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The role of defect elimination as strategy to improve reliability

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***Abstract*— the main concern of most industrial organization is how to improve the reliability to cope with uncertainty and change in the global market. They struggle to achieve the needed improvement by adopting traditional maintenance strategies. These strategies focus on repairing the problem which may reoccur several times without eliminating the source of the defect. In other ward , they fix forever instead of forever fixing. Thus, a strategy that improve the reliability by eliminating the source of defect and prevent the problem from recurring is needed. In other ward . they fix forever not forever fixing. This strategy is known as defect elimination that aim at increase the uptime and consequently improve the reliability. Thus , the aim of the paper is to emphasize the role of defect elimination as a strategy to improve reliability. To achieve this aim , descriptive and analytic approaches and case studies were conducted . The conduct work showed , the traditional maintenance strategies induce an extra cost without eliminating the source of the defect whereas defect elimination eliminate the source of defect and make cost saving. Also , showed the defect elimination are in some way implemented in Libya and achieved good results. Finally , the human errors represent the main cause for.**

Keywords*— *(reliability , defect , strategy, elimination. improvement)

I. INTRODUCTION

the increase competition in global market and complexity of manufacturing put great pressure on industrial organization to improve the reliability to cope with uncertainty and change in the global market. They are required to achieve the highest availability and targeted output.at the lowest cost. They are required to improve quality and optimize the life cycle cost while assuring safety and protecting the environment. Thus , they focus on improving reliability to deal these requirements.by implement traditional strategy but a little or no sign of improvement was noticed . Because these strategies require big investment, need an extra time to carry the planned maintenance and need some time to show some results[1]. This resulted in increase in the cost and in the down time consequently decrease the availability and the time between failure .thus, strategy that aim improving the reliability by elimination the source of defect and is needed . Eliminating the wastes and losses generated or cause by defect improve the overall equipment effectiveness and consequently improve reliability as result of increase the time between failures[2]. This strategy is known as the defect elimination aims at removing unplanned maintenance by preventing or eliminating the source of the problem.. also , In aspiring toward operational excellence, a standard of using root cause analysis (RCA) has been established to deal with the what ifs [3] . the aim of this paper is illustrate the implementing the defect elimination as strategy for improving the reliability by conducting two case studies.

II. THE OBJECTIVE OF PAPER

The paper aims at emphasizing the role of the defect elimination strategy to;

- Elimination the defect without induce an extra cost.
- Improve the reliability
- Remove small problems before causing failures by encouraging the involvement of the front works.

III. RELIABILITY AND MATNTANCE STARATAGES

Reliability is defined as the probability that system or component will perform a required function for a given period of time when used under stated conditions [4]. The reliability is affected the rate of failure and decrease as the time between failure decreases. It is improved or sustained by increasing the uptime. Various strategy are implemented such as planning and scheduling optimization , preventive and predicative maintenance and defect elimination. The results of a study performed by Winston Ledet and MIT Sloan School of Management Senior Lecturer Mark Paich [5]. Is shown in figure (1).

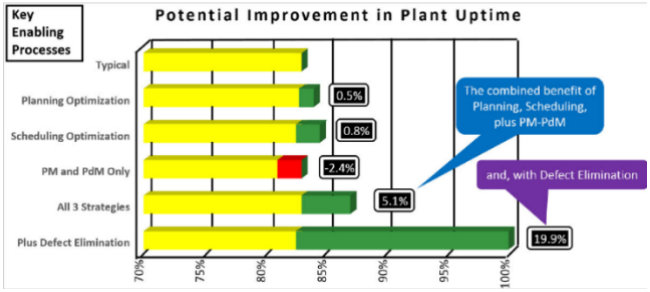

Fig.1: the results of performed study [3]

The study show the largest increase is achieved when combined strategy are used. Thus , defect elimination is not stand alone strategy and combined with other strategies. Since the largest increase is achieved when combined planning , scheduling plus preventive and predictive maintenance which amount to ‘ 5.1%” add to defect elimination. then the focus of paper will on the defect elimination strategy because a large increase occur when the defect elimination was introduced.

Before indulging in this strategy . it is better to shed some light on various aspects of defect.

IV. DEFECTS & THEIR ASPECTS

Defects are "Anything that erodes value, reduces production, compromises health, safety and environment), or creates waste." [6] . they includes , leaks, looseness, vibration, excessive heat, missing or broken parts, wrong materials or parts. Defects aren't just physical problems or equipment failures, they also include poor documentation and lack of precision maintenance. , poorly written procedures and maintainability, safety and ergonomic issue. The defects are introduced during the design , installation and operation phases.

A. Type of defects

Define The defects are divided into (7) :

- Age and process related defects such as corrosion, fatigue, wear-out of /seals/rotor and motor winding degradation)
- Inherent defects such as unbalance , misalignment and resonance
- Induced defects such as improper lubrication ,improper installation , excessive or insufficient bearing clearance, an adequate foundation..

B. Causes of defect

The defects are generated and caused by aging , human and wear factors. The type of causes and their shears s are shown in figure (2).

Fig.2 : the causes of defects [7]

Based on figure (3) , (A) IS the human error with 84% represent the biggest cause for defects. (B) is the wear cause defect with 12%. (C) is age cause defect with 4%.

C. Source of defects

The defects are generated from various sources which are shown table (1)

TABLE I. SOURCE OF DEFECTS.

Type of Source	Defects
Raw Material	Off specifications, corrosive agents, contaminants
Operational Discipline	Misperation , running out of limit , cavitation
workmanship	Missing skills ,lacks of tools
Quality of the material	Improper storage ,poorly manufactured, expired
Design	Undersized , difficult to operate , difficult to maintain
Failure	Defects generate from failure , e.g. bent shaft from sized bearing

The defects are generated and entre the operation which became like a bucket for collecting defects and eventually causing many problems. the creation and where most failure casing defects and errors come from. Is shown in figure (3).

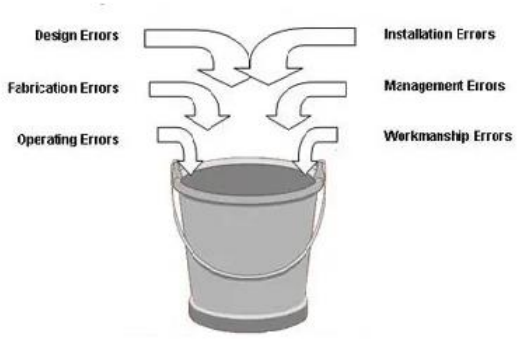

Fig. 3 : defect creation [8]

Maintenance is used to address the effects of the continually growing number of defects and add more r preventive into the system. More maintenance is not the answer—it only adds more expense without benefit of defect elimination. Thus , they try to manage the defect to keep their head above by drain the defects. The way how they manage the defects is shown (4).

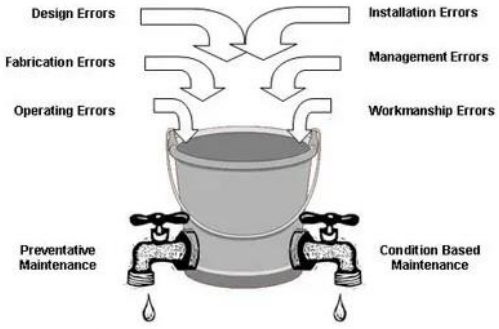

Fig. 4 : defect management [8]

Since the maintenance add more cost without benefit the defect elimination. Then the best way is reduce or eliminate the defect entering the operation. Thus , the best answer is to reduce the number of defects and so reduce needed maintenance . Defect elimination reduces maintenance cost and increase production. The defect elimination process is shown in figure (5).

Fig.5 :defect management [8]

D. Defect elimination strategy

Defect elimination is an approach for improving reliability by eliminating common causes of failure [9]. A defect elimination program targets the smallest, most irritating problems in a plant. It does so by giving everyone a stake in improving daily work life by eliminating errors and faults. In the process, a stronger continuous improvement culture takes hold, creating more widespread support for reliability initiatives at every scale .

Fig. 6 : defect elimination approaches [7]

As can be seen from the figure(4) tens of thousands of defects lead to thousands of repairs, multiple losses, and eventually to a major incident. Do not use the word "essentially" to mean "approximately" or "effectively".

A. Defect elimination approaches

Top – down approach is driven by upper management and follows a highly structured approach . It involves very focused teams, and limited to engineers and s elect maintenance technicians and operators, who were either involved in the incident or have a strong working knowledge of the equipment. It is used when a catastrophic failure has already occurred and almost every one hear about, failure root analysis are used to find the source of the defect. Body.

Bottom – top approach comes from the frontline workers who know the equipment the best. It is much more flexible approach. It isn't governed by a formal structure. The bottom-up approach also differs from top-down in the scale and timing. It targets short, quick wins. The value of the bottom-up approach comes from a lot of small gains, and a high degree of ownership across the company. So Bottom-Up defect elimination is all about eliminating small, repetitive reactive work before it happens, and in such a way that it won't happen again. It uses trouble shooting or failure analysis to find the source of the defects.

B. Defect elimination approaches

The steps of defect elimination process are :

- Identify the defects through analysis or by event.
- Define the problem clearly, identify the team members , target improvement and time.
- Gather the information about the problem
- Identify the root causes by analyzing and varying cause – effect relation.
- Select and implement improvement action.
- Make the problem solution sustainable.

For successful implementation of defect elimination ,organization should :

- Train the worker for defect elimination and failure analysis.
- The investigation team should be formed from all concerned department
- Health , safety and environmental risk should by considered.

V. CASE STUDIES

two case studies were conducted in Hot strip mill in Libyan Iron steel company to illustrate the benefit of implementing the defect elimination strategy t.

A. Case study #1

The system consists of eight Alas Copa compressors with auxiliary equipment. The compressor suck the air through the filter to the oil tank. The mixture of air and oil that leaves the tank enter the compressor element. The compressed mixture goes to the separator in which the oil separate from the air. The compressed air goes to furnace where is used to atomize the fuel oil in burner and oil goes back to tank. The compressors system underwent frequent shut down as result of high temperature after overhauling. The operators and maintenance personnel notice decrease in oil level in tank and oil carried over with air. The problem got worse as result of overheating and one compressor was completely burned. After this incident , the company make preventive maintenance plan that changing the oil filter, oil and separators . the company could carrying with this plan because of spare parts shortage [10]. The proposed plan did not make any improvement and induce an extra cost as result of increase in oil , oil filter and oil separators. Also , increase the downtime to perform the maintenance and compromise the safety of workers and compressor system (9). A failure analysis was carried out team headed by researcher as maintenance engineer . defect failure analysis for case #1. is shown in figure 7 :

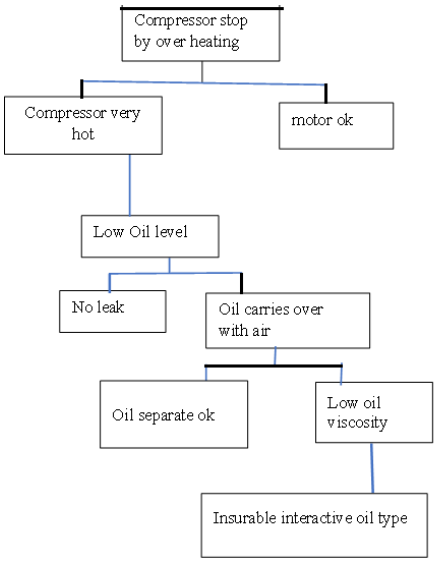

Fig. 7 : defect failure analysis for case #1

B. Case study #2

Chain conveyor system is used to transfer a hot rolled coils from the mill to the storage area . it is driven by electric motor and the wheel of the chain is continuously greased by central greasing system. The conveyor underwent many stoppages as result of motor overload specially when the conveyor was load with heavy coils. The operator and maintenance crew notice some wheels are seized and they slide instead of rotate and the grease was melted . to overcome this problem , the management made plan that include reduce the loading of conveyor , weekly manual greasing for the wheel and weekly program for dismantling and clean the wheel. This plan induced reduction in mill output as result of partial loading of conveyor. Also , an extra work for the maintenance preventing them from doing other maintenance work. An investigation was carried out to find the reason behind the problem. The outcome of the investigation is shown in figure (8)

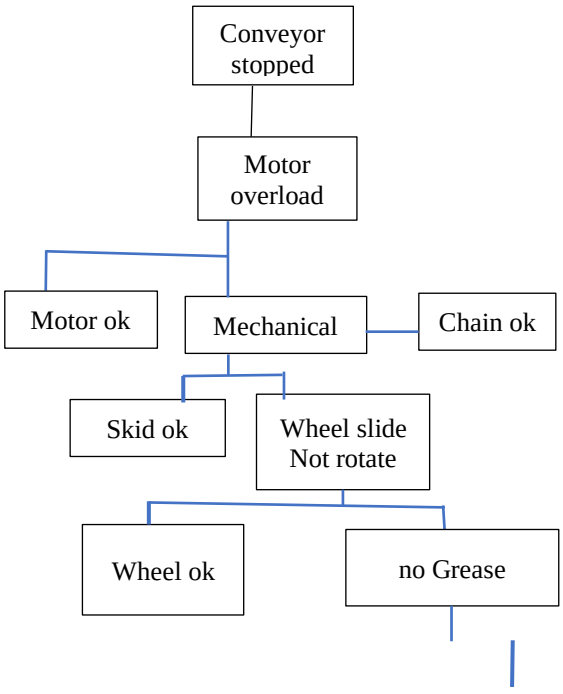

Fig. 8: defect failure analysis for case #2

Based on analysis of the study case , it can be concluded , the preventive maintenance induced an extra cost without solving the problem whereas defect elimination strategy by eliminating the source of the problem without induce an extra cost. The reason for problem in case study#1 was using alternative type of oil has specification different from the origin oil type. The reason for the problem in case study#2 was the used grease is not suitable for high temperature environmental condition.

VI. CONCLUSION

1. Traditional strategy manage the defect without elimination its source result in ;
   - Increase in down time
   - Induce an extra maintenance cost
   - Compromise the safety of the workers and equipment
   - Fixing forever instead of forever fixing
2. Traditional strategies fail to improve reliability by increase the uptime.
3. The human errors are responsible for 84% of defect causes
4. Defect elimination strategy eliminates the source of the defect results in :
   - Improve the reliability by increasing the up time
   - Saving in maintenance cost
   - Remove of unplanned maintenance
   - Encourage the frontline worker to take part in defect elimination process
   - Fixing forever instead of forever fixing
   - Assuring the safety of workers and equipment.
5. Defect elimination is not stand alone strategy and combined with other strategies
6. The defect elimination is everybody ‘responsibility
7. The analysis of the case studies showed :
   - Increase in the downtime to perform the unplanned maintenance
   - Increase in maintenance cost as result of increase in spare parts consumption
   - Reduction in the production
   - Increase in the maintenance backlog.
8. Eliminate the source of the defect resulting in restoring
   - The systems to normal operating conditions.
   - The production normal rate
   - Remove the unplanned maintenance and reduce the maintenance backlog.

9. The sources of the defects were improper type of oil and grease page.

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