Maintaining Rolling Mill Performance

Part 3: Avoiding a Decline in Performance

By Tom Farley and Dan Miller, Innoval Technology Ltd

In part 1 we explored factors responsible for a decline in rolling mill performance over time. In part 2 we looked at how productivity and quality can be improved and the need to have good metrics to monitor these. In this final article, we will illustrate some key factors which are essential in achieving and maintaining high performance figures.

Any immediate fall-off in performance following mill commissioning can be avoided through good preparation. Even when the equipment chosen is supplied by a technologically advanced company with strong proven engineering experience, such as Danieli, two further factors need to be considered. The first is the skills and understanding of the staff that will run the new machine and the second is the knowledge of the way the final properties and product quality are affected by the different processing stages.

Training and skills enhancement is crucial to ensure an effective handover at the end of commissioning. The opportunity to learn from the commissioning engineers and experts from the supplier company while on site is essential. Staff time must be allocated to work with the supplier’s staff to maximise understanding of the equipment and process control before the end of commissioning.

Process and automation engineers and mill operators all need good training to ensure they are all aware of how their tasks impact on the quality of the final delivered product. For example, profile control on a hot mill may seem a long way from the final customer, but the hot mill creates the profile of the strip which will impact flatness of the sheet at the customer. This through-process knowledge can be communicated to staff via training courses from Innoval Technology Ltd (Innoval), where the learning is tailored to the products being rolled and to the equipment on site (Figure 1).

Innoval also uses a knowledge mapping approach in its training to demonstrate the effect process stages have on key product attributes and this becomes a powerful problem solving tool for the plant engineer (Figure 2).

Figure 1 Delegates attending Innoval's Aluminium Rolling Technology Course

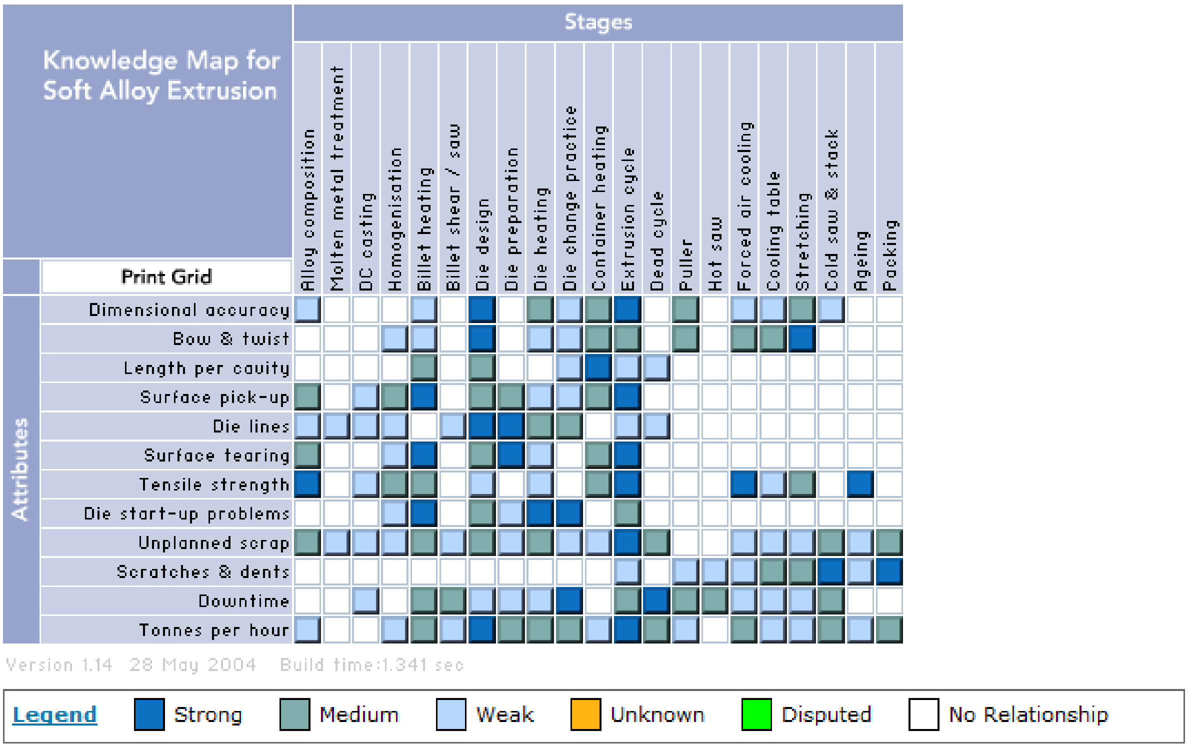

Figure 2 An example of a knowledge map, or K-Map, from Innoval Technology

Achieving and Maintaining world-class product quality and machine performance often requires the solution of difficult problems. These may relate to the complexity of the product metallurgy, the evolution of the product surface during the process, the need for precise control of product dimensions and residual internal stresses, or the need to overcome machine constraints. To solve the most challenging problems requires a deep technical understanding provided only by experienced industry experts such as Innoval Technology. This specialist understanding can be supported by the application of computer models to "see inside" the process allowing critical variables, that can't be easily measured, to be observed. This modelling approach allows optimisation of the processes so that maximum productivity is achieved without prejudicing product quality. Innoval has significant experience of both creating and applying these types of model. Innoval's current toolkit of process models includes: Rolling models, spray cooling models, thermal heating models for slab preheating, plate aging and coil annealing (batch and continuous), mill vibration models, levelling and multi-slitting models.

Where appropriate these calibrated models can also be implemented on-line to maximise the value of the understanding contained within them. When embedded in a mill set-up model, the key quality parameters can be kept within specification through transients as well as during steady-state conditions and so improve the yield for the plant. Used off-line for new products or to explore the limits for an existing product, they ensure realistic conditions are used on the mills and so avoid the drop-off in performance that can occur during the period after the plant hand-over, when products other than a specified acceptance test set are being rolled and when the mills are being ramped up to perform at higher productivity levels with the full range of the product mix. Furthermore, thermal models play their part in the plant profitability by minimising energy usage and reducing the work in progress times.

The monitoring of plant data is also essential. The key performance indicators for the plant will be scrutinised by the management team, but the detailed performance needs to be checked by dedicated engineers. With the large volume of data now generated by processes, it can be difficult to find time to look at more than brief summaries of the logged data. Few plants implement exception reporting and in general, unless there is a failure, the criteria for generating an exception are set high to avoid too many false positives. It is often only when there is a major complaint from a customer that the data is examined to see what went wrong, and without an idea of what is normal and what the normal process variation is, finding a subtle fault is not easy. Keeping on top of these small differences is critical to maintaining performance but this does require proper resourcing. For example, Figure 3 shows the flatness of a coil and seems only to indicate a problem at the start of the coil. However closer examination reveals a repeating pattern during the steady-state portion of the coil and this could imply the coolant control is becoming unstable. The reliability of coolant control in the system is a more important issue than the occasional poor start of a coil, however undesirable that might be.

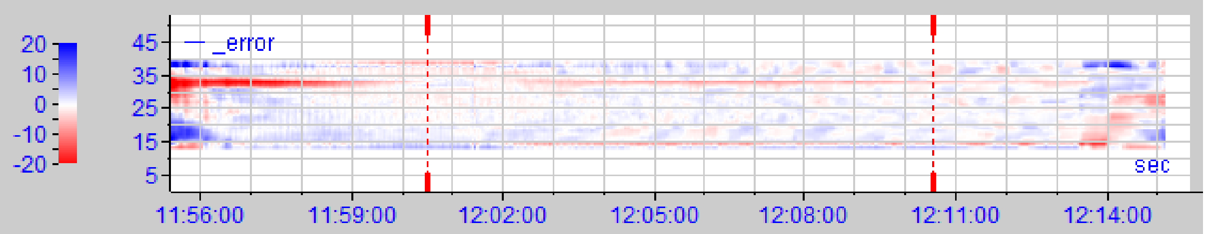

Figure 3 Flatness map showing borderline instability

Putting all these factors together will result in performance which does not drop immediately at the hand-over from the supplier and will allow for the maintenance of the performance of the plant as the product mix changes or customer specification tightens during the coming years (Figure 4). Engineers from Innoval Technology can be on hand to help and support you through this process, whether you're putting a new mill into production or you want to improve and maintain the performance of an existing mill.

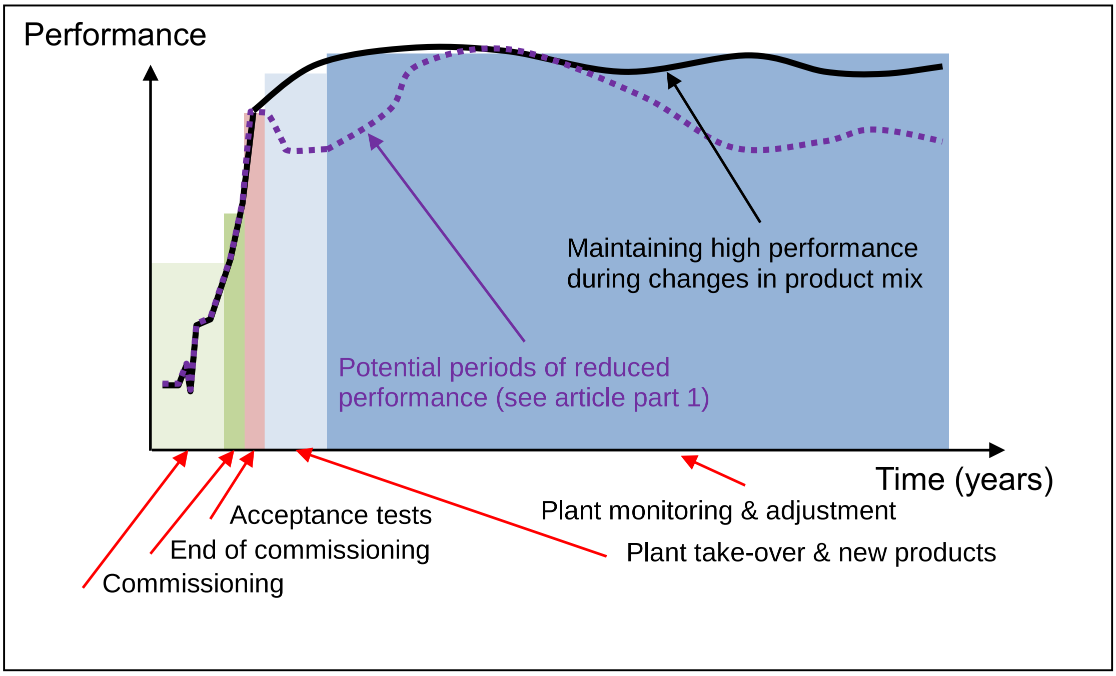

Figure 4 Achievable performance characteristic of a mill during its lifetime