

Enterprise Resource Planning to handle data in the steel industry

ERP breaks the boundaries between the different applications and databases of various processes and builds a unified database to provide transparency between all departments without duplicating data input. The authors discuss the approaches that can be taken by the steel industry for implementation of ERP to make correct decisions at the right time to meet ever changing market demands.

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IN today's competitive market, the steel industry is living in a constant state of change. Industry must quickly and cost-effectively react to business changes to stay competitive. As a pro-active measure, businesses are using state-of-the-art Information Technology (IT) tools for rapid decision-making. People are opting for multicurrency, multilingual, flexible web-based architecture coupled with efficient database management systems providing data-sharing across the enterprise as well as with outside agencies. The IT solution providers, understanding the needs of the hour, are upgrading their software solutions to support recurring changes in stringent quality requirements or supporting new business processes and best practices. Similarly Enterprise Resource Planning (ERP) vendors are offering services for compliance to new regulations, mergers and acquisitions, changes in business process, reorganisation and restructuring etc, as well as other basic functional requirements.

The steel industry, traditionally, has developed in-house applications, based on the prevailing business scenario and market requirements in all of its major business processes. These applications, developed in isolation, lack free communication between them. Process automation systems that are mostly outsourced also run in isolation with other peer automation systems. This heterogeneous nature of the IT systems and processes has led to disjointed and duplicated data which cannot be relied for its authenticity and accuracy.

Today, all-round competition is forcing steel plants to cut costs and align their business strategies with customers. IT systems have to bridge the communication gap between the various processes and applications to optimise utilisation of internal resources and improve inter-shop as well as inter-unit communication for centralised or integrated functions. The need has been felt to integrate the various processes that help the organisation in timely delivery of quality products and services to the customers. This can only be achieved by an IT system that provides services to all processes with an integrated approach.

ERP breaks these boundaries between different applications and databases of various processes and builds a unified database catering to the needs of all departments without duplicating a single data. It provides a totally normalised database across the organisation

and a common information backbone for contemporary manufacturing enterprises. It works on fundamental principle that the whole is always greater than the sum of its parts^[1].

This helps manufacturers handle their routine jobs such as order processing, inventory control, accounting, production scheduling and human resource management more efficiently. Apart from these common routine functions, ERP provides end-to-end, on-time information visibility that can help the company adapt to business and market changes more quickly. The territory of ERP has expanded into such areas as Supply Chain Management (SCM), Customer Relationship Management (CRM), Business Intelligence (BI), Data Warehousing (DW) and e-Business.

The steel scenario

The modern world is built on steel. Steel has become an indispensable part of life in both developing and developed countries. In the past five years, the pace of growth has accelerated and in 2007, world crude steel production reached 1343.5Mt^[2]. This was an increase of 7.5% over 2006. The future growth in demand for steel will be driven mainly by the needs of the developing world. So, the steel industry must continue to grow worldwide and dynamically adjust the production targets in various scenarios including such situations as the financial turmoil that the world is facing today.

The steel industry is changing rapidly to realign itself with the market. To meet the just-in-time demands of the market, the steel companies are

focusing on improved scheduling systems for efficient production planning and control and on optimisation of manufacturing execution by integrating the process with the business. Higher prices of raw materials have put pressure on reducing work-in-progress for a better Net Sales Realisation (NSR). Organisations want to track materials, work-in-progress and finished products to satisfy the ever increasing demands of the customers instantaneously and more efficiently by linking suppliers and customers using supply chain management systems. A need has been felt to synchronise the manufacturing process with quality management, plant maintenance and other business processes. The state-of-the-art software tools need to be integrated with material resource planning for reduced inventory along with optimisation of

raw materials as well as product costs. Hence, the decision making software tools with respect to procurement, product-mix, marketing and pricing are in great demand.

An ERP package can play a crucial role in providing the consistently correct data for analysis in order to make the correct decision with respect to demand, quality requirements, work-in-progress, costs and future plans. Keeping all these in mind, the decision makers in the steel industry are taking steps on a priority basis to address various issues such as:

- Direct linking with the customers for detailed information on order, work-in-progress etc;
- Integrated planning for procurement of raw materials and spares;
- Availability of centralised data for finished products in stockyards and stock-in-transit;
- Integrated software in place of legacy

accounting systems to handle the fixed and variable costs at different stages of production efficiently as well as statutory requirements followed in different countries;

- Availability of company-wide process optimisation tools as well as data warehouse management tools.

ERP has evolved technologically from a monolithic legacy implementation into a flexible, tiered, client-server or web enabled architecture^[3]. ERP has become an enabler for standardisation, integration and consolidation in order to achieve lower cost production, reduced inventory, improve supply chain efficiency, achieve better quality, better collaboration with partners and higher performance standards.

Automation and IT model

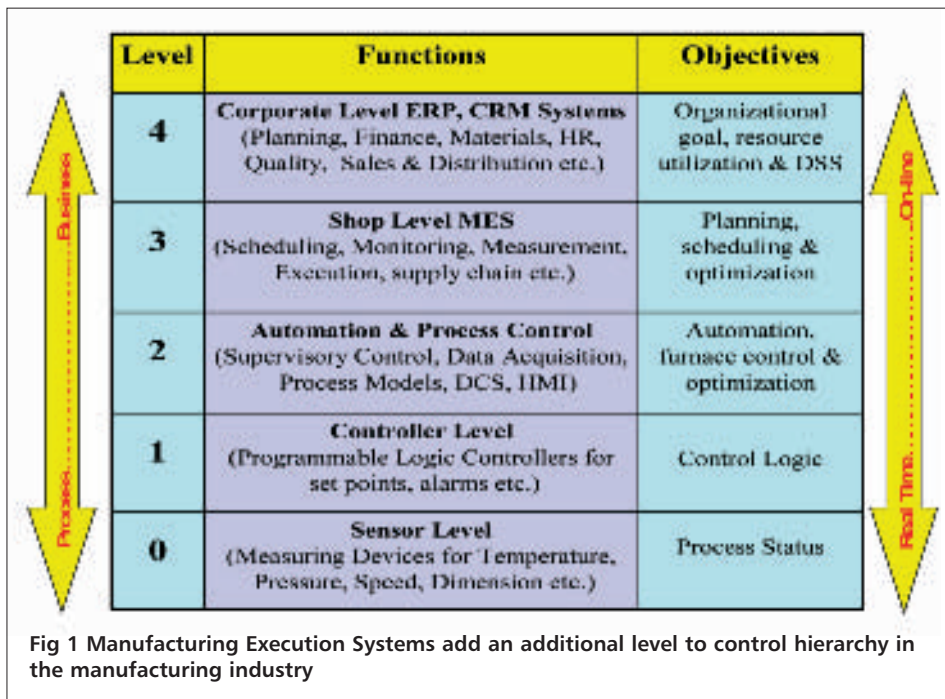
In an integrated steel plant each processing unit implements its own automation and IT systems for different activities related with the process and business. There is a need for sharing of data among these databases at organisation level for availability of information to the top management for quick decision making. So, the databases of different departments are integrated on a very fast and reliable network. This integration helps the organisations handle their resources more efficiently and remain competitive in the global market. A need has also been felt to seamlessly integrate the different levels of automation or control hierarchy in the steel industry to enable the flow of information on-line from business level to process level and vice versa. Traditionally, the control hierarchy was considered as four levels. These are:

- level-0 for sensors or measuring devices,
- level-1 for shop level automation with SCADA or DDC systems using Programmable Logic Controllers (PLC),
- level-2 for process control by using models
- level-3 for shop level production, planning and control using databases.

"ERP is a suite of application software that represents best practices to manage the resources of the entire enterprise."

"Communication is the need of the hour."

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Level-3 is integrated with the organisation level business applications such as finance, materials, sales and order processing etc.

There are of course differences in opinions on the number of levels in control hierarchy. Some people have proposed three levels of hierarchy by merging level-0 and level-1 while others add manufacturing execution systems as an extra level. But, there has to be seamless integration among these control levels in order to meet the requirements of information about the process and business by the decision makers at different levels of the organisational hierarchy. On-line data about the process is provided to ERP packages by shop level Manufacturing Execution Systems (MES). MES works at a more detailed level in the shop and helps production tracking showing status and operational data in real-time. MES can be used to measure and control critical production activities. It provides the base data for upward integration. Therefore, the levels of this control hierarchy can be extended by incorporating ERP and MES to make it a 5-level hierarchy. The diagram on this extended control hierarchy (Fig 1) shows the role of ERP at the top as Level-4 in manufacturing to business integration.

ERP functions

ERP systems can be easily implemented in non-process industries, but specialised functionality has been added to some as required by specific manufacturing industries. ERP today has expanded from simply coordinating manufacturing processes to being the integrator of enterprise-wide backend processes. The four major functional areas of ERP are^[1]:

- Business or Manufacturing Process related modules;
- Material Management modules;
- Financial Accounting modules; and
- Human Resource Management modules.

Business or Manufacturing Process modules cover production planning, work-in-progress, delivery of products, marketing etc. Some packages also include marketing and customer complaint/feedback management. Production

planning activities are also expanded and integrated with Manufacturing Execution System for production control. Some of the main functions of these modules are^[1]:

- *Production Planning:* Unit wise production schedule and material planning.
- *Production Tracking and Maintenance:* Resource management and allocation, product tracking and information, product dispatching, quality control, costing, rejection and waste management.
- *Sales and Marketing:* Customer database, market survey, customer awareness, pricing strategy, packing and shipping.
- *Warehouse Management and Distribution:* Goods-in-stores, stocks-in-transit, transportation and logistics, distribution schedules, goods diversion management, asset management etc.

Materials Management modules cover activities such as procurement, inventory management etc. These modules help in on-line availability of information about material procurement, supply status, supplier information etc for decision making with respect to production as follows:

- *Raw Material Management:* Inventory Management, Supply Tracking, Raw Materials Receipts, Payments, Raw Materials in Transit, Liability Provisions etc;
- *Order Processing:* Order entry, tracking, pricing, invoicing and customer care;
- *Procurement:* Supplier database, Supplier performance.

Financial Accounting modules take care of the activities with respect to accounts receivable and payable. It keeps track of the accounts due to the company from customers and others, accounts payable to suppliers and distributors, maintains centralised details of accounts and prepares general ledgers, balance sheets, manages cash, manages statutory requirements, prepares budget and its accounting as well as allocation, maintains depreciation and other costs associated with fixed assets, analyses product costs with

respect to fixed as well as variable costs, provides all information for financial consolidation etc. This enables organisations to deliver real-time performance analysis directly to the desktops of business managers or decision makers. Even the customers and suppliers are linked via the internet to provide them with the relevant key information for faster communication and timely action.

Human Resource Management functions of ERP cover data and functions of personnel managers, decision makers and employees themselves. This covers all the information starting from recruitment to superannuation of the employee including pay packages, promotion history, development needs/training etc. Tools for analysis of the workforce, allocation of tasks, performance management, understanding of the expertise available and development needs are helpful for strategically managing the company's human resources. These tools have become the latest focus of the human resource information/management systems.

Leading ERP systems available in the market have progressed beyond the conventional transaction processing capabilities by providing tools for project management, on-line analysis by integrating the system with the business data warehouse to provide effective decision support systems, thereby increasing the overall profitability of corporate accounting operations. Some packages also include features such as both forward and backward scheduling, preventive maintenance (PM) capability, probability-based simulation, optimisation capability and expert system knowledge. In addition to the core functions, integrated industry-specific applications can add significant functionality and value to an ERP package. As an example, in the steel industry, the ability to configure products and produce an accurate bill of material based on a multi-dimensional, user-defined matrix greatly simplifies the complexity of order entry and production^[1].

ERP in process industry

There are currently more than 3500 different grades of steel with many different physical, chemical, and

environmental properties. Approximately 75% of modern steels have been developed in the past 20 years^[3]. Customers look for the details of these products on-line. So, they go to manufacturers who can supply the information about the product, its production and quality and delivery details instantaneously. Many organisations so far concentrate on the production process and pay very little attention to the requirements of customers since appropriate tools have not been readily available. ERP provides web based tools to build customer relationship and strengthen the supply chain of the manufacturing industry. It helps in seamless remodelling from product-driven to customer-driven enterprise.

ERP creates the environment for an on-line integrated single database resulting in the single version of the data that cannot be questioned because everyone accesses the same repository of data. There is standardisation among the processes leading to time saving, increased productivity, improvement in quality and better customer satisfaction. This standardisation also helps companies to easily migrate the important data in case of mergers and acquisitions.

"Customers go to manufacturers who can supply the information about the product."

Standardisation can be carried out for unified codification for products, materials, suppliers, customers etc. For multiple business units, the standardisation helps greatly in human resource activities in tracking personnel activities and communicating with them. However, standardisation is advisable in the business segments defined by regional and market alignment so long as it is a business enabler^[1].

ERP integrate processes

As per the outcome of the business process management benchmarking study conducted by the American Productivity and Quality Center (APQC), the integrated processes creates values by increasing productivity and decreasing costs. Processes when integrated end-to-end align technology with business needs more precisely and help companies realise operational goals as shown in Fig 2. The integrated systems help companies to comply with various statutory requirements, as well as certification requirements. It helps in merger adjustments, outsourcing, resource utilisations and other services^[4]. The shop level MES when integrated with ERP modules helps in a comprehensive Supply Chain Management (SCM) solution. This delivers better manufacturing and customer service.

ERP selection

Selecting an ERP is one of the most expensive and difficult decisions. There are many challenges and it needs much hard work to make the right selection of an ERP; its modules as well as its implementation partners. Many companies appoint experienced consultants who help to decide what is best for an organisation. Still, the options available are so many, but navigating these options and selecting the right one for the business is not an easy task.

The first option is to assess the capabilities of the ERP modules and whether they can provide additional functionalities over what the present legacy systems are providing in addition to the enterprise wide integration of processes. How easily the ERP system can align its applications with the business processes or vice versa must be assessed.

Much of the customisation of an ERP package is performed during implementation. This customisation on site cannot be avoided but the extent of customisations should not cause the length of implementation to go beyond a specified limit. One must determine and define the detailed project objectives beforehand. In case of merger or acquisitions there is a need to be extra careful during selection especially if ERP is already implemented in one or more of the merging units because interfacing heterogeneous ERP systems is a costly affair. A good demonstration of the system before a decision is taken, followed by an awareness programme for the people at all levels, might help in this respect. The areas that need attention while implementing ERP packages in the steel industry are:

- Integrated production planning and scheduling based on market demand and raw material availability;
- Efficient product mix management;
- Detailed analysis of production cost with respect to fixed and variable costs;

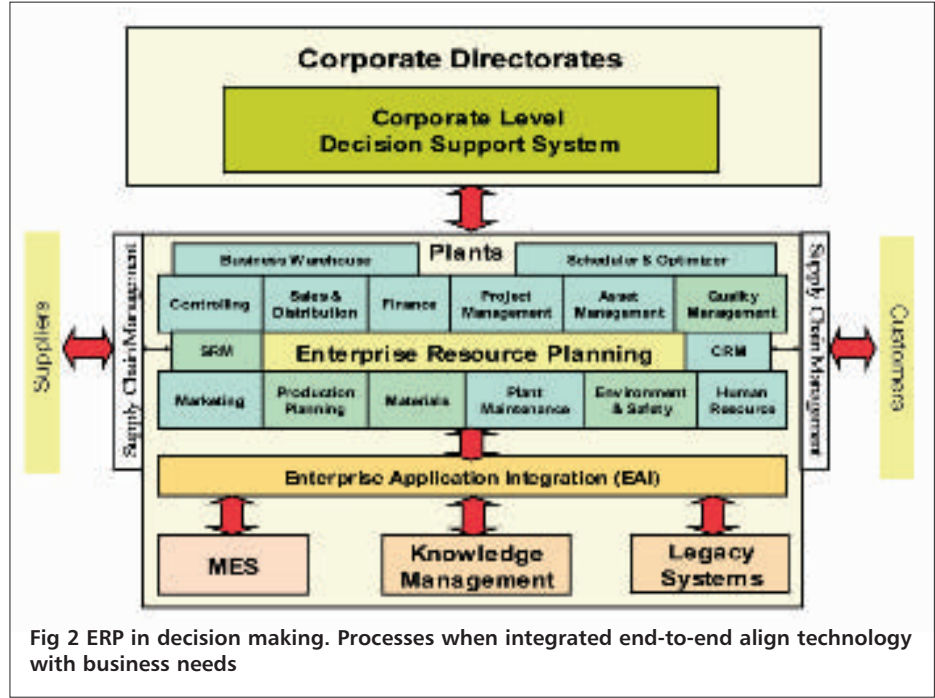
"the larger the number of stakeholder groups involved and more complex the processes, the more likely the project will fail due to business requirements related problems."

help the organisation achieve world-class success and industry leadership. The data is an asset for the organisation. So, emphasis should be given to automatically transfer the data that one maintains about finance, HR, suppliers, production etc^[5].

Phases of implementation

The critical success factors of ERP systems are mainly the selection of modules required and their proper implementation and use. According to the various studies made across the globe it has been found that steel companies have implemented ERP in a phased manner. The main modules implemented in various steel companies are typically:

- Production Planning;
- Marketing including Sales and Distribution;
- Financial Accounting;



- Information sharing with customers and suppliers.
- Steel plants handle large volumes of data on material movements comprising of qualitative and quantitative information on raw materials, semi-finished and finished products, energy consumption and cost related data. To manually enter all this shop floor data into an ERP database is an impossible task. Therefore, it is necessary to upload the relevant information from the process applications via a proper interface or exchange infrastructure for a complete unified database for the ERP. This must be properly addressed while selecting ERP modules. Integrating the ERP system with real-time shop-floor applications such as MES can drive interoperability for plant-to-enterprise business operations.

- Materials Management;
- Maintenance Management;
- Quality Management;
- Human Resources;
- Assets Management;
- Project Management.

Steel producers across the world have implemented or are in the process of implementing similar types of modules with common objectives. The preliminary approach has been to establish a business planning process to improve accuracy of forecasting and reduce the planning cycle time. Therefore, these industries are implementing the modules to optimise production planning and scheduling, thereby transforming the operations from 'production push' to 'market oriented pull' models for better alignment with customers' needs.

One approach has been to implement the modules in three phases. For example, in the first phase go for planning, process restructuring, scheduling, quality management and first go live with core models such as finance, materials management and sales and distribution. In the second phase one can go for data warehousing, plant maintenance and human resources. In the final phase of ERP implementation, one can integrate the system with a Customer Relationship Management (CRM) module and Supply Chain Management (SCM) capabilities. The project task force should map the ERP modules with business processes. The programmes on change management should be conducted to appraise the people who are directly involved with the process. This may also help in getting innovative ideas from the process workforce.

It is advisable to implement those modules that are similar in all the units of an organisation at its various localities to fully exploit the benefit of integration in a new situation. This approach helps the organisation to better use its expertise and resources. For example, if a unit does not have a particular resource or expertise one can globally search and take action to transfer resources or even transfer a customer order to an appropriate unit considering all logistics including raw materials, processing capabilities and transportation. This approach also helps in consolidation of

financial accounts due to the availability of all information on-line. A properly designed Knowledge Management (KM) system can also be integrated with ERP for better implementation of the modules and help bringing everyone at the same level. In the case of mergers of companies where different ERP packages are already in place, standardisation of ERP may be too complex because of diversities and intrinsic complexities in different market and geographic regions. In such a case it is better to go for standardisation in selected segment wise business processes.

ERP implementation statistics demonstrate an important relationship: *the larger the number of stakeholder groups involved and more complex the processes, the more likely the project will fail due to business requirements related problems*^[6].

To overcome the problems during implementation the different stages of conceptualisation to implementation must be detailed to address the following points^{[6],[7]}:

- Define the project by thoroughly understanding the requirements or deliverables.
- Detail the critical business process scenarios that should be addressed by ERP.
- Visit successful ERP implementations in other steel plants.
- Create a roadmap of the project. This will include detailed micro-planning.
- Ensure support from top management as well as involvement of executing levels.
- Form a dedicated project team for involvement until the end of the project.
- Prepare the scope of the project clearly

including role clarity, quality requirements, software validation techniques and risks involved.

- Always separate business requirements (what the system must do) from technical design (how it will do this).
- Organise change management programmes for all levels before implementation.
- Quantify the project outputs.
- Ensure use of state-of-the-art-technology for development of the ERP package, availability of up-to-date source code and continuous technical support from suppliers.

Why ERP?

ERP provides more accurate material and financial status due to consistency in the flow of processes and information enabled by a real-time integrated database available on the web. Content is dynamic, giving end-users the information they need to make decisions on their desktops. The inherent integration of processes allows knowledge sharing. Due to standardised content management process, the decision makers can more easily retrieve information. Leading ERP vendors are also building their applications based on small components using object oriented software development and Service Oriented Architecture (SOA). These newer methods allow gradual evolution and change of systems without resulting redundancy and complexity. Lastly, the implementation must be backed up by appropriate change initiative measures and organisational realignment with support from top management. The implementation road

map must include extensive and comprehensive training activities as well as proper communication on process changes throughout the organisation. ■

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