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Failure Analysis - Watanabe Model

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Abstract : Failure/problem is defined as a deviation from standard / desired performance. It is an undesired result of a job. It can also be stated as the gap between target and current level. Traditional mind set about Problem/ Failures is Shame, Humiliation, Disgrace, Dishonour, Faults, Weak Points, Flaws etc. Naturally people look to cover up or hide their problems. But the ideal view is exactly the opposite. It tells that Problems = Mountains of treasure. Our problems show us how much room for improvement we have.

Introduction

We are encountering failures almost every day in every aspect of activity. Most of them go un-noticed, but the major ones affect us so badly that the idea of failure clouds our mind set and prevents it from making the right decision at the right time.

Let us first digest the fact that failures are not targeting us, but we target it and make the failures possible. We as a whole are responsible for such failures and we also let the failures repeatedly attack and affect us.

So, how to eliminate failures from our life and stop it from getting repeated?

Watanabe devised a model for failure analysis and prevention. The model was first successfully implemented by TOYOTA and now the model has become a back bone for TPM ideology. If you wonder what is TPM, it is one single concept that revolutionising the manufacturing industry in the world.

According to Watanabe's model, Failures are classified into Sporadic (new) and Chronic (repetitive) problems. Sporadic are the problems occurring for the first time. These problems could be Major or Minor.

Implications are more in Major Problems and less in Minor Problems. But both the problems or failures have to be analysed in a systematic manner as explained to get into the root of the problem.

Analysing a Sporadic Problem:

There are some details one has to know while analysing a problem to get into its root. There are

- About the problem
- Time it had happened
- Place where it occurred

- Person was in-charge at that time
- Reason for problem
- Facts that led to the problem

These can be answered by 5W 1H analysis-

“What is the Problem?

When the problem occurred?

Where the problem occurred?

Who is the witness for the problem?

Why the problem has happened? And

How the problem happened?”

For example, there is a puddle of oil in floor surface. So, by answering the 5W 1H analysis a clear view about the problem can be obtained.

- Oil leakage in Machine
- 02 MAY 2014 in B shift at 03:30AM
- at Drive motor of ring plant
- Operator
- Damage in Gasket
- Oil has leaked.

After answering all the above questions, a ‘Why’ analysis has to be started.

‘Why’ Analysis:

From above analysis, we understand that there was a puddle of oil on the floor. On further analysis about ‘why’ it had happened, it was found that there was leakage in machine. Oil was leaking because gasket had deteriorated. On asking why it had deteriorated, it was found that gasket was made of inferior material. The gasket was bought at low cost because the purchasing executive had evaluated and finalized on this particular quality on short-term cost savings.

By asking the question why, and going on asking it again and again, the any kind of a problem could be fully and clearly analysed and understood.

So, the reason for failure had ultimately squared up at choosing a gasket with correct specification. What is the solution then? Change the evaluation policy of the Purchase Department.

Analysing a repetitive / Chronic Problem:

If a problem or a failure is encountered, counter measures are to be taken to ensure that the problem / failure never gets repeated again. There are three conditions that influence repetition of problems or failures:

- **Counter measure not taken**
- **Counter measure taken but not effective**
- **Counter measure taken but not maintained**

In case of the problem we have concerned, the problem gets repeated due to the following reasons-

- **Counter Measure not taken:**
As the problem was considered as minor, counter measure was not taken.
- **Counter measure taken but not effective:**

Counter measure was taken but that is not effective enough to prevent repetition. Gasket was replaced but the replaced gasket was of poor quality that could not give a long life. If gasket was purchased as per specification the failure would not have occurred again. So the solution is to change process of procurement of the gasket.

- **Counter Measure taken but not maintained:**

The correct counter measure was devised but was not maintained properly. The root cause for this problem is the wrong understanding of Cost Saving. But a gasket of poor quality was used and that resulted in repetition of the problem. This problem was clearly understood but not communicated to the concerned department or made a standard and included in the procedure for procurement. So the purchase department had again purchased the gasket of poor quality.

The Watanabe Model for failures was proposed for industries. Almost most of the manufacturing industries in India are opting for TPM to optimise their target, production and profit.

Total Production Maintenance(TPM)

TPM is a system used to maintain and improving the production and quality through machines, employees, process and equipment.

Phases Of Equipment Management¹

- Breakdown maintenance – In this machine are serviced only if repair is required.

Demerits

- Unplanned stoppage, Excess damage, spare parts problems, High repair cost, High trouble shooting
 - Preventive maintenance (PM) – It is the physical checkup of equipment breakdown and service life. Its work include equipment lubrication, tightening, adjustment etc.
 - Predictive maintenance (PM) – its maintenance based on equipment condition and performance deterioration.
 - Corrective maintenance (CM) – its purpose is to reduce the equipment failure or improving reliability.
 - Maintenance prevention (MP) – in this equipment is designed to carry the free maintenance.
 - Reliability centered maintenance (RCM) – it is a process used to determine the maintenance requirements in its operating condition by knowing the function of assets, cause and effect of failures.
 - Productive maintenance (PM) – it increases the production level of the equipment.
 - Computerised maintenance management system (CMMS) – computerised maintenance management system in managing a more information on equipment histories, maintenance work etc.
 - Total productive maintenance (TPM) – its purpose and objective is to maintain and optimise the equipment effectiveness, eliminates breakdowns etc.

TPM is a process used for maximize the productivity of the equipment for its entire life and will extend the life of the equipment. tpm fosters an equipment where improvements effort in safety, quality, delivery, cost, creativity are engaged through the participation of all the employees. The goal of TPM is to maximize the overall equipment effectiveness (OEE) and to reduce equipment downtime.

OEE has three factors such as performance, availability and quality.

- $OEE = \text{performance} \times \text{availability} \times \text{quality}$.

Eight Pillars of TPM^{2,3}

1. Focused improvement
2. Autonomous maintenance
3. Preventive maintenance
4. Training and education
5. Maintenance prevention(initial flow control)
6. Quality maintenance
7. Administrative TPM
8. Safety and environmental

These are said to be the eight pillars of TPM as they prevent any failure to occur. Focussed improvement focuses on a particular equipment or part of a plant for its steady working. Autonomous working

and preventive maintenance postpones any failure that has to occur. Other pillars like administrative and safety pillars improve the quality and working of the equipments as well as the entire process.

Implementation of TPM

Steps Involved:

- Initial evolution of TPM level
- Introductory evolution and propaganda(IEP)for TPM
- Formation of TPM committee
- Development of master plan for TPM implementation
- Stage by stage training to the employees and stakeholders on all eight pillars of TPM
- Implementation preparation process
- Development of road map for TPM implementation.

Benefits of TPM

- Time saving
- Maximum equipment effectiveness
- Less waste
- Clean environment
- Decrease in maintenance and repair spending.

Conclusion:

Failure occurs in every industry and various models are available for failure analysis. Here we Watanabe model has been discussed in detail that involves 5W 1H analysis. It involves analysing sporadic and repetitive/chronic problems and have been discussed. Total Preventive Maintenance (TPM) methodologies have been briefed out above and the implementation procedures are discussed.

References

1. I.P.S.Ahuja and J.S Khamba ,”total productive maintenance – literature review and directions”, international journal of quality and reliability management.
2. William M.Goriwondo,Samson Mhlanga,Tapiwa Kazembe,”optimising a production system using tools of TPM;Datlabs pharmaceuticals as a case study”,proceedings of the 2011 international conference on industrial engineering and operations management.
3. Upadhye Nitin,Deshmukh S.G.2010,”Lean manufacturing in biscuit manufacturing plant”, international journal of advanced operations management.
