



ERP implementation for Manufacturing Enterprises

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Abstract— *The manufacturing industry is faced with many issues like Moderating demand, Supply and Demand balancing and Rising operation costs. This requires acute customization from ERP backbone to account for Complex manufacturing processes which might combines both continuous and batch operations. The successful implementation of any ERP project requires that all stakeholders have a clear understanding of their role and responsibility in the process, as well as realistic expectations about what is about to happen. The modalities of operation were too complex and not error free. The improved integration & standardization have made the ERP systems attractive to Steel companies to support their business processes. This paper identifies the challenges faced in implementing ERP solution for steel industry and presents the results in ERP implementation lifecycle perspective. The identified factors provide a foundation for identifying the challenges in ERP implementation and give a direction for further investigation.*

Keywords ERP, SRM, CRM, SCM, BI, ROI, MES

I. INTRODUCTION

Steel usage has increased by 6.5% to 1,398 MMT in 2011, following growth of 15.1% in 2010. In 2013, it is forecast that world steel demand will grow further by 5.4%. In 2011, India's steel use is forecast to grow by 4.3% to reach 67.7 MMT due to economic growth. In 2012, the growth rate is forecast to accelerate to 7.9% [1]. Domestic crude steel production grew at a compounded annual growth rate of 8.4% in the last few years. Crude steel production capacity of India is projected to be around 110 million tonne by 2012-13. Increase in the demand of steel in India is expected to be 14% against the global average of 5-6% [2]. China and India are expected to maintain strong growth, but the potential overproduction by China could have a major negative impact on the supply/demand balance. Implementing an ERP solution for steel industry is quite complex as discussed her

As with any other industry, the client needs to understand the core processes in steel making, the goals and a management directive to achieve the goals using the processes outlined. Generally speaking, Functional requirements and Business rules cannot be ported from one ERP implementation to another because local operations have highly specific and customized procedures for operating that equipment. The Manufacturing processes are quite complex in Steel Industry and no amount of Discovery will be able to reveal all of the functional requirements prior to the solution design. ERP implementation for production scheduling must follow proper modelling for the complex production problems being faced in industry. Product attributes like thickness, width, length, tensile strength, opacity, brightness, etc. vary in production cycles. Only a few ERP Vendors support attributes on the manufacturing side. The capital justification process for ERP solutions in the Steel Industry is extremely rigorous and the anticipated ROI (return on investment) timeline is often unrealistic and unattainable. None of the ERP solutions meet expectation from a functional perspective. Often times, ERP funding is withdrawn or cut back within the Steel Industry and diverted towards more tactical solutions with verifiable ROI as executive support erodes due to artillery fire from the board of directors [4]. These ERP implementation challenges are discussed with focus on current Indian Steel Industry scenario.

II. OPERATING CONCERNS OF STEEL INDUSTRY

The drives which have resulted in several important characteristics of today's steel industry are:

- a. **Rising operating costs:** Costs of raw materials and energy have increased significantly, but the corresponding price rise in finished product means margins remain strong. However, environmental costs in developed regions continue to push up energy prices and could start to erode margins [3].
- b. **Consolidation:** Consolidation in the industry has accelerated. Two major mergers – Arcelor-Mittal in 2006 and Tata-Corus in 2007 have intensified the interest in consolidation. Many steel companies are shifting towards making steel in lower cost regions, which are also nearer to the growth markets. Leading companies such as Arcelor-Mittal and POSCO are investing in Orissa, India and in China. However, developed countries still lead in finishing equipment and technical know-how [3].
- c. **Operational efficiencies:** Steel companies need to refocus on improved scheduling and on optimizing manufacturing execution. Higher prices have put pressure on work-in-progress reduction, particularly with high-end stainless steel [4].

- d. **Increased niche players:** Smaller niche players have the potential to make more profits than the less focused giants. This is especially true when niche players co-operate with customers to develop products and services jointly. The bottom line is that today's Steel industry is changing quickly [4].
- e. **Information systems for a quickly changing industry:** In a quickly changing industry like steel, CEOs need information systems which quickly provide them the data they need. We believe that ERP, especially in its mature implementations today, is the crucial component for a company's IT data backbone. Figure1 shows typical Application Layers in a Steel Plant.

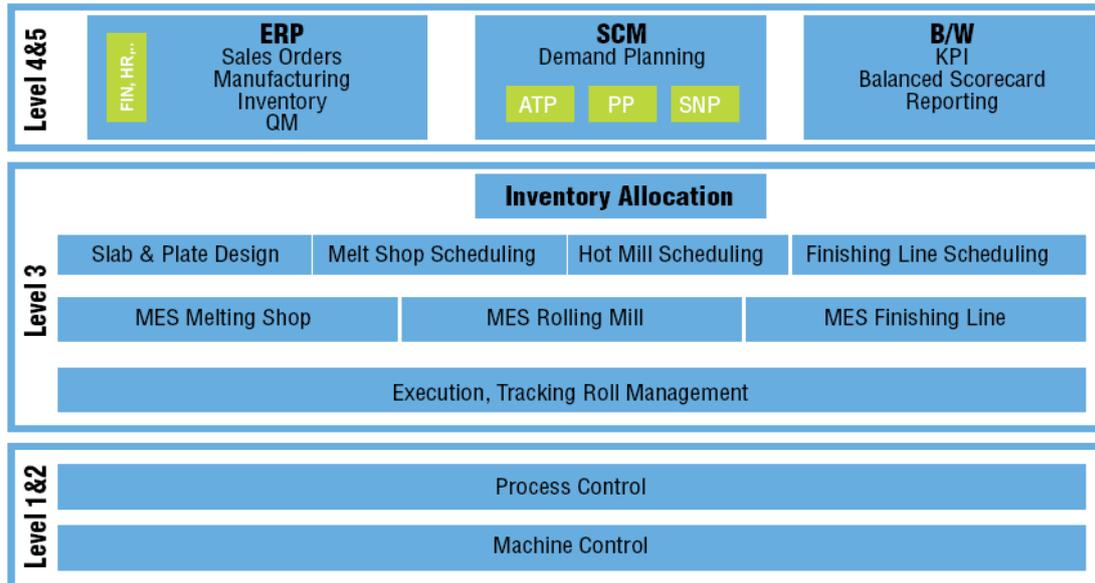


Figure 1: Application Layers in Steel Plant

III. ERP IMPLEMENTATION ISSUES

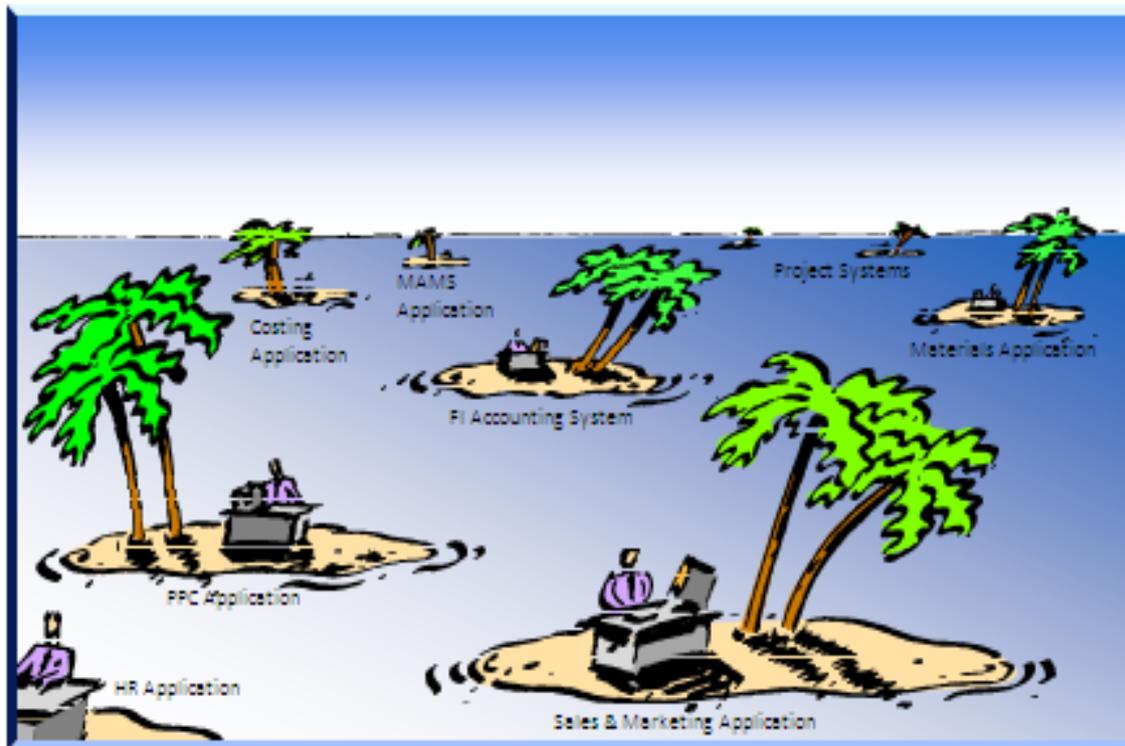
The benefits from ERP implementation for steel industry can be measured both in qualitative & quantitative terms like- efficient business processes, enhanced customer service, reduced costs, improved productivity, accelerated transaction time, workflow management and reduction in the number of credit management errors. There have also been significant savings in manpower, inventory levels, and resources. The provision of real time data facilitates improved decision making.

ERP can play an essential role in Driving accurate and fast decisions (product profitability, procurement spend) with consistently defined data. ERP solution is ideal for Harmonizing and optimizing back-office processes across the enterprise that comply with performance requirements [2]. The availability of online information facilitates quicker and reliable trend analysis for efficient decision-making. Besides the streamlined business process reduces the levels of legacy system and also provides consistent business practices across locations and excellent audit trail of all transactions. Companies are faced with a no of complexities when implementing ERP system some of which are listed below.

- a. **Enabling best-practices in Demand Planning and Supply Network Planning processes:** Adopting the latest production and business practices to offer innovative processes that meet the changing demands of its global and local customers
- b. **Future-proofing global applications that support global enterprises:** Integrating business activities across an enterprise from product planning, parts purchasing, inventory control, and product distribution, to order tracking. ERP implementation also has to account for localization issues like Tax requirements, document handling etc.
- c. **Checking on Critical Success Factors (CSF) for ERP:** CSF's are ordered like - Organizational fit, Skill Mix, Management Structure and Strategy, Software Systems Design, User involvement and Training, Technology Planning and Project Management.
- d. **Flexibility to respond to domestic & overseas opportunities:** Companies operating in a global market need to control & coordinate their worldwide operations. ERP should provide information for heterogeneous decision support systems.
- e. **Process Orientation vs. Customer demands:** There is a need to achieve balance between flexibility i.e. level of standardization and local needs. The move to become process oriented rather than functionality focused and the resultant need for business process integration can result in a loss in competitive advantage in particular areas. However the potential benefits across the entire organization often outweighs the losses in individual areas
- f. **The key driving factor for the profitability** of all steel players will ultimately depend on more tightly managed operating expenses and capital expenditure. Apart from these technical aspects, ERP implementations have to overcome both these many Cultural challenges. Culture issues apply to all ERP vendors & Technical issues are product specific [5].

Prior to ERP implementation, information of business applications resides in separate islands in an isolated fashion, as shown in figure 2 below. Figure 2: Information Islands corresponding to various disintegrated applications

Information Islands corresponding to application



At the core of ERP is a well managed centralized data repository which acquires information from and supply information into the fragmented applications operating on a universal computing platform. Information in large business organizations is accumulated on various servers across many functional units and sometimes separated by geographical boundaries. Such information islands can possibly service individual organizational units but fail to enhance enterprise wide performance, speed and competence. Today's ERP software architecture can possibly envelop a broad range of enterprise wide functions and integrate them into a single unified database repository. For instance, functions such as Human Resources, Supply Chain Management, Customer Relationship Management, Finance, Manufacturing Warehouse Management and Logistics were all previously stand alone software applications, generally housed with their own applications, database and network, but today, they can all work under a single umbrella – the ERP architecture.

In order for a software system to be considered ERP, it must provide a business with wide collection of functionalities supported by features like flexibility, modularity & openness, widespread, finest business processes and global focus. Integration is an exceptionally significant ingredient to ERP systems [5]. The integration between business processes helps develop communication and information distribution, leading to remarkable increase in productivity, speed and performance. These critical aspects of ERP are shown in figure 3.



Figure 3: Integration is Key for ERP Systems

IV. Erp Implementation Life Cycle

The implementation life cycle of an ERP system consists of many phases and can extend to external business entities as shown in figure 4.

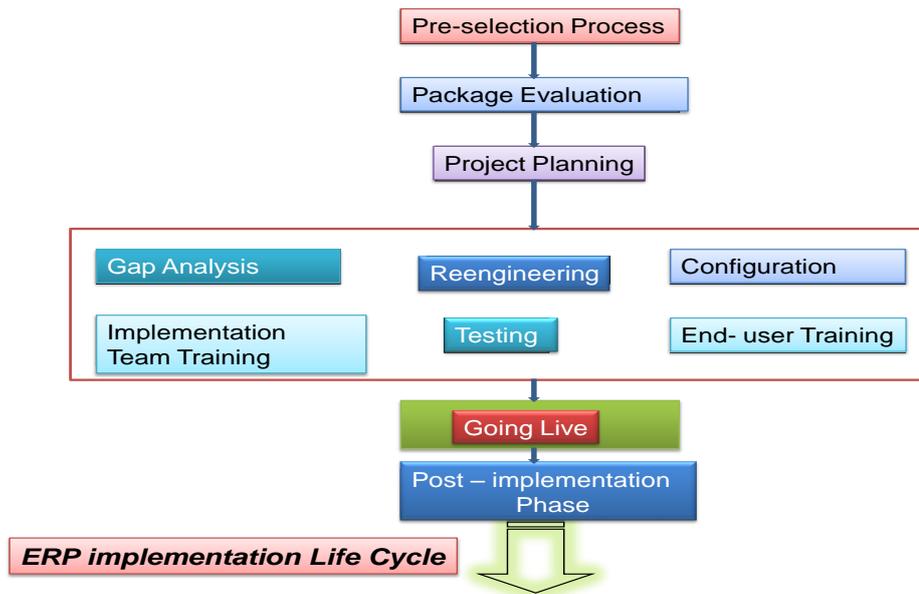


Figure 4: Typical Phases in ERP Implementation Life Cycle

V. Major Challenges In Erp Implementation For Steel Industry

A steel company presents many industry-specific design challenges for implementing ERP as described below. For an ERP project to be successful, we can start by analyzing these challenges in detail across all of the company's integrated processes. This analysis will result in formulating decisions that will be the foundation for a successful ERP project.

MES Vs. ERP FOR STEEL INDUSTRY

Standard ERP vendors even with their Steel Industry specific solutions can't address the complex Mfg. processes of Steel Industry. MES (Manufacturing Execution System) is implemented in steel plants worldwide to bring about efficiency in mainly production processes and ERP for business processes. MES helps in planning daily schedules in the process shops like blast furnace and steel mills which can really help 'make money' rather than ERP which just counts money. Planning & scheduling tools are usually based on scientific and rigorous logic for optimal decision-making in production management [6].

Bringing Efficiency In Production Processes

The production processes in steel industry are quite complex and a seamless transition from a production-driven company to a customer-driven one demands quick response to customer needs. In Steel industry, the Reliability of information obtained was questionable because of inconsistency and duplication of data from different departments. Also there was no built-in integrity check for various data sources [7]. Besides, several times the information against certain items was found missing. To respond to changing customer needs on cost competitiveness, steel companies need to further support the re-engineered core processes and quickly align the business processes to radical changes in the market place as explained below.

- 1. More than one Planning Strategy** - Steelmakers often use a combination of production planning strategies. Typically the flat or strip products are make-to-order, whereas the long products are make-to-stock. Depending on the existence of a "de-couple point", finish-to-order could be a relevant planning strategy as well. Such a combination of planning strategies affects the design of most ERP processes, including supply chain processes as well as the financial/cost control processes. Cost control in make-to-stock tends to go for standard price approaches, but in a make-to-order environment costing happens on an individual order cost collection and forecast basis. ERP systems today can handle this kind of complexity.
- 2. Complex product variations** - A steel product is made up of a large number of characteristics, making the product difficult to configure when entering it in the ERP system. Configuration in the make-to-order entries is typically done while entering the order, whereas for the make-to-stock entries, configuration is done in the product definition, that is, on the "material master". This burdens the early discussions during the design phase of an ERP implementation. Fundamental decisions need to be made very early in the project about how many (finished product) products should be defined: one extreme is to define by material group which needs to be configured completely in the order, or the other end of the spectrum is to define all possible/feasible characteristic combinations which can possibly explode into an extremely large number of finished product definitions. A steel product tend to explode towards the end of production processing; in other words, the bill of material "stands on its head" or is "v-shaped," This means that the later in the process you define a product, the higher would be the number of products to be defined. ERP solutions

today can readily handle the complexities this of the V-shaped bill of material. This allows “characteristics based product configuration” with automatic deduction of characteristics. Also enabled is “characteristic value inheritance” from sales order header to item level, entry of multiple order units such as pieces, tons, dimensions, and so on. Characteristics then drive production, shipping and purchasing processes across the supply chain network.

3. **Flexible Planning** - Planning for steelmaking often needs to happen on short notice, with unstable production processes and unplanned outputs [8]. This requires continuous re-assignment of products to processes and orders dependent on the Characteristics described above. ERP systems today allow re-assigning flexibly to handle these situations.
4. **Specific Customer service Requirements** - To cope with high-demanding customer segments such as automotive and construction, tight integration with business partners on forecasts, electronic customer orders (EDI, internet etc.) are typically needed. ERP systems today support electronic integration with partners through CRM module.
5. **Complex production scheduling combining both continuous and batch production** - While the Blast Furnace and Converter work in batches, the caster (CCM) works continuously and the finishing lines work in batches again. The batches need to be selected based on characteristics during production, preparation and shipment planning. This means that the planning process needs to be able to derive batches with characteristics inheritance and history tracing. Finally, the scheduling part of the planning system needs to be able to work with multiple and dynamic bottlenecks – that is, bottlenecks which can change based on incidents such as production problems in certain process steps. ERP systems today can handle all of these situations
6. **Detailed margin analysis**- In today’s steel industry when prices are high and capacity short, margin analysis becomes the essential method to tell what money is being made on which customer/product segments. On top of segment analysis, it is also essential to differentiate between “strategic materials” (cokes and ore, Ni and Cr for stainless) and the other cost elements that may be easier to control. ERP systems provide the tools to support these decisions. The ERP system will also need to work closely with the company’s legacy systems to optimize the business benefits [9].
7. **Change Management**: to reach out to people involved non-directly in the project to apprise them of the developments taking place in terms of accountability administration and control.
8. **To Achieve business agility through ERP** - Driven against the speed of time, the pace of implementation need to be fast enough with all activities backed by a lot of thought process and meticulous planning
9. **Functional & Technical expertise of ERP consultants**: This aspect plays a crucial role in accurately assimilating business requirements & finding viable solutions especially in areas where standard ERP processes does not offer any support [10].
10. **Gap Analysis**: Process through which company can create a model of where they are standing now (*AS IS*) and where they want to go (*TO BE*). Gap Analysis Model should uncover the functional gap and where customization or workarounds are needed.
11. **Project Management**: Needs a different approach especially when interfacing with legacy applications.

ERP product selection requires a thorough understanding of business requirements and should be justifiable in terms of return on investment (*ROI*). Figure 5 shows some important criteria for selecting ERP products. Quite often a *misfit* analysis is carried out to identify the gaps between functionality offered by ERP solution and that required by the enterprise. Most of the Business Models underlying ERP are based on practices in USA, Europe and hence needs acute customization to match local demands. ERP solutions have decision support modules like ARP (Advanced Resource Planning) which yield realistic information about production lead times for scheduling purposes, sales and marketing, strategic and operational decision making, suppliers and customers. This is aimed at reaping cross-company benefits. The ERP implementation process goes through five major stages which are Structured Planning, Process Assessment, Data Compilation & Cleanup, Education & Testing and Usage & Evaluation. The critical stages in ERP implementation life cycle and corresponding challenges involved with suitable strategies are shown in figure 6. By a proper implementation strategy these challenges can be overcome which can be advantageous to an enterprise in terms of improved communication across all departments, improved efficiency, performance and productivity levels and enhanced tracking and forecasting.

I. Conclusions

ERP systems have become Sine qua non for steel industry. The systems provide an increased level of integration to support core business processes. Experience of ERP consultants plays a crucial role in understanding business structure of steel plants and drafting suitable plans. Given an awareness of the best practices and a good understanding of the project complexities, the risks in an ERP implementation are usually outweighed by the benefits. For Steel industry, implementation of ERP is done with certain strategic goals to achieve a world-class status for its products and services and strengthen its leadership position in the industry by bringing forth a culture of continuous learning and change. Addressing above challenges in ERP implementation would result in quick decision-making, transparency and credibility of data and improve responsiveness to customers across all areas. Some visible benefits from ERP implementation are activity based costing, a consolidated picture of sales, inventory and receivables. Customer satisfaction is improved because of on-time delivery and better quality of products. The suggested methods for implementation in each phase of ERP implementation are actually from authors own experience in customizing SAP ERP solution for Steel Industry.

Scope exists to rework on these suggested practices, while similar ERP solutions are implemented at different manufacturing industries. The real challenge in ERP implementation lies in building a congenial environment where ERP will be embedded in the hearts and minds of the people and the customers by making the organization knowledge-based.

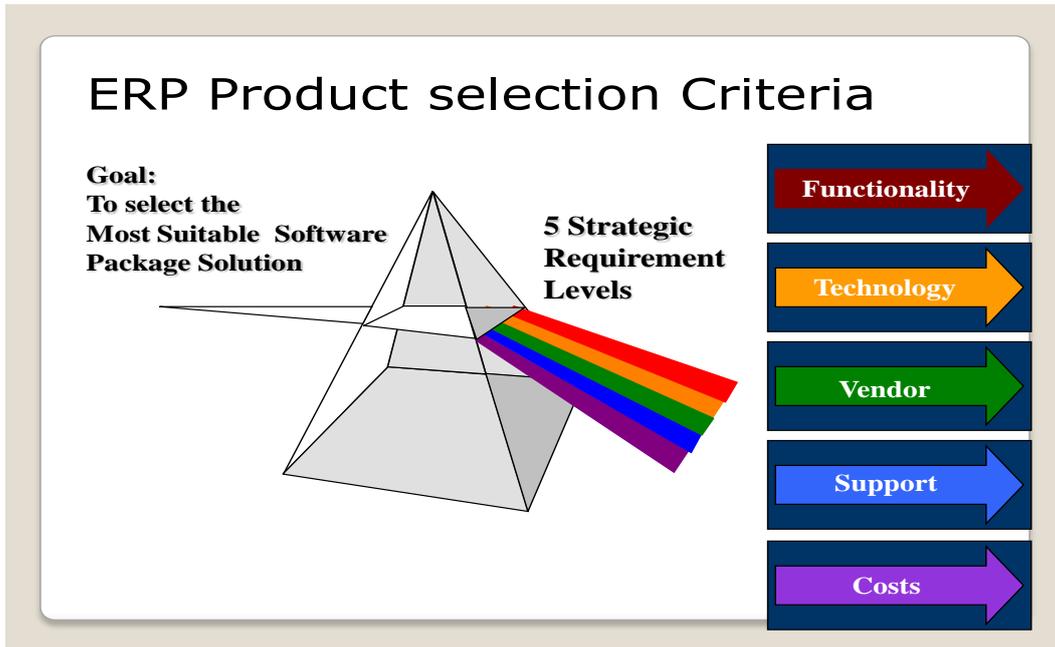


Figure 5: ERP Product selection Criteria

Phase in ERP implementation	Identifiable Challenges & Implementation Strategies in each Phase
Pre Evaluation Screening	<ul style="list-style-type: none"> Identifying Strategic goals for ERP (ROI) Working on Timelines for Go-Live
Choosing Implementation Partner	<ul style="list-style-type: none"> Choosing the implementation partner with expertise in steel industry Project Plan Preparation - Flexibility to accommodate slippages without adversely affecting overall objectives
As is Process Document	<ul style="list-style-type: none"> Document existing Business Processes across all Function Modules with KPI Matrix Plan for complex product variations
To Be Process Document	<ul style="list-style-type: none"> Identify Areas where enhancements are envisaged Focus on specific customer requirements Account for complex production scheduling
GAP Analysis	<ul style="list-style-type: none"> Make a detailed analysis of margins Develop an integrated IT Model for steel
Business Blueprint	<ul style="list-style-type: none"> Details about how Project Objectives would be met through customization & enhancements
Team Training	<ul style="list-style-type: none"> Train the ERP Core team as per Project Plan Develop complete understanding on System Landscape
Testing	<ul style="list-style-type: none"> Rigorous Testing required to check any data inconsistencies Generation of Test scripts to include critical functional aspects
Go-live	<ul style="list-style-type: none"> Plan for cut-over strategy Preparation of cut-over data
Post Go-Live Support	<ul style="list-style-type: none"> Integration with Non-ERP systems ERP support issues for Enhancement Packages, fixes etc

Figure 6: Impact on each phase of ERP implementation cycle

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