THE ADOPTION OF ENTERPRISE RESOURCE PLANNING (ERP) SYSTEMS

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Abstract: A representative sample of 60 firms drawn from the Fortune 1000 that had recently adopted Enterprise Resource Planning (ERP) systems were used to test a model of weak appropriation with significant results. Leadership (social learning theory), business process reengineering (change the company not the technology) and acquisition strategy (buy, don’t make), controlling for EDI (electronic data interchange), when the project was begun, industry (manufacturing versus service) and scale (sales) and were found to be significant predictors of adoption performance (final model R-square=43%, F=5.5, p<.001, df=7,52). In general, strong, hands-on leadership, and business process re-engineering coupled with purchasing ERP systems was found to be a much more effective adaptation strategy than tailoring enterprise software.

Keywords: Enterprise Resource Planning, Leadership, Business Process Reengineering, Acquisition Strategy

1. THE ADOPTION OF ENTERPRISE RESOURCE PLANNING (ERP) SYSTEMS

Most R&D resources are allocated to developing new products and services. In contrast, operations or process technologies and new information systems are usually purchased from suppliers. Therefore, organizations simultaneously use strong and contend with weak appropriability regimes when attempting to capture benefits from new technology investments. Further, traditional methods of protecting inventions often fail to create strong appropriability (Joly and de Looze, 1996). The effectiveness of patents relative to other mechanisms of protecting intellectual capital property has not increased since the 1980’s (Cohen, Nelson and Walsh, 1997). Backward vertical integration does not always provide lower cost (Fronmueller and Reed, 1996) or is not feasible (Teece, 1998). In this study, we ask how can the same adopted technologies generate such an array of different appropriation consequences?

The context chosen for this research is the adoption of enterprise resource planning (ERP) systems, which involves large purchases of computer software and often requires new hardware technologies, as well. The cost of a new ERP systems...
system runs from $50 million to $500 million or more, depending upon size of the organization and system options selected (Davenport, 1998). Enterprise resource planning (ERP) is a technology that helps organizations attempt to standardize their information systems in order to avoid the high cost of multiple hardware-software systems' maintenance. The way this works is through the adoption of “…enterprise software, programs that can manage all of a corporation’s internal operations in a single powerful network.” In this paper it is argued that enterprise integration is an example of what economists call the “appropriation of rents” problem. Any purchased technology is theoretically available to all organizations—including competitors. Further, because of the popularity of these new hardware-software systems, all customers are now competing for the scarce resources of supplier attention, since there are only a handful of companies that can provide this technology.

Reports indicate considerable variance in success with enterprise integration programs. Hershey Foods Corporation was recently estimated to have lost $100 million when a new computer system designed to integrate every thing from taking orders to loading trucks did not come on line as planned just as Halloween orders were coming in (Nelson and Ramstad, 1999, p. A1). Whirlpool and others have experienced similar problems (Boudette, 1999).

1.1 Leadership, Social Learning Theory And Discontinuous Change

Social learning theory has great potential application in understanding the role of leadership in discontinuous change. If behaviors are unprecedented, they need to be demonstrated. For senior managers, just providing verbal direction or vision will not be sufficient in this situation, they have to “walk the talk” (Steyrer, 1998). This becomes self-reinforcing for managerial efficacy (Wood and Bandura, 1989). Early research (Ettlie and Rubenstein, 1980) and subsequent work shows that leaders should coach as well as articulate vision (Popper and Lipshitz, 1992). The vast number of organizational departments and members that need new information would overwhelm the typical organization; therefore all senior managers need to demonstrate adoption.

Hypothesis 1: Leadership through exemplary action promotes the successful adoption of discontinuous change, especially when general managers demonstrate a cohesive front of support vis-à-vis the new technology.

The rationale for this hypothesis is based on the social learning theory interpretation of leadership behaviors required to influence organizational behaviors during discontinuous change and weak appropriation conditions, e.g., the adoption of ERP systems. Exemplary modeling of action is the key leadership behavior, consistently demonstrated by the management team, especially when the technology is unprecedented and sourced external to the firm that makes the difference here.

1.2 Adaptation Strategy: Business Process Reengineering

What is the appropriate strategy for deployment of large, new technology systems, adopted from suppliers, primarily outside the firm? There are a number of ways of answering this question, depending upon which part of a company’s strategy is examined. At the highest level, to what extent will new technology adoption change corporate (business choice) or business unit strategy (competitive strategy)? Are strategic alliances a part of this acquisition plan?

Significant organizational change accompanies significant information system adoption (Davenport, 1998). Companies have not understood the value-added contribution of every business process (Guimaraes, 1997). Tailoring systems to meet the requirements of an organization under weak appropriation conditions is counterproductive for two important reasons. First, it is costly, and benefits under weak conditions are less likely to be forthcoming and second, it tends to maintain status quo within an organization rather than promote change to meet future needs. Hypothesis two is offered for testing.

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2 Stephen Baker, “SAP’s Expanding Universe,” Business Week, September 14, 1998, 168, 170. The market for enterprise software is now dominated by SAP and is estimated to be about $12 billion per year, and if installation is included, this rises to about $30 billion. What is ERP? “An Enterprise Resource Planning system is a packaged business software system that allows a company to: automate and integrate the majority of business processes; share common data and practices across the entire enterprise; and produce and access information in a real-time environment,” Deloitte & Touche, “ERP’s Second Wave: Maximizing the Value of ERP-Enabled Processes,” Deloitte & Touche Consulting LLC, 1998.

3 Baker, Ibid. SAP grew at a rate of 66% in the first half of 1998.
Hypothesis 2: Successful capture of benefits from purchased technology results from changing the organization (e.g., business process reengineering) to leverage internal strengths for the future of the firm. Attempting to maintain the status quo of an organization, while changing the technology is counterproductive under weak appropriation conditions.

The typical information system adoption through outsourcing has been driven by cost reduction (DiRamo and Gurbaxani, 1998; Earl, 1996) but successful adoption of the best current state-of-the-art, usually requires organizational change. In the case of ERP adoption, this adaptation strategy takes the form of business process reengineering (Davenport, 1998).

1.3 Technology Acquisition Strategy

Scholars investigating appropriation of rents have typically framed this theory and empirical testing using vertical integration as the focus (Masten, Meehan and Snyder, 1989). However, there are two limitations of this approach. First, appropriation is not directly conceived or measured using this method. Second, vertical integration patterns, or make-buy decisions are far too simplistic to capture all the sourcing alternatives available to organizations when exploring market versus hierarchy costs. Further, options and benefits streams are rarely considered in this research. Alternatives to vertical integration and innovations like information systems and new technology used to reduce transaction costs and boundary-spanning activities are needed to supplement this theory.

Without clear focus on core technology, efforts to deploy complex, new adopted technology systems are likely to be very unproductive. Only companies with clear strategic segregation of developed (product and service) versus purchased (process) technology systems are likely to be successful in their appropriation efforts. Exceptions to this theory include companies that are also in the business of selling these process or information systems like the ERP suppliers.

The second part of this argument says information technology needs to be coupled with successful business process re-engineering. Under weak appropriation conditions of purchased technology, the most efficient approach to adaptation, as painful as it might seem at first, is to focus on changing the organization (e.g., business process re-engineering).

Hypothesis 3: Successful acquisition strategy for process technologies is likely to be dominated by purchase of “off the shelf” systems rather than internally developed, proprietary systems or tailored systems, either purchased or developed internally.

The rationale for this hypothesis is that for most organizations, process technology of operations, such as computer systems, is not part of their core technology supporting products and services. The more companies source standard modules and tailored systems rather than developing their own technology, more successful they will be.

1.4 Methodology

A mailed survey using a 2-page questionnaire of large U.S. companies in the Fortune 1000 resulted in a representative sample of 60 companies that had recently adopted enterprise resource planning systems in 1998-9. Data collection was suspended in June of 1999. An earlier version of the questionnaire was pilot tested with six ERP adopting companies. Phone-screened respondents (chief information officers were the primary respondents) were encouraged to mail, fax or record answers on a web page. Because the usable response rate was only 6%, comparisons were made between an archive compiled on the Fortune 1000 and the sample. No significant differences were found on earnings growth (t=1.2), employees (t=0.25), R&D (t=0.82), R&D percentage (t=0.79), ROE (t=1.19), and sales (t=0.88). However, the Fortune 1000 is approximately 40% manufacturing and 60% non-manufacturing, whereas in the survey, firm distribution was just the opposite: 60% manufacturing and 40% non-manufacturing adopters of ERP systems. The distribution of ERP

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4 The questionnaire from the authors, and includes both structured and open-ended questions.
5 This archive was compiled from Hoovers (http://www.hoovers.com/capsules/13494.html) and Lexus Nexus in the Michigan Business School Library computer files. Response rates have become a critical problem in business research, and single digit or small double-digit return rates have become typical. A comparable, 4-page questionnaire survey of APICS (American Production and Inventory Control Society) members on ERP adoption completed in September, 1999 by Professor Vince Mabert at Indiana University, produced a response rate of slightly less than 10% (479 of 5000). This was reported at the 6th Annual Midwest Manufacturing and Logistics Roundtable, Kelly School of Business, Indiana University, Bloomington, IN, October 23, 1999.
suppliers mentioned by survey respondents was nearly the same as current market share distributions (e.g., SAP, Baan, Oracle, PeopleSoft, etc.). For example, SAP currently holds 32% of the market share of ERP systems (Boudette, 1999), and in this sample of 60 companies, SAP had 30% of the adoptions. Further, R&D spending as a percentage of sales as reported and as shown in the computer files for the Fortune 1000 were very significantly correlated (r= .87, p< .001). All indications supported a representative sample.

1.5 Adoption Performance

The dependent variable of the study was adoption performance or the degree of progress towards full-scale, successful implementation of the ERP system under investigation. The rationale for selection of this variable is twofold. First, acquiring data on adoption of ERP as it occurs is better than rationalized self-report data after systems are fully deployed. Second, it is assumed that the tournament model prevails in weak appropriation situations: early winners are the ultimate winners in new technology adoption. This rationale is a variant on the first-mover strategy. Two items on the questionnaire emerged from factor analysis of candidates for this scale: “What proportion of the project ($) is done?” (Category responses were 10%, 25%, 50%, 75% and 100%); and “Relative to other companies in your industry, are you ahead, even or behind on project outcomes?” Factor analysis with principal components of these two items yielded a factor score of .85, communality=.73, and an eigenvalue =1.45, accounting for 72.6 percentage of variance in comparative, adoption performance. The intercorrelation of these two items was r=-.45 (p=.014).7

1.6 Results

Regression results are OLS (ordinary least squares) using mean substitute for missing data was used in this analysis. Correlations with and without mean substitution were compared and no significant differences were found. The overall regression equation is significant (F=5.54, p<.001, with 7,52 degrees of freedom), and accounts for 43% of the variance in the dependent variable (35% of the variance adjusted for degrees of freedom). Results strongly support the three hypotheses of this study. Leadership as measured by the five-item scale constructed here, was a very significant predictor in the regression equation, with beta=.357 (p=.002). Business process reengineering (beta=.267, p=.019) is significantly related to adoption performance. These two results sustain the first two hypotheses. The third hypothesis was also strongly supported. Acquisition strategy, as represented by the percentage of systems purchased by the firm (% buy), is significantly and directly related to adoption performance (beta =.337, p=.006). Buying tailored systems percentages and making (writing own)5 software do not enter this model.

Two of the control variables were not statistically significant (sales, industry). On the other hand, both EDI usage (beta=-.268, p=.014), and start date (beta=-.257, p=.02) were significant predictors in the regression equation. This indicates that these firms are possibly somewhat behind in EDI adoption and are using ERP to complete many integration tasks. Alternatively, EDI takes the place or “substitutes” for at least part of what ERP can offer a firm. This EDI substitution effect warrants further research.

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7 Validation of the Dependent Variable Measure:

A double-blind test was used with a panel of experts from the largest ERP system supplier in order to validate the dependent variable measure of adoption performance. A total of 14 firms on the supplier list were also in the sample. These firms were scored by the panel of experts and also had evaluations from the respondents in the survey. Kendall’s correlation for the rank-order association between the survey scores and supplier expert panel scores was tau b= .418, p=.061 (n=14). The Pearson r =.439, p=.058 (n=14). The second validation test of the dependent variable was a review of recent journal and popular press articles about the ERP progress of the firms in the sample. An independent reviewer sought to answer one question from the survey questionnaire: “Relative to other companies in that industry, is the firm ahead, even or behind on project outcomes?” Ratings of 3, 2 and 1 were assigned for ahead, even and behind respectively. This procedure is comparable to criterion validation used in psychological studies.

Of the 60 firms in the sample, 27 were found to have relevant articles in the ABI/INFORM database since 1999. The reviewer rankings correlated significantly with the dependent variable with Pearson r=0.589 (p = .021).

8 Although the “make” percentage does not enter this equation, it was inversely related to the dependent variable (r = - .355, p=.075, two-tailed test, n=26), consistent with these results.
REFERENCES


