

**Total Productive Management (T.P.M.)
& Overall Equipment Effectiveness (O.E.E.)
in the Irish Healthcare Manufacturing Industry**

- A Management Briefing from BSM



Total Productive Management (T.P.M.) & Overall Equipment Effectiveness (O.E.E.) in the Irish Healthcare Manufacturing Industry

Increasingly in the Healthcare Manufacturing Sector, it is an organisation's ability to manage and utilise its equipment efficiently which determines its manufacturing performance. Also as machines become more automated and sophisticated, the role of operators is less about operating them and (should be) more about maintaining them so that they work properly and don't break down. TPM is an approach to equipment management that takes account of these realities.

This briefing will provide managers with an understanding of :

- The need to manage and improve equipment productivity
- Best practice tools for equipment management
- The Key Strategies of TPM
- How to Improve OEE
- The Results of BSM's benchmarking survey on TPM and OEE in the Irish healthcare Manufacturing Industry

The Need to Manage and Improve Equipment Productivity:

In recent times, there has been increasing pressure to reduce costs across all sections of the Healthcare supply chain including manufacturing. This pressure, which is in direct response to the rising cost of healthcare provision, is coming mainly from state and private medical insurers both in Ireland and across Europe and represents one of the key drivers of change within the sector.

A well-implemented TPM programme can significantly increase productivity, reduce maintenance costs, increase plant capacity and defer capital expenditure. TPM also directly impacts on key financial measures such as return on assets (ROA).

A TPM programme should also be much more than self-financing. Returns on Investment (ROI) exceeding 1,000 % are not unusual. Given all this, it is no surprise that industry leaders are starting to employ the best practice tools of TPM and OEE to control costs and gain a competitive advantage.

Best Practice Tools for Equipment Management:

What are TPM & OEE ?

TPM is an approach to equipment management that goes way beyond the more traditional preventative maintenance (PM) approach. Its aim is not just to prevent breakdowns but to proactively work to maximise equipment performance. 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.



Preventative Maintenance prevents breakdowns via regular checks for deterioration, overhauls of equipment, and the early replacement of wear parts.

Corrective Maintenance is the modification or re-design of equipment based on breakdown data which prevents breakdowns or makes the equipment easier to maintain or repair (E.G. central lubricating tanks or inspection covers).

TPM is the management of equipment productivity via World Class PM, autonomous maintenance and team based analysis & reduction of losses. (Autonomous maintenance is daily maintenance of machines by operators – normally cleaning, lubricating, tightening & checking)

The maintenance function has evolved over the years from simple breakdown recovery through preventative and corrective maintenance and eventually to TPM. TPM still includes all the elements of preventative and corrective maintenance but whereas PM & CM only aim 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. It does this by concentrating on the OEE measure.

OEE is a comprehensive metric that combines availability, quality and performance.

OEE = Availability x Performance x Quality

<ul style="list-style-type: none"> • Breakdowns • Set-ups & Adjustments 	<ul style="list-style-type: none"> • Minor Stoppages • Reduced Speed 	<ul style="list-style-type: none"> • Defects and Rework • Start up and Yield Loss
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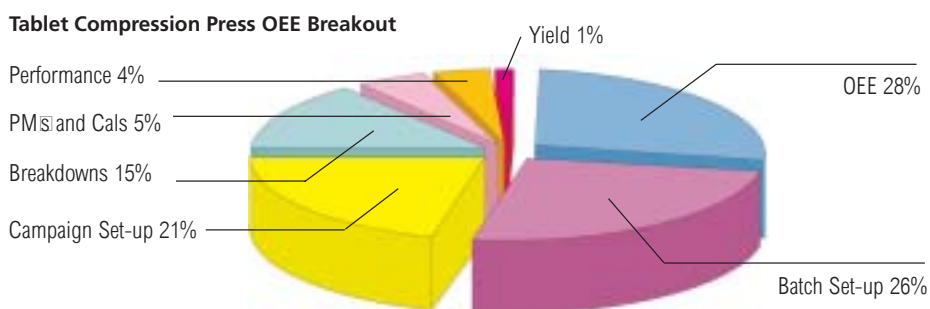
Also calculated as Actual Output / Theoretical Max. Output and expressed as a percentage

OEE effectively captures all equipment related losses and weights them all equally. Improvement activity is then focused on the biggest losses no matter what the root cause.

Anything which prevents a piece of equipment from producing good quality product at the rate recommended by the equipment manufacturer is a loss. Equipment related losses often fall into one of the so called 'big seven' categories. It is important to separate out the losses because there are different 'tools' to address different loss types. The first task of any OEE improvement team should be to measure the OEE and to quantify and categorise the losses.

Loss Category	Improvement Tool
Breakdowns	Preventative Maintenance Procedures
Set up & Adjustment Losses	S.M.E.D Programme
Idling & Minor Stoppages	Corrective Maintenance
Reduced Speed	Preventative Maintenance Procedures
Defects and Rework	Machine Capability Improvement
Start up & Yield Losses	Start up Procedures
Waiting for Work / Material	Planning / Supply Chain Management

OEE Breakout - Tablet Compression Presses



The chart shows the typical OEE breakout for a new Tablet Press (before any improvement activity). The 28% OEE effectively means that the press only produces saleable tablets (at normal efficiency) for 28% of the time that it is planned to run. For the remaining 72 % of the time available, the press either produces scrap or does not run. A traditional PM based equipment management system will only concentrate on the 15% loss from press breakdown essentially ignoring the remaining 57% of losses whereas a TPM based system will address all losses.



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 several 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, 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 & 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 things 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 & 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. Some companies display a maintenance history at the machine that would normally include details of breakdowns & PM schedules etc. This means that the PM status and performance history of the machine are instantly visible. Visual controls should also be used whenever possible to indicate things like correct oil levels, standard settings etc.

How to Improve OEE :

The Basic Steps :

- 1. Form a Project Team**
- 2. Measure OEE and 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.

The team uses simple problem solving techniques to help identify the root causes of losses. They use 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 S.M.E.D. 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, and carry out cause & effect analyses. These skills are not innate so training is essential.

If a company was buying a new machine to increase output by 20%, it would have no problem appreciating the need for training. Setting up an OEE improvement team to do the same should not be any different.

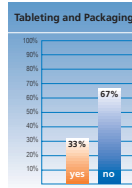
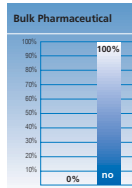
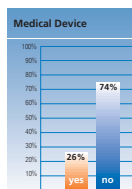
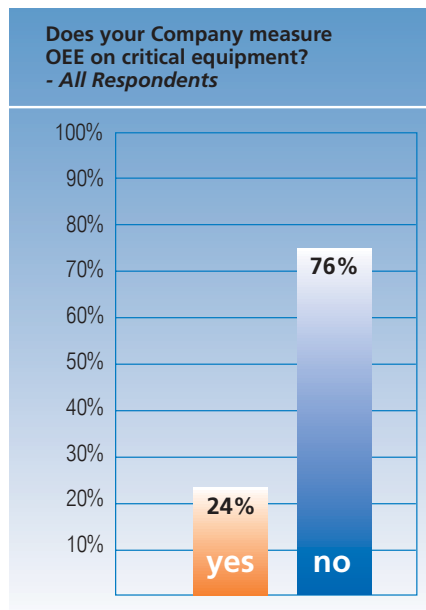
Survey Results

TPM & OEE in the Irish Healthcare Manufacturing Industry

BSM recently conducted a survey of over 90 Medical Device & Pharmaceutical companies with operations in the Republic of Ireland. The participating companies were asked about their use of OEE as a key performance indicator and the provision of training in TPM and structured problem solving.

Respondents were also asked about their application of various TPM best practice techniques and the use of cross functional teams to improve and maintain OEE. They were also asked to indicate the average OEE of their key equipment and the Quality, Performance and Availability components of OEE.

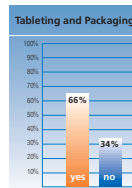
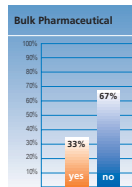
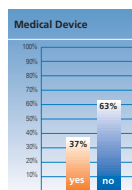
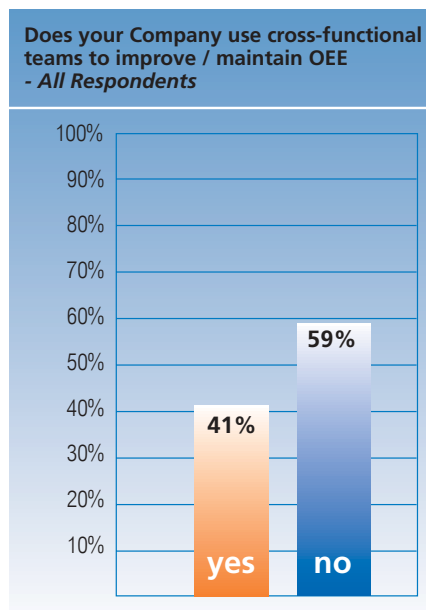
The results indicate that the Irish Industry generally (and especially the Bulk Pharmaceutical sector) has been slow to adopt TPM and OEE. Instead there is a reliance on preventative maintenance (PM) only which tends to limit the focus of any improvement activities and can fail to highlight many significant losses.



The results indicate that less than a quarter of all respondents use OEE as a key performance indicator. This compares badly with the High Tech sector where in a similar benchmarking survey, 43% of companies were using OEE.

Tableting & packaging companies led the way with a third of the respondents using the OEE measure. These companies typically have a lot of complex high cost equipment with relatively long set-up and changeover times, so it is no surprise that they are to the forefront in trying to find better ways to manage and utilise their equipment.

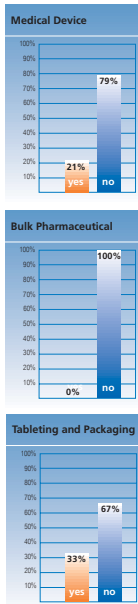
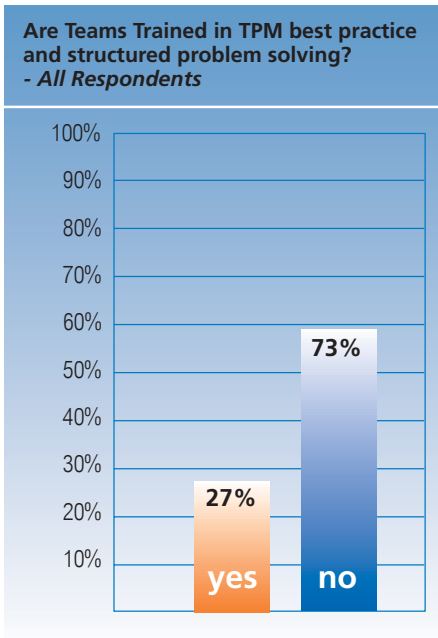
Because of the chemical nature of the processes in the bulk pharmaceutical sector, the focus has traditionally been on the integrity of the reactions and on yield rather than on how well the equipment itself is utilised. This is strongly reflected in the survey results with none of the bulk pharmaceutical respondents using OEE as a measure.



41% of all respondents are using cross functional teams to try to effect improvements in OEE however as we have seen above, only 24% actually measure their OEE.

Failing to measure OEE and its components will usually result in teams missing out on significant opportunities for improvement. Very often the 'low hanging fruit' in improvement terms is in planning (to improve Utilisation /Performance) or eliminating 'short stops' and reduced speed (to improve Performance).

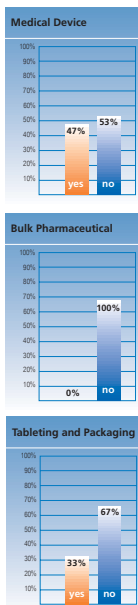
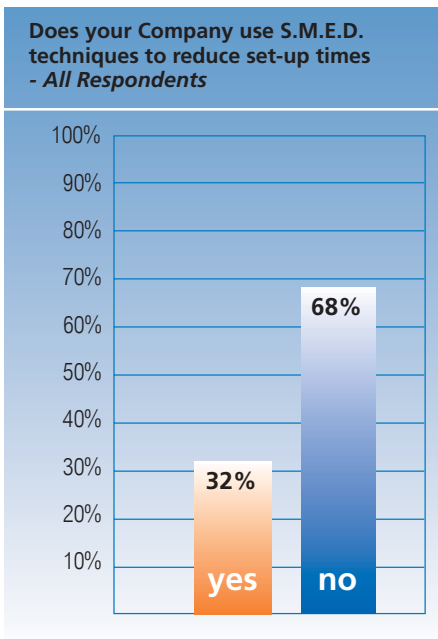
Without an OEE approach such losses will remain hidden and will not be addressed.



Although 41% of respondents are using cross functional teams, only 27% are providing them with training in the basic skills and best practice knowledge required for them to be as effective as possible.

It is a mistake to assume that because individual team members are good managers, engineers or operators, that they also inherently have the skill sets required to effectively improve OEE.

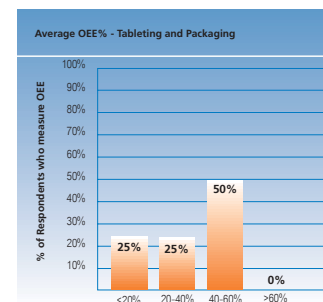
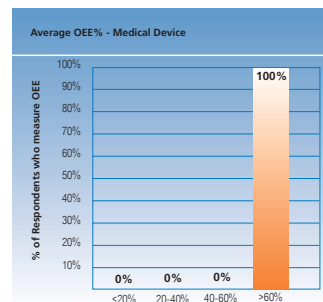
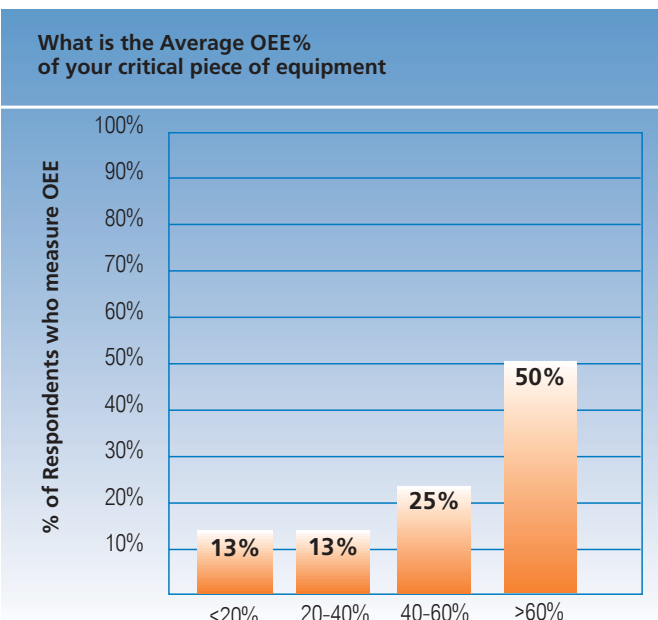
A little training goes a long way!



SMED is a simple and effective methodology for reducing set-up times (and therefore improving OEE). However just under a third of all respondents are actually using the technique.

The application of SMED is being led by the Medical Device sector. This probably reflects that due to competition the need to improve is greater in this sector than in the others.

None of the Bulk pharmaceutical respondents were using SMED to improve Set-up times. Again this is indicative of the sectors traditional narrow focus on the core chemical processes rather than on the wider overall process.



None of the Bulk Pharmaceutical companies surveyed actually measure OEE



When it comes to actual OEE figures, there is a clear divide between the Medical Device and the Tableting & Packaging sectors. All of the medical device companies who measure OEE reported values of over 60% on critical equipment. This is no surprise as these companies are also the ones using trained cross -functional teams and applying TPM best practices.

The achieved OEE values from the Tableting & Packaging sector are however lower and there is also a greater spread across companies. One of the reasons for this difference is the fact that Set-ups in this sector are typically much longer (especially on packaging lines) and often more frequent than in the medical device sector. Also the equipment in this sector is typically more complex and subject to more frequent breakdowns and short stops.

It should be remembered that only 24% of respondents actually measure OEE. Because of the lack of focus and structured improvement activity in the companies that don't, one would expect the OEE to be lower in these companies and therefore the average in the healthcare sector overall would also be lower.

	Availability	Performance	Quality	OEE
Medical Device	70%	94%	95%	63%
Bulk Pharmaceutical	N/A	N/A	N/A	N/A
Tableting & Packaging	46%	68%	99%	31%
All Companies	52%	72%	98%	37%

** Compared with bottleneck equipment OEE of 65% in the High Tech and 85% in the Automotive Sector*

Analysis of the components of OEE indicates that Availability losses are a big issue in both the Medical Device and the Tableting & Packaging sectors. Availability is particularly poor in Tableting & Packaging. This is almost certainly due to the impact of long and /or frequent set-ups and breakdowns. 'Performance' is also poor in the Tableting & Packaging sector reflecting issues with reduced speed and short stops.

Summary :

While medical device companies who measure OEE and apply TPM techniques are achieving OEE values that are at least comparable with the High Tech sector, there is still room for further improvement by reducing availability losses.

Tableting & packaging companies have quite a bit further to go and in addition to making in-house improvements, the sector probably needs to involve equipment manufacturers in developing strategies and designs which allow for faster Set-ups and reduced performance losses.

The bulk pharmaceutical sector needs to widen the focus of improvement activities from just the core chemical processes to include the management and utilisation of the equipment. The best way to do this is to measure OEE and to apply TPM best practices. TPM also offers the opportunity to develop the role of operators and to implement continuous improvement structures and activity.

The main challenge for all the sectors however is to widen the base of companies in which these techniques are employed. This is especially true for the bulk pharmaceutical sector who have failed to look beyond yield in terms of improving productivity. Any company which is prepared to invest the time and resources to pursue a carefully planned implementation can enjoy the competitive advantages that good TPM offers.

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