, poor machinery maintenance, and supplier qualification issues, among others. A company that succeeds on customers' expectations is guaranteed to have great Return on Investment (ROI).Reliable and Stable production processes influence on a lot of KPI (Key Performance Indicator) that is most important for business success. In order to be successful in the market it is necessary to satisfy the customer and in hence companies should continuously improve their product quality by implementing different quality improvement methodologies because if we don't follow then their will more rework needed, which consumes additional recourses, time and money and we will failure. In this paper will be reviewed and discussed different quality and process improvement methodologies which are intended to solve customer complaints and problems in virtual organization network. The 8Ds tool is based on Quick Response Quality Control (QRQC) and it is also known as G8D, Global 8D, and TOPS 8D). It is one of the most widely used problem-solving tools related to stop the reoccurrence nonconformities in the manufacturing process. The 8-steps to be followed by team to reduce the defects and improve the quality of manufacturing product. QRQC (Quick Response Quality Control) is quick and comprehensive problem-solving process for the industrial and services sectors that ensures problems. Before 8D tool and its implementation process first look on the concept of 'quality".

In manufacturing company many problems occur this one is just one of them. Some experiments were conducted in order to find out the root causes.:

Eight discipline in problem solving (The 8 Disciplines are)

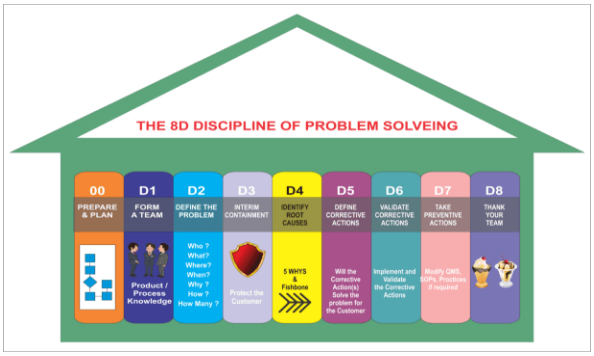

Fig.1. 8 Disciplines of problem solving

Discipline Number definition	**Discipline number definition**
D1	Establishing the team
D2	Problem Description
D3	Immediate action
D4	Identification of causes
D5	Corrective action
D6	Measuring of effectiveness
D7	Expansion
D8	Congratulate the Team members

The response time rules in 8D methodologies for any complaint are as follows:

(1 day) - D1;

(2 days) – D2 and D3;

(14 days) - D4 and D5; D6 andD7 defined;

(60 days) - All steps completed

The 8 Disciplines are:

D0: Make Plan- Learn the basic principle and Make the plans for resolving the Problem

D1: Prepare a team- Prepare a team of people, on the basis of specialist

D2: Draw and define the problem- To resolve the problem by the help of 5W2H terms that is (who, what, where, when, why, how, and how many) (Suraj Kumar, Munna Verma 2021).

D3: Containment Action – To find and implement containment actions to identify the problem from any client i.e. it is a action where we stop the products which are reaching the customers after detecting the problem.

D4: Determine, identify, and verify root causes – Locate all the applicable cause That can explain why obstacle has passed and identify where they took place.

D5:- Confirm Corrective action- Confirm that whether the selected correction can resolve the trouble.

D6:-Validate Corrective Action - Corrective action that was implemented in the next batch of production and it is observed that this action was found to beneficial

D7: - Prevent recurrence/system problem- Rearrange the system either man Planning, operating or processing to prevent the reoccur same problem.

D8: - Congratulate your team-. The team needs to be officially thanked by the system.

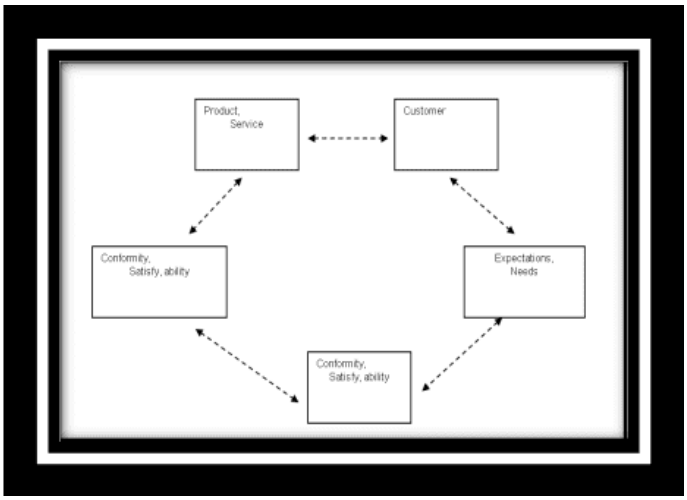

Fig. 2: Flow process chart of process layout.

Work Plan and Implications

(a) Study about the cause and to collect all data by following steps: How, Why and

When, Flow process chart, Ishikawa diagram, Documented Detail

(b) In order to facilitate data collection, it was necessary to construct case study

(c) Analyses the collected data to find out the root cause

(d) After that we take corrective and preventive action as per requirement

Need of the Proposed Research Work

In manufacturing industry sometimes minor and major issue arises due to which quality goes down. To optimize this issue and keep up the quality high, we implement 8D tool instead of this it is seen that several research work has been carried out using 8-D tool in different research area and only few research work has been carried out in the area of reducing the defects and improving the quality of manufacturing product and other important benefits of 8D (Eight Disciplines) is as follows:

The 8D method is very easy for implement in workplace

- The method is very popular in industry because it is reliable and well know problem solving tool for automotive industry.
- An excellent way of reporting non conformances to suppliers and their corrective actions.
- 8D helps to eliminate complicated issues at appropriate locations where defined the causes of the problem incorrect, lack of consequences in implementation and same problem appear again.

The team approach works best when the problem, because 8D is designed and capable for special cause of problems identification and elimination

2.1. **Tools and technique used 8-d tool**

It is a Team Oriented Problem Solving (TOPS) and used in Ford Motor Company in 1987.

- (D1)Establish the Team
- (D2)Define the Problem:- Who, what, when, where, how, how many
- (D3)Take short term action (Containment)
- (D4) Determine Root Causes
- (D5) Develop the Corrective Actions
- (D6) Validate Corrective Actions
- (D7)Prevent the Reoccurrence of the Problem
- (D8)Congratulate the Team

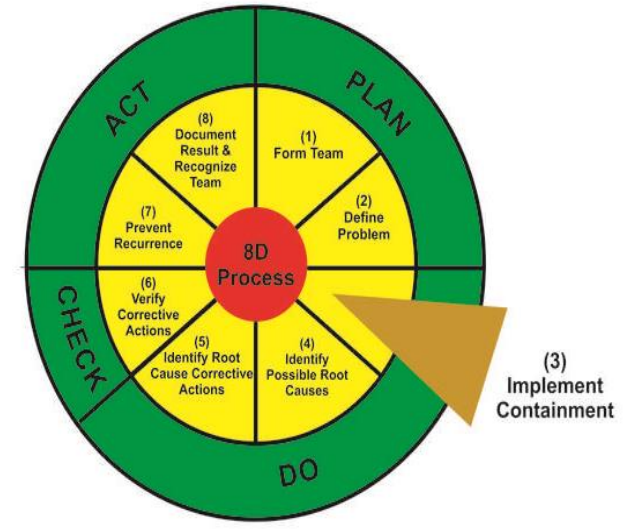

Fig. 3: Diagram of 8-D in term of PDCA (Ref. PDCA cycle)

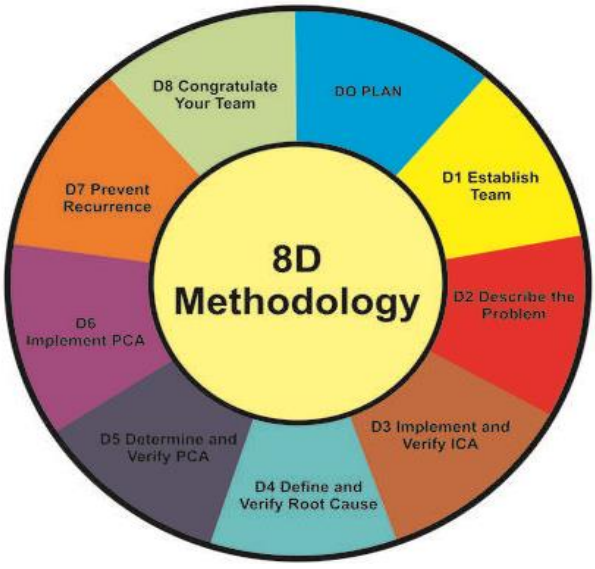

Fig. 3(a): Diagram of 8-D Methodology

1. Flow chart
2. Check sheet
3. 5W, 2H (what, why, where, who, when, how, how much)
4. Root cause analysis
5. Ishikawa diagram

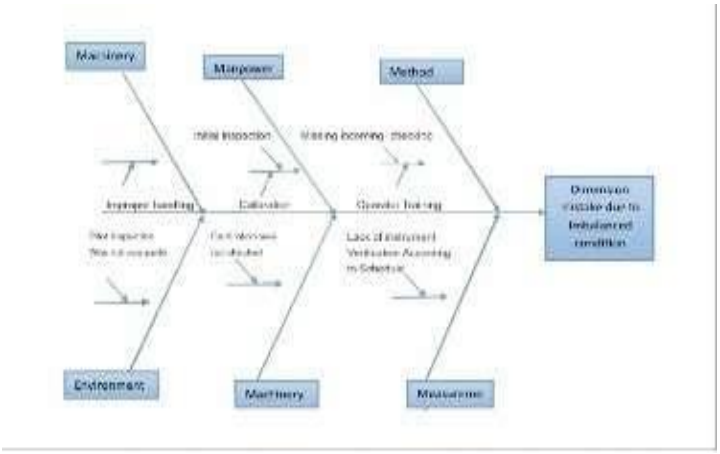

Fig. 3(b): Ishikawa diagram/ Cause and effect diagram

Kaoru Ishikawa invented the causes and effect diagram that's why it is known as Ishikawa diagrams and it is also known as fishbone charts. The main cause of diagram is to identify the factors which causing the defects. People involved in the process will identify the affecting factors. The"5 M's" Method, Manpower, Material, Measurement, and Machinery.

Fig. 4: 5

While represent the problem the 5 W (WHO, WHAT, WHERE, WHEN, WHY) as well as 2H (HOW, HOW MUCH, HOW MANY) used

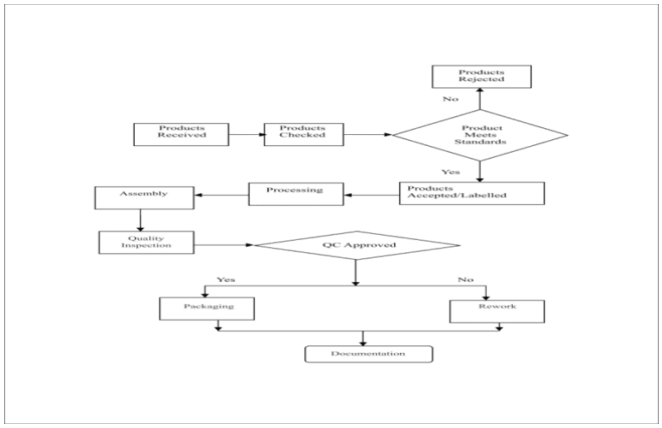

Fig. 4(a): Flow process chart

Fig. 5: CT Wheel of Crab

Data Collection and Data Analysis

During final Inspection of crab, (The 'crab' is the 'cross travel unit' from which the hook is lowered and raised. The lifting crab of a EOT crane is an independent two motion machine and consists of the hoist machinery built on to a frame, which is mounted on runner wheels, and driven by a motor through suitable gearing. The crab is also known as trolley.) Crab gets rejected because runner wheel was not in a proper plane/not symmetric because dia. of wheel was not equal. As per the guideline of 8D Tool every point taken in to under consideration/ tested and then final result came out by the help of documented record (ISO 9001:2015). We start up our step as per flow process chart .We should have to look out the QC manual regarding in process material either purchase related data, internal inspection, calibration record etc. During the inspection of set up of measuring devices a lot of fault found in that instrument. We found there is variation in measuring devices due to which size of CT wheel not more than tolerance chart as per drawing. Then we adopted a new process which helps to reduce and remove the occurred problem which is necessary for the quality of product. Our proposal is during pilot inspection one QC person will check and calibrate the measuring instrument either vernier caliper, micrometer, gauge etc. daily at a fixed interval of time for that, to reduce the time i.e. at that time one calibrated instrument will be given to machine operator and machine operator's instrument will be taken and after completion of one cycle all instrument will be calibrated by slip gauge. It reduces the time, increases the accuracy and improves the quality. This process will be continued under the instruction of QM along with this Operator training will held within 15 days.

Inspection Rejected Report of CT wheel, adopter, gear box.etc.

During Inspection we found the dimensional error in CT wheel of different size, adopter, and gear box on behalf we checked the specified dimensional instrument and found the error.

Spec.	tolerance	Dia max	Dia min	Obs.	Mean observ ation	P/R	Root cause
118	0.035	118	117.86	116	116.007	R	Dim. Instrument
118	0.035	118	117.86	116	116.007	R	Dim. Instrument
118	0.035	118	117.86	116	116.007	R	Dim. Instrument
118	0.035	118	117.86	116	116.007	R	Dim. Instrument
65	+0.5, 0.5	65.5	64.5	64.42	64.407	R	Dim. Instrument
118	0.035	118	117.86	112.14	112.033	R	Dim. Instrument
140	0.035	140.035	139.065	140.51	140.53	R	Dim. Instrument

118	0.035	118	117.86	116	116.007	R	Dim. Instrument
118	0.035	118	117.86	116	116.007	R	Dim. Instrument
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118	0.035	118	117.86	116	116.007	R	Dim. Instrument
118	0.035	118	117.86	116	116.007	R	Dim. Instrument

Fig. 6(a) : Dimensional Error in CT wheel(OD118), adopter, gear box

Spec.	tolerance	Dia max	Dia min	Obs.	Mean obs	P/R	Root cause
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument
130	0.035	130	129.89	128	128.005	R	Dim. Instrument

Fig. 6(a): Dimensional Error in CT wheel (OD130)

Spec.	tolerance	Dia max	Dia min	Obs.	Mean obs	P/R	Root cause
120	0.035	120	119.90	118	118.006	R	Dim. Instrument
120	0.035	120	119.90	118	118.006	R	Dim. Instrument
120	0.035	120	119.90	118	118.006	R	Dim. Instrument
120	0.035	120	119.90	118	118.006	R	Dim. Instrument
120	0.035	120	119.90	118	118.006	R	Dim. Instrument
120	0.035	120	119.90	118	118.006	R	Dim. Instrument
120	0.035	120	119.90	118	118.006	R	Dim. Instrument

Fig. 6(b): Dimensional Error in CT wheel (OD130)

Defect wise rejection data for ct wheel

Type of Defects	No of Rejected parts
Crab	7
Ct Wheel	40

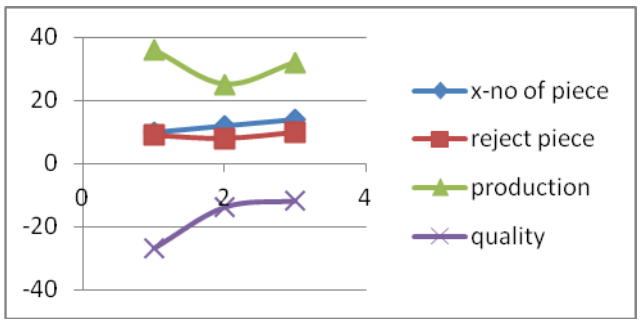
Fig.7. Rejection data of ct wheel

Hardness test record

Fig. 8: Hardness test record

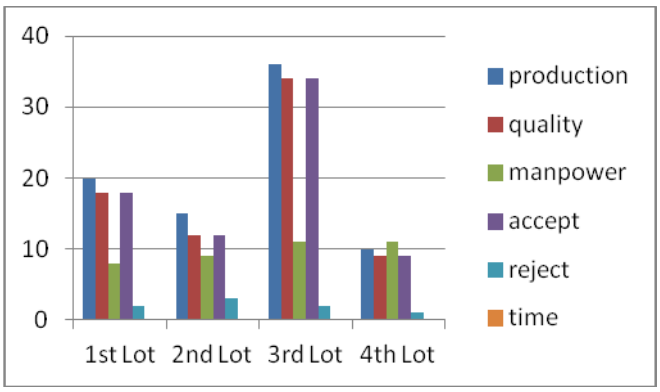
Hardness test record found as per specified recorded documents

Fig. 9: Imbalanced Position of crab



Graph 1(a): -After inspection

Above graph shows the result of rejected piece before implementing the new policy which is lack of calibration of dimensional instruments.



Graph 2: -After inspection

This graph shows the quality vs. production chart after implementation the new policy. When we started the new policy, to improve the quality by 8D Tool quality (accept product) gradually increasing and no time factor arises.

Addressing the Corrective Actions (D5)

Following corrective actions were recommended in order to avoid the occurrence of defects Use proper calibrated instrument instead of un calibrated measuring device.

- Tool for performing bore operation. Use proper Go, No-Go gauge for checking

hole

- Size during the dispatch. Revise sampling inspection method

(Instead of one sample, check 5 samples per lot)

- Maintain the tool history card

Discussion: In order to obtain the product of good quality during certain time or without disturbing the time we should have to implement some tool and techniques among them 8D is better and easy to handle .This study reports the application of 8D approach in a crane manufacturing company. As a part of this work, the study was conducted on crab part (crane components).The data was collected to identify the defect and found that there are different types of defects such as functioning length variation, burr etc which are major causes for rejection. In order to reducing the defects and improving the quality of manufacturing product (CT wheel/Crain part) using 8d problem solving tool certain materials were used to analyses and solve the problem which is shown in Flow chart, Check sheet, 5W,

2H (what, why, where, who, when, how, how much) and Ishikawa diagram and We found that dimensional issue is major cause for rejection. That was the lack of uncalibrated of instrument. In other word we can say that it is lack of follow the QC manual.

There was found the variation in the dia. All stages were checked tempering cold setting, NDT test, and final cleaning as per the tool room /QC manual. In this work the objective was set to reduce the rejection level to 80%. The suggestion is given and also checked the result, found ok.

In Ishikawa diagram root cause is mentioned and then we adopt this procedure and also test it, found good result. For trial we implement this procedure four times which is result is shown in above graph 1st, 2nd, 3rd, 4th lot. At last again say that 8D tool is one of the important key of any trouble.

This case study proves that we can reduce the defects and improve the quality of manufacturing product using 8d problem solving tool.

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Nomenclature

8D	: Eight discipline method
PDCA	:PLAN-DO-CHEACK-ACT

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