Integrating process improvement and automation for optimizing steel plant operations

Atanu Mukherjee – President; 15 March 2009

Optimizing steel plant operations requires that we address various aspects of process, operations, methodology and related capital expenditure. Addressing the subject of optimizing operations in a steel plant remains incomplete till a few questions are not answered

- What are the levers to increase the plant throughput with minimal capital expenditure?
- Can a phased plant-wide automation strategy be developed considering planned equipment and other technology upgrades?
- What other capital projects should be undertaken to achieve the next level of improvement?
- What are the potential savings opportunities, risks and implementation complexities of these improvements?
- What are the timelines for achieving these results?

Areas for improvement

Inventory Optimization, Cycle Time Reduction, Material Movement and logistics along with Automation are the typical areas to be explored for improvement while planning optimization.

In our experience management of inventory across the production chain can yield significant results. Inventory management in steel operations is complicated by the nature of steel making process from iron and steelmaking to rolling due to the nature of material transformation. Inventory optimization ensures a low work-in-progress and finished goods inventory. Along with reduced shipping time between steel making and mills, improved visibility through better real time tracking across shops coupled with spare parts inventory management; in turn, lead to reduced working capital requirement

Cycle time reduction entails reduced time between hand-offs in convertor shops and mills, reduced test time through better integration with test instrumentation and laboratory management systems, improved billet/slab sequencing in reheat furnace area and minimized re-setup time in mills, thus increasing plant throughput.

Better Material movement and plant logistics results in improved shop production efficiency. This area draws attention to the movement of products between casting and rolling mills, evaluating options of capital investment on raw material and its scheduling and the hot metal wait time between blast furnace and converters. Additionally, careful planning of material routing and movement reduces capital expenditures on fleet like locomotives. We find that simulation exercises are an important mechanism to design efficient material movement and logistics plans.

Automation when leveraged well improves plant wide efficiencies. It increases operational efficiency and flexibility by reducing manual intervention while increasing flow. Automation should

be implemented starting from instrumentation right through MES and ERP with integrated systems across all levels in a phased manner with careful consideration to return on capital.

Implementation Principles

It is important to understand that automation is not a silver bullet; however, when preceded by process improvements, its efficiency is multiplied. Big bang automation only focused solutions usually entail a higher cost and longer time for implementation. Also the risks of failure are higher. Whereas, process improvement followed by phased automation is easier to implement, has lesser resource intensity and run a minimal danger of amplifying the negatives.

Process improvement, when implemented in phases, bears lesser risk compared to a big-bang approach which is marked by larger upfront investments and resource deployment, uncertainties in realization of the full project, coordination complexity and most importantly higher cash flow drain. The phased approach on the other hand prioritizes implementation thus making way for benefits much faster; it minimizes risks through progressive learning and better visibility and facilitates progressive deployment of resources which helps limit the project if required.

An integrated system across operations is another important dynamic in a steel plant optimization. In contrary to shop specific solution, integrated solution is characterised by inter-shop coordination, global optimization, integrated islands of automation, better end-to-end yields, and better cash flows.

An improved cash flow and working capital needs is always set as one of the most important objectives; and the phased approach devises just the right process to meet this objective. This approach minimizes capital intensity by extracting maximum operational efficiencies. In this process, capital improvement projects are incrementally deployed and operations are re-optimized to leverage new improvements thus maximizing returns on current assets.

Recommendations on approaching plantwide integration

First focus on process improvement and basic automation

- Material movement and logistics optimization
- Process optimization across SMS, caster and mills
- Laboratory cycle time reduction and test integration
- Transport process optimization
- Overall automation roadmap
- Level 1 automation upgrades where required

Next focus on Level 2 automation and MES

- Inter-shop coordination and sequencing
- Level 2 optimization models , empirical where necessary

- Manufacturing execution system involving Level 3 automation – scheduling and sequencing, order management, inventory management and plant wide product and quality tracking

Finally focus on leveraging IT across all functions

- Supply Chain Management (Level 4) IT solutions across the plant
- Integrating all levels – 1 through 4, of IT solutions
- ERP systems for better inter plant or enterprise level coordination

Implementing

Firming up the scope

The first step of implementation defines the scope of blueprint exercise, identifies specific process improvement and automation projects to be taken simultaneously, firms up the process improvement analysis areas and tunes the engagement model for the levels to follow.

Two parallel streams

The second step has two functions operating simultaneously – Automation and Operational Process. For the automation part the projects portfolio is analyzed, the engagement team is set up and then the project is designed and piloted. Simultaneously, the operational process is analyzed, the team for redefinition is set up and the operational process is redefined.

Implementation plan

This is the final step where scope of the implementation complexity is identified followed by the plan migration strategy. The cash flow is then analyzed and the financial model created. And finally the change management process is defined. Improving and optimizing existing steel plant operations requires that process analysis be integrated with automation system design. Careful analysis and planning are required for such projects to succeed. This also means that a thorough analysis on return on capital, cashflow is also undertaken. And finally implementation of such projects should be in a phased manner to minimize risks and maximize the return on investments.