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Emergence of ERP II Characteristics within an ERP integration context

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ABSTRACT

It is widely accepted that Enterprise Resource Planning (ERP) can provide organizations with efficiency and productivity gains, in terms of aggregating and streamlining internal business processes. It is also well understood that embarking upon the implementation of such an IT project, also presents many risks and challenges to the incumbent corporation, as witnessed by numerous cases in the normative IS literature on this subject. Through the description of a case study organization's ERP integration experiences, the authors highlight the emergence of those characteristics which define the componentization, and extension of ERP functionalities (i.e. so-called ERP II) in terms of a failed ERP-led, Enterprise Application Integration (EAI) implementation within an industrial products organization. As a result of the exploratory research approach used, it is hoped that the definition of such factors will provide an insight into the development and management of such technology investments.

Keywords

ERP, ERP II, EAI, Case Study

INTRODUCTION

Enterprise Resource Planning (ERP) systems allow organizations to manage their core data and information across the enterprise, via a collection of business software modules that attempt to automate business processes such as finance, HR, procurement, manufacturing and logistics. ERP technologies have been designed to address the fragmentation of information across an organization's business, by integrating such information together. ERP has typically been marketed as the backbone of an automated and efficient organization, bringing together enterprise data and information from a multitude of business process sources, in order to overcome limitations inherent in legacy information systems (Parr and Shanks, 2002).

Although conceived as a panacea with respect to solving inherent legacy application integration issues (Linthicum, 1999), implementing ERP holds inherent organizational risks for organizations seeking to adopt this technology (Akkermans and van Helden, 2002; Economist, 1999; McVittie, 2001; Nah and Lau, 2001; Stefanou, 2001; Vogt, 2002). In implementing ERP, it is accepted that a significant level of re-engineering is required to streamline 'as-is' processes, to fit the given implementation software architecture. Whilst this approach has indeed proved to be successful in terms of execution, companies have tended to incur increased costs (direct and indirect), as well as a degree of organizational pain (Nah and Lau, 2001), particularly in terms of resource allocation and personnel restructuring (Al-Mudhimighi *et al.*, 2000). This is often due to organizations viewing ERP implementation programmes as IT, as opposed to business-led, projects. As a result, there is often a time lag before the benefits or dis-benefits of an ERP system are realized or can be determined. Zrimsek and Brant (2000) report that the implementation and adoption of ERP can be a time consuming and costly exercise, requiring a significant change in working practices, policies and systems. There is no doubt that ERP can, and will, continue to play a vital role in improving organizational performance but only if business processes linked to ERP functionalities, are aligned with internal and external business processes (Sprott, 2000). The multitude of failed ERP implementations and inherent risks involved (McVittie, 2001), has resulted in the emergence of integration approaches such as Enterprise Application Integration (EAI), which seek to integrate information across diverse IS sources (Linthicum, 1999). As defined by Themistocleous *et al.* (2000), EAI-based solutions seek to address integration problems faced by companies when they are

faced with attempting to incorporate enterprise or cross-enterprise applications. Such an approach consists of tools or software adapters (middleware, workflow, application servers) that not only cover package-to-package application integration, but also many other dimensions of IS information management. Within this context, this paper investigates and describes the technical and organizational issues associated with an ERP-led EAI initiative, in a case study company. In doing so, the authors provide a taxonomy of factors that impinge upon such ERP/EAI implementations. Hence, the authors identify and highlight case study implementation details that point to the emergence of ERP II characteristics, in this ERP integration context. The paper concludes with an analysis of the case study, which highlights particular shortcomings in the approach taken, from organizational and IT viewpoints.

DEVELOPING A TAXONOMY OF ERP II CHARACTERISTICS

It is widely recognized that businesses can no longer compete in isolation to their suppliers and customers, and as a result, need to optimize their supply chains in order to achieve and maintain competitive advantage. For example, Tapscott *et al.* (2000) advocate such improvements via tight integration between core supply chain components such as ERP and web-based portals in order to realize the goal of the so-called “digital enterprise”. For ERP to provide the core functionality for interconnected business systems, such as those electronically connected digital networks or “webs” of business processes, requires that organizational IS should become more extendable, flexible and interconnected (Lee *et al.*, 2003). Li (1999) notes that there needs to be a step change in the role that ERP plays, in managing and optimizing internal enterprise information, to one that can include information and collaboration not only internally within an organization, but also outwards to the external business community via digital business architectures and technology solutions (i.e. via Business to Business, B2B; Business to Consumer, B2C; Customer Relationship Management, CRM; and Supply Chain Management, SCM). The ultimate aim for the development of ERP systems is to define and automate those collaborative business processes that reach across and outside a given organization, to encompass the overall business and trading environment. Thus this next stage of ERP, known as ERP II (as defined by market analyst company Gartner Group), is considered to be the expansion of “enterprise-centric ERP”, which seeks to externalize and share business processes across trading communities via an adaptable, collaborative IS infrastructure (Bond *et al.*, 2000; Ericson, 2001). Figure 1 summarizes the evolution and impact of these ideas on the development of ERP II concepts, in terms of a taxonomy of these key factors discussed so far.

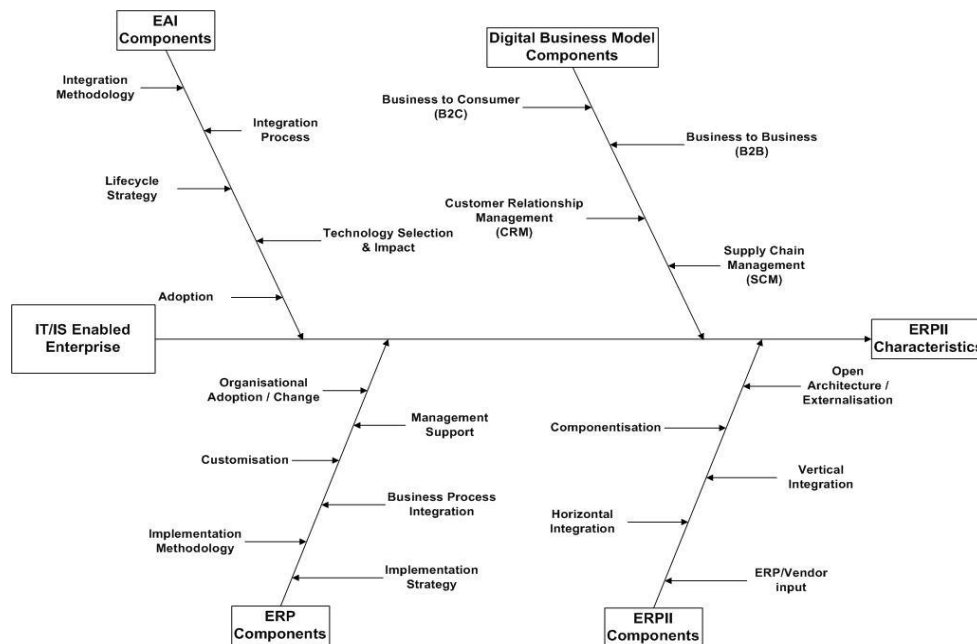


Figure 1. Taxonomy of Organizational and IT factors leading to ERP II

In essence, ERP II seeks to provide better integration with customer or client-facing solutions such as CRM / B2C with back office transactional services such as SCM. As Bakht states, ERP II is the summation of three key enterprise technologies: SCM, CRM and ERP (Bakht, 2003). This can be achieved by componentizing, or de-coupling, traditional ERP functionalities

through an open-architecture approach. Traditional ERP components such as HR, logistics and financials, can therefore be made more accessible and tailorable to suit industry vertical needs, and can facilitate the communication of information amongst all enterprise stakeholders (Bakht, 2003; Ericson, 2001). The progression from ERP to ERP II systems is based upon the demand of organizations to build and sustain collaborative business models (Geishecker, 1999). Hence it can be seen from this diagram that in approaching the notion of ERP II, a multitude of organizational and IT factors impinge upon the outcome of the integration effort in order to realize the goal of a connected enterprise. As such, in order to classify an organization as having ERP II capability (the right hand side of the diagram), a number of key factors have to emerge.

A fundamental requirement is that the enterprise has to be fully IT/IS enabled, having the capability to operate and accommodate rapidly changing business requirements via technology (i.e. the left hand side of the diagram). As such the core components of ERP II can be sublimated into those aspects of resource planning (in terms of ERP); systems integration (EAI); business process business models (B2C, B2B, CRM and SCM); componentized and stratified business-technology catalysts (i.e. ERP II components). However, this approach to enterprise integration poses newer and some would say greater risks. Web-enabled ERP functionality, faces competition from many existing eCommerce technology providers— many of whom provide robust collaborative solutions already (Blincoe, 2001). Secondly, although providing an open architecture for ERP is a vast improvement on existing ERP infrastructures, there is still a significant amount of effort required to carry out the integration amongst different IS (Ericson, 2001). ERP II significantly increases the complexity of managing an inter and intra-enterprise portfolio of systems, processes and tools (Bakht, 2003). This relies upon an externalization of an organization's internal business processes and information. It is within this context that the authors now expand upon a case study organization's attempt at improving their exiting ERP system via an EAI approach.

RESEARCH DESIGN AND METHODOLOGY

To investigate and describe the core issues associated with the enhancement of an existing ERP system, the research design and methodology is now presented. This encompasses the definition of appropriate research questions posed; the selection and design of an appropriate theoretical and methodological stance (exploratory, empirical case study-based research); and use of an appropriate data collection and coding protocol (transcribed semi-structured interviews and company reports and literature).

The purpose of this research was that of attempting to understand those factors which involve ERP, CRM and SCM technology solutions, in a contemporary organizational setting. In so doing, capturing and defining those components which define and characterize the emergence of so-called ERP II, via an exploratory approach to the subject. The research design involved a review of the extant literature on the aforementioned technologies; the selection of an appropriate case environment and participants exhibiting the given ERP / ERP II issues (via purposive sampling); the selection of a methodological stance (in the form of an empirical, qualitative case study); the use of a research protocol to gather and categorize case data for presentation and analysis (by means of semi-structured interviews, observations and case company archive material); developing and analyzing results of the case study (synthesizing case data against available ERP II evaluation literature); and finally identifying lessons to be learned from the analysis presented. This approach to enterprise systems research was utilized as this has been successfully applied in similar research as reported by Irani *et al.*, (2001). Considering the originality and contextual surroundings of this research, a case study research strategy was followed as advocated by Fielder (1978), Hakim (1987) and Yin, (1994). The case data was primarily gathered and coded via a combination of semi-structured interviews, indirect observation and organizational archival material. This information was then synthesized and put into the context of assessing the case organization's approach against available published literature.

One-on-one interviews were conducted with the Chief Executive Officer (CEO), Chief Operating Officer (COO), Chief Technology Officer (CTO) and Chief Financial Officer (CFO), as well as two managers from the IT department. The interviewer ensured that the interviewees were fully informed about the purpose of the interviews, and tried to avoid interviewer bias as much as possible, via careful selection of non-leading questions and using follow-up questions in order to get respondents to elaborate on ambiguous answers, i.e. "probes" (Shaughnessy and Zechmeister, 1994). Furthermore, transcriptions of interviewee statements were given to respondents to validate and verify notes taken. A variety of secondary data sources were also used to collect data, such as financial reports, company memos, business and IT strategy documents, IT implementation plans and press releases. In this way, the authors attempted to address human, organizational, management and process perspectives in order to extract meaning from such IT/IS evaluations (Serafeimidis and Smithson 2000; Irani and Love, 2001). The case used for the research was not systematically sampled, and as a result, it is not possible to generalize the findings to a wider population. However, the findings are considered appropriate to provide others with a frame of reference when seeking to evaluate approaches that seek to improve ERP implementations.

CASE STUDY DETAIL

The case study company is a renowned global industrial products company (herein known as Company X). Company X is unusual in that it not only sells a range of products for the manufacturing sector, but also heavily utilizes some of its own products itself in running the business, much akin to the philosophy adopted by Oracle Corporation (Stone, 2002) in using their own systems in-house. The primary business lines of expertise that Company X focuses on are Enterprise Information; Automation and Control; Manufacturing Execution; and Safety. Coupled with their market leading position in enterprise management and safety-critical systems also. Hence, the organization proceeded to purchase companies that were producing similar/complementary software products. Since there was a direct need to support the underlying ERP requirement of those packages (Baan ERP), Company X would be able to provide an integrated information system right across its industrial automation software product line. During this time, the organization was faced with the prospect of upgrading and maintaining its current SAP R/3 product internally, which was a significant cost outlay. One of the main reasons for the purchase of the software vendors was that Baan was seen to have the most modern and flexible architecture for these products within the industrial products / automation sector.

Given these issues and also a better fit with Baan ERP within a process and discrete manufacturing environment, the board of Company X decided to adopt Baan not only as their own internal core ERP, but also as the basis for their entire product line. Senior management instigated an EAI programme to enhance the integration between the organization's order entry, planning, production and order tracking and logistics technologies. Management went so far as to suggest that a new software and services division should be set up to address this programme (led by a selection of the product business lines). To maintain and grow the profitability of Company X, management planned to implement a rigorous restructuring and cost management program under which costs were forecasted to be cut by half over a 12-month period. The project would involve the delivery of an internal 'B2B portal' concept, using Baan as the core manufacturing process ERP system to aggregate core planning and fulfillment information for customer orders, embracing both partners and customers similar to that explained by Davis (1995). At the time of conducting the research, Company X had approximately 15 such systems, which feed into both the production planning and fulfillment processes, and involve tight integration with their core ERP. Since each of these source systems were the result of previous mergers and acquisition purchases, each software product was essentially run as a separate business unit (with its own unit business manager reporting to the CTO). The integration programme began by attempting to implement and configure the packaged ERP within the organization. Componentization of ERP modules, would allow the implementation of the ERP package to be faster, as each ERP component could be isolated in terms of core data dependencies. Following this, existing interfaces from each of the source systems across the product range would be modified to transmit messages to the core ERP system, whenever a business process event would occur (such as a sales order being submitted), via a dedicated XML interface, as shown in Figure 2. As such, it was envisioned that such architecture would effectively "mesh" with supplier and customer systems as shown in Figure 3.

In seeking to achieve this solution, Company X faced numerous obstacles which impeded its progress and resulted in an abortive ERP re-implementation. Considerable effort had to be expended to integrate and consolidate the core business process applications (not least of which, was replacing their existing ERP package, SAP, with Baan). Although this effort was planned for, there was little or no realization of understanding of the level of complexity that such a re-engineering process would require. As such, the primary focus of the integration effort was spent on installing and configuring Baan to fit the particular requirements of Company X, which took 6 months. The effort required to setup the EAI publish/subscribe broker and application-specific applications was underestimated. The apparent disregard for the inherent risks associated with the vigorous and aggressive timescales suggested by senior management, did not take into account the severe change management issues, which would be encountered. Coupled with this was the amount of time being spent on development; the organization had to juggle the multiple pressures of keeping the overall business running and attempting to merge the acquired software product lines into the business.

This was essentially at the expense of an overall reduction in headcount within the firm, which was being carried out to achieve a low cost income ratio thus, providing a 'value for money' investment in its ERP system. The proposed B2B portal concept and EAI implementation was shelved after a period of 8 months as it became clear, that the successful adoption of Baan internally to achieve 'reference site' status, was not achievable.

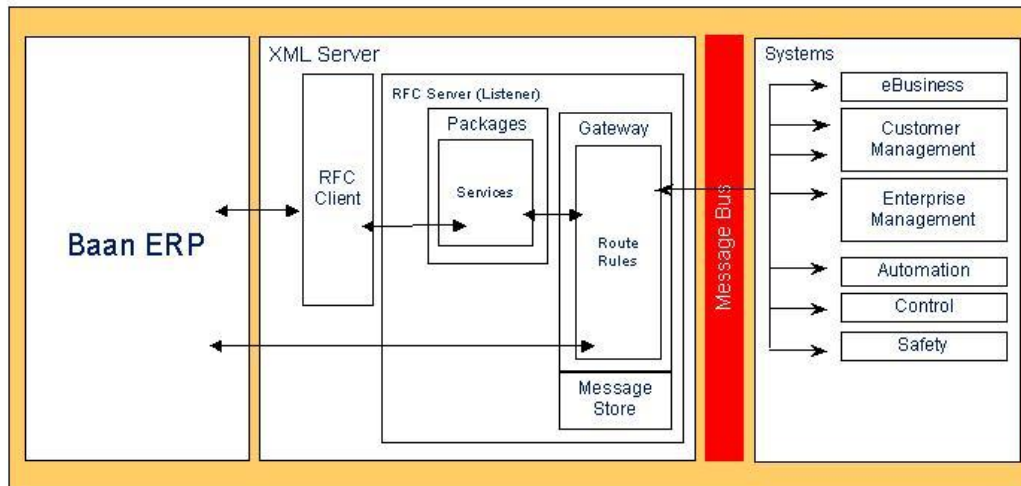


Figure 2. Company X proposed internal B2B architecture

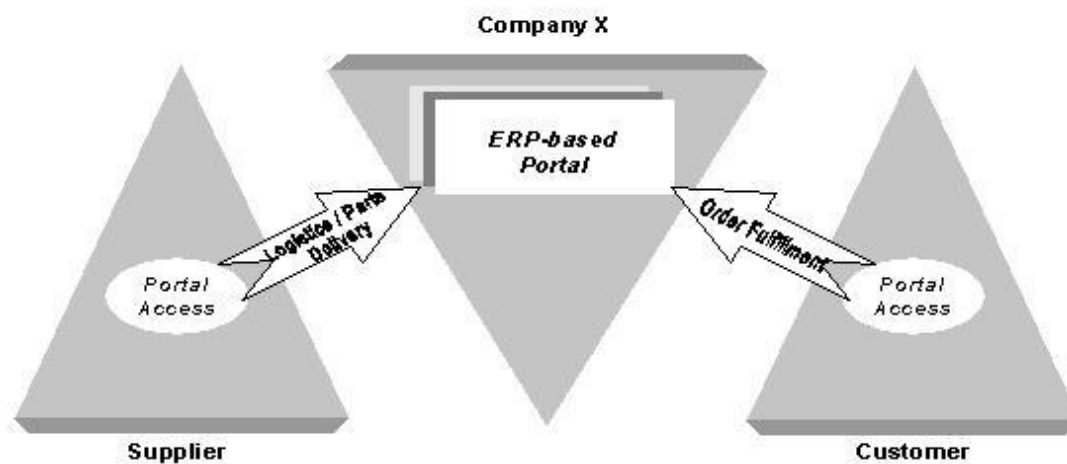


Figure 3. Company X proposed external B2B architecture and connectivities

Product line heads (such as for Enterprise Management and Automation) were also concerned about the extent of effort required to integrate and standardize their product lines with Baan (which had not even been fully implemented as core ERP within the company). They consistently noted that although the board had their support, there was little or no co-ordination from the newly setup software division for ensuring inter-team and cross product integration and collaboration occurred.

CASE STUDY ANALYSIS

Ultimately, Company X was not able to implement the planned the combined ERP and EAI implementation it anticipated. One reason for this could be that it was too reliant upon its internal capabilities, for which strong integration capability was not a primary strength. Coupled with this, Company X was a conglomeration of a number of existing companies, the residual people, processes and techniques of each constituent part of the organization being at times, at odds with each other. This may also have caused internal tensions and strains that were not directly evident to senior management, and would have

undoubtedly have inhibited project success. For the 15 or so subsystems and software products that Company X had invested, the sheer size and scale of the integration effort that presented itself may also have been too great. Even by a conservative estimate, integrating all these systems together *at the same time* as implementing a core ERP system, would be a significant undertaking for a technologically competent organization within the time frame given. Due to the lack of evaluation of the enterprise systems, there could also have been a lack of understanding of the fit of the existing systems and if there was any real requirement to integrate *all* of the products together in the first place.

Although the given ERP system, Baan, was ultimately a very capable and mature resource planning package in its own right, at the time it was not as advanced and extensible (including scaleable) as SAP or PeopleSoft. Many ERP vendors had repositioned their technologies to encompass e-Commerce type functionalities (CRM and SCM for example). In this respect, Baan was not able to execute that combined vision. Company X attempted to implement a combined approach to extend and integrate a base-level ERP system to encompass CRM and SCM functionalities, through an application integration approach. This was very much in the guise of ERP II.

In addition, the vague usage of the term “B2B portal” by Company X as relates to this specific integration programme, was something of a misnomer as there was no external integration carried out during this phase. This was purely an internal EAI scheme (i.e. intra-enterprise application integration), but couched in terms and the language of contemporary business information systems. This may also have confused the technical issues around the exact needs and requirements of the integration to be achieved. As such, and based upon the analysis given in this paper, it can be said that Company X unwittingly encountered and experienced a *failed attempt* at an ERP II implementation, the effects of which are shown in Table 3. Integrating its separate enterprise systems in a piecemeal fashion was not considered at all by Company X. This could have involved a phased implementation of Baan alongside SAP, whereby data and enterprise information could well have been migrated between both systems over a period of time, using application integration technologies and data transformation engines (as detailed by Alshawi *et al.*, 2004). This could also be put down to organizational inertia and lack of mature skills in combined ERP and EAI integration skills. Potentially the short-term cost-based approach to achieving an implementation date within the timeframe would have had an inevitable impact on the ability of the organization to sustain such an effort. In short, the overall approach was completely over-ambitious for the goals set by management.

<i>Contextual Factor</i>	<i>Characteristic</i>	<i>Case findings</i>
ERP II	<i>Open Architecture</i>	Combination of CRM and SCM
	<i>Componentization</i>	Weak / incomplete
	<i>Vertical Integration</i>	None required
	<i>Horizontal Integration</i>	Planned, not implemented
Organizational / IT	<i>Optimization of business model</i>	Planned, not implemented
	<i>Acceptability of Success</i>	Cost reduction; integrated system within 12 months
	<i>Scope of technical effort involved</i>	Large / Complex (15 subsystems; replacement of existing ERP)
	<i>Level of change required in the organization</i>	High (cross-product collaboration for SCM enablement)

Table 3. ERP II characteristics found in Company X

In this way, Company X may well have been able to achieve their goal using a best-of-breed ERP approach. Company X also did not seek professional advice and research implications of ERP implementation into consideration, during and *after* the project was started (as in the case of Siemens Power Corporation - Hirt and Swanson, 1999). Indeed, if research such as Themistocleous *et al.* (2001) were taken into account, it would have found that 82% of such implementation project issues were due to technical problems; 58% due to project delays and barriers; 42% due to resistance to change within the organization; and 46% due to problems associated with integrating disparate applications together. Whilst the remit of the ERP-led EAI programme was wholly technical in nature, the effect of their proposed approach was to change the way in

which the company was to operate. Company X was inadvertently satisfying one of Markus’ criteria: that of aligning new business processes with new technology in order to engender change. So whilst in principle the B2B EAI initiative was in the spirit of a Techno-change programme (Markus, 2004), the lack of realization of any of the benefits, supported the fact that the initiative was poorly constructed and ill-conceived, in terms of underestimating the extent of change relating to replacing SAP with Baan ERP. It was found that people-related integration issues were simply not included in the scope of the project (effect of change, skills and training required). In addition, costs relating to adopting this approach largely centered on the licensing of the core ERP product and associated training (as would be expected).

The internal pressures present within the organization ultimately tempered the potential benefits also. For example, in order for Company X to be more customer-centric, it would eventually have to reorganize its product lines and integrate with Baan. Hence, the key to adopting the ERP-led EAI solution within Company X, involved a juxtaposition of implicit organizational change factors (aligning product lines, restructuring and running the business). Thus, Company X was unable to begin the programme of change due to this lack of organizational inertia.

Table 4 highlights and summarizes these issues faced by the organization. This principally shows that Company X could have well avoided disaster, if it had simply taken time to align and optimize its internal core competencies (skills and business operating mode), and seek advice on the efficacy of such an initiative.

<i>Problem</i>	<i>Potential Solution</i>
§ Lack of internal EAI capability tackle system integration within a period of 12 months	§ Use external professional service organizations
§ Weak understanding of eBusiness concepts and business models (mistaking a B2B portal as an <i>internal</i> initiative predominantly)	
§ Lack of cohesion among divisional groups, inhibited a 1-firm view of business goals	§ Group strategy to consolidate operating procedures
§ Poor understanding of fit of Baan ERP to replace SAP ERP internally	§ Could have carried out ISE and package selection tasks

Table 4. Key Issues faced by Company X and potential resolutions

DISCUSSION AND CONCLUSIONS

This paper has attempted to highlight those factors and issues that were experienced by a case study organization, in attempting to carry out an ERP-led EAI initiative. The authors presented a taxonomy which provided factors that contribute to a holistic view of ERP/II implementation characteristics. As such, by viewing the case company’s integration initiative the authors conclude that several ERP/II characteristics were present (namely componentization, extension of supply chain, and limited CRM functionalities), but these were not realized or corrected in a timely and logical manner. Rather, because of senior management’s desire to achieve integration “at all costs”, the pertinent issues of effective strategic and tactical IS architecture planning; interdepartmental collaboration and communication; and adherence to integration lifecycle methodologies, were essentially overlooked. This meant that for this particular ERP integration approach, improvements that were sought essentially in an ERP/II-manner were never fully realized due to these shortcomings. The authors also suggest that the numerous problems encountered by the case organization could have been rectified if the company took more time to understand what it wanted to do; and sought help and advice in order to achieve its aims (noting that it would not be capable of doing everything itself). Hence, from analyzing the case study data the authors highlight the following lessons that can be learned from the experiences of Company X:

- § *Combined ERP / EAI efforts are risky*: the failure of not being able to finish the internal roll-out of the SAP replacement, Baan, significantly hampered the success of achieving the goal of realizing a B2B portal;

- § *Technical capability is different to technical ability*: the relevant technical skills and experience were fundamental to achieving a successful transition from ERP to ERP II. Company X unfortunately lacked the resources, and potential of carrying out such an integration due to a lack of deep integration skills and experience – even though the IT organization was committed to achieving the CEO’s goals;
- § *Strong communication warrants strong collaboration*: although there was a strong level of communication about the initiative from senior management, there was little or no supporting collaborative effort to get cross-divisional software teams to actively approach the integration effort together;
- § *Mis-direction and Mis-understanding*: the senior management of Company X, perceived the B2B portal concept as being a programme which could be driven from inside the organization itself, rather than involving all supply chain stakeholders;
- § *Silo mentality*: as Company X historically consisted of a series of mergers of several industrial automation and software companies, many of the acquired companies (such as ManuWare and SuperPak), were still very much run as separate concerns;
- § *“Keep the eye on the ball”*: even with the best intentions, it was very difficult for Company X to maintain a maintain operational excellence, in the light of potentially massive changes to internal business processes and technologies – cost control via headcount reduction did not assist in this approach at all;
- § *Insight and Governance*: although Company X had previous relationships and had engaged with professional services organizations before, there was a distinct lack of advice sought, to “sanity-check” the approach being taken, either by management or by such external firms.

Therefore, from the preceding points highlighted, the authors hope that further research in the area of organizational, IT and the importance of including external stakeholders and modalities during ERP-led integration efforts, can shed light on the significance and relevance of ERP II for organizations wishing to improve and enhance their strategic technology investments.

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