# Maintaining Rolling Mill Performance
# Part 2: Stop the Decline and Improve Performance

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In part 1 we explored factors responsible for a decline in rolling mill performance over time. In this second article we discuss the approaches and methods used to stop this decline and to improve rolling mill performance.

Most aluminium rolling companies will be trying to improve their performance by increasing their asset utilisation, improving their product quality and reducing their operating costs. Finding a balance between these aspirations requires a careful approach combined with a deep understanding of the products being rolled and the rolling process itself. It is a relatively easy exercise to calculate theoretical rolling mill capacities based on the product mix and maximum mill powers & speeds, but achieving this theoretical productivity can be a much more difficult task, especially when market conditions require changes to the product mix and volumes

Innoval Technology has expertise in conducting technical audits to assess the rolling and finishing processes and the products being produced. Careful study and assessment of the operations and material flow, combined with benchmarking against world-class performance, highlights where practices on equipment can be improved or in more extreme cases, where the purchase of new capital equipment makes economic sense.

Optimum mill performance can occur only when the mill capabilities, process understanding and coil sequencing are dynamically linked. Examples of how improvements in productivity and product quality can be achieved without the need for new capital outlay, will be discussed further below.

The theoretical capacity of rolling mills is best assessed using rolling models based on available powers and forces to roll the desired mix of products. It is important to include known product-related constraints within this calculation, such as the need to achieve a particular exit temperature on the mill for metallurgical reasons. This is often used as the engineering limit for asset utilisation and a technical audit will highlight the reasons why the actual mill capacity is less than the theoretical value. Usually these reasons are due to process and product constraints which prevent operators from achieving maximum speeds or pass reductions. Examples of speed constraint on a cold mill might be mill vibration, poor performance of an ironing roll, oil carryover, fear of strip break due to a tight edge, etc. Figure 1 shows a table of sensitivities for parameters that can affect the capacity of a cold mill.

| Varying parameter | Base case | Average exit gauge | Product yield | Mill speed | Average handling time | Units |
|---|---|---|---|---|---|---|
| Average exit gauge | 0.59 | 0.49 | 0.59 | 0.59 | 0.59 | [mm] |
| Yield | 85 | 85 | 80 | 85 | 85 | [%] |
| Mill speeds | 100 | 100 | 100 | 90 | 100 | [% of expected] |
| Coil handling time | 5 | 5 | 5 | 5 | 7 | [min] |
| Output Mill Capacity | 119 | 99 | 112 | 95 | 94 | kt/year |

Figure 1: Sensitivity of a specific cold mill capacity to changes in various input parameters

To improve asset utilisation it is crucial that there is careful definition of the metrics and also identification and understanding of where the data comes from. For example, what is included into up-time and down-time for a machine centre can vary from plant to plant even within the same company and key data may be stored in different databases, which is not ideal. With robust definitions, it then becomes possible to compare mill performance within a company and also with world-class performance metrics, identifying differences and gaps in performance that can then be reduced.

There are many techniques that consider both the process efficiency during rolling of a coil (up-time) and the time between coils (down-time). Overall Equipment Efficiency (OEE) analysis is a method that captures the most important sources of manufacturing productivity loss and converts them into metrics that provide good indicators of current status of the plant performance as well as how the processes can be improved. OEE analysis addresses both process productivity and the production quality aspects, recognising that there is little merit to producing faster if that leads to increased rejections. An example of successful application on a hot mill is shown in Figure 2 where the initial target of the study was exceeded.

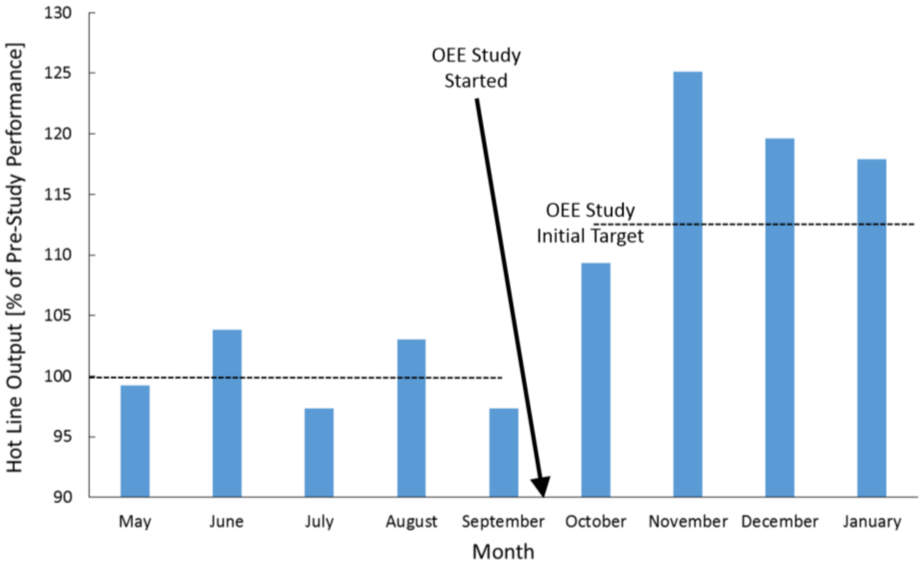


Figure 2: Plant data showing improvement in hot mill output following OEE study (performance normalised to 100% pre-study)

The variations that can be observed after the project start are caused by the natural changes in the product mix for each month. Understanding this prevents plant personnel from reacting to data variation, the cause of which is not related to the way the hot mill is run.

Similar approaches can be adapted for cold rolling mills, even though the balance between contact time and non-contact time is very different from that of hot mills. Analysis of plant data helps to identify and prioritise the activities of plant personnel. Backed up with good process knowledge, the action plans can be implemented quickly and improvements made without the need for large capital expenditure. Innoval Technology has facilitated and led several such initiatives.

Product quality can be categorised in terms of dimensional properties such as thickness and flatness, surface properties and mechanical properties. It is important to understand the source of any quality issues as these may come directly from the mill being studied or they may originate in an upstream process. A good example is the impact of strip profile (the thickness variation across the strip width) on downstream quality. The profile is generated in the hot mill and will vary depending on changes to the thermal state of the hot rolling process (alloy changes, strip width changes, delays, etc.). The profile has an impact on the on-line flatness performance in downstream cold mills and also the off-line flatness performance resulting from any rolling or finishing coiling processes and this is often observed by the end user customer. It is important that these interactions between the mills and process lines is understood to increase the overall quality performance of the delivered coil. A large hot rolled profile will also lead to losses of reels in multi-slitting, linking hot rolling performance to downstream product recovery issues.

During a technical audit the product quality attributes can all be checked and compared to an expected level of performance based on technologies available on the mill and the preceding process stages. Improvements to quality attributes such as gauge, flatness and surface can usually be made without capex investment, for example by retuning a control system to improve performance for new products.

Technical audits by a team of process and product experts, together with the use of process models, provides a powerful approach in the fight against declining mill performance. It can highlight gaps in performance and will show where to focus effort to bring the performance back to world-class levels. The process can also assess the potential return on any potential capex investment made on the mill.

The next and final article in this series will describe how to avoid the initial decline in performance of new mills, through good design, training and ongoing technical support.