Production Accounting in Mining

Most mining houses have investigated Manufacturing Operations Management (MOM) Systems and Manufacturing Execution Systems (MES) implementations for several years, and most of them are looking at improving their Metals Accounting systems. Are these the same or different?

- *Gerhard Greeff : Divisional Manager : Bytes PMC*

The difference between Metals Accounting Systems (MAS) and MES/MOM reminds me of the difference between Six Sigma and TQM. Why is it that TQM failed to be accepted as widely as Six Sigma, especially in South Africa? It could be that our culture and management style were just not conducive for TQM, as it entails a change in company culture and the way things are done. It pushes decision making responsibility down the company hierarchy, something quite foreign to the South African way of thinking in the 1990's and early 2000's. Did Six Sigma succeed because it came at the right time and TQM failed because it was premature?

Getting back to MAS and MES, I previously mentioned similarities between these and TQM/Six Sigma, one being that as in Six Sigma/TQM, MES/MAS also work from the same base, and is at the heart the same thing with a different focus. So the answer is yes, there is a difference, about the same difference as between a Toyota Hilux and a Nissan Hardbody. They look different, they handle different, they perform different, but they are both trucks.

A MOM system, according to the ISA95 standard is grouped into four functions: Production, Inventory, Quality and Maintenance. Assessing these functions and their activities, one can establish that with the exception of Maintenance, all the others are needed for an integrated MAS solution.

One may argue that Execution functionality is not required, as MAS is only a reporting system, using process data to report certain data in a specific format, in actual fact a "Management Information System (MIS)". This is the first mistake! Continuing along this path will have MAS ending up like MES, something everyone has heard about but no-one is using.

A MIS system takes pre-recorded data and places it into a report in a certain format, irrespective of the source or accuracy of the base data. By comparison, a MES system has as its aim the collection of electronic data from the correct source, and the quality assurance of the data through built-in business and systems rules and checks. MAS that has as its base hand-recorded and MSExcel-manipulated data, is neither accurate nor integrated. The accounting may just as well be done in a spreadsheet (*often more trusted by users anyway*).

To put together an Integrated MAS, the following need to be resolved:

- Electronic measurement data such as weights and content is not always available at hand-over between processes;
- There is a combination of process types such as continuous, batch and discreet with different business rules;
- Measurement data is often derived from flow and density and instrumentation is often inaccurate or out-of-order;
- Sampling is inadequate or not done at the right time or place;
- Most solutions need to cover more than one site, and definitely more than one department.

These cannot be resolved by only reporting on captured data. A change in work methods and additional data capturing is required throughout the production process. It requires a change in the way that instrumentation and systems are maintained, as inaccurate instruments result in inaccurate weight and content data. Additionally, business rules need to be defined and agreed. Business rules ensure that material only moves to permissible locations, metal content results are assigned to the correct batch or lot of material and that material is identified appropriately throughout the process. This is all Execution functionality.

MAS is in a sense a material tracking system. It tracks a specific metal element (or elements) through the production process and accounts for the over-all yield (or recovery) of the metal at the end of the process. In order to do this, it needs to have the material weight and the specific concentration (or content) of the specific element within that weight. This is required for each step of the process. For a discreet batch process and one element this is reasonably simple, but for continuous processes it becomes more complex. For multiple product streams and a number of elements it is exponentially more complex.

Furthermore, to obtain element concentration in a load, lot or batch of material, one needs a chemical analysis of the material. For this, one needs a sample. One thing often overlooked is that samples are not necessarily taken representatively, or not taken at the correct points required for Metals Accounting. For instance, not all waste streams are always sampled and weighed.

Let us assume all material streams are sampled. The next complication is that chemical analyses are not instantaneous. Samples may only be transported to the laboratory at the end of the day and only tested the following day. Then there is a results approval or verification process and potentially a re-analysis. After a two to three day period, the results are available. These results must then be assigned to the specific load/lot it relates to. This is the only way in which the mass and concentration can be used to calculate how much of the specific element moved into- or out of- the process.
Then one is faced with the integration issues. Implementing an integrated MAS, one needs to integrate with the laboratory system (or LIMS) for concentration results and with the weigh-bridge system or scales for weights. The system will be of little use if not integrated with the company ERP system, therefore the processes in the MAS needs to map directly with those in the ERP. This may change the way in which material weights are captured and identified at the point of handover between processes. Batch or lot numbering conventions may change to avoid double-accounting. Provision must be made to weigh, sample and analyze additional material streams. The way in which this is done is based on production or business rules; not just reporting functionality, but actual MES functionality. All this involves changes to current systems and the interfacing between them.

It is even more difficult to track material between continuous processes. Here weights are normally quantified using mass-flow meters with flow and material density being used to calculate material mass. Automated samplers may be used to ensure consistent and representative samples. In terms of the MAS itself, these weights and samples are no different from a discreet batch weight and sample. From a technical and maintenance point-of-view however, this may require a culture change.

These instruments are no longer only used to control the process, but now directly contribute to the financial accounting of the company. If the instrument is out of calibration, the incorrect weight will be reported and if the automated sampler sticks or breaks, the sample will not be representative and may lead to inflated or deflated metal content results. So without a proper instrument calibration regime, one cannot even begin to consider integrated MAS!

The amount of work-in-process or “lock-up” is normally calculated using some business rules, but these can be manipulated to inflate actual performance. Lock-up is a great place to hide process inefficiencies and low yields. If metal recovery is a bit low, increase the lock-up quantity slightly and yield is in range again. With SOX and other regulations, performance reporting is in the lime-light. Auditors want to see defined reporting and calculation rules enforced to eliminate “artificial good performance”. Implementing an integrated MAS will reduce the potential of “hiding” inefficiencies, making it extremely unpopular with production and inventory people. So be prepared for a palace revolt!

Any company considering implementing a MAS needs to ask itself the following before even planning to embark on this journey (because it is a journey, not an event):

- Do we have sampling, weighing and measuring infrastructure in place at the appropriate places to measure each material stream within the different processes?
- Do we have the appropriate maintenance and calibration culture?
- Do we have the employees with the right skills to maintain the instruments, systems and interfaces?
- Do we have a company culture that accepts change easily (probably the most important question)?
- Are we ready for an initiative that spans and touches each production and material inventory movement and storage department in the company?