International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 01 | Jan -2017 www.irjet.net p-ISSN: 2395-0072

Overall Equipment Effectiveness in Construction Equipments

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Abstract - *This paper will review the goals and advantage of implementing Total Productive Maintenance and it will also focusing on calculating the overall equipment effectiveness in construction equipments. In construction activities on a immense scale require the standard equipments for effective operations especially in the area of infrastructural development. This is the true picture of large construction companies whose physical lucrative activities lean on men, materials and sophisticated machineries that will produce output of operations during a particular period use. Therefore, the effectiveness of construction machineries is a major consideration that denuciates construction companies in terms of heavy construction and light construction. In the today's period of agonizing global competition, construction industries are determined to progress and amend their productivity in order to remain competitive. Overall Equipment Effectiveness (OEE) of a machine plays a vital role where performance and characteristic of the product are of key relevance to the company. The OEE intended at minimizing the breakdowns, increasing performance and quality rate and thus improving the efficiency of the machine. The availability rate of the machine, performance rate of the machine and quality rate of the products are considered as parameters while escalating the Overall Equipment Effectiveness (OEE) of a management system. The objective of the work is to enhance the overall equipment effectiveness (OEE) at a construction company.*

Key Words: **Maintenance, Overall Equipment Effectiveness, Availability, Quality Rate, Performance, TPM**

1.0 INTRODUCTION

Overall equipment effectiveness (OEE) is a term formulated by Seiichi Nakajima in the 1960s to evaluate how effectively a manufacturing operation is utilized. It is based on the Harrington Emerson way of thinking in regard to labor efficiency. The results are stated in a comprehensive form which allows comparison between manufacturing units in differing industries. It is not however an unconditional measure and is best used to identify opportunity for process performance improvement, and how to get the improvement. If for example the cycle time is reduced, the OEE will increase i.e. more product is made for less resource. Another case is if one company deliver a high volume, low variety market, and another enterprise serves a low volume, high variety market. More transition will lower the OEE in correlation, but if the product is sold at a premium, there could be more margin with a lower OEE.

OEE measurement is also commonly used as a key performance indicator (KPI) in affiliation with lean manufacturing endeavor to provide an indicator of success. OEE can be illustrated by a brief discussion of the six metrics that constitute the system. The chain of command consists of two high-level measures and four basic level measures.

Overall equipment effectiveness (OEE) and total effective equipment performance (TEEP) are two firmly linked metrics that report the overall application of facilities, time and material for manufacturing operations. These top view metrics directly indicate the gap between actual and ideal performance.

1.1 Background

OEE breaks the performance of a manufacturing unit into three separate but measurable components: Availability, Performance, and Quality. Each basic points to the condition of the process that can be designed for improvement. OEE may be applied to any individual Work Centre, or rolled up to Department or Plant levels. This tool also allows for break down for very definite analysis, such as a particular Part Number, Shift, or any of several other parameters. It is unlikely that any manufacturing process can run at 100% OEE. Many companies benchmark their industry to set a challenging target; 85% is not uncommon.

1.2 Status and necessity of OEE

By implementing a system that can measure and analyses OEE, manufacturers can boost equipment performance, operating measures, and maintenance processes. The following are six categories of productivity losses that are almost universally accomplished in manufacturing:

1. Breakdowns
2. Setup and Adjustments
3. Small Stops
4. Reduced Speed
5. Start-up Rejects
6. Production Rejects.

The main concept of any OEE initiative is to become the most capable, most valuable manufacturer within a market, minimizing the above main losses. A world-class OEE has a benchmark OEE rating of at least 85%. However, easily maintaining an 85% rating does not assure world-class status. Each component of OEE must meet different levels of individual performance; availability should be at 90%, performance should be at 95% and quality at 99%. These standards allow manufacturers to have a point of reference for determining when these components meet acceptable levels. Instead of making active maintenance decisions based on failure reports and product manufacturing decisions based on plant schedules, OEE measurements enable proactive decisions based on throughput, efficiency, effectiveness and process bottleneck constraint reasoning. Tracking OEE can aid manufacturers to spot patterns and influences of equipment problems and allows them to see the results of their advancement efforts. More commonly, OEE also apprehend reasons for downtime (due to machine conditions, material status, production personnel or quality issues) and can encircle the entire plant. At the plant level, OEE metrics can be associated with other plant metrics to provide more KPI's. With enterprise level technologies, such as Executive Dashboard, managers can supervise OEE plant metrics and drill down to find root causes of problems, getting minute-by-minute updates to enable real-time process improvement.

2. THEROTICAL CONTENTS

OEE in construction industry

In construction industry, the knowledge about principles of operation, management of construction equipment and their most efficient field of operation is essential. Construction equipment have pretended a role of great importance to Engineers in the present construction industry particularly construction of roads (paved and unpaved), dams, runways, power plants, irrigation schemes, water and wastewater works, etc. comprises a lot of earth moving a lot of earth moving works, which are equipment intensive operations. The use of construction equipment for achieving construction tasks is increasing at speed. Plant and equipment now create a substantial portion of the construction costs in every Civil engineering project. The cost component usually rely on the nature of the project work and the extent to which equipment is employed. In a building project, the equipment costs may vary from 5% to 10% of the direct costs. While in highway construction proposal, the plant and equipment costs may touch as much as 40% of the project direct costs. Therefore, understanding the fundamentals of the equipment is of crucial importance to contractors and practicing experienced Engineers in the field. OEE is important parameter in Total Productive Maintenance (TPM) which is fundamentally a maintenance program that comprise a newly defined concept for managing plants and equipment. The objective of the TPM program is to markedly increase production while, at the same time, increasing employee self-confidence and job satisfaction. TPM brings maintenance into target as a necessary and extremely important part of the business. It is no longer regarded as a non-profit activity. Down time for maintenance is anticipated as a part of the manufacturing day and, in some cases, as an essential part of the manufacturing process. The goal is to hold emergency and unscheduled maintenance to a minimum. Overall equipment effectiveness (OEE) is characterized as one performance-measurement tool to materialize the quest for perfection of lean manufacturing into daily practices. This is the origin of the Total Productive Maintenance (TPM) concept lofted by Nakajima (1988), who consider that it is imperative to continuously improve all operational conditions. The objective of TPM is to attain zero breakdowns and zero defects related to equipment, which could lead to advancements in the production rate, reduction in inventory, reduction in costs and eventually increases in labor productivity. As evaluated by Muchiri and Pintelon (2008), this is especially true of highly automated processes.

OEE Benchmark

A good OEE score can be classified as:

1) An OEE score of 100% is ideal production, manufacturing only good product, in short-lived time, with no down time.
2) An OEE score of 85% is considered world class for discrete manufacturers.
3) An OEE score of 60% is fairly common for discrete manufacturers, but express that there is substantial room for improvement
4) An OEE score of 40% is not uncommon for new manufacturing companies that are just starting to track and improve their performance. It is a low score and is to be readily improved.

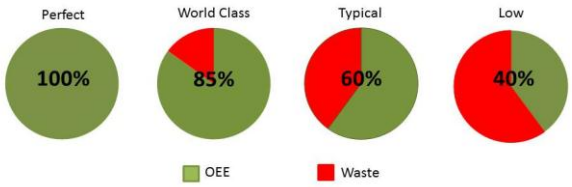

Fig -1: OEE Benchmarks

TPM (Total Productive Maintenance)

TPM evolved way back in 1951 when preventive maintenance was induced in Japan from the USA. Nippondenso of Toyota Group became the first company to attain TPM certifications. It is a maintenance program with a newly defined concept for the main parts and equipments. The objective of TPM is to commercially increase production

and simultaneously increasing confidence of the employees and contentment at work. Total Productive Maintenance is an extension of Total Quality Management. In a nut shell, TPM can be summarized as the backbone of any sound production process occurring in a machine assemblage. The outstanding targets of TPM are: no product defects, no equipment unplanned failures and no fatal injuries. It is accomplished by studying the past data of the aforesaid factors by applying Ishikawa fishbone diagram analysis or why- why analysis and find out
the covered fuguai in the initial step of TPM autonomous maintenance. The basic six losses mentioned above can be removed by TPM with the help of extended improvements. Japanese technologies are permeate to achieve the target of zero. TPM has 8 pillars of activity which are set to eliminate wastes.

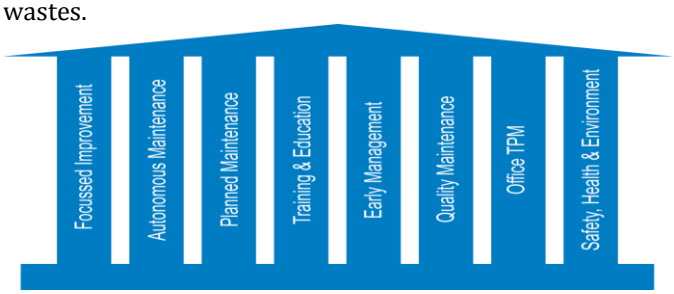

Fig -1: 8 Pillars of TPM

5S of TPM

Sort: The first pillar of 5S helps to clearly distinguish the items needed in a work area from those no longer needed.

Set in Order: The second pillar of 5S helps to keep the needed items in the right place to allow for easy and immediate improvement.

Shine: The third pillar of 5S helps to keep work areas, all work surfaces and equipment clean and free from dirt, debris, oil, etc.

Standardize: The fourth pillar of 5S defines the standard activities, procedures, schedules and the persons responsible for keeping the workplace in a clean and organized manner.

Sustain: Sustain is the last pillar of 5S and drives the organization to be disciplined in maintaining these new standards and procedures and in continuously improving the 5S state of the workplace.

Equipment Selection

Equipment selections a critical factor when trying to complete a project within budget and on schedule. Without the proper working equipment, productivity reduces, delays raises, possible injuries occurs and unnecessary costs provoke. It is important for all the partied involved in an earth-moving operation that the project begins with the most relevant selection of the equipment needed to implement the work. Right selection of equipment contributes to project efficiency and to increased profits. There are varieties of aspects that a good manager should acknowledge in acquiring the equipment. A good construction manager should identify these factors and by evaluating them decision making is possible.

The Enterprise benefits

Implementing an adequate OEE system brings immediate financial benefits to manufacturing operations. A few major benefits are listed below.

Reduced Downtime Costs

When a critical machine is faulty, it brings next operations to a standoff. This can negatively affect delivery commitments to the customer, which in turn impacts cash flow and earnings. For example, in a typical semiconductor application (based on year 2000 data), it is estimated that each hour of downtime for a critical unit of process equipment can translate into $100,000 of disoriented revenue. Contrariwise, reducing downtime by 1% on the 50 most analytical tools can provide revenue opportunities and cost savings nearing $100,000,000 annually. International Technology Roadmap for Semiconductors 2002 Update

Reduced Repair Costs

OEE enables foreboding maintenance that can considerably reduce repair costs. As the historical database of downtime reasons grows, the maintenance department can detect trends to predict an approaching failure. Also, by interfacing the OEE system to for instance a Computerized
Maintenance Management System, the maintenance department can take proactive predictive maintenance steps. For example, the maintenance department can order the necessary part in advance and get better rates. It can earmark repair personnel from an current pool of resources instead of hiring someone on an emergency basis. This can result in huge savings compared to repairing a machine after the breakdown has occured.

Increased Labor Efficiencies

Due to economic circumstances, many manufacturing companies have downsized considerably.
Consequently, manufacturers are eager to optimize the productivity of their current workforce. An OEE system supports, because it not only captures operator downtime reasons, but also productivity data. With this information, management can better judge the proper allotment of resources based on organization productivity. When the business climate improves, OEE systems could enable managers to analyze additional capacity within the current workforce instead of hiring new labour.

Reduced Quality Costs

Quality is a percentage of good parts produced versus the total parts produced. Thus, an OEE system must take the quantity of total parts produced, the number of scraps and defects and the reason for defects. Because this information is captured at a distinct machine or line level, this capability actually takes the quality in the context of the part produced. By tracking context-rich quality data using OEE, production managers can determine root causes and wipe out further costs associated with rework and scrap. Improving the focus on quality at every stage of production also reduces warranty costs.

Increased Personnel Productivity

An OEE system facilitate the shop floor to go paperless. Typically, facility operators and supervisors spend an enormous amount of time recording, analyzing and reporting downtime reasons and root causes on paper, then later explaining these reports to management. An OEE system captures and reports downtime and efficiency automatically. This saves time lost in non-value added reporting works and allows organization to focus on more beneficial tasks. With
OEE, everyone from the plant floor to the boardroom is more informed, more often, more with ease.

Increased Production Capability

The net effect of reduced machine downtime, higher productivity of operators and reduced defects is the ability to achieve higher production levels with the same amount of resources.

3. CONCLUSIONS

Success of OEE depends on various pillars like 5-S, Jishu Hozen, Planned Maintenance, Quality maintenance, Kaizen, Office TPM and Safety, Health & Environment. The key factors for this operation are workers involvement and top management support.

To improve productivity it is essential to improve the performance of the construction systems. The desired production output is achieved through high equipment availability, which is influenced by equipment reliability and maintainability.

TPM is a structured equipment-centric continuous improvement process that conflict to enhance production effectiveness by identifying and eliminating losses associated with equipment and production efficiency throughout the production system life cycle through active team-based involvement of employees across all levels of the operational hierarchy.

Total productive maintenance (TPM) methodology is a proven approach to boost overall equipment effectiveness (OEE) of equipment. It comprises of eight activities; focused improvement and autonomous maintenance are two important activities to enhance equipment performance. These activities intent to educate the participants in the concepts and philosophy of equipment maintenance and give them an opportunity to develop their knowledge and skills.

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