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# Understanding the Organisational Impact of ERP: A Case Study in Manufacturing

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# UNDERSTANDING THE ORGANISATIONAL IMPACT OF ERP – A CASE STUDY IN MANUFACTURING

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## Abstract

*An underestimated aspect of the study of ERP implementations is the longer term impact of these highly integrated applications on the way that managers work. This paper reports on the changes to managerial decision processes arising from an ERP implementation four years prior to the study. Using the managers' own description of their goals as a lens, the objective was to gain an understanding of the impact of enterprise integration on the capability of the firm. We found that the ERP system has helped the support functions of the organisation (Finance, Quality and IS) by standardising transaction processes and thereby increasing their administrative grasp of the firm's activities (visibility and control). The benefits for managers responsible for the demand and supply cycles are, however, scarce. Furthermore, in a dynamic business environment where processes require constant tweaking to keep abreast of changes in market conditions, highly structuring technologies such as ERP can rapidly go out of kilter with the reality of doing business, and eventually hinder the flow of basic performance information. Managers lose out on the efficiency of integration promised by ERP because of latency in the access to key operational data.*

*Keywords: ERP impact, decision making, data integrity, organisational goals, latency*

# 1 INTRODUCTION

ERP systems have been implemented by large numbers of firms with the aim of speeding up business cycle time and reducing the potential for error in information handling in the administration of core processes in the organisation. By incorporating efficient data capture and storage technology with powerful networking capacity, the vital transactional information is captured at source by users as an integral part of their work processes, and then made available instantaneously for other stages in the process and for management information (Kalakota and Robinson, 2001). This theoretical ideal makes the concept of ERP an extremely attractive one for large firms faced with on-going struggles to reduce costs, control large disparate entities and report detailed results to shareholders in a timely fashion (Holsapple and Sena, 2002).

In practice however, the mixed experience in local sub-units has prompted researchers to question how to ensure that a local manufacturing plant, for example, can derive benefit from the highly standardising approach to the management of resources contained in ERP systems (Gattiker & Goodhue, 2005). Proposing differentiation and interdependence as contextual factors affecting the eventual benefits derived, the authors show that the overall benefits derived by the plant are principally centred around data quality and task efficiency. The authors also demonstrate empirically that the degree of customisation of the application is directly related to the level of local task efficiency. In other words, organisations derive benefits from ERP implementations in terms of an increased granularity of information concerning operations, but this granularity has an impact on task efficiency. Local plants' ability to derive benefit operational benefits from centralised transaction processing systems may depend on the fit between the standard processes and local practice. Also, the highly detailed visibility of the steps in a business process comes at a price. ERP applications, because of their data hungry nature, expose implementing organisations and their staff to a double *observer effect*, whereby not only is the need for users to keep the system up to date disruptive for business processes, but the very fact that certain activities are clearly visible in the application is behaviour-altering and leads to goal displacement. ERP users experience significant constraints in adjusting the evolving reality of business activities to "what the system wants". Consequently the integrity of the information is increasingly dependent on virtual tools capable of re-interpreting transactional information from the ERP system into a "version of the truth" that is useful for management decision making. The development and application of these tools has consequences for the organisation in terms of resources, but also in terms of reporting latency, as this study revealed.

The potential of highly integrated enterprise systems for decision support must therefore be investigated in the light of certain factors. Firstly, when selecting and implementing an ERP system, companies are looking at a good fit with operations, not with the more abstract decision processes. Companies strive to align their ERP architectures with their operational processes, but the performance implications of these technical choices are often not considered (Bendoly and Jacobs 2004). Although organisations may have operational policies differing from plant to plant, and these differences are an accepted element of the corporate landscape, the lines are less clearly drawn around management decision making in general, and the manner in which managers use performance information from ERP systems in particular. Managers may rely on many tacit processes for key decisions and these processes are not necessarily analysed in detail (Lee *et al.*, 2000), nor widely communicated, as their content may be of strategic importance for the firm, or of tactical importance to plant managers within the wider corporation. When tacit decision processes are subjected to an integrating force such as an ERP system, an improvement in performance may not always result.

Secondly, managers are generally concerned with the efficient use of all company resources, including people, capacity and materials. The data model of ERP applications is inventory centric, and therefore lacks the scope to be able to support managers in decisions that involve trading off the costs related to these different resources.

Finally, an ERP implementation implies a certain number of assumptions about the company and how it operates at a specific point in time (Davenport, 1998). These assumptions may change over time, due to the organisation changing what it does (Lee and Lee, 2000) or reacting to new opportunities and threats in the market, leading to radical changes in its business model. The extension of the product set, or the adoption of new distribution channels are examples of “structural” process changes that have a clear impact on back office execution activities.

ERP systems require constant maintenance in order to keep pace with these changes. This maintenance tends to happen by making adjustments at the level of the data because vendors and consultants profess that the layers of metadata external to the ERP system are easier to change than disrupting the tightly linked ERP processes. In any case, the skills required to modify an ERP system at the process level are rare. The daunting complexity of the relational data models at the heart of these applications, coupled with the depth of business experience required to understand the implications of process changes for the business, ensure that finding and retaining such resources is an expensive matter. In a time when business processes were less complex, Dearden (1972) already cast major doubts (referring to it as “absurd”) on the ability of a group of experts to design a single system for all aspects of the business for this very reason.

Without the competence and resources to update the application as business processes evolve, the ERP experience may begin with the promise of increased visibility of operations, but rapidly deteriorate to a point where management information is more opaque than ever. Inevitably, this visionary initiative to unite disparate systems becomes itself one more legacy application, and an extremely “high maintenance” one.

In this paper, we present a case study of a firm in the high tech manufacturing sector which had carried out a global implementation of a single instance ERP system 4 years previously. The paper begins by considering the articulation between business processes, the decision making of managers and the applications that support them. It then presents our research questions and the methodology before presenting the facts of the case and the conclusions we have derived from them with regard to the impact of ERP on business processes and the knock-on effects on the decision making of managers.

## **2 DECISIONS, THE ERP AND THE ORGANISATION**

Langley et al. (1995) have identified 3 aspects of decision making which render it a difficult area for empirical research, and by extension for the highly structured processes of an ERP: (1) Many decisions do not imply distinct identifiable choices, and are difficult to pin down, in time or in place, (2) Decision making processes do not necessarily proceed as a linear sequence of steps, rather they are driven by the emotion, imagination and memories of the decision makers, punctuated by sudden crystallisations of thought and (3) It is difficult to isolate decision processes, as decisions typically become intertwined with other decisions. In the context of an ERP implementation, these observations mean that envisioning the impacts of the ERP on all levels in the decision making processes of the firm is extremely far-reaching. Post-ERP, organisational actors may face significant changes in their status and positions as roles and responsibilities have been re-assigned to adapt to the new ERP-enabled processes. At a minimum, their contribution may have changed towards less autonomy and less control. The decision process may have changed insofar as there are new or modified sources of information and / or different steps to the process. Key decisions may change as the system now incorporates some of the conditions and exception traps which were previously dealt with manually.

The way most currently implemented ERP applications operate raises the question of whether management decisions are subject to programming, ie *programmable* in the sense of Simon’s (1977) ideas on the structure of decisions. During the implementation of an ERP system, information that was previously tracked manually (if at all) must now be recorded unambiguously in the system in order for automatic triggers to be activated allowing transactions to move on to the next stage in the process. Whether a complete model of the factors involved in any given decision can be proposed is not

considered at this stage, as the focus tends to be turned towards what the application, rather than the manager, requires. As a result, organisational actors will find out post-implementation if all the relevant parameters required for their decision making purposes have been taken into account in setting up the application. If not, they will have to live with reduced flexibility or a workaround until the ERP is updated. Post go-live, the impetus and resources required to change the application evaporate rapidly, and the reality is that the workarounds become the rule until the next ERP project.

Gorry (1971) argued that the expansion of information systems into higher management functions has resulted in an exaggerated focus on information quality, at the expense of an emphasis on decision making models and their components (constraints, goals and other parameters). In the case of ERP, this means that implementing an ERP system may complicate decision making for managers. Each ERP package uses operational models as underlying frameworks and these models can differ in terms of how they operate. Although managers may have involved in making the configuration decisions embodied in the business template as implemented by the ERP project team, they will usually be dissuaded from proposing any changes to these decisions post-implementation. Much of the requirement for business intelligence tools post-ERP derives from a desire to correct or clarify the meaning of corporate data that was explicitly hard-wired in the original process template (Carton and Adam, 2007). In addition, there is a wealth of information important for decision making, which lies outside the traditional ERP boundaries (Stefanou, 2001) in external sources, and in legacy systems. Finally, managers require decision making models to help them decipher the complexity of the real world. ERP systems, while providing solid transactional engines at Anthony's (1965) operational control level, tend to increase the volume of information available to managers, but in so doing, add even greater complexity to decision making at the management control level.

To conclude this argument, the use of such notions as "best practice" and "zero modifications" used by ERP vendors implies that the collective experience of individual business managers could not be more apt than the experience of the software vendor. The operational know-how and industry specific experience of firms can thus be superseded by canned transaction processes. This notion is perhaps easily sold in the boardroom, but harder to swallow when confronted on a daily basis with the issues arising from a poor fit between the software and the reality. The tight timescales for the implementation of ERP systems don't allow an adequate margin for questioning the corporate template being rolled out. Managers are thus expected to take on process models that are not their own, with parameters they had little influence on, and with little access to management reports.

This is likely to bring significant resistance to change post implementation as observed in pre-ERP times by Little (1970). Such resistance to change will make the impact of ERP applications even more unpredictable as workarounds emerge that by-pass key stages in the application's tightly defined business processes. Because of the automation of the flow of work inherent in these systems, and because people are compensated on their work rather than their proficiency in using information systems, users will do what is necessary to keep the transactions running, at the expense of data quality and integrity. In terms of decision making, this will have significant consequences. Pfeffer (1992) discusses the selective use of information in management to rationalise decision processes, and how, under conditions of uncertainty, individuals would prefer to use data and decision making processes "with which they are comfortable". Thus, managers may continue to use their own *ad-hoc* sources of data and processing routines, if they cannot easily manipulate the data in the ERP.

However, from the broader perspective of the organisation, rather than the individual, integrating mechanisms are adopted which increase its information processing capabilities (Galbraith, 1974). ERP systems are integration mechanisms in Galbraith's parlance, allowing routine and predictable tasks to be automated. As such, they may take the organisation towards Winter's (1985) routinised or high volume mechanistic decision making. Winter (1985) however suggests that there should be a conscious choice in the selection of which matters to treat mechanistically, and which to treat with some deliberation. It is debatable whether such selection is up for discussion in an ERP project in that the choices inherent in implementing and configuring ERP processes amount to suppressing the choices to be made by process users regarding the day to day routine work. Winter (1985) warns

however, that as the range of situations subsumed by routines expands, and the performance of the systems improves, there is a corresponding reduction in awareness of the exceptions that may be useful or even essential to survival. This can lead to “irresponsible or slothful” inattention, whose consequences are “made to seem tolerable” (p. 111).

Thus, the implementation of ERP, for all its merits in standardization and centralization terms, may have unpredictable effects on the local decision making abilities of the firm. Existing research is primarily carried out at the level of firm level benefits, rather than at the level of operational process level (Cotteleer and Bendoly, 2006). Not only are there many factors involved in the achievement of these benefits, the range of operational activities touched by these cross functional systems precludes all but a cursory empirical approach at the transactional level. In an effort to provide definitive leads for managers involved in implementing ERP, a case study was carried out in a firm with a mature ERP application to study in detail the impact of these applications on the repetitive decision making routines in key areas of the manufacturing organisation. In so doing, the authors provide suggestions for how organisations can equip themselves to support managers in deriving benefit from integrated enterprise applications.

### **3 RESEARCH OBJECTIVE, QUESTIONS AND METHODS**

An information system by definition supports the centralisation of control (Markus & Robey 1988). Multi-national companies have been implementing integrated enterprise wide systems such as ERP for more than a decade, with a view to reaping the rewards of the increased visibility of operations that these applications offer. In this research, an in-depth case study of a successful multinational company (MNC) was used to explore the role of integrated enterprise applications in supporting managerial decision making. One of the challenges of research into the impact of integrated applications such as ERP is to properly identify where this impact should be measured (firm level or process level, for example), and also where the root cause of “issues” lie. Problems in decision making may be expressed by managers without reference to ERP systems specifically, and some of the constraints may arise from legacy applications, or from the complexity of the technical architecture in place, including the use of multiple data warehouses for management reporting. Managers understandably show different levels of trust in, and understanding of, these new sources of data.

The aim of this study is to focus on the role played by mature ERP systems in supporting day to day decision making for managers. By removing the focal point from the ERP project itself, the emphasis is removed from the implementation choices made by the firm in adapting the ERP solution to their needs. Improved decision making is rarely a stated objective of these projects, thus the goal of the research is not to measure implementation success. On the contrary, the goal is to investigate, once the dust has settled on the ERP implementation, their longer term contribution to management’s ability to make decisions.

Qualitative data can help researchers understand the dynamics underlying complex relationships, that is, the “why” of what is happening (Eisenhardt, 1989). The approach adopted in this research was to triangulate views of key decisions from the different functional managers involved. It was felt that this qualitative approach represented a non-judgmental, exploratory way for managers, who have themselves internalized the logic of the “way things are done”, to elucidate their own decision patterns and biases. For example, extreme pressure on the sales order fulfilment cycle at quarter end is an observable management headache. However, it is difficult (for all concerned) to identify the causality relationships between the variables involved, or to delineate definitively between the effects of transaction volume, administration inefficiency or information system shortcoming.

Single case studies pose an additional challenge of extricating the findings from their specific organisational context towards generalisable principles. This risk of bias was attenuated by a number of factors. Firstly, ERP packages are based on a common view of the underlying business model. The gaps between this model and the way companies operate may vary from case to case, but the latency

impact on decision making is comparable. Secondly, publicly quoted MNC's operate under the scrutiny of the Stock Exchange, and the top-down pressure on keeping inventory and costs low, while maintaining profit margins and customer satisfaction, is universal. Finally, managers are faced with the same daily high level challenges in any business, ensuring resources are being used efficiently and effectively in the execution of these corporate objectives.

The research objective was operationalised into 3 separate research questions which yielded a complete picture of the "footprint" of ERP in different aspects of the managers' responsibilities.

**Research Question 1** was concerned with discovering the goals pursued by the different functions. The crucial point was to understand how these goals were operationalised, and what managers were expected to deliver. **Research Question 2** was concerned with a more granular view of the execution of these goals by analysing what decisions managers made on a day to day basis, and their perceptions of what the critical issues were. **Research Question 3** drew on the output from Question 2 and explored the footprint of ERP in the decisional domains thus identified. Here we sought to gauge the value of a mature ERP implementation in the map of managerial decisional activity.

These questions were investigated during an in-depth field study of SIT Ltd (not the company's real name), a large multinational manufacturing organisation. From April to August 2005, 50 interviews were carried out with middle and senior managers in all functional areas that were impacted by ERP, covering manufacturing operations in Ireland and the US, as well as corporate headquarters in the US (see Table 1). SIT went live on their ERP system in October 2001, so these interviews reflected the views of managers using a relatively mature system, which is why this firm was selected.

Interview table	SIT Ltd		
	Cork	Boston	Total
Finance	5	9	14
Manufacturing / Distribution	13	6	19
Sales	4	3	7
IS	4	2	6
Engineering	2		2
HR	2		2
Total	30	20	50

Table 1. Breakdown of interviews by functional area.

The interviews were recorded and transcribed, yielding over 250,000 words of material. An extremely high level of access was gained in this firm, and the experience of these managers can be heard in the language used regarding goals, decisions and issues. In analysing these observations, the meaning was retained by returning to what was actually said, rather than the researcher's interpretation of the same. An example will illustrate the point, where a Cork based purchasing manager is talking about the point of departure between data driven decisions and real life:

... you have vendors that don't have anything in capacity, so therefore, at a point in time, which comes before you actually get a sales order, you are going to have to make an intellectual decision, to say, yes, go and build it, yes, go and position it.

In this example, the slightly unusual use of the term "intellectual" implies intuitive, gut-feeling decision making, the subject of Research Question 3, but might easily have been overlooked if not captured verbatim. Many such examples of embedded meaning justified the transcription effort.

On the other hand, a robust and unique coding methodology was applied to reduce the data and avoid data analysis paralysis (Yin, 1989). Observations from the transcripts were extracted to a matrix structured by research question, yielding a total of 1,845 observations. Cell entries were either direct quotes from transcripts or more often a summary of the issue raised. Using hyperlink functionality each extracted observation was linked dynamically back to the original transcript, thereby retaining richness and avoiding "too thin cell entries" (Miles & Huberman, 1994).

These observations were coded at three levels, identifying the interviewee, the business process commented, and the theme. The business process was recorded independently of the functional affiliation of the interviewee. For example, observations regarding shipment decisions were classified as pertaining to the “Deliver” process, and were commented upon by managers from Finance, Materials, Manufacturing, Distribution, and Sales. The themes began as a set of 13 seed categories, developed from the literature review, and complemented by themes which emerged from the data.

The next section outlines the background to SIT as a company and the context of the ERP implementation.

## **4 CASE STUDY BACKGROUND**

The market leader in data management solutions, SIT sees itself as specialising in helping customers to derive more value from their corporate data. The company is following an aggressive growth, with 17% growth in consolidated revenue in 2005, which was the year in which the case study was carried out. Revenues have since then continued their upward growth trend, topping \$11.2 billion in 2006. SIT Ltd employs over 26,500 people in 52 operations worldwide. Manufacturing is concentrated in three sites, one of which is Cork.

From mainframe storage systems in the late 80’s to platform independent network products by the mid 90’s, SIT has evolved into a “solutions” company, delivering not just hardware, but also information “lifecycle” tools and consulting services. A key complexity of this trend towards full service offerings is the management of the information flows related to executing a single customer order, which increasingly is constituted of hardware, software and services. Many of these revenue lines are executed by multiple locations, over different time horizons, yet the customer will require a single sales order, single invoice and single goods shipment.

SIT implemented a single instance global ERP system in 2001. This big bang implementation addressed user requirements for transaction processing in all back office activities relating to sales order processing, manufacturing, materials planning, distribution and finance. The Oracle based system supports 4,500 users in 52 countries worldwide, 3 of which involve manufacturing operations.

Sales demand is focused through the ERP based quotation and sales order processing system. Although a “build to plan” operation, SIT suffers from the hockey stick effect on sales, whereby the majority (>80%) of orders only become firm in the final 2/3 weeks of the quarter, which places enormous pressures on managers, operators and systems. One of the key issues of this case is whether the ERP application helps managers to cope with this pressure or aggravates it.

The next section presents the case study according to the three research questions outlined above.

## **5 FINDINGS OF THE CASE STUDY**

### **5.1 Research Question 1: Organisational goals**

SIT is characterised by a “stretch goal” culture, whereby top management communicates high level goals in terms of revenues and product mix at quarterly shareholder briefings. This communication draws a line in the sand both for the sales organisation and the three manufacturing operations and their respective supply chains. Goals and budgets are disseminated downwards through each functional organisation and geography. Manufacturing are driven by product availability plans, sales are driven by revenue targets, and Finance are driven by external shareholder expectations of revenue and profitability.

The goals are subject to frequent change, depending upon the messages that company officers wish to transmit to the stock market regarding SIT’s performance, or according to unpredicted trends in



demand. At an operational level, these changes directly influence managerial decisions (concerning the disposition of resources) and operational decisions (which products to ship). Changes to goals seem to permeate right down to the execution level, where distribution and customer operations are making decisions on what backlog orders to ship based on sales targets. These targets are viewed simultaneously by revenue, margin, product and geographic region.

A key issue in achieving corporate goals is that revenue targets use average prices which don't capture either the complexity of the products or the seasonality of sales activities. SIT's data storage solutions are required to fit the customer's specific technical infrastructure, thus the products are highly configurable, and consequently the sales procedure for higher end solutions can be long. Furthermore, with hockey stick pressure on sales reps to close their deals in the current quarter, the actual price on any given customer order can vary considerably as the bargaining power of customers increases.

The pressure on distribution and managers increases with the seasonality of the business. Requiring simultaneous access to information on units shipped and consequent revenue attainment, managers at the plant find themselves running "blind", that is transacting shipments to execute on customer orders but missing the visibility of these shipments from a reporting perspective due to systems latency.

Thus, the SIT case illustrates the trend in multinationals towards a culture based on a "load and chase" philosophy. High level goals are set at the beginning of the period and communicated broadly, being thereafter treated as set in stone. Variations in demand, on the other hand, cause uneven patterns of operational activity and place huge strain on the execution organisation. Reacting to actual versus plan updates becomes an onerous part of execution activity, as distinct from simply dealing with execution issues. Exactly how this decentralisation of responsibility impacts the decision making of managers is explored in the next section.

## **5.2 Research Question 2: Management decisions**

The key management decisions at the SIT manufacturing plants and at headquarters level are concerned with how to orchestrate the increasingly multi-source supply chain to meet customer demand effectively, whilst keeping costs at a minimum. For the execution side of the business, this means guaranteeing the availability of raw materials to production, ensuring procurement stays in line with the build plan and actual demand, dealing with production contingencies that affect capacity or yield, and prioritising customer orders for shipment, all this with minimal stock levels. Four principal questions summarise these decisions, *what to plan, what to buy, what to produce and what to deliver*.

### *5.2.1 What to Plan and what to Buy*

The basic planning decisions concern what quantities of raw materials to purchase and what production schedule to follow in order to meet the material availability goal specified in the build plan. These decisions entail a high degree of visibility of current sources of inventory, in all its forms, and planned product build levels, in sufficient details to be able to break out component requirements. Alternate sources of supply are managed through the Bill of Materials, and buyers must be prepared to take into account component level revisions and quality issues arising from the test process. As SIT's high end products have long lead times, planners, and consequently buyers, are working in a "build to plan" mode where key purchasing decisions must be made in the absence of actual demand data. For mid- and lower-range products the lead time is shorter, but the volumes are greater.

Product goes out to, and comes back from, a variety of sources, including vendors for normal receipts and re-worked material, customers with material on loan or evaluation, and internal customers such as engineering and customer service. Planners need visibility of all these potential sources of demand and supply, and a custom solution was built to accommodate the functionality that an ERP system could not handle. Even with this custom built tool, much of the decision making is off-line, as one materials manager in Cork commented:

Well, you know, you're always going to have to be intuitive anyway. But what you are doing is you're making your intuitive decision in your brain, but you're inputting it into the tool

Once materials have been made available to production, Assembly & Test kicks off and the decisions for managers become more focused on capacity, yield and achieving the build plan.

### 5.2.2 *What to make*

The manufacturing mindset at SIT is focused on “not being the obstacle” to the company achieving its revenue target because of product availability. The build plan for high end products is executed “blind” in terms of what product configurations will actually be specified by customers on sales orders. Management decisions revolve mostly around the impact of quality issues or build plan changes on capacity (equipment, space or labour) because all products are manufactured “fully loaded” and then de-configured to fit customer orders as needed.

Purges due to quality issues and product revisions are daily occurrences for manufacturing managers. For example, there can be as many as 40 “up-revs” a week (suppliers deliver upgraded versions of their components). In these cases Engineering will require an immediate snapshot of all affected inventory. Decisions on what, when and how to purge are evaluated in terms of impact to the build plan, but also in terms of individual customer commitments.

The effect of dealing with the various contingencies in manufacturing is often to push the problems to the back end of the quarter, as one manager described it:

I think the reality is, as the problems arise, inevitably all the people will tend to back-end it on the quarter, and we will have more to do later in the quarter than previously considered.

Once goods have made it through manufacturing to the finished goods area, they are now in a position to be allocated to sales orders, which is the responsibility of the Distribution organisation.

### 5.2.3 *What to deliver*

Distribution is focused on achieving the revenue target and clearing the backlog of approved orders. Although sales are satisfied once revenue targets are achieved, unfulfilled orders in backlog are seen as revenue “left on the shelf”. This means delivering customers everything ordered within the commit dates, no matter how late orders are received. This implies a radical shrinking of process cycle time at quarter end, with orders turned around in a fraction of the time it normally takes. There is even a “Day 32” customisation to the ERP system which allows orders to be physically shipped in time for quarter end, but allowing the related keying of the transactions on ERP to happen the next day.

SIT have an essentially manual sales order allocation process for higher value sales. Instead of sales orders being assigned to finished goods, it is the other way around, whereby managers run through a list of finished goods, allocating them to sales orders. Once the “best match” has been found for a product and corresponding sales order, and sales operations are satisfied that this deal represents the optimal use of that inventory (in terms of revenue and margin), then technicians manually de-configure the product in question to the sales order, and the order can move on to shipment.

The task of managing shipments in this way has become much more complex due to the range of products sold. The price book now contains 1400 products. Fulfilment of an order might conceivably involve physical product coming from many different places, including some third party product. This is a mindset change for distribution, who are used to physically handling everything that goes out the door, and also a process challenge, as the ERP based shipping process is based on a presumption that an order is entirely shipped from one location.

Meanwhile sales operations, a sales support group working alongside their colleagues in Distribution, but reporting to the Finance organization, are concentrated on trying to get the “highest dollars out”. This implies not simply reducing backlog, but reducing it in an order of priority which optimizes the

chances of hitting revenue targets for the different lines of the business and reduces the risk of the corporation being penalised on the stock market.

### 5.3 Research Question 3: ERP value in managerial decision making

ERP has had a huge positive impact, particularly in the corporate finance area, where month end close has been reduced to a matter of days. The immediate integration of the expenditure activities of newly acquired companies is only possible because of the global Chart of Accounts and standardised purchase requisition processes offered by the ERP system.

Nevertheless, at a local manufacturing level, it is highly debatable whether the ERP investment can be considered beneficial. The latency in transaction processing time (up to several hours at quarter end), the failure to use MRP (because it does not understand the full complexity of SIT's Bills of Materials), the inability of ERP to give a true and accurate picture of all inventory (because of units that are being reworked or on loan to potential customers), have diluted the contribution of ERP in manufacturing.

Managers were asked about the value of ERP across the different processes investigated at SIT. Table 2, where “-“ denotes negative opinions, “+” denotes positive opinions and “=” denotes neutral opinions gives a summary of the quantitative analysis of the interview transcripts. The table shows the dominance of negative opinions on the impact of ERP (68.5%) and the polarisation around negative or positive opinions (less than 2.8% of references to the value of ERP in terms of the key business processes were neutral). The largest proportion of negative opinions were concerned with the value of ERP to the “deliver” process (89%), which comes as no surprise given the still largely manual process.

ERP impact by Business Process	-	+	=	Total
Plan	13	6	1	20
Buy	20	10		30
Make	50	28	5	83
Deliver	103	13	7	123
Quote to cash	71	26		97
Report	87	63	2	152
Approve & Pay	20	8		28
Forecast	8	2		10
Total	372	156	15	543

Table 2. Footprint of ERP by process at SIT

Thus, ERP is a poor fit to SIT's most transaction intensive business processes, notably production planning, MRP, procurement and sales order execution. Furthermore, management information at SIT transits via a number of custom-built data warehouses, each of which has different refresh rates from the ERP production data (varying from every 10 minutes, to every 8 hours, to every 24 hours). Thus, despite the existence of a centralized repository for all transactional data, SIT managers are in a quandary regarding reporting, as one corporate controller described it:

We need to have one source of information, you can't use your version of the truth, and my version of the truth, we spend all our time reconciling to each other's reports

This complex and centralised technical architecture means that in practice, if managers are not physically close to the ERP support organisation (at corporate headquarters in Boston), the chances of obtaining the reports they require for decision support are slim. At the time of the case study, three years after go-live, some Cork managers had system modification requests still pending development. Even corporate finance found it difficult to retain the skills necessary to exploit the richness of information held in the ERP system. These highly skilled resources are tied up in the sort of low-value and repetitive data reconciliation work that the ERP system was destined to eradicate. In SIT, as in many organisations, the information required by managers to make decisions is contained in a number of systems, including the enterprise systems such as ERP, associated data warehouses and manual

tools such as spreadsheets. The more systems involved, the greater the information latency. Equally, the multiplication of systems introduces data integrity issues.

The ERP system has allowed the firm to face up to accelerated flows of transactions and supported the constant growth of the business over a 4 year period. However, at the time of the case study, the systems were again beginning to grind to a halt at quarter end.

## **6 LESSONS FROM THE CASE STUDY**

The data integrity brought about by the ERP system at the time of implementation has removed *some* of the dead time involved in arguing about data integrity, and in-so-doing it gave managers more time to focus on more value-adding activities. A Senior VP for Finance described the benefit and its reliance on people thus:

Finance is able to spend more of its time in analysis and less arguing about the validity of the data. Analysis is extremely powerful and investigative, we need smart people (...) to drive it.

On the other hand, plant level managers are limited in their ability to exploit ERP to investigate the causes of variances in operational performance. This study highlights a number of barriers to site level managers exploiting the richness of information held within the ERP system:

- Lack of local skills (detailed knowledge of the business processes and of the ERP configuration)
- Consequent inability to reconstitute meaning from the transactional data extracted from the ERP structure, or to integrate it with data from other sources
- Lack of access to data (access to production data is more or less proscribed)
- Process latency resulting from the poor fit of the ERP with the specificities of certain business processes (the application doesn't capture the necessary detail, or too much detail)
- Latency in providing the required data because of the technical infrastructure

Plant level users are left on their own to master the information held in the ERP, and yet very few have the requisite level of access (or skills) to explore the possibilities of using the data to support management questions. Standard reports are often ignored, by both users and IT, and there is a commonly held belief that "if it's not in a spreadsheet then it's not acceptable", which is paradoxical in an ERP-enabled business. To conclude, there is a multi-faceted gap between the information required to put together managerial metrics and the information and functionality available automatically in ERPs.

## **7 FURTHER RESEARCH**

This research validates the approach of using business processes, and the detailed steps within those processes, as the unit of analysis in measuring the impact of these hugely integrated applications. The organisation is extremely diverse, and ERP systems touch so many different functional areas, that it is impossible to decipher their impact without descending into the detail of what people actually do.

A limitation in this research has been the abstraction from the detailed implementation issues faced by the organisation in implementing their ERP system. Specifically, during implementation, choices were made in the configuration, customisation and integration of the standard ERP software to work with legacy applications and processes for this organisation. Manager's opinions of the role of ERP will therefore inevitably be coloured by factors that are outside the scope of the ERP system itself, and linked to the context in which the system was implemented. In this study we did not seek to differentiate between the contextual elements and the system itself. Instead we focused on the perceptions of managers, where these two dimensions are inextricably merged. In extending this research, it is not certain how a methodology could be adapted which would take into account the decisions made at implementation time.

Further research should be oriented towards frameworks for modelling and actively managing the gap between business processes and the enterprise system, such that adequate resources can be deployed to address the gap before the benefits of a centralised IT infrastructure are frittered away in a blossoming of local data warehouse solutions and personal spreadsheets. This research should address the means the organization needs to put in place to plan for the eventual divergence of ERP systems from reality, and to mitigate against this gap with skills and tools. A non trivial starting point would be to design a framework for the tools, skills and resources capable of reporting on the gap, such that the gradual tendency towards system obsolescence is visible, and can be rectified on the fly.

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