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Enterprise Application Integration and its Effect on Business Value: A Stock Market View

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ABSTRACT

Enterprise application integration (EAI), or software technologies designed to integrate various corporate computer systems, are rapidly gaining importance. The objective of this study is to ascertain the relevance of EAI to achieving tangible benefits, specifically from the investors' perspective. Using an event study approach and 71 corporate announcements of EAI implementations, we attempt to shed some light on this issue by analyzing stock price reactions. Our results suggest that from investors' perspective, EAI investments are not always positive. Furthermore, investors react negatively to financially distressed companies investing in EAI.

Keywords

Business value, enterprise application integration, event study

INTRODUCTION

Integration of the various corporate information systems (IS) is a challenging issue for many organizations. As companies continue to implement different systems that are not easy to integrate with their existing structures, their overall business efficiency may decline. This decrease in overall efficiency resulting from such integration problems could possibly be a partial explanation of the so-called "productivity paradox" of information technology (Brynjolfsson 1993).

Enterprise application integration (EAI) technology emerged to address this integration issue (Johannesson and Perjons 2001; Themistocleous, Irani and Love 2004). This sophisticated type of middleware is believed to increase flexibility and prolong the lifecycle of many corporate applications (Irani, Themistocleous and Love 2003). Thus, EAI could be expected to have a positive effect on a company's efficiency and, therefore, on business value.

In spite of the fact that EAI is being implemented by a growing number of corporations, there are not many systematic studies about the business value of such investments. The little evidence that does exist is largely based on isolated case studies (Puschmann and Alt 2004).

The objective of the current study, described in this paper, is to explore the effects of EAI technology on business value. In the context of our study, the term business value denotes the impact on company financial performance (Mukhopadhyay, Kekre and Kalathur 1995). Specifically, we attempt to assess the financial merit of investments in EAI from the investors' perspective. Using event study methodology and a sample of 71 EAI implementation announcements, we attempt to provide some empirical evidence regarding this issue.

BACKGROUND

One approach for gauging corporate decisions from an investor's perspective is event study methodology. Event studies examine the changes in stock prices to explore the relevance and implications of different information as it becomes available. This approach relies on the efficient market theory, according to which stock prices fully reflect all available information at a given time (Fama 1970, 1991). Thus, when unexpected relevant information is released, the stock prices promptly react. If the released information is perceived as having positive implication for future cash-flows, the stock prices are expected to increase (Fama, Fisher, Jensen and Roll 1969). In contrast, if the information is perceived to have negative implication and future cash-flows are expected to be reduced in consequence, the stock prices are expected to decrease. In essence thus, the event study approach uses unanticipated movements in stock markets to better comprehend intricate and complex issues.

Past applications of this methodology have contributed to a better understanding of various kinds of events, such as announcements of new governmental regulations, changes in corporate strategies, corporate mergers, or corporate

performance. Attracted by its efficacy, investigators in the field of information technology (IT) research have started to embrace the event study approach to examine different aspects of the payoffs from IT investments.

One of the first event studies in the field of IT focused on industry and innovation (Dos Santos, Peffers and Mauer 1993). Due to the information intensity of the financial industry, it was expected that IT investments would have a larger effect on stocks of financial firms than on stocks of manufacturing firms. However, this claim was not supported. Regarding innovation, it was asserted that the launch of new technology would result in a competitive edge until the technology becomes routine within the industry, and indeed, positive stock price reactions for innovative IT investments provided evidence for this claim.

A later study examined IT investments and stock price reaction in the context of industry, firm size, and time period (Im, Dow and Grover 2001). The results of that study show positive price reactions for smaller firms and for newer announcements. A different event study was used to assess the outcomes of e-commerce initiatives (Subramani and Walden 2001). The results of that study suggest that announcements of e-commerce initiatives enjoy positive reaction in stock prices. In addition, the stock price reactions to *business-to-business (B2B)* as compared to *business-to-consumer (B2C)* initiatives were found to be only marginally different. Also no substantial differences between offering tangible, traditional products as opposed to digital goods were shown.

Event study methodology has also been used to compare investments that target IT infrastructure to those investments that primarily target particular applications (Chatterjee, Pacini and Sambamurthy 2002). A more recent study suggests that transformative IT investments are received positively (Dehning, Richardson and Zmud 2003).

Overall, application of the event study approach in the IS/IT research area appear to have notably enhanced the existing knowledge in the field of productivity. Furthermore, the event study approach points to several research avenues worthy of additional efforts (McWilliams and Siegel 1997).

In the past, IT decisions often were made at department levels, with each department choosing applications that suited the needs of the department, and thereby leaving the enterprise as a whole with a collection of isolated systems that could not communicate with each other. These systems were often bought from different vendors, using different technologies and interfaces, thus making it difficult to combine them. Some middleware technology was used to allow some systems to communicate with others, but mostly this was one-to-one communication, and far from a total integration approach. EAI technology emerged to address this issue. EAI technology integrates systems applications to enable information sharing and business processes, which results in more efficient operations and flexible delivery of business services (Erasala, Yen and Rajkumar 2003).

Taking into account the seemingly obvious technical advantages of EAI systems, it could be expected that implementing EAI will provide significant additional business value, which according to the efficient market theory should reflect in positive stock market reactions to announcements of EAI investments. However, EAI implementations are very complex issues, so not all EAI can be expected to result in equally substantial improvements.

HYPOTHESES DEVELOPMENT

Looking at IT investments in general, previous event studies (Dos Santos et al. 1993; Im et al. 2001), as mentioned earlier in this paper, did not find any significant reaction in stocks due to such investments. In this study, however, we look at IT investments related to EAI technology. In spite of the indisputable technical advantages, we argue that for most companies the investments in EAI will not convince investors that these initiatives result in higher future cash flows. Therefore, for a full sample of companies, we hypothesize:

H1: Announcements of investments in EAI do not, on average, significantly affect stock prices.

Firms which implemented EAI early on, in the late 1990s, were able to achieve competitive advantage that way, but now investments in EAI are more or less expected and companies are investing in EAI just to keep up with their competitors that already have EAI. In addition, investments in EAI pose less of a financial risk as the technology matures, and corporate decision makers and IS consultants may benefit from past experiences and be guided by earlier EAI implementation frameworks and methods (Lam and Shankaraman 2004; Themistocleous 2004). Therefore we hypothesize:

H2: The magnitude of stock price reactions to announcements of investments in EAI diminishes over time.

Often, companies invest in technology in an attempt to overcome serious organizational problems. Inefficiently and poorly managed companies may see investments in technology as a remedy for their problems, but such under-performing companies are generally considered risky investments. The *Capital Asset Pricing Model (CAPM)* (Lintner 1965; Sharpe

1964) provides a measure of relative market risk called the security's *beta* (Fuller and Wong 1988), defined as the covariance of the stock's returns with the market's index returns, divided by the variance of the market's returns. In essence, companies perceived as about average risk have a beta higher than 1.

Investments in EAI are, however, in most cases not able to fix serious organizational problems. To the contrary, such investments may not only add additional costs but also lead to greater managerial challenges. Therefore, we hypothesize:

H3: Stocks of firms with high beta (perceived as risky financial engagement) will respond less favorably to announcements of investments in EAI.

EAI implementation allows many companies to integrate different types of software packages and thus create an efficient and maintainable IS infrastructures (Themistocleous and Irani 2006). Expanding the EAI focus to also include systems external to the organization, such as for example, supplier and/or customer systems, may improve the supply chain. By integrating inter-company *enterprise resource planning (ERP)* systems and by improving co-ordination among suppliers, manufacturing firms can better employ *just-in-time* and other inventory control systems. A large portion of capital investments in manufacturing firms is in inventory: reduced inventory due to EAI technology relates to higher profits, as the firms can get more value out of their ERP, *supply chain management (SCM)*, and other systems. Thus it could be expected that the indisputable operational, managerial, technical, strategic, and organizational advantages that come with EAI implementations (Themistocleous 2004) especially benefit manufacturing companies. Therefore we hypothesize:

H4: Stocks of manufacturing firms will respond more positively to announcements of investments in EAI than stocks of non-manufacturing firms.

METHODOLOGY

Data Collection

The announcements about the EAI investments were collected using Lexis-Nexis database. A number of relatively complex queries were developed for this task, which included combinations of words related to the EAI technology. Frequently, these queries yielded a large number of announcements, the majority of which, after examination, proved to be not relevant to our study. For instance, some of the announcements were related to non-publicly traded companies. The final sample, after excluding those that were not applicable, consisted of 71 announcements. Table 1 shows the distribution of the announcements by year and industry.

	1998	1999	2000	2001	2002	2003	2004	Total
Manufacturing	4	3	8	11	3	0	2	31
Non-manufacturing	1	3	8	9	5	6	8	40
Total	5	6	16	20	8	6	10	71

Table 1. Distribution of Announcements by Year and Industry

As Table 1 shows, until 2001 about half of EAI investments were in manufacturing companies, but beginning 2002, the overwhelming majority of EAI investments were outside the manufacturing sector. In addition, the distribution suggests that investments in EAI peaked in the years 2000-2001.

Data Analysis

Assessing the Stock Price Reaction

To assess the stock price reaction to the EAI announcements, we followed the methodology used in earlier studies (Loderer and Mauer 1992). Accordingly, for a given stock, we calculated the expected returns from the CAPM. Unexpected returns, or *abnormal returns (AR)*, possibly triggered by the EAI investments, are the difference between the actual returns and the returns which can be expected based on the CAPM calculation.

The day of announcement was defined as day 0. For determining the alpha and beta parameters needed for the CAPM calculation, we used a 200 day estimation period, which started 201 days and ended 2 days before the announcement. The SP 500 index was used as proxy for stock market returns. To measure the stock price reaction to the EAI investments, we used two different event windows: both starting one day before the announcement, but the one ending on the day of the

announcement, and the other ending one day after the announcement. The first event window is denoted as (-1,0) and the second as (-1,1).

For both event windows, *cumulative abnormal returns* (CAR) were calculated by summing the AR for the days of the event window. We further tested the stock price reaction for significance using *cumulative standardized abnormal returns* (CSAR) (Loderer and Mauer 1992).

Dividing the Sample

Our first hypothesis was tested using the whole sample, while the remaining three hypotheses compared stock reaction of different sub-samples. To test the second hypothesis, our sample was partitioned in two sub-samples: “older announcements” including years 1998 to 2001 and “newer announcements” including years 2002 to 2004. To test the third hypothesis our sample was divided into two sub-samples: “low risk” and “high risk” firms. In this context, companies with beta below 1.1 were categorized as “low risk” firms while companies with beta of 1.1 and higher were defined as “high risk” firms. Similarly, in order to test our fourth hypothesis, the sample was divided into two sub-samples: “manufacturing” firms and “non-manufacturing” firms.

RESULTS

Based on the full sample, the CSAR values are close to zero, as shown in Table 2, supporting Hypothesis 1 that investments in EAI do not lead to significant abnormal returns.

With regards to Hypothesis 2, the CSAR values give no indication of significant differences in abnormal stock returns between the investments in years 1998-2001 and 2002-2004. However, the standard deviations of the CAR values, as shown in Table 3, are greater for the sample of earlier EAI adoptions. For the event windows (-1,0), the *F*-test for equality of variances suggests that the variability of CAR was indeed greater for years 1998-2001 than for years 2002-2004, with a significance level of 0.01, thus supporting Hypothesis 2. In contrast, for the event windows (-1,1), the difference in variability of CAR values was insignificant. Therefore overall, the support for Hypothesis 2 seems inconclusive.

Hypothesis 3 is supported, as the significantly more negative CSAR values for beta > 1.1 indicate. Hypothesis 4 is not supported as indicated by CSAR values that do not significantly differ by industry breakdown. These results are summarized in Table 4.

Thus our results suggest that from an investors’ perspective, EAI technology does not necessarily lead to improvements in shareholder value. Stocks of financially distressed companies that are perceived as investment risks react negatively to investments in EAI.

Sample	Number of Announcements	CSAR [-1,0]	Z-Value	CSAR [-1,1]	Z-Value
Full Sample	71	-0.181	-1.52	-0.183	-1.54
Breakdown by time					
1998-2001	47	-0.181	-1.25	-0.225	-1.54
2002-2004	24	-0.178	-0.87	-0.101	-0.50
Breakdown by beta factor					
1.1 or higher	19	-0.458	-1.99*	-0.534	-2.33*
below 1.1	52	-0.079	-0.57	-0.055	-0.18
Breakdown by industry					
Manufacturing	31	-0.137	-0.76	-0.160	-0.89
Non-Manufacturing	40	-0.215	-1.36	-0.201	-1.27

* Significant at $\alpha=0.05$

Table 2. Cumulative Standardized Abnormal Returns (CSAR)

Sample	Number of Announcements	CAR [-1,0] in %	Std.D. in %	CAR [-1,1] in %	Std.D. in %
Full Sample	71	-0.91	3.89	-0.98	4.08
Breakdown by time					
1998-2001	47	-1.16	4.50	-1.34	4.36
2002-2004	24	-0.44	2.25	-0.25	3.43

Table 3. Cumulative Abnormal Returns (CAR)

Hypothesis	Results	Comments
1	Supported	Overall, investments in EAI do not result in abnormal returns
2	Inconclusive	The magnitude of stock price reactions may diminish as technology becomes more established
3	Supported	Announcements of Investments in EAI in companies, perceived as risky investments, result in declining stocks
4	Not supported	There is no significant difference in stock price reaction between manufacturing and non-manufacturing firms

Table 4. Summary of Results

CONCLUSION

In this study, we investigated investors' expectations regarding the business value derived from investments in EAI. Overall, our results suggest that investors do not believe that EAI implementation would positively impact future cash flows. This appears contrary to common expectation.

One possible explanation of this could be that the top management in many companies fails to properly communicate the advantages of EAI investments to the stockholders.

Furthermore, our results indicate that early implementation of EAI did not necessarily result in a positive stock price reaction. This may suggest that first-movers, who embrace a particular type of new technology such as EAI are not always perceived as being able to achieve competitive advantage that way. Many of the first-movers' advantages need to be related to the many first-movers' disadvantages (Lieberman and Montgomery 1988). In addition, the late-movers may benefit from reduced implementation costs and more mature, and thus stable technology.

CONTRIBUTION, LIMITATIONS, AND MANAGERIAL IMPLICATIONS

There is considerable value in research that takes the investors' perspective, as investors often decide on the commercial success of a technology. Convincing investors about the business value of a particular technology, such as EAI, should be of great advantage as supportive inventors are more likely to provide the necessary funding.

We believe that our study makes a worthwhile contribution to the existing body of knowledge, while pointing to several possible avenues for future research. First, in contrast to many previous studies, we have investigated investments limited to only one particular technology, namely EAI. This relatively narrow focus allows a better comparison of results. In our study, we have examined the business value of EAI from the investors' perspective.

A limitation of our study, as in other event studies, is the lack of accounting for possible confounding events. Though we made every attempt to exclude from the final sample the announcements with perceived, potential confounding events around the release time, the existence of such confounding events can never completely be excluded. For example, changes in regulatory environment may have an impact on a particular industry, but is hardly traceable to a single company. A further limitation is our relatively small sample.

Regarding the practical implication for management, our study provides further evidence that not all investments in EAI receive positive reaction in stock markets. Managers should not view EAI implementation as a way to compensate for

organizational problems. Our results indicate that financial markets mostly respond negatively to EAI announcements when the announcing company is perceived as an investment risk. Therefore, decision-makers in such companies may be advised to devote their attention and allocate their financial resources toward other projects, rather than investing in EAI.

Though the relatively small sample and other limitations described above limit the generalizability of our findings, other scholars may build on our results and perhaps validate our findings through other approaches.

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