

Broner Metals Solutions



Choosing Planning & Scheduling solutions for Metals

White Paper

The planning and scheduling of metals production presents special problems because of the complexity of the manufacturing process and the large number of constraints and bottlenecks occurring throughout the manufacturing supply chain. This White Paper presents a detailed review of the functionality that should be included in a metals production planning and scheduling system.

November 2003

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1 High-Level Functionality

What is important to have in a planning and scheduling system for a steel producer

- Time Instead of Tons:** Because different products take different time to produce on the same machine, the capacity of a machine depends on the actual product mix. A good planning and scheduling system will convert the tons into time.
- Attribute-Based System:** Most metals companies don't use part numbers. They produce material with a variety of attributes/characteristics that makes it impractical to specify every product as a part. While part numbers or similar may be used for higher-level planning, at the detailed level, it is important to be able to use all of the attributes of an order, sales or manufacturing, so as to be able to make decisions based on those attributes.
- Finite Capacity:** For the most part, metals companies "sell" time on their machines. Given that different products take different time to produce on the same machine, it is important to have a finite view (as opposed to infinite) of the used and available capacity of machines – both from a planning and scheduling standpoint.
- Variable Lead-Times:** Historically, many metals companies have used standard lead-times for products (such as 6 weeks for cold rolled product). These fixed lead-times can be inaccurate because they do not take into account the load on the plant nor the availability of the machines into the future. A good planning and scheduling system will determine the lead-time for orders, not fix this regardless of actual conditions. Standard lead-times that don't take into account the load and product mix do not work well in a metals plant.
- Variable Buckets:** Historically, many metals companies have used one week as the "bucket" of time for each operation. If a product had four processing steps, then the lead-time would be four weeks. A good planning and scheduling system will determine the bucket size based on capacity, machine availability and other factors. This is a key point as fixed buckets and fixed lead-times fix the amount of inventory in the system and the inventory turns. The result is that it is very difficult to change this once it is set but this is where large improvements can be made.
- Level of detail:** It is important that a planning and scheduling system work at both a higher level of detail (customer order level) and lower level (individual coils or pieces) and be able to link the two together. For example, to know if a customer order is on-time, one must be able to link the customer order to the pieces and then know if all of the pieces will be completed on-time.
- Sequencing Matters:** While in some industries this is not a major issue, in metals, the exact sequence of products run on a machine is important because it affects the quality and number of setups or equipment maintenance and, therefore, the throughput of that machine. Sequencing in metals can involve relatively simple sorting and grouping all the way to very complex time, quality and product dependent sequencing rules.
- Batch Operations:** Metals requires batch operations such as casting and furnaces where several pieces are processed at the same time. Many of these batch

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operations have a series of constraints that affect the number of pieces that can be processed at one time (i.e. it could depend on furnace type, the particular product and physical limitations of equipment). A good planning and scheduling system has to be able to handle single and batch-type operations.

- Yield Considered:** As metal is produced, scrap is created. A good planning and scheduling system has to be able to consider yield as it affects material application and capacity planning. The yield of a metals product can be influenced by a variety of factors including the routing, how well the equipment is running and how difficult it is to make; yield adjustments can be made by product, by operation and by a number of other factors – and the system must be able to account for this.
- Bill of Materials:** In a metals plant, there is a product structure (i.e. pickled band comes from a hot rolled coil) but there is not a traditional bill of material structure, Generally, the bill of material is a piece of metal that is “heated, beaten, cut and treated” as opposed to being assembled with a number of parts (as in discrete parts manufacturing).
- Application/Re-application:** While certain metal might be intended for certain orders, due to a variety of reasons (such as metallurgical or quality), this might need to be changed. Particularly in the primary end of the business where steel is made, the resulting material might not meet the specifications but it might be able to be used for another order. This is a key issue in metals plants and must be dealt with at the attribute level – not as a product or part number.
- Speed of Solution:** Many ERP systems still take many hours to run – due to constant computer I/O, sequentially processing data or other reasons. A modern planning and scheduling system should be able to run in an hour or less (or minutes) depending on the level of detail and the computer being used.
- Rule-Based:** The user should have the ability to turn rules on and off and to change parameters in rules so as to make the model reflect current conditions in the plant.
- What-If:** A good planning and scheduling system should be able to be used in an on-line mode as well as an off-line, what-if analysis tool. The user should be able to make changes to the model, store them in his/her own area, run one or more scenarios and complete an analysis – all without affecting the “official” model and others seeing these test runs.
- Modeling Capability:** Should be able to model a variety of things including product structure, machines and other resources, including availability, maintenance, setups, cooling, etc. and details of operating constraints and rules.
- Vendor Industry Experience:** The vendor should have some experience in the industry with either consultants having come from the metals industry or having worked as consultants in metals plants.
- Successful Implementations:** The vendor should have experience in delivering, implementing and servicing metals companies like yours – and have references that are willing to discuss the benefits that they have received as a result of the system.
- Single integrated database:** The complete planning and scheduling system should use a single, integrated database. This means that all the modules are fully integrated – there is no requirement for moving data or files around (which is the case with some other systems). It is generally not the “owner” of sales order or manufacturing data, therefore should be integrated to other systems.

2 Specific Modules

What is important to have in particular modules of a planning and scheduling system for a steel producer

2.1 Production Planning

The planning systems within steel plants need to be able to manage multiple bottlenecks. The bottlenecks within the steel plant will depend on product mix and steel plant configuration. Planning systems need to optimise and balance flow of material through the supply chain considering inventories, equipment capacity, production cycles and process restrictions while taking into consideration customer and product/segment priority. This is required to:

- Minimize lead times and inventories for the actual product mix.
- Improve productivity and throughput through better management of bottlenecks
- Maintain a flow of material based on campaigns and batching rules
- Maximize customer service

Infinite and Finite Capacity: The ability to show the load on resources with either an infinite or finite amount of capacity available.

Smooth the Load: The ability to solve capacity problems by smoothing the load.

Backward Planning: Starting from the last operation and planning in reverse order; sometimes referred to as Pull; will result in lower inventory as tries to minimize the amount of time that material is in the plant.

Multiple Pass Planning: To plan a plant with bottlenecks that move during the planning horizon, the system must have the ability to plan Backwards and Forwards, to plan the flow into the Bottlenecks so as to protect them with a Time Buffer, and to expedite urgent material after the Bottleneck.

Synchronous Zones & Asynchronous Points:

The system should allow the flow of material to be synchronised through parts of the plant (i.e. a synchronous zone like Casting, Slab Treatment, Hot Rolling), and then stage the material (asynchronous point) before launching into the next synchronous zone (for example a Plate Section or Cold Mill and Process Lines)

Multiple Strategies: The system should allow the steel plant management to define different manufacturing strategies for different product families or market sectors; for example, for an OEM customer a JIT strategy is followed, while mass

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production for foreign stocks are produced using a high utilisation, opportunistic strategy.

Detailed Resource Calendar: Ability to model resources, such as machines, tools and labor, in-detail, so as to be able to determine the amount and timing of capacity required.

Planned Start-Dates: A key output of the production planning process; the date that each step in the routing should be completed; referred to as task-dates.

Dynamic Task-Dates: Refers to the ability of the software to change task-dates based on the load in the plant or to react to problems such as a machine going down or material being late.

Alternate Resources: The ability to plan using multiple similar machines when a capacity shortage or problem with a machine occurs.

Multiple and Changing Bottlenecks:

In a metals plant, there may be one or more bottlenecks that change during the planning horizon, depending on product mix and machine availability. A metals planning system needs to be able to determine what the bottlenecks are and react accordingly.

Campaign Planning/Batching:

The ability to control the flow of material in a metals plant is a key requirement. Metal must be batched or grouped together with similar material based on detailed attributes and characteristics.

Control Utilization: There should be some ability to control the utilization of machines in the plant.

Flexible Pegging: The planning system should have the capability to keep material applied to a certain order (hard pegging) and also allow that link to be broken if necessary (soft pegging).

2.2 Material Planning

Material planning must exploit flexibility during allocation of materials to customer orders, make plans for new materials and be able to re-apply material when problems occur. A key function of Material Planning in metals is to generate planned material that is required to be planned through the plant at a low enough level of detail so as to enable an accurate view of capacity. The metals industry has specific requirements for material planning that includes attribute matching, trim optimization, piece size optimization (coil splits & welds), plate cutting optimization and mass allocation (considers all orders and all material).

Attribute-Based Allocation: The ability to apply and/or re-apply material based on attributes, not at a part level.

Alternate Applications: The ability to consider preferred and alternate material specifications.

Consider Yield: The ability to consider whole and partial material yield when applying material.

Prioritize Material:	The ability to protect priority customers and products against material shortages and quality problems.
Plan Material:	The ability to plan material requirements at a detailed level sufficient for capacity planning.
Optimize Size:	The ability to use coil splits and welds, trim optimization, and slab/plate cutting to apply the best material for the order.
Automatic Lock:	The ability to lock material to an order (or the reverse) based on a combination of the order and the route.
Mass Allocation:	The ability to re-allocate material on a large-scale based on customer and priority to respond to major quality problems, production delays or order changes.

2.3 Production Scheduling

Taking the planned start-dates from the Production Planner as input, Production Scheduling generates the actual sequence of work to be done at each machine considering the detailed operating constraints, practices and rules while considering overall plant inventory, utilization and on-time delivery. The requirements for scheduling differ depending on the area of the plant (steel making vs. hot mill vs. cold mill vs. finishing).

Overall View:	The ability to resolve the complex needs of scheduling of steel making, casting and hot rolling in order to provide the best overall, coordinated performance of the plant.
Primary Scheduling:	The ability to schedule all of the equipment in the primary area including generating heat and tundish sequences, support hot charging and consider physical, metallurgical and quality rules.
Primary Optimization:	The ability to optimise the primary part of the plant including lowering the cost and increasing productivity by reducing pig iron dumping, longer heat and tundish sequences and increasing hot charging.
Hot Mill:	Considers the detailed scheduling requirements at the hot mill while also taking into account the effect on the Primary and Finishing areas, particularly considering hot charging, if applicable.
Cold Mill and Finishing:	The ability to create detailed, short-term synchronized schedules all parts of the cold mill and finishing operations.
Flexible Rules:	The ability to configure the scheduling rules to match individual plant and equipment requirements.
Display Violations:	The ability of the scheduling system to show violations of rules based on user-set parameters.
Drag and Drop Editing:	Refers to several capabilities including being able to move pieces and/or orders and changing material allocations through a mouse-enabled, drag and drop process.

2.4 Demand Planning

Demand Planning in a metals plant consists of Demand Management, Business Optimization and Order Promising. Together, these are sometimes also referred to as Master Planning. Demand Planning is mostly strategic and tactical business planning tools that focus the capacity of the plant on the most lucrative products and markets while Order Promising is more of an operational tool. Demand Management is mainly concerned with forecasting demand while Business Optimization is looking at long-term, rough-cut demand vs. capacity. Order Promising determines the due-dates for customer orders, considering capacity, product mix and/or profitability.

Historic Mix:	Uses the historic mix by customer to project an aggregate and disaggregated forecast.
Selling Price:	Maintains a database of selling prices for products for use in profitability/product mix calculations.
Production Restrictions:	Can consider production restrictions when determining constrained demand.
Optimized Plan:	The system has the capability to optimise the sales plan, production plan and procurement plan based on maximizing the profit margin.
Flexible Data:	The system should allow different data values to be used for different time periods, such as different selling prices for each customer and time period.
Quick Response:	Provide near real-time (seconds) response to Order Promising inquiries.
Realistic Due-Dates:	The system should consider the actual load on the plant using finite capacity when calculating promise dates.
Consider Campaigns:	When determining due-dates, the system should consider campaigns and batching requirements.
Piece-Level:	The system should be able to calculate the piece(s) size based on order weight and coils max/min restrictions. This level of detail is required to adequately check capacity and material availability and, therefore, determine realistic due-dates.
Other Restrictions:	The system should consider other restrictions such as product mix and process restrictions.

3 Value to your Business

A Production Planning and Scheduling System is not just a computer system but it can be used to differentiate one company from another. A planning and scheduling system can be used to provide a superior level of customer service and to enhance a company's business processes. This system can be used to provide quantifiable, measurable benefits that directly impact the bottom line of a metals company. Some of these benefits are:

- **Improved delivery performance**
- **Improved product profitability**
- **Improved productivity**
- **Increased revenues**
- **Reduced downtime**
- **Increased utilization**
- **Lower manufacturing costs**
- **Better product sourcing**
- **Improved yields**
- **Lower work in process inventories**
- **Lower finished goods inventories**
- **Reduced lead-times**
- **Shorter order to cash time**
- **Improved asset utilisation**
- **Fewer physical assets (i.e. plants, warehouses, material handling equipment, trucks, etc.)**

A Production Planning and Scheduling System can also provide a variety of non-quantifiable benefits – real benefits that are hard to quantify but still valuable to the business. Some of these non-quantifiable benefits are:

- **Improved customer service**
- **More reliable supplier**
- **Improved competitiveness through shorter lead-times**
- **More responsive to changing customer requirements**
- **Some ability to pick business and product mix (from being a better, more reliable supplier)**
- **Reduced administrative paperwork**
- **Consistent application of business rules**
- **Ability to train new workers and retention of corporate knowledge**
- **Better decision making**

4 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.

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