Broner Metals Solutions

Integration of MES with Planning & Scheduling Solutions

White Paper

This White Paper describes the separate features of MES and Advanced Planning & Scheduling Systems and shows how an integrated MES/APS solution should work. It shows how an integrated and collaborative approach will help to significantly increase the benefits that would be obtained compared with a separate and independent implementation of these systems on a Make-to-Order plant.

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1 INTRODUCTION

Most major steel companies have made large investments over the last few years, to improve their systems, in order to enable their administration to be flexible enough to respond in a environment full of changes and uncertainties.

In most of the cases these investments started with the implementation of an ERP system. The objective was to standardize the business procedures and to allow the high-level management to have a good view of the company's situation in almost real time. The implementation of these systems also helped to reduce the cost of managing the company.

In many cases, following on from this, major investments have often been made in APS (Advanced Planning and Scheduling), Supply Chain Management and/or MES (Manufacturing Execution System) systems. While the ERP focus is in areas such as finance, HR, etc, these new investments focused on improving and optimizing the production and logistic resources.

An APS system uses advanced programming techniques to improve/optimize production planning and scheduling, to allow the company to achieve pre-defined objectives, such as allowing improvements on the delivery performance without raising inventory levels, or maximize the plant throughput.

The Supply Chain Management systems focused on the extended logistic chain, including the demand management systems, order entry and delivery scheduling/control systems.

Finally, the MES systems work at a more detailed level, in order to provide efficient production tracking, and provide the production data showing the actual status, operational data and production for the whole plant. This allows the operators to make small adjustments in the scheduling, etc in order to react to deviations from the planned production and to unexpected or unplanned stops in production.

2 THE INTEGRATION PROBLEM

To allow all these systems to work properly, lots of information has to flow between them. For instance, in order to schedule the plant the APS system most have information regarding all stock available in every step of the production. Depending on the strategy, this information can come from the ERP or the MES system. As a consequence a large number of interfaces are required to allow for this information flow.

These interfaces have also created a big problem, because, in many companies each of these systems and interfaces was supplied by a different vendor, and thus each product has its own data structure.

In some cases the data would be updated on-line from more than one system, creating a heavy transaction workload.

In other cases, batch interfaces would replicate the information periodically, once a day, for instance. Typically this type of interface is divided into three steps: data extraction from the source system, data conversion, and data update to the target system. These processes can take hours.

Almost all interfaces between MES and APS systems are batch. The main reason is that the APS needs information about stock and production from every process in the plant. To allow an on-line interface to work, would mean changing a few thousand programs used by the shop floor workers. Aside from the huge costs involved in such a change, there is a large risk of losing synchronisation because one or two programs may not have been updated and the impact on the quality of the schedules and plans created would be huge.

On the other hand, as discussed before, a batch interface can take hours to run, and as a result the APS will plan/schedule the plant based on a “picture” of the plant that is a few hours old. Consider also, that the APS itself can take a few hours to run, and then the interface to return the plans and schedules to the shop floor will take even more time.

So, to avoid the re-scheduling/re-planning of orders that will be produced during the next few hours, it is necessary to “freeze” these orders, meaning that the APS will not be able to change their dates/sequences. The bigger the time between the start of the MES/APS interface and the end of the APS/MES interface (planning cycle), the bigger the number of orders that have to be “frozen”. Due to the size of the planning cycle, it is almost impossible to run it more than once a day.

To allow us to understand better the impact of this constraint on the results of the plan, first we need to understand the whole of the MES and APS environment.

3 THE APS SYSTEM

The main objective of the APS system is to improve the production planning and scheduling to allow a certain business objective to be achieved. On a make-to-order plan these are typical business objectives:

- Improve delivery performance
- Reduce intermediate inventories level
- Balance the production among all the production lines in the plant
- Maximize productivity.

To allow these objectives to be achieved, an APS system typically has the following functionalities:

- Generation of liquid steel needs to produce orders from the order book

- Order size calculation
- Free stock allocation
- Order re-allocation due to production out of spec
- Production planning for all resources in the plant
- Detailed production scheduling of all resources in the plant

4 THE MES COLLABORATIVE APPROACH

The MES system, under the collaborative approach, is called CPM – Collaborative Production Management. What changes with the collaborative philosophy is that besides its classical functionalities as defined in the ANSI/ISA S95 standard (see Table 1), it also considers the extended supply chain. The MES tracks the production execution in all processes in the plant and reports this data to the upper levels. The MES supplies this image today called “process response”, and this is fundamental to a good execution of the APS and to the report generation on the ERP. It also calculates the real process capacity.

Initially the APS can do its work assuming, for instance, that a certain furnace has a capacity of 90 tons/day. After tracking the execution for some time the MES can figure out that the real capacity is 87 tons/day and pass this information to the APS, allowing a more precise plan/schedule to be created in the future. Although the nominal capacity of the equipment could be bigger than that, the MES must take into account the imperfections in production. The equipment is not available 100% of the time, and it might not work on the nominal production rhythm all the time and part of the material it produces will be out of spec. The result of this is that the actual capacity is smaller than the planned one. It is part of the MES system to receive the schedule from the APS and execute it on the plant in accordance with actual plant status.

ANSI / ISA S95.03

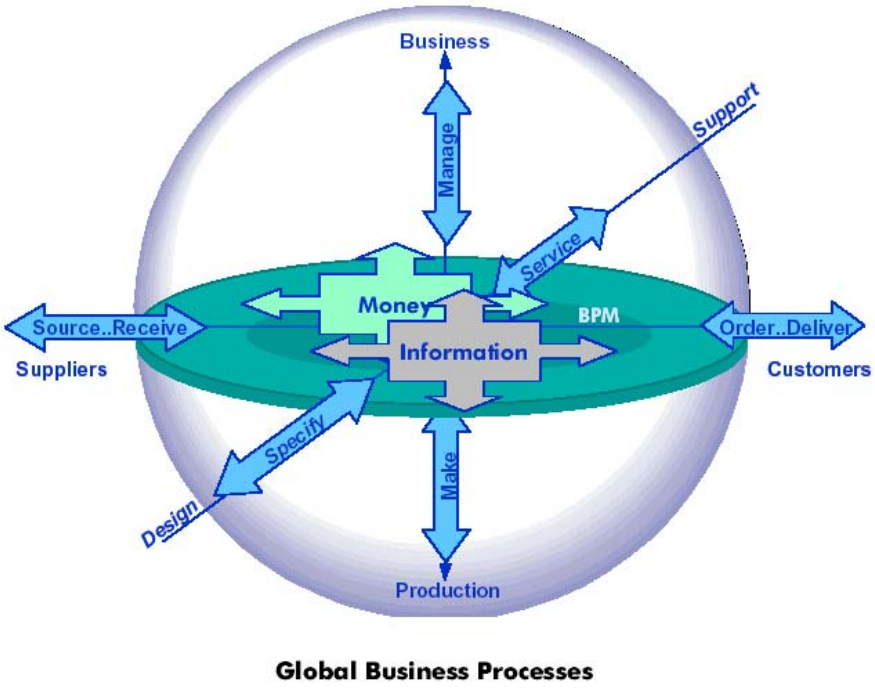
- Detailed operation sequencing
- Production tracking
- Production despatch
- Resources management
- Historical data management
- Product Analyses
- Process Analyses
- Production Analyses
- Product definition management

• Process tracking • Manual operations • Automatic Control

Table 1 –MES functionalities according to ANSI/ISA S95

MES systems help in transforming the production/process management process in a scientific, quantitative activity, based on measured data and not on beliefs or folklore about what really happens. The MES supplies the operators and managers with on-time information for decision making. Another important consequence is empowerment at the operational level. A well-informed operator will make better and safer decisions. The plant operator now has the appropriate tool to help him make decisions.

This vertical view unifying the production and business worlds is the first view of the collaborative model (Picture 1).



Picture 1 – CPM: the three axes representing the three business focuses

The second axis unites suppliers, production and customers along the supply chain. In this view the MES must supply information to the supply chain. The customer and the suppliers can have access to the pertinent information from production. The customer wants to know what is the actual status of its orders, and what is the expected lead time for production. This is essential for the customer to plan their activities. There may also be the same requirements from the suppliers. One of the greatest insights of this

approach is that it is not possible to produce something alone, without taking into account the performance of your business partners. One productive process is not a standalone activity, but it is part of an “orchestra”. For a mining company to perform its activities properly, it depends on the rail network to transport its products to the harbour and it then depends on the operational efficiency of the harbour. It is useless to optimize the harbour supply chain alone, as it is part of a more complex system. If the trains do not arrive as scheduled, the shipping activities will be late.

The harbour depends on information about the wagons that will be received, in which order, containing which kind of product. On the other hand, the railway company needs to know the time and sequence in which the wagons will be released. The simple exchange of information among players in a collaborative chain will help to achieve a better global performance.

Another important point is that the MES must have a multi-site view. Corporate management needs information about all factories from the group, their stock levels, bottlenecks, and so on. The first objective is to optimize by benchmarking. The best practices in one site will be transferred to others. The second is to allow the planning and scheduling at all the sites to happen together. If a certain furnace in site A is stopped, part of the production can be done at other sites.

The last axis represents the product life cycle management, which is essential in industries where the renewing of products is constant. Although this is more common in industries such as automobile, electronics, pharmaceutical, one of the aspects of this view is very important in industries with huge assets: asset management. The MES is fundamental to tracking the life cycle of the assets, as it keeps historical information about rolling cycles, engines operations, etc, providing the maintenance teams with on-line information.

5 NEGATIVE EFFECTS OF A LONG PLANNING CYCLE

One of the collateral effects of having a planning cycle that is so long that it can be run only once a day, is that problems that happen on the shop floor after the cycle is started will not be considered until the next day.

Obviously, the MES will allow small adjustments to be made, and will provide the operators and managers with information about differences of what was planned and what is actually happening. But it is part of the APS system to verify the impact of these changes on the plan and re-plan the plant to minimize its impacts on the business objectives defined by the top management.

If the number of problems is small, this limitation is not a big issue. But what happens when a major problem, such as a breakdown of an important plant resource happens? All production lines after this resource will be unbalanced, production will be lost, and the impact of that will be felt by a failure to meet the business objectives for the month.

Since the APS could not be run again that day, all the other production lines would still be trying to produce according to what was planned prior to the breakdown.

On the other hand, if the APS could be re-executed rapidly, it would help to identify the changes in production that could minimize the effects of the unexpected stop. Besides that, the plant managers would quickly have a clear view of these effects, and of what they need to do to minimize them.

6 THE INTEGRATED APPROACH

How would it be possible to reduce the planning cycle to a level in which the APS could be run many times a day?

One of the ways of reducing the cycle is to eliminate (or reduce drastically) the interface time between MES and APS. This can be achieved in two ways: changing the interface from batch to on-line, in other words, replicating each event that happens on the shop floor from the MES to the APS, or to allow both systems to share the same source of information.

We have already discussed some of the problems in using an on-line interface between an MES and APS, but in this case we can add that this approach would only solve half the problem. The data would flow from the MES to the APS very quickly, but when the APS finishes its run, it would need to update the MES with a big chunk of information at once, in other words, the APS/MES interface would still be batch.

The second approach has the advantage of eliminating the interfaces themselves, which means that the interface time is eliminated , and there is also a reduction in the software maintenance time and cost.

If improvements could also be made to the APS architecture, or a faster hardware could be used to run the APS the total cycle reduction would be even greater. This reduction would allow both systems to interact or collaborate, allowing the APS to be used not only as a planning and scheduling system, but also as an analysis tool to understand the problems found by the MES. Both systems would work together to solve these problems.

7 ADVANTAGES OF AN INTEGRATED MES/APS APPROACH

One immediate effect is that it would not take one day to identify the best production strategy to minimize the impacts of a breakdown of an important resource (as discussed previously). The planners would very quickly have an image of the future effects of the event, and a good knowledge of what needs to be done to minimize the losses.

While the MES alone would allow the operators and managers to see the difference between what was planned and what was actually produced, an integrated MES/APS would allow them to visualize the difference before what was originally planned and what can be done after the differences identified by the MES. Based on this information, the plant production rhythm could be changed to reflect what is really happening on the shop floor. Using the same break down example, other maintenances could be re-scheduled to happen now, reducing the impacts on the stock levels.

Another important point is that the planning cycle time reduction would also allow a reduction on the number of orders “frozen”, increasing the flexibility of the APS to change the planning and production strategies to reflect the new needs of the plant.

All these aspects would result in smaller inventories levels without losses to the operational stability of the plant or, worse, to customer service. Less stock could also mean shorter lead times and consequently contribute to more orders and increased revenue.

The implementation of an integrated MES/APS solution would bring many benefits to a Make-to-Order steel company, creating a competitive advantage that would be very difficult to copy with any other strategy.

About Broner Metals Solutions

Broner Metals Solutions is a company focused on delivering value to the Steel and Aluminium industries through the application of Supply Chain Planning, Scheduling and Manufacturing Execution Systems. Our customers gain improved shareholder value, which is achieved through: reduced inventory; shorter manufacturing lead times; increased throughput; improved delivery performance and better customer service.

All Broner Metals Solutions products have been developed specifically for the Metals industry. Our product range includes Demand Management, Sales and Operation Planning, Availability To Promise, Capability To Promise, Advanced Planning and Scheduling and Manufacturing Execution solutions.

The Broner Metals Solutions team has almost 20 years experience in improving the performance of metals supply chains worldwide including companies such as Baosteel, Dofasco, Corus, CSN, Gerdau, Nippon Steel, Norandal, and Usiminas.

Address

Broner Metals Solutions Ltd
1 Century Court
Tolpits Lane
Watford, Hertfordshire
WD18 9PT
United Kingdom

Telephone: +44 (0)1923 652000
Fax: +44 (0)1923 816456

Email: sales@bronermetals.com
Website: www.bronermetals.com