ROOT CAUSE ANALYSIS OF DIMENSION TOLERANCE AND MISALIGNMENT IN RADIAL DRILLING OPERATION


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Abstract

‘5’Whys is an iterative interrogative technique used to explore the cause-and-effect relationships underlying a particular problem. The primary goal of the technique is to determine the root cause of a defect or problem by repeating the question “Why?” Each answer forms the basis of the next question. The “5” in the name derives from an anecdotal observation on the number of iterations needed to resolve the problem. Not all problems have a single root cause. If one wishes to uncover multiple root causes, the method must be repeated asking a different sequence of questions each time. The method provides no hard and fast rules about what lines of questions to explore, or how long to continue the search for additional root causes. Thus, even when the method is closely followed, the outcome still depends upon the knowledge and persistence of the people involved. So, in this project we had taken the cause and effect diagram to find the root cause of the problem. Fishbone diagram is one of the TQM tool which is used in this project to obtain the root cause of the conventional radial drilling machine which is used in the industry and they are facing the problems in products which they are machined. So, our aim is to find out the root cause of their problems and determining the possible solutions of the problems and modification is to be made according to the requirements.

Key words – 5 Whys, Root cause, cause and effect diagram, fishbone diagram (Ishikawa diagram), Why whys concept.

INTRODUCTION

In Today’s fact industrial projects and every organizations should facing the problems while they are doing their project or any work. So, it is necessary to the organizations to found the problems that is why they are happened and how it was happened and what are the factors influencing such type of problems. That’s why this cause and effect diagram is used in this project to find the root cause of the problems. Especially in our project we are doing the root cause analysis of the drilling operation in which the drill offset is varying at the front end to the back end of the Work piece. And the alignment is differs from one hole to another which is minimum but it is more than the tolerance of the product which is given by the manufacturer’s specification.

a) The seven QC tools

- Stratification
- Histogram
- Checksheet
- Cause and effect diagram
- Pareto chart
- Scatter diagram
- Control chart

b) Fishbone diagram

Fishbone is the one of the specific tool under the cause and effect diagram to find the root cause of the problems by determining the major causes and the minor causes and detailing the sub causes of the problems

c) Techniques

Two primary techniques are used to perform 5 Whys analysis:

- The fishbone or(Ishikawa)diagram
- A tabular format

These tools allow for analysis to be branched in order to provide multiple root causes.

d) Finding a solution

While the 5 why technique is used to identify the root cause of a problem, corresponding "how" methods may be used to identify a solution to the problem. One technique is to match the 5 whys with 5 how’s. Using the same logic, “how” is asked 5 times until the best solution for a problem is found.

e) The 5 Whys – What is it?

- A technique developed by Saki chi Toyoda to uncover the cause and effect relationships of a problem and determine the problem’s root cause to help identify the solution.
- A detailed questioning process designed to drill down into the details of a problem and peel away the “symptoms”.

II. LITERATURE SURVEY


[3] Ayaz M. Khana et al. (2017) were conducted a failure analysis of an actual balance arms surface was carried out using Fractography and Non Destructive testing techniques to dig out the root cause.

[4] Zhu Quanta, Zou Zongming et al. (2017) were done a Down hole vibration causing a drill collar failure and solutions.


III. FISHBONE DIAGRAM

A fishbone diagram, also called a cause and effect diagram or Ishikawa diagram, is a visualization tool for categorizing the potential causes of a problem in order to identify its root causes sample fishbone diagram is constructed below.

![Sample fishbone model](image)

A radial arm drill press is a large geared head drill press in which the head can be moved along an arm that radiates from the machine's column. As it is possible to swing the arm relative to the machine's base, a radial arm drill press is able to operate over a large area without having to reposition the work piece. The size of work that can be handled may be considerable, as the arm can swing out of the way of the table, allowing an overhead crane or derrick to place a bulky work piece on the table or base. The biggest radial arm drill presses are able to drill holes as large as four inches (101.6 millimeters) diameter in solid steel or cast iron. Radial arm drills are specified by the diameter of the column and the length of the arm. The length of the arm is usually the same as the maximum throat distance. The Radial Arm Drill pictured in this article is a 9-inch column x 3-foot arm. The maximum throat distance of this drill would be approximately 36”, giving a swing of 72” (6 feet).

CAUSES IN RADIAL DRILLING OPERATION

- Vibration of the tool
- Ineffective clamping of the work piece
- Unskilled labors
- Environmental conditions
- Tool material (or) Work material
VI. ROOT CAUSE ANALYSIS

This is a product which is machined in the radial drilling machine and at machining there are upper hole is accurately drilled at required offset, but the bottom hole is not accurately drilled as of top drilled hole. There was some tolerance is exceeds the specifications given by the manufacturer. Actually, this product was used in bull machines which is a manufacturer of the hydraulic cranes. So, it is necessary to machine the product without any deviations because it is used in high load carrying application.

The various parameters considered in RCA are,

- The various parameters in the radial drilling machine has to be gathered
- Suitable jig and fixture is to be selected according to the workpiece
- Sample product is machined
- Analyzing the factors that are influencing the problems
- Providing the solution of that problem
- Finally accurate product is manufactured

VII. PART MODELING AND WORKING OF MANUAL ROTATING ATTACHMENT

Designing of the turning attachment is done by the part modeling, by using the software called as CATIA V5. So we are created the fishbone diagram for the respective problem and detailed the major causes and the sub causes of the drilling operation. And we have found that the drill bit is too larger in length due to that, when upper hole is drilled at a precious offset and the it will start machining the bottom hole, it will creates some vibration at the front end of the drill bit because of its length. So we have decided to reduce their length and decided to do the operation by drill the first hole and rotates the work piece by 90 degree and again drill the work piece at the opposite end.

The attachment is coupled with the work piece carrying part as shown. The schematic diagram of the turning attachment is shown in the figure below.

The important thing is this problem is that, when the turning attachment is rotated towards 90 degree, it will not affects the alignment and offsets of product. For the prevention of the misalignment a locking pin is used to arrest the misalignment of the turning attachment.

VIII. EXPERIMENTATION OF JIG

The suitable jig is selected with the turning attachment is fixed at the back side of the drilling jig. And the work piece is clamped together with drill jig and tightened to avoid the ineffective clamping. Then suitable drill bit is selected according to the diameter of the hole dimensions. First of all, upper hole is drilled and the work piece is rotated at about 90 degree through the turning attachment and after the rotation, the locking pin is inserted towards the hole at the turning attachment. Due to this principle, the drilloffset is aligned properly and the deviations from the tolerance is getting eliminated. Due to the elimination of the possibilities of the inaccuracy of the products the standard tolerance and the precious dimension parameters has to be maintained.

This jig has consists of work piece, locking pin, drill bush, collar, hexagonal headed threaded bolt, work holding bar, slots, ‘L’-channel, screws. Each of the components are fixed together with respective position to form a suitable drilling jig. And the schematic designed 3-D representation of the drill jig with turning attachment is shown in the figure below.
IX. RESULTS AND DISCUSSIONS

As the root cause analysis is conducted and using the fishbone diagram and using the concept of why whys the causes of the drilling operation is found and the jig is modified by introducing the turning attachment. It is designed at the software called CATIA V5 and it was manufactured to machining the work pieces. The turning movement is given to the work piece through 90 degree and the work is drilled at both ends respectively according to the requirements. Products are inspected before and after the root cause analysis effects.

X. CONCLUSIONS

In this project we are bothered about the radial drilling machine and extensive industrial machines and its causes then learnt and executed the root cause analysis of the allied operation by using the TQM tool which is called as fishbone diagram (Ishikawa diagram), why whys concepts, cause and effect diagrams rectified the drill offset problem by introducing the manual turning attachment. Thus the drill jig is modified and the accuracy is maintained within the manufacturer’s specified tolerance limits.

REFERENCES

