BSM
FOCUS
WINTER 2002
a publication from BSM

Electronics and Engineering

Effective Management of Equipment

TPM's aim is not just to prevent breakdowns but to proactively work to maximise equipment performance and utilisation.

Increasingly across the electronics and engineering sector, it is the ability to manage and use equipment effectively which determines overall manufacturing performance.

Also as machines become more automated and sophisticated, the role of operators is less about operating the machine and (should be) more about maintaining them so they work properly and don't break down. Total productive management (TPM) is an approach to equipment management that takes account of these realities. Although it has been around for many years, it is only in the last few that substantial numbers of companies have realised the potential for competitive advantage that TPM offers.

So what is TPM all about?

The 'maintenance' function has evolved over the years from simple breakdown recovery through preventative maintenance (PM) and eventually to TPM. TPM still includes all the elements of preventative maintenance but where as PM only aims to ensure that equipment is kept available for production, TPM goes much further by also focusing on how well the equipment is used when it is available. Its aim is not just to prevent breakdowns but to proactively work to maximise equipment performance and utilisation. Also unlike preventative maintenance, which is centred in the maintenance department, TPM is a team based methodology which involves all levels and functions within manufacturing. A TPM team will normally include operators, technicians, engineers, managers and increasingly equipment suppliers. They work to improve and maintain a measure known as OEE (overall equipment effectiveness).

OEE is a comprehensive metric that captures all equipment related losses and expresses them as a combined percentage.

OEE = AVAILABILITY x PERFORMANCE x QUALITY

AVAILABILITY	PERFORMANCE	QUALITY
• Breakdowns • Set-ups & Adjustments	• Minor Stoppages • Reduced Speed • Planning	• Defects • Start up & Yield Loss

Calculated as actual Output / Theoretical Output and expressed as a percentage.

A traditional PM based equipment management system only concentrates on the loss from machine breakdowns, essentially ignoring the remaining losses, whereas OEE and TPM correctly weighs all losses equally. Improvement activity will be focused on the biggest losses no matter what the root cause.

The Key Strategies of TPM

The detail of TPM systems may vary from one company to another depending on the nature of the process and the equipment, however there are some key strategies which are core to any comprehensive TPM programme:

1. Focused Improvements
From time to time, project teams are set up to work on OEE improvement on critical equipment. This is sometimes carried out as an intensive 'kaizen' event but is more usually conducted over a period of two or three months by a dedicated cross-functional project team.

2. Autonomous Maintenance
Any maintenance person will tell you that the greatest root causes of breakdowns are dirt and inadequate lubrication. TPM addresses these by a structured system of daily cleaning, lubricating, tightening and checking. These daily maintenance activities are usually carried out by the machine operators rather than dedicated 'maintenance personnel' hence the term 'autonomous'. It is critical that the operators are adequately trained, that procedures are properly defined and documented and that standards of acceptability are also defined.

3. Preventative Maintenance
Even with 'autonomous' maintenance, there is still a need for a structured PM system. This is normally based on the periodic inspection of equipment (typically using 'check sheets') to detect machine deterioration and a system of periodic restoration / overhaul to correct this deterioration. However, because of the daily autonomous maintenance activities, the volume of PM checks is normally substantially less than in a non-TPM based system. The autonomous maintenance structure also allows for more effective utilisation of key technical resources.

4. Technical Training
It is essential to build technical knowledge in equipment maintenance and operation at both operator and maintenance engineer levels. This leads to better and quicker diagnoses of deterioration and normally leads to a substantial reduction in the number of breakdowns due to improper operation of the equipment.

The training needs to be structured but can be very effectively delivered on the shop floor as a series of short 'one-point lessons'.

5. Daily Checks & Visual Controls

A key part of TPM is the early detection and correction of equipment 'abnormalities'. This is normally achieved by a system of daily checks carried out as part of the autonomous maintenance. These would typically be for items like oil temperature, leaks, excessive vibration or heat etc., but they can be anything, which is relatively quick to carry out and indicative of equipment 'health'. In many TPM systems, the abnormality is then highlighted by a visual signal such as a red tag, which would record a brief description of the problem, the date and time and the name of the person inspecting. This would then be attached to the offending part of the machine. Typically a maintenance engineer would make regular 'tours' of the shop floor and address each tag, making plans to correct the problem at the earliest possible opportunity.

Improving OEE

As we have already seen, focused improvement is one of the key strategies of TPM. Ideally there should be a continuous series of improvement projects on individual areas or pieces of equipment. It is important to identify the bottleneck process or piece of equipment and to concentrate on this, otherwise there will be no net gain.

The basic steps for improving OEE are as follows :

1. **Form a Project Team**
2. **Gather & Analyse Loss Data**
3. **Select Top Loss and Determine Root Cause(s)**
4. **Brainstorm for Solutions**
5. **Plan Implementation**
6. **Implement & Monitor**
7. **Repeat Steps 3-7**

A cross functional team is set up which includes equipment operators, engineers maintenance personnel and managers. Having established the current OEE and analysed the losses, the team works on the biggest loss category until it isn't the biggest any more. This cycle is repeated until their improvement objective has been met.They use simple problem solving techniques to help them to identify the root causes of losses and brainstorming techniques to develop effective solutions. If breakdowns or reduced speed are the major problem the team will normally look to improve the current PM activities. If the issue is the time lost at product changeovers, they may choose to use SMED. (Single Minute Exchange of Die - a sytematic methodology for reducing set-up times) techniques to reduce the set up time. If the greatest loss is the sum of frequent minor stoppages corrective maintenance techniques may be appropriate. This means improving or modifying the equipment such that it doesn't stop as often or so that when it does stop, it is possible to restart it more quickly. The group may also look at planning or machine capability issues if these are relevant to reducing the losses.

Teams need skills

In addition to the techniques already mentioned, OEE improvement teams need project management and communication skills. They also need to be able to flowchart processes, develop problem statements, carry out cause and effect analyses, etc. These skills are not innate so training is essential. If a new machine were being bought to increase output by 20%, the company would have no problem appreciating the need for training. Setting up an OEE improvement team to do the same should not be any different.

Conclusion

Total Productive Management clearly represents best practice in the management and utilisation of equipment. It is not easy to implement and sustain, but has the ability to create a real competitive advantage in any industry that is significantly equipment dependant. It also offers the opportunity to develop the role of machine operators and break the traditional 'us and them' culture that often exists between maintenance and manufacturing.

BSM is a leading management and technology consulting company. We help clients achieve significant improvement by implementing sustainable process, people and e-technology solutions. If you are interested in finding out more about BSM, and in particular if you are interested in the topics discussed in this Newsletter, please contact Tom Reynolds, Manufacturing Practice Director, tom.reynolds@bsm.ie

BSM, Parkmore Business Park West, Galway. T: 091 746900, F: 091 746959, E: info@bsm.ie, W: www.bsm.ie
BSM, 3015 Lake Drive, City West Campus, Dublin 24. T: 01 4038466, F: 01 4661002