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Review on Enterprise Resource Planning Software in Manufacturing Industry

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Abstract – The ERP software integrates all functional areas of business, including sales, logistics, billing, production, inventory management, quality, and human resources management, into one organization-wide system. Enterprise Resource Planning systems may be considered as one of the most important development in the application of information technology in the business world. Enterprise Resource Planning vendors need to ensure modification and customization of their software package to suit the business' processes needs of their customer. The focus of this study is not merely on the technology per se but is also on the selection and implementation strategies, as well as implications of the software towards organizational effectiveness.

Key Words – Enterprise Resource Planning, ERP Software, ERP Life Cycle

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INTRODUCTION

Enterprise Resource Planning (ERP) technology has long been a staple for manufacturing organizations that wish to streamline operations and hasten inventory and warehouse management while improving customer service. However, with the advent of new technologies, ERP implementations are about to get dramatically better. In fact, these new ERP innovations will allow manufacturers to completely jump-start their operations. For example, in the very near future, manufacturers will rely on mobile networked devices and on-demand software to increasingly enable the seamless integration, tracking and optimization of key tasks from inventory, shop floor and management all the way to capacity and materials planning and product quality control.

In a conventional organization, each of the department typically has its own computer system optimized for the particular requirement of the department and Enterprise Resource Planning software combines them all together into unified, integrated software program that runs on a single database so that various departments can more easily share information and communicate with each other. When a company has operated in a specific geographic market or a country for a long period of time, it needs to grow to achieve its growth targets. One solution to continue the growth is to expand into new emerging international markets. Orgnisations may spread out into multiple countries, the companies may do so as to reduce the risks that an organization may faces, if conditions in one country changes drastically and adversely. A multinational manufacturing company does business in a number of countries with has substantial commitments of its resources in international business.

Project Management Success Factors for ERP Implementation

What is considered a large project varies from one context to another depending on determinants including complexity, duration, budget and quality of the project. In ERP projects, the complexity depends on the project scope, including the number of business functions affected and the extent to which ERP implementation changes business processes. ERP projects achieving real transformation usually take from one to three years in duration. Resources required include hardware, software, consulting, training and internal staff, with estimates of their cost ranging from $0.4 million to $300 million, with an average of about $15 million (Koch 2002). Therefore, by viewing ERP implementation as a large project in general, we can adhere to the fundamentals of project management for achieving the success of ERP implementation.

ERP Software

A report that stated the enterprise resource planning (ERP) applications market grew to $25.4B in 2005, and will reach $29B in 2006. Over the next five years, the market will grow at an average of 10%

The ERP market continues to benefit from a widespread acceptance of the idea that businesses must have integrated information systems to be competitive. Management and IT organizations are realizing that the most effective way to satisfy this need is to purchase an ERP package that features broad functionality and pre-built integration

Table 1: ERP vendor ranked by 2005 application revenue (include est. '06 growth)

2005 Revenue Rank	Vendor	Revenue Share, 2004	Revenue Share, 2005	Revenue Share Forecast, 2006	Growth Rate, 2004–2005	Growth Rate Forecast, 2005–2006
1	SAP	40%	42%	43%	12%	17%
2	Oracle	10%	20%	23%	110%	29%
3	Sage Group	5%	6%	5%	16%	10%
4	Microsoft	3%	4%	4%	15%	18%
5	SSA Global	3%	3%	3%	7%	3%

Source: AMR Research, 2006

ERP vendors ranked by 2004 worldwide ERP license revenue can be seen in the chart below. The top ten ERP vendors by revenue include the following companies

Table 2: ERP vendor ranked by 2004 application revenue (include est. '05 growth)

2004 Revenue Rank	Company Name	Revenue, 2003 ($M)	Revenue, 2004 ($M)	Revenue Forecast, 2005 ($M)	Revenue Share, 2003	Revenue Share, 2004	Revenue Share Forecast, 2005	Growth Rate, 2003–2004	Growth Rate Forecast, 2004–2005
1	SAP	7994	9372	10403	39%	40%	43%	17%	11%
2	PeopleSoft	2682	2880	0	13%	12%	0%	7%	-100%
3	Oracle*	2470	2465	4534	12%	10%	19%	-0%	84%
4	Sage Group	900	1243	1375	4%	5%	6%	38%	11%
5	Microsoft Business Solutions	683	775	891	3%	3%	4%	14%	15%
6	SSA Global	471	700	700	2%	3%	3%	49%	0%
7	Geac	431	445	445	2%	2%	2%	3%	0%
8	Intentia	361	388	407	2%	2%	2%	8%	5%
9	Infor Global Solutions	123	375	395	1%	2%	2%	205%	5%
10	Lawson	341	357	358	2%	2%	2%	5%	0%
Total (including other ERP vendors)		20711	23649	24288	100%	100%	100%	14%	3%

* Oracle acquired PeopleSoft on December 28, 2004.

Source: AMR Research, 2005

The report revealed several trends that affected the ERP market in 2004, including: The ERP market is entering another major technology transition phase. Service Oriented Architectures (SOA) may have the same disruptive effect that other technologies have had on the market, such as the emergence of client-server systems had in the 1990's.

The pace of acquisitions shows no sign of slowing down. Oracle's recent purchase of Retek makes it very clear that PeopleSoft was simply the first of what is likely to be a series of purchases. Vendors like Sage Group, SSA Global, Infor Global Solutions, and Epicor have all been very active in the Merger and Acquisitions (M&A's), and as a result have all been growing more rapidly than the overall ERP market.

ERP buyers have moved away from large, upfront purchases. Now most tend to license user seats and functional ERP modules incrementally as they deploy a product. Along with widespread discounting, this has led to smaller average deal sizes.

Benefits of ERP

Data discipline, build-up of solid information infrastructure, integration across firm-level functions (finance, production, marketing and HR), process orientation at the level of internal processes, significant usable transactional data generation are some of the real benefits of ERP. Data discipline provides an ability to try out new business models that are necessary in the connected world; a solid information infrastructure provides robustness and control in the "mergers and acquisition" dominated volatile business world. Firm-level integration provides foundation for integration across suppliers and customers. Process orientation within an enterprise, that is characteristic of ERP, is another key benefit.

ERP as Information Infrastructure for an enterprise

The key benefit of ERP implementation is that ERP provides a solid information infrastructure for an enterprise. As an infrastructure, ERP data is shared by all departments across the organization and owned by all users. ERP is NOT one more project initiative from EDP/ MIS/ IT departments. ERP also ensures ready data availability. A well-implemented ERP would pave the way for organizational level data discipline. With "Information available on tap", it is important that the users start planning for innovative use of this information for planning & analysis. Finally infrastructure should not be viewed from a narrow "cost benefit" and ROI perspective. The true benefits of ERP are not necessarily apparent on day one. Accordingly benefit cost ratio might unduly overemphasize costs that are apparent and underemphasize benefits that may not be apparent. Like every other infrastructure - roads, seaports, airports, telecom and railways – information infrastructure in the form of ERP needs a different mindset too. It must be noted that investments in infrastructure pays by the innovative ways in which the infrastructure is put to use – investments in roads pays off through returns from trucking industry, business generated through phone calls pays for investments in telecom network – similarly innovative use of data generated through ERP would pay for ERP investments. The improved organizational agility provided by ERP must be put to good use.

ERP Life Cycle

Typically ERP introduction in an organization goes through the following stages

a) Concept selling – In this stage ERP consultants take the top management through the ways in which ERP will help the organization in achieving the business goals. Generally this process takes several

weeks. The CEO, CFO, CTO and the CIO must be actively involved in this process.

b) ERP Feasibility Study – Once the top management is convinced of the role of ERP, consultants do a feasibility study that broadly quantifies the benefits, costs and the readiness of the organization for ERP implementation.

c) ERP Readiness – Once the feasibility is achieved the organization is readied for ERP by way of getting the IT and information infrastructure good enough for ERP implementation. This may involve hardware addition / upgradation, network upgradation and standardizing key business elements (account codes, material codes, cost centers etc.,) and key business processes (order entry, procurement, production, logistics, invoicing etc.,). Often this process leads to significant Business Process Reengineering (BPR). Depending on the context BPR could be a full blown exercise or integrated with ERP implementation. It is pragmatic to view the "best business processes" built into the ERP software as desirable for the organization and modify the existing processes to adapt to the ERP software.

d) ERP Software Selection – At this stage a detailed evaluation of the existing leading edge ERP software available and support in the local market is done(based on distributor availability, knowledgeable user / consultant support and training support). Some puritans postpone software selection to a later stage.

e) Mapping "as is" processes and "to be" processes (through pragmatic reengineering) – At this stage, the existing organizational processes are modelled and using the combined expertise of the entire organization, the processes are improved to take advantage of the ERP. This process is often called the "reengineering process". Special tools to map processes, document processes and improve processes are available either as part of the ERP software or as independent software pieces under the name "process modelling software" such as ARIS Toolset or Visio Enterprise Edition.

f) ERP Implementation Plan – After the process mapping, the entire process of implementation is identified that includes the nature of implementation, extent of implementation, time schedule, cost schedule, training requirements, identifying key users, transition planning, data migration etc., A key issue is the nature of implementation – some users prefer "big bang" that implies all modules implemented across all departments of the enterprise in one go. Many others prefer module based implementation, say finance first, followed by sales…Yet others implement all modules in one location and roll out the modules in other location (in multi-location organizations). There is no universal "best" option; the user & consultant should jointly decide the choice. Generally an ERP Steering Committee with the blessings and representation of the top management is constituted to supervise the implementation.

g) Actual Implementation – This stage involves the training of the users in the detailed modules, customizing the software to meet the specific needs of the enterprise, configuring the software to understand industry and firm specific practices (accounting, material, bill of material structures, scheduling practices, depreciation options, valuation of inventory / storage, stocking policies…)

h) Preparing to "go live" – At this stage the decision of project going live is decided. This may coincide with natural "roll over" dates such as beginning of the fiscal year, planning period etc., To keep the enthusiasm level of the people, a "kick off" function is organized to formally mark the "go live" phase of ERP. All account related start-up figures are fed into the ERP software.

i) "Go live" - when the organization starts using the ERP software

j) Post implementation – In this phase the ERP software performance is fine tuned to meet the user's needs. Often more reports as demanded by the user community is identified and designed.

Client server computing to componentization

Corporate applications in general and ERP systems in particular were well-integrated and offered reliable solid code that appealed to CIO's; prior to ERP they had the "headache" of integration problems associated with many disjoint systems. One key success factor for the wide acceptance of ERP systems was the client-server architecture. This architecture allowed corporations of varying size with multiple product lines and many locations to distribute database servers, application servers and clients across diverse platforms – IBM mainframes / high-end servers for database servers, medium end servers / PC-based servers for application servers and PC / Mac / Terminals for clients. This partitioning allowed CIO's to choose servers best suited for a specific function from a cross section of vendors, shift

hardware as per application need without users even knowing the changes; and guaranteed performance over the natural growth of application complexity and the extent of implementation. Of course there was a price to pay – the ERP code was a solid monolithic code! With e-enabling of corporations and individual functions like HR, procurement, logistics, manufacturing getting a Web-interface, there was a felt need to move towards "nimble" software that was less complex, needs less training and runs on limited hardware resources (server and network). Also, there was a need for "mix and match" across the functions. For example, users wanted an option of using PeopleSoft for HR, BaaN for Manufacturing and Oracle for Financials. The ERP vendors also realized the potential of the emerging object-based framework (that goes beyond object-oriented programming) using technologies such as COM/DCOM from Microsoft, CORBA from OMG, EJB from Sun Microsystems that promised better, reusable and far more reliable code to replace the solid but monolithic code.

Cross-discipline integration to integration across enterprises

The key to the success of Enterprise Systems was their process orientation and application integration across the enterprise – financials, accounting, order processing, human resources, procurement, production, logistics, sales, support, invoicing and billing. In the pre-Internet era such integration was sufficient. As the new Millennium dawned and the Net economy boomed, organizations could not afford to be content with the success of the firm within their walls. Applications had to necessarily extend to their business partners – suppliers, resellers and key customers (if not all customers). This in turn necessitated the move to look beyond enterprise – to an extended enterprise.

Orderly processes to creative thinking

Enterprise systems had an excellent "process orientation". In fact such process orientation helped organizations to think beyond their "factory chutes" and remove enormous inefficiencies across their internal functions – finance, marketing, production and HR – Benefits from process orientation far outweigh the benefits of introducing some ERP software. But the process orientation also led to rigidity – the processes were frozen in the ERP software. With the shift from business to e-business, organizations quickly needed to offer new "business models", new channels including Internet and new forms of service. The emphasis had to shift to organizational innovation rather than organizational discipline.

Web changes everything

The arrival of the Internet had a profound impact on corporate applications. Almost every business is becoming e-business. There is no industry unaffected by the impact of WWW – core industries like Coal, Steel, Power, Utilities, Manufacturing, Auto industry, Oil & Gas etc., - all these industries could all benefit from the power of the Net. This in turn led to the demand for Web-enabling all corporate applications. Most HR systems had to shift to self-service operation over the corporate Intranet; Manufacturing had to embrace e-engineering, e-procurement over public Internet or Virtual Private Net between its suppliers. Marketing had to adapt to electronic storefront, e-services and e-support. Accounting and Financials had to adapt to e-commerce. In a sense every function of the enterprise had to be e-enabled calling for design changes in ERP systems. The transformation of SAP to mySAP and Oracle to e-applications represents this fundamental shift in corporate applications.

E-Markets

The arrival of Digital marketplace (also called e-markets) is a major development with far-reaching significance for corporate applications. It is a marketplace created by digital technology; obviously the Internet plays a crucial part. Since digital goods like books, CD, music, newspapers, databases, travel services and magazines are the first ones to be sold over the Internet, digital marketplace is a marketplace for digital goods and of significance to IT industry. With the success of Dell Computers' experience of direct selling of PC's over the Internet (now followed by IBM, HP, Compaq & Acer), digital marketplace is NOT limited to digital goods alone. With several portals (horizontal portals like Yahoo and vertical portals like e-AutoMart) and storefronts appearing on the Net every day, digital marketplace is influencing every other industry.

Mobility is the watchword

With its inherent globalization, Internet is permitting many users to be mobile. With its ability to send and receive information during movement, mobile computing is introducing a "paradigm shift" in corporate applications whose real impact will be felt in the next two years. Mobile computing and mobile Internet access have suddenly started to influence corporate applications. Thanks to explosive growth of NTT DoCoMo mobile Internet service (with 1.4 million customers in 18 months), applications have to address ways of delivering information over mobile devices. The added complication is the multiplicity of promising technologies; with no clear indication of any one of them dominating. For example, in the access area: analog mobile phones dominate the US market; GSM dominates Europe and much of Asia; a range of technologies (UMTS, GRMT) are under deployment in Japan and Europe; there is a promise of 3-G (third generation mobile) that is likely to be around by the year 2003 throughout the globe. Then there are intermediate

technologies like WAP (Wireless Application Protocol).

With enough data to warehouse and cheap processing power OLAP is a reality

Thanks to ERP deployment over several years in the corporations, enough corporate data has been archived that is structured, machine readable, accurate and authentic. Enterprise systems being transaction oriented, the data captured has sufficient "metadata" information (organizational units, time stamp, account codes, customer profile, batch size etc.,) that is "hidden" but recoverable through sophisticated "data cleansing" and "transformations" that modern data warehouse engines can perform. With the sophistication of OLAP tools, visualization tools and data mining tools and the increased processing power of the corporate desktop, online analytical processing is a reality today. Managers with sufficient analytical ability can routinely perform sophisticated analysis right from their desktop computers without needing an analyst to assist them. The "what-if analysis" need not be a mere "simulation" or "scenario planning" but use "live" and "real" data captured for years through OLTP systems (that are part of enterprise systems). This offers an unprecedented ability to the end managers to go past "information" to "insight" into corporate performance.

The power of the Objects

"Best of breed" is an oft-quoted term in the ERP world. All the ERP software vendors claim to have built in their software products, the "best practices" for all the major organizational functions - order processing, procurement, manufacturing planning, transportation, invoicing etc. Every one of the products is a "tightly integrated" system that addresses all the needs of a typical enterprise - an automobile plant, an oil refinery, a supermarket chain, an airline, a seaport or even a courier company. The tight integration gives lots of value to the ERP software products. The "organizational processes" have been mapped into the world-view of the ERP vendor so as to get over the nightmare associated with lots of home-grown software that were "sewed up" with individual functional modules. The "tight integration" also limits any user to single ERP software for all its functional needs. Due to historic reasons each of the ERP software "fits" some particular "function" exceptionally well - SAP for Logistics, Oracle for Financials, BaaN for Manufacturing and PeopleSoft for HR modules, for example. If an user wants the "best of the breed" among ERP software for individual modules - say HR module of PeopleSoft & Manufacturing module of BaaN, no consultant would advice him to implement both the ERP products. The reason is quite simple - the ERP software products are complex; they are complex to understand, internalize & deploy.

Single "core" to multiple "core" competencies

A difficult decision for progressive organizations is the way to approach the individual technologies of ERP, SCM, CRM and SFA. Historically these technologies have come from different vendors. However realizing the stagnation in ERP growth, the ERP vendors over the years have embarked on offering all these services as an "integrated suite" of services. The individual software vendors of SCM, SFA and CRM also offer ways of "working with" every ERP software product. For the end users, it is a difficult choice - either to work with multiple vendors or to take the "suite" from ERP vendors. The "core competency" of ERP software vendors is very much the "enterprise" function and it is not clear whether their attempts to provide "full suite" of services will be entirely successful. The CRM, SFA and SCM vendors "co-working" with all the ERP software vendors' poses another set of difficulties. For the end users the advantage of "best of breed" amongst SFA, CRM, SCM and ERP can easily be offset by the drawback of "integrating" multiple products.

ERP and "niche" enterprise software

For sustained competitive advantage firms should start leveraging the "special processes" that give distinct competitive advantage. Such an activity must be driven by the "core competence" of the firms and not by ERP software vendors alone. For example, many firms have "core competence" in product design, development, deployment and maintenance. Industries in this segment would include Shipbuilding, Machine tools, Capital goods manufacture, Aircraft manufacturers, Railway equipment manufacturers, Power plant manufacturers etc., In these industries product development is the key. Firms in these industries may find current generation of ERP software addressing only the peripheral functions. Engineering designs and project management that are generally outside the ERP software must start driving the enterprise; mere importing of product data from design software (AutoCAD / Pro Engineer / UG II) or the import of ERP data into project management software such as Primavera would not be sufficient. Design and development processes must be integrated into the very core of the organizational business processes. This would imply design data (including 3-D data, rendering, surface and machining characteristics) must be integrated into basic workflow, viewing, searching, version control and access control. Current generation of ERP software does not implement all these, though they would support all these functions.

CONCLUSION

Enterprise Resource Planning software serves as an information backbone for a number of big company's core business processes. Today, as we are aware every aspect in modern organization relies heavily on

timely and accurate information to survive, in fact information system serves as the life-line of an organization as no process may be carried out without centralized information dissemination. The organizations are using Enterprise Resource Planning software for in all functional areas for gaining competitive edge among the competitors. ERP system has been defined as a packaged business software system that allows a company, to automate and integrate the majority of its business processes, and share common data and practices across the enterprise.

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