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Revisiting the impact of ERP systems on business value: A triangulation method

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ABSTRACT

The present study will examine the impact of Enterprise Resource Planning (ERP) investment on business value. While there is considerable amount research on the impact of IT investments on business performance, few studies have provided empirical evidence about the business value of ERP investments. Case studies have shown positive impacts of ERP implementations. However, there are many cases where ERP systems have caused serious financial and operational problems. The present study attempts to provide evidence about the impact of ERP investments on business value by comparing the reaction of investors to ERP investment announcements with senior managers' perceptions (*ex ante*) about the net benefits of the ERP system after its implementation (*ex post*), the proposed research in progress will shed some light on the conflicting results.

Keywords

Enterprise resource planning, business value, event study, market reaction, managers' perceptions.

INTRODUCTION

Enterprise resource planning (ERP) solutions seek to streamline and integrate operational processes and information flows in organizations. The integration of complex sets of business needs requires sophisticated software development tools and highly skilled software developers, including functional area analysts. There is considerable uncertainty associated with ERP implementation and high levels of risk (Harris, 2003). In addition, ERP systems automate and integrate the organizational networks of business processes, making the ERP project very sensitive to communication and coordination problems. According to a 1999 survey conducted by META group, the average implementation cost of ERP systems was \$15 million per year and the average time of implementation was 23 months. Some have estimated that 90% of ERP implementations end up late or over budget (Martin, 1998), 40% accomplish only partial implementation, and about 20% are abandoned before completion (Trunick, 1999).

The potential benefits of ERPs have been the drivers of its diffusion. Davenport (1998) described ERP as the "most important development in corporate use of information technology". The late 90's experienced a boom in the adoption of ERPs (Kennerley and Neely, 2001). At that time, 70% of the Fortune 1,000 firms had adopted ERP systems (Hoffman, 1998). In 1999 AMR Research estimated an astonishing growth for the ERP market from 16.6 billion in 1998 to 66.6 billion in 2003 (Kennerley and Neely, 2001). However, in 2003 IDC reported that ERP market reached only 25 million and estimated a market growth of only 1% by 2004 (Poston and Grabski, 2001).

Research which has examined financial and accounting performance measures (e.g., Hitt *et al*, 2002) has provided some information about the *ex post* success, or performance, of ERP systems. On the other hand, capital market event studies identify, on aggregate, the market's expectations (*ex ante*) about the information conveyed in a firm's announcement to invest in ERP technologies (Hayes *et al*, 2001).

The goal of the current research is to investigate the business value of ERPs by relating information from *ex ante* and *ex post* measures of ERP system success. Case studies, surveys, and empirical research can provide measures and/or evidence of an ERP's success or failure, *ex post*, or after implementation. Market reaction to ERP investment announcements provides evidence about investors' expectations about the performance of the firm in the future, representing an *ex ante* evaluation of the proposed system.

The article is organized as follows. The first section is a literature review about the impact of ERP investments on business value, from which the hypotheses are derived. The research methodology, including data sources, is explained in the next section, and, finally, the potential contribution is discussed.

LITERATURE REVIEW

ERPs: Success and Risk

Advocates of ERP systems argue that these systems enhance firms' value by increasing efficiency and competitive advantage (Hayes et al. 2001). However, the cost and risk associated to ERP implementation are substantial (Davenport, 2000). There are case study examples of both ERP successes (Motwani et al, 2002) and failures (Gattiker, 2002). For instance, Hershey Foods's 112 million ERP project created such operational problems that Hershey's sales plunged by 12% during the last quarter of 1999 (Stedman, 1999). Microsoft has saved over \$2 million in equipment depreciation and has reduced its financial closing cycle from twelve days to four (Davenport, 2000).

Empirical studies have found that implementing ERP systems impact organizations' accounting measures positively (Poston and Grabski, 2001). Hitt *et al* (2002) did not find corresponding increases in the accounting measures studied right after implementation, although he found out that, in average, ERP adopters showed better financial performance than non-adopters in the long run.

The case study reports of ERP successes and failures offer contradictory evidence on the value of ERP systems. Although empirical studies consistently show positive impacts of ERPs, more specific impacts are unknown. For example, financial measures after implementation could show positive impacts, while end users are struggling with the inefficient redesigned processes and managers are misled with inaccurate information coming from the ERP system. Since users play a pivotal role in achieving ERP system success (Somers, et al. 2003), user satisfaction is a good indicator of system success that could complement our understanding of ERP impacts on business value.

Event studies as ex-ante measure

Because ERPs are intended to provide long-term strategic benefits, an approach to studying business value of ERP systems by looking at the change in market value of ERP firms should be appropriate. The study of market reaction to IT-related announcements is well established (Dehning *et al*, 2003). An event study can be used to evaluate the effect (in terms of the existence of abnormal returns) of IT investment announcements on security returns. Dos Santos *et al* (1993) found positive abnormal returns only for announcements of innovative IT investments. Chatterjee *et al* (2002) found positive abnormal returns related to announcements about IT infrastructure and IT application investments. Hayes *et al* (2001) found a significant positive market reaction (abnormal return) for 91 ERP investment announcements between 1990 and 1998. Their results also suggest that small/healthy firms experienced a higher positive return than large firms, while small/unhealthy firms reacted negatively to ERP investment announcements.

Even though the event studies have shown consistent results, they do not identify specific impacts attributable to ERP systems within organizations. They have also not addressed the risk associated with ERP systems, in that they have not attempted to determine whether the system has ultimately succeeded or failed to provide the promised benefits.

RESEARCH QUESTION & HYPOTHESES.

How accurate are investors' expectations of ERP implementation success at the time the project is announced? We will investigate whether market expectations of the anticipated benefits of an ERP implementation (*ex ante*, at the time of the investment announcement) are accurate predictors of the ultimate success of the ERP system. To answer this question, we must identify the effect of ERP investment announcements on stock prices. Then, for the firms with ERP installation announcements, we must also determine (*ex post*) whether the end-user/managers consider the ERP system to be a success.

When confronted with complex events or incomplete information, individuals tend to revert to the use of a simple "rule of thumb" (Tversky and Kahneman, 1974) for decision making and problem solving. Recent research has suggested that event study methodology might not be adequate when the information conveyed by an event is so complex that the investors do not have the cognitive ability to process it (Harrison et al., 2004). Since ERP implementation is an inherently complex and risky process, we might expect investors to act based only on a *rule of thumb* that ERP is a good investment, perhaps mitigated by

the investors' faith in the organization to manage such a complex project. This is consistent with the positive abnormal returns for ERP announcements identified by Hayes *et al* (2001). Thus, we will investigate the following hypothesis:

H1: ERP investment announcements will result in a positive market reaction.

The human element has become a critical determinant of IS success (Martinsons and Chong, 1999). The realization of benefits from ERP investment depends on the effective use of the system and the level of user satisfaction (Somers *et al*, 2003). With different profiles, managers and employees are both end users of ERP systems. Thus, the opinion of experienced end users about ERPs after implementation should be related with its impact on business value. Few studies have examined the perceived benefits of ERPs. Using data collected from 270 manufacturing firms that implemented ERP systems, Gefen & Ragowsky (2005) examined associations between the business characteristics of manufacturing firms and their perceived benefits from ERP system investments. The perceived ERP benefits are measured at two levels: (1) an enterprise level and (2) a specific IT module level. They found that the perceived value for ERP investments was consistently better explained at the specific IT module level. Since the reaction of investors to announcements of ERP investments is an *ex ante* measure of the impact of ERP on business value, we will investigate the following hypothesis:

H2: Users'/Managers' satisfaction with the ERP measured two years after the implementation will be related to investors' expectations at the time of the ERP investment announcement.

METHODOLOGY

Event Study.

The event study methodology will be employed to study the association between announcements of ERP investments and changes in the value of the announcing firm. Event studies draw on the efficient markets hypothesis, that capital markets efficiently process information relevant to current and future expectations about firm valuation (Fama *et al*, 1969). The efficient markets hypothesis suggests that investors act rationally and quickly to information about any activities which affect a firm's profitability. Thus, the stock price will change correspondingly. The event study methodology captures the aggregate assessment of a large number of market participants of the discounted value of future firm profits attributable to a specific event. See McWilliams and Siegel (1997) for a thorough review of the event study methodology.

The ERP investment announcements will be collected from Lexis-Nexis Academic Universe's (News) Wire Service Reports from the periods 1994 to 2002. We will not consider announcements that could be confounded with other major announcements related to the same firm. In addition, for each announcement with no confounding events, we will search for previous published information related with the announcement that could lessen the effect of the official announcement. In order to have more accurate results and identify possible inconsistencies, we will run a t-test to compare both groups in terms of abnormal returns. For example, in June 1998, CompUSA announced the acquisition of Tandy's Computer City, and they mentioned that they were going to implement an information system to integrate their business processes in the next 60-90 days. In January 1999, CompUSA announced the adoption of an ERP (SAP Retail). In this case, the investors' reaction to this announcement may be minimum or null, and this would not completely reflect the value of the ERP investment since they knew that this event was going to happen.

For each announcement, we compute the stock returns for the relevant firm within a three-day window, including the day prior to the announcement ($t = -1$), the day of the announcement ($t = 0$), and the day following the announcement ($t = 1$). The CRSP database of daily stock market returns will be used to compute individual security returns and to compute changes in a market-wide index for these corresponding periods. The actual returns will be compared to the returns predicted by the market model to determine the cumulative abnormal returns (CARs) related to each announcement (McWilliams & Siegel, 1997). Positive abnormal returns will mean that, overall, investors believe that the investment in ERP systems will be profitable for the firm.

User satisfaction.

Somers *et al* (2003) have studied the End User Computing Satisfaction (EUCS) Instrument (originally developed by Doll and Torzadeh [1988]) and they have validated it for studies of ERP systems. Studies (Seddon, 1997; Gefen and Ragowsky, 2005) imply that user satisfaction is a reasonable measure of ERP success. EUCS (End User Computer Satisfaction) is a

multidimensional construct requiring self-reports of users' satisfaction with the content, accuracy, format, timeliness, and ease of use (Somers *et al.*, 2003).

We will track each of the ERP investment announcements to determine whether the ERP system is implemented and currently in use. For each firm, we will survey one group of user/managers in each of the four functional areas (*Marketing & Sales, Production and Materials Management, Accounting & Finance, and Human Resources*) to get a measure of user satisfaction with the ERP. The functional areas are interdependent, reflecting the business processes within the firm. Within each area, one or more specific subgroups (business functions) will be selected, based on importance and relevance within the industry and environment in which the firm operates. We hope to identify at least 25 firms who will allow us to conduct our survey within at least four business functions across the functional areas.

Individual EUCS scores for each business process will be averaged to determine customer satisfaction measures at the process, or module level. These scores will also be aggregated to the functional area level, and to the firm level. T-Tests and F-tests will be used to determine if there are differences between the mean and variance of the satisfaction measures, at the process and functional area levels. For those firms where an initial ERP investment announcement does not result in a system which is in use, we assume that the system was not successful.

Relationship between initial expectations and outcome

EUCS scores for each firm will be classified according to three levels: high levels of satisfaction/success, moderate satisfaction/success, and low satisfaction/success. These will be regressed against the cumulative abnormal returns derived in the event study, controlling for relevant firm characteristics such as size.

EXPECTED CONTRIBUTION

The present study will provide more evidence to the scarce empirical results about the impact of ERP systems to business value. Results from this research will also provide a longitudinal perspective about the market reaction to ERP that could be related to the recent slow growth of the ERP market. Finally, by using a triangulation method, the present study will contribute to knowledge in IS about the business value of IT large-scale investments, and about the sophistication of investors when evaluating complex, enterprise systems.

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