



A TPM³ Journey to Excellence Case Study

The Introduction of TPM³ into an Australian Zinc Mine

Keith Saul - General Manager Mining & Resources, The Centre for TPM (Australasia)

Abstract

This is a Case Study on the successful introduction of **TPM³** to an Australian underground zinc mine.

The paper is about the experiences of a small group of miners taking their first steps on their **TPM³** Journey to Excellence. It is not just about maintenance; it is about leadership, empowerment, learning by doing, ownership, performance measurement, working together and culture change.

What is TPM³?

TPM is not a new concept, it was developed by Toyota in the 1970's to lift equipment reliability to the higher levels required by the introduction of the Toyota Production System and Lean Production. It has evolved over the years from just being equipment focused (1st Generation), to process focused (2nd Generation), and then company focused (3rd Generation).

TPM³ is an enhanced and expanded Australasian version of 3rd Generation TPM. It is a company wide equipment management improvement strategy involving all employees aimed at significantly improving capacity, productivity, quality, delivery, safety, morale and bottom-line results.

TPM³ is not a simple maintenance program and it cannot be implemented by a handful of people. It requires the co-operation and involvement of all levels of the company, the breaking down of traditional attitudes towards specialization (I operate, you fix) and the establishment of educational systems designed to upgrade skill levels of all employees, especially maintenance and production personnel.

What is The Centre for TPM?

The Centre for TPM (Australasia) is a membership-based organisation providing companies with TPM³ Training, Navigation, Research and Networking. Since its inception in 1996, the Centre has developed TPM³, an enhanced and expanded Australasian version of 3rd Generation TPM.

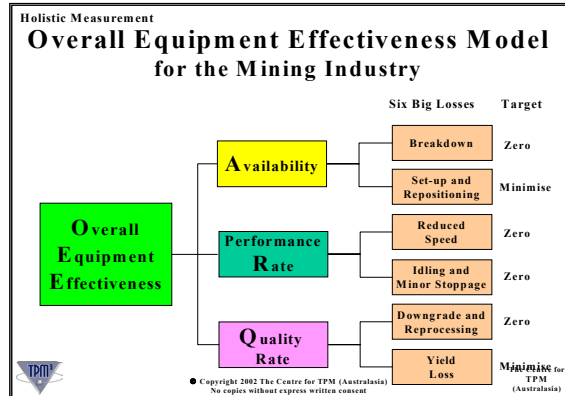
TPM³ is now being introduced throughout Australasia at over 40 sites involving some 14 industry groups.

What is World Class Equipment Performance?

So what is World Class and how do you know when you get there? The **TPM³** Methodology utilizes the holistic measure '**Overall Equipment Effectiveness**' (OEE) to measure progress towards World Class Equipment Performance. The OEE incorporates three traditional measures;

- Availability (impacted by break downs and set-ups)
- Performance Rate (impacted by slow running, idling and minor stops)
- Quality.

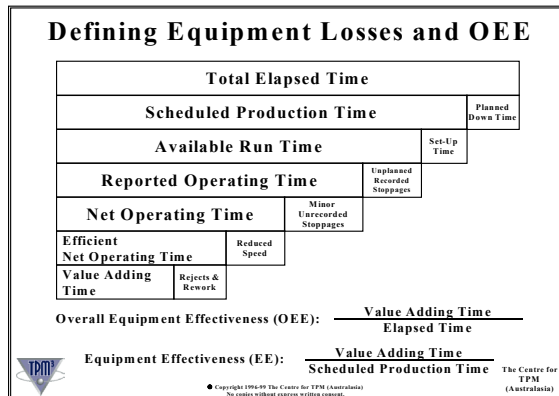
OEE Model



Companies are recognized as having achieved World Class Equipment Performance when they have achieved and sustained an OEE in excess of 85%.

Most companies find that the OEE on their key items of plant is less than 50% at the start of their **TPM³** Journey to Excellence.

Equipment Losses



TPM³ in the Mining Industry

Pasminco and TPM³

Pasminco first trailed **TPM³** in 1998 at their smelter at Port Pirie in South Australia. The initiative was extremely successful, lifting key plant OEE's towards the World Class levels and yielding significant cost savings with the added benefit of a greatly improved safety performance.

Pasminco Mining

Pasminco operates a number of zinc mines in Australia, but it is the Rosebery Mine in Tasmania that is leading the way in the **TPM³** Journey to Excellence. Rosebery is a medium sized underground base metals mine located in the North West of Tasmania.

The mine is over 100 years old but is quickly becoming regarded as one of the most innovative and profitable zinc mines in the country. The site employs some 220 people and mines over 750,000 tonnes of ore per annum.

The Journey – The Decision

Under the leadership of General Manager, Brett Fletcher, the Management Team had been looking at **TPM³** for some time as a possible vehicle to involve everyone in continuous improvement.

The Journey – Training

In a move that signalled his commitment to **TPM³**, Brett Fletcher took 20 of his key people to Strahan for a 2 day Introduction to **TPM³** Workshop.

The Journey – Leadership Team and TPM³ Introduction Strategy

A **TPM³** Leadership Team was established comprising the General Manager, Mine Manager, Technical Services Manager, Metallurgy Manager, Metallurgy Superintendent, and the two **TPM³** Co-ordinators.

A half-day **TPM³** Introduction Strategy Workshop resulted in the selection of the first two pilot improvement teams, one from the surface (Mill) operations and the other from underground (Mine) operations.

The teams were each given a mandate, which was to identify all of the losses associated with their selected pilot area, to increase the Overall Equipment Effectiveness (OEE) by 25%, make recommendations for further loss improvement activities, and to complete the project within 12 weeks.

The Journey – Team Awareness Training

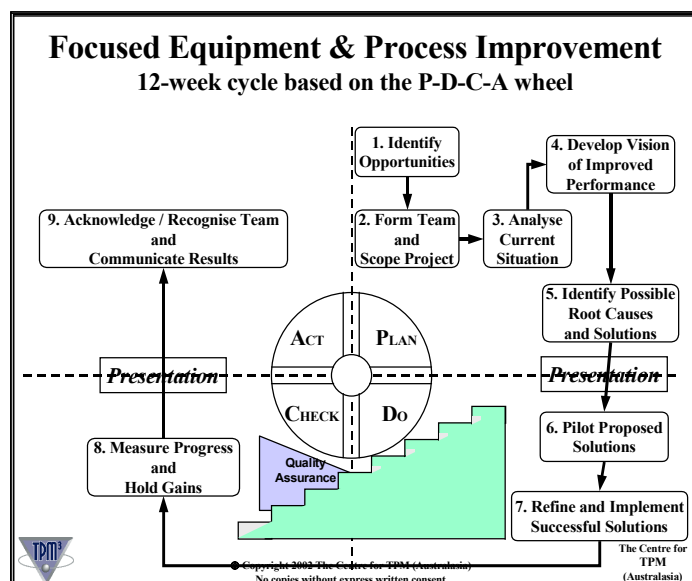
All team members attended a one day **TPM³** Awareness Workshop. The majority of the team members had never worked at another site and with many long serving employees amongst them, there was several hundred years of experience in the room.

Cycle 1 – Team Kick –Off

The first of 12 team meetings was a half-day kick-off workshop to form the team through a series of team building exercises and to guide them through the structured step-by-step approach that is an integral part of the **TPM³** Methodology.

Cycle 1 – Going Solo

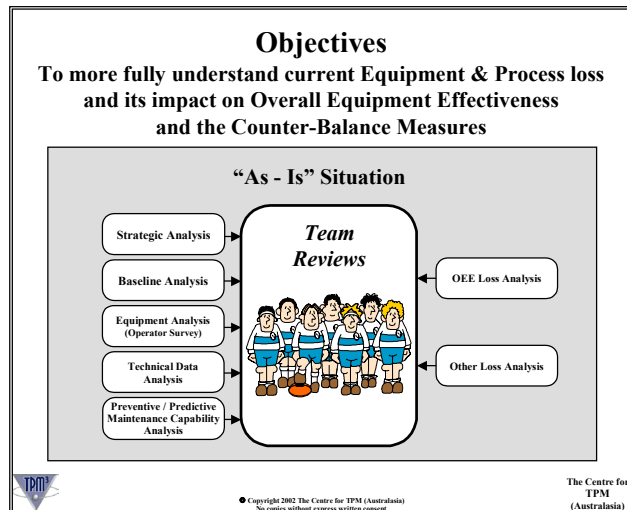
For a number of team members this was a major learning experience wrestling with issues such as how to be a team leader / team member, how to plan meetings around shift work, how to carry out surveys and how to analyse data with the added pressure of a 12 week time limit to achieve a significant improvement in performance (25% increase in OEE). The team followed a 9-step process, with each step clearly outlined in their **TPM³** Team Member Manuals.



Cycle 1 – Analysing the Current Situation

The Mine Team, which focused on Mine Development, spent the next 3 weeks busily analyzing the current situation, determining the OEE for the Drilling Rig and identifying the OEE losses, the strategic intent and expected life of the equipment; the baseline performance of drilling and blasting, the preventive/ predictive maintenance capability, the status of drawings, operating procedures, spares etc.

“As-Is” Situation



This was complemented with a survey of their work mates to determine how operators and maintainers viewed the equipment in regards to ease of operation, reliability, process capability, housekeeping, safety, environment, rework / rehandle, and maintenance practice.

The results provided the team with valuable information about the equipment and processes and a better understanding of issues affecting the rate of development. The survey involved all other plant operators in the project and provided some interesting

feedback on the WIIFM (what's in it for me) issues that need to be addressed in order to reduce operator frustration and gain commitment and ownership to any changes in operating procedures.

Cycle 1 – OEE and Loss Analysis – Some Surprises

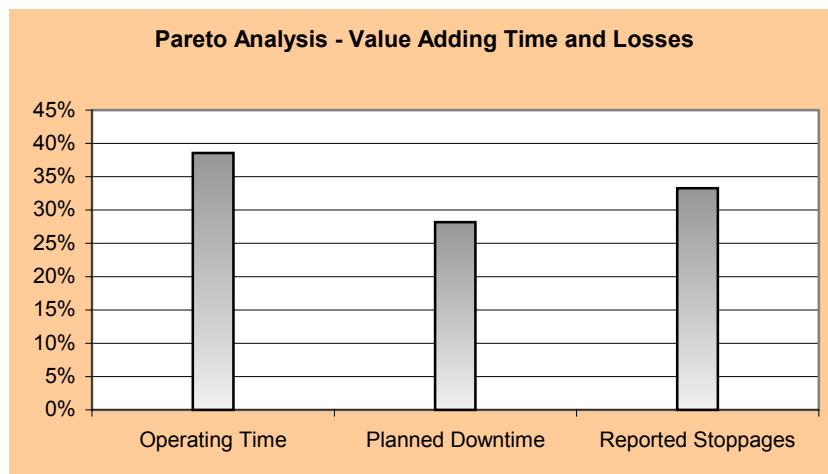
The engineer on the team calculated the OEE of one drilling rig and presented his findings to the team. The team members were used to seeing their performance measured in terms of metres of development (tunneling) and this generally averaged 100m per week. The traditional measure does not give any real indication of how much better the performance could be if all losses were eliminated. The team was surprised to find that the OEE was averaging 55% - leaving 45% in losses.

The OEE was being eroded by losses in Availability, Performance Rate, and Quality. The Performance Rate is a comparison of the actual drilling rate compared to what should be the optimum rate.

Traditionally, the Drilling Teams considered that completing 3 faces per shift was the very best rate that could be achieved. It took a lot of discussion to finally agree that with the best conditions, best equipment and the best operator; they could conceivably complete four faces in a shift. This was a major turning point for the Team

Detailed analysis of data gathered from records and observations allowed the team to construct a first level Pareto Analysis showing the relationship between operating time, planned downtime and reported stoppages.

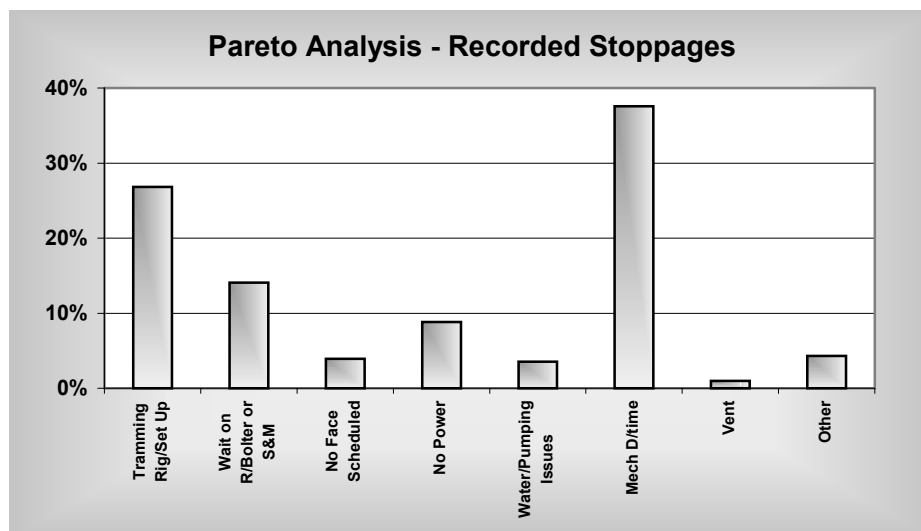
The team was surprised to find that the operating time was only 38% of the available time and reported stoppages were over 30%.



The team then conducted a second level Pareto Analysis on the reported stoppages, revealing the major losses that were affecting the OEE of the drilling rig.

Mechanical and Electrical Downtime made up only 37% of the reported stoppages. Most team members start with the belief that **all** inefficiencies are caused by maintenance problems. **TPM³** Teams discover what maintenance people already know, that losses from other operational causes are as big, if not bigger than the losses due to equipment failure.

So the team was surprised to find that the drilling rig breakdowns made up only 37% of the reported losses affecting the rate of development. This proved to be another turning point for the team, further breaking down the barriers between operations and maintenance.



Armed with this valuable information the team set about looking deeper into these issues to determine the root causes.

Cycle 1 – Root Causes and Recommended Solutions

This is where the team began to ask “why” several times and explored every possibility in order to get to the root causes of the losses.

The preventive maintenance schedules were closely reviewed and plans made to introduce the changes as soon as possible. Recommendations were put forward for operators and maintainers to work together on some of the PM work.

In looking at the other losses it soon became evident that most of them were caused by a lack of adequate planning and scheduling. This resulted in a significant change in both the planning and overall mode of operation.

Management had been looking at increasing the length of the drilling booms in order to gain extra length at each firing. The team decided to adopt this modification on the rig dedicated to face drilling.

The team undertook a thorough cleaning and inspecting of the primary drilling rig and identified numerous defects that they determined would lead to accelerated deterioration and early equipment failure.

The team agreed that the **TPM³** approach of “Clean for Inspect” was a very good way to identify defects and oil leaks and they recommended that each rig be fitted with its own high pressure washing rig.

Cycle 1 – Half Way Presentation – The Fear Factor

An essential part of the **TPM³** process is a presentation to the Management Team half way through the 12-week cycle. This is where the team presents their findings to the Management Team and gain approval to implement the teams recommended solutions.

Despite extreme nerves, the team presented their work and gained approval to implement their recommendations.

Cycle 1 – Results

Initial results were extremely good, but the improvement quickly fell away. This was for a number of reasons including the inability to always have a face ready for drilling (planning issue), and mechanical failures resulting from the increased working hours of the face drilling rig. After the scheduling changes were made and equipment failure issues addressed, the OEE improved dramatically.

The OEE improvement was reflected in the development advance metres, with an increase from 100 to 125m per week being achieved.

Cycle 1 – Final Presentation – With Confidence

After 12 weeks of working together at weekly team meetings, the team faced their last challenge – the Final Presentation to the Management Team. This was their opportunity to review what they had achieved, what they had learned and how they could have done things better.

The Journey – Learnings

So what did the team learn?

- How to identify losses
- How to work together on continuous improvement
- That planning and scheduling have a big impact on performance

- That breakdowns are not the most significant factor affecting performance
- How to present their findings to management
- How to manage a project
- Listening to operators is critical
- Operators and maintainers need to work together

The Journey – Next Steps

The Journey does not end here; the team is continuing to monitor the OEE to ensure that they do not lose the gains that have been made. They will continue with cycles of **TPM³**. For example, the third cycle of **TPM³** will see the team focus on the drilling rig itself, gaining a detailed understanding of its operation whilst searching for and removing defects and defect generators.