Returns on Investments in Information Technology: A Research Synthesis

Bruce Dehning
University of New Hampshire

Vernon J. Richardson
University of Kansas

ABSTRACT: Understanding the return on investments in information technology (IT) is the focus of a large and growing body of research. The objective of this paper is to synthesize this research and develop a model to guide future research in the evaluation of information technology investments. We focus on archival studies that use accounting or market measures of firm performance. We emphasize those studies where accounting researchers with interest in market-level analyses of systems and technology issues may hold a competitive advantage over traditional information systems (IS) researchers. We propose numerous opportunities for future research. These include examining the relation between IT and business processes, and business processes and overall firm performance, understanding the effect of contextual factors on the IT-performance relation, examining the IT-performance relation in an international context, and examining the interactive effects of IT spending and IT management on firm performance.

Keywords: information technology; literature review; performance measures; returns; market measures; accounting measures; research opportunities.

I. INTRODUCTION

A large and growing body of information systems (IS) research investigates the return on investments in information technology (IT). The objective of this paper is to encourage researchers to explore the synergies between accounting and IS, and to consider where accounting researchers trained in firm- and market-level analysis may contribute to this area.

Quantifying the financial returns on IT investments is a major topic of IS research. In the early 1990s, researchers found a productivity paradox concerning IT investments. This paradox showed IT investments with negative or zero returns. In an age where management carefully weighs the costs and benefits of every discretionary investment dollar, finding evidence of the returns on IT investments is critical. In particular, research considering the context surrounding an IT investment is likely to be essential and useful to corporate IT management.

This paper is not a comprehensive review of the IS literature. Instead, it synthesizes prior research, and develops a model to guide future research in the evaluation of information systems investments. Our model can act as a guide for researchers interested in pursuing a line of traditional IS research where

We thank Dan Stone, Mike Ettredge, Tom Clausen, and two anonymous referees for their helpful comments. Professor Dehning acknowledges the financial support provided by the Virginia Paul Dee Professorship. Professor Richardson thanks KPMG for their generous support.
accounting researchers may hold a competitive advantage. Thus, we focus on studies using archival data and accounting or market measures of firm performance. Numerous IS studies that use a variety of methods such as field studies, surveys, and experiments are beyond the scope of this paper.

Sircar et al. (1998) review the literature on the impact of IT on firm performance through 1996. As necessary, we review research covered in their paper as background material. We then add two areas not covered in their work: market performance measures and papers published after 1996. In order to provide a complete view of this recent literature, we examine the tables of contents in the leading journals in information systems from 1997 to the first half of 2001. Relevant working papers are also included. To provide an unbiased sample of working papers, we examine the Proceedings of the International Conference on Information Systems and the American Accounting Association Annual Meeting from 1997 to 2001.

**Returns on Investments in IT: The Productivity Paradox and Beyond**

The “Productivity Paradox” refers to the early literature on the relation between IT and productivity that finds an absence of a positive relation between spending on IT and productivity or profitability. Research on the paradox exists on two levels. The first is at the industry- or economy-wide level. This was summed up in 1987 by Nobel Prize-winning economist Robert Solow, who wrote, “We see the computer age everywhere except in the productivity statistics.” The second Productivity Paradox was observed at the company level, where “there was no correlation whatsoever between expenditures for information technologies and any known measure of profitability.” It is the second version of the Productivity Paradox that most intrigues researchers in IT (e.g., Brynjolfsson 1993; Landauer 1995; Strassmann 1990, 1997a; Weill 1992). These early studies confirm either no relation or a slightly negative relation between firm-level spending on IT and firm performance.

However, by the late 1990s several studies found there were positive payoffs from investments in IT (Brynjolfsson and Hitt 1995, 1996; Dewan and Min 1997; Hitt and Brynjolfsson 1996; Lichtenberg 1995; Stratopoulos and Dehning 2000). The question changed from “is there a payoff” to “when and why is there a payoff.” Because the payoffs from IT appear contingent, Brynjolfsson and Hitt (1998) call for more research into what determines success, and how to make IT effective. It is in this area that we believe accounting researchers can leverage their knowledge and skills to make a significant contribution to our understanding of the benefits of IT investments.

We organize this paper as follows. First we introduce the return on IT investments research, and discuss the comparative advantage of accounting researchers in this area. In the next section we develop a model to categorize the research in this area. To organize our discussion of IT investments, we classify each study into one of three categories: IT spending, IT strategy, or IT management/capability. In the next section we review related work in accounting and finance, and discuss potential areas for future research. The final section provides our conclusions.

**II. COMPARATIVE ADVANTAGE OF ACCOUNTING RESEARCHERS**

Accounting doctoral programs generally require a seminar in empirical-archival research studies. This seminar often includes research designs that emphasize stock market returns and accounting performance measures. In addition, accounting doctoral students are generally familiar with the use of short- and long-window event studies and market valuation studies. In addition, they are often knowledgeable about the trade-offs of using different accounting measures such as Return on Assets (ROA), Return on Equity (ROE), Return on Sales (ROS), and Return on Investment (ROI). Accounting researchers may have clear insights into how IT investments might affect intermediate financial performance measures.

---

1 The *Journal of Information Systems* was chosen as the leading journal in Accounting Information Systems, the other journals (*Communications of the ACM*, *Decision Sciences*, *Information Systems Research*, *Journal of MIS*, *Management Science*, and *MIS Quarterly*) were chosen for being ranked in the top four in Walstrom et al. (1995), Holsapple et al. (1994), or Gillenson and Stutz (1991).

2 *New York Times Book Review*, July 12, 1987, as quoted in Brynjolfsson and Hitt (1998). This version of the paradox is sometimes referred to as the “Solow Paradox.”

3 Strassmann (1997b, 2).
such as profit margin and turnover ratios. Accounting researchers with these skills can leverage them in an IS context by examining the returns on investments in IT.

Accounting researchers have long been interested in returns on investments in research and development (R&D), advertising, and capital expenditures, which makes the study of the returns on IT investments a natural extension of current accounting research. This allows accounting researchers to use the concepts and designs developed from researching the returns on discretionary management investments, and apply them to the IT context.

In addition, accounting researchers may have a competitive advantage in relating the implications of IT research to non-MIS user groups such as the firm’s financial management, investors, financial analysts, auditors, regulators, etc. The managerial accounting literature has long considered the environment in which a firm operates as an important determinant of the success of a company’s management accounting systems. Many of these concepts have yet to appear in the IS literature.

III. INTRODUCTION TO THE LITERATURE REVIEW

We propose a framework for IS research by considering the returns on investments in IT measured with market measures such as abnormal returns or accounting performance measures such as ROA. Our review encompasses research that addresses the general question shown in Equation (1): Can differences in firm performance be explained by differences in IT investments?

\[ \text{Performance} = f(\text{IT}) \]  

We present a general framework for analyzing this research in Figure 1. The top portion of Figure 1 shows that IT has a direct or indirect effect on business processes, which together determine the overall performance of the firm. An example of a direct effect is improving inventory management, which reduces inventory levels, inventory holding costs, waste, and spoilage. An example of an indirect effect is improving decision making by having information from a new IS that was previously unavailable.

The bottom half of Figure 1 shows how researchers have measured IT, business process performance, or firm performance. Generally, investments in IT have been examined three ways: (1) differences in the amount of money spent on IT, (2) the type of IT purchased, (3) how IT assets are managed. We refer to these as IT spending, IT strategy, and IT management/capability.

Researchers who quantify the explanatory variables based on IT spending have looked at total IT spending, IT training expenditures, and IT staff expenditures. Researchers who examine IT investments using IT strategy usually examine IT deployments such as type of system (e.g., electronic commerce or ERP), performance advantages from early deployment of technology (first-mover advantages or proprietary technology advantages), or IT-enabled strategies such as improved product quality due to new IT. Researchers who quantify the explanatory variables based on IT management or capability examine differences in the emphasis on IT or level of ability within an organization. For example, researchers classify firms as successful users of IT, or as those that have systems personnel in upper management positions.

The relation between IT and firm performance follows three paths of Figure 1. Path 1 is a direct link between IT and overall firm performance, bypassing the effect of IT on business processes. In this research, researchers usually measure firm performance using market measures or accounting measures. Market performance measures include event studies (short-window abnormal stock returns), market valuation of common equity and Tobin’s q. Accounting performance measures include ratios such as ROA, ROE, and ROS. All studies that use market performance measures are by default investigating Path 1 since there are no market measures of business processes.

Path 2 of Figure 1 describes the relation between IT and business process performance. Business process performance measures include gross margin, inventory turnover, customer service, quality, efficiency, and other cost, profit margin, and turnover ratios. Path 3 shows how these process measures combine or interact to determine overall firm performance.

The link between IT and performance depends on other factors, which we refer to as Contextual Factors in our framework. Path 4 of Figure 1 presents the Contextual Factors that link business processes and firm performance measures. Examples of Contextual Factors include firm size, industry, financial
health of the firm, growth options, and IT intensity. As shown in Figure 1, these Contextual Factors affect business processes through Path 4 and overall firm performance through Path 5.

We divide the studies into the three general categories used to frame the differences in IT investments, IT spending, IT strategy, and IT management/capability. Figure 2 contains a summary of each reviewed study, including the authors, publication date, focus of the study, measures of business processes or firm performance, summary of findings, and investigated paths from Figure 1.

**IT Spending**

*Stock Market Reactions to Announcements of IT-Related Expenditures*

In this section we investigate Paths 1 and 5 of Figure 1 by examining five relevant event studies. One market-based method of determining whether IT investments pay off is to see if shareholders believe IT investments are value-relevant. Event-study methods can be used in an IT context to study the market reactions to salient IT events. One such event is a press release announcement of an IT investment. Creative and careful research designs allow researchers to investigate which attributes of IT investments influence shareholders’ interpretations of such announcements as measured by abnormal movements in the investing firm’s stock price.

The first two studies examine Path 1 of Figure 1 by considering the path between IT spending and firm performance. The latter three studies focus on contextual factors (Path 5 of Figure 1) such as size, time, industry, industry-strategic-IT role, and type of IT investment. They find evidence that contextual factors are critical in understanding the relation between IT investments and the related stock market reaction.
# FIGURE 2

Summary of Research on the Return on Investments in Information Technology

<table>
<thead>
<tr>
<th>Author and Year</th>
<th>Focus of Study</th>
<th>Performance Measure</th>
<th>Summary of Major Finding(s)</th>
<th>Path(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IT Spending: Market Measures—Event Studies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dos Santos et al. 1993</td>
<td>Announcements of IT Investments and Innovative IT Investments</td>
<td>Stock Returns on Days −1 and 0 (where 0 is the date of the press release)</td>
<td>No excess stock market returns on full sample or industry subsample. Innovative IT investments increase firm value by 1.03%, while non-innovative (−0.09%) and unclassified investments (−0.46%) do not.</td>
<td>1</td>
</tr>
<tr>
<td>Chatterjee, Pacini, and Sambamurthy 2001</td>
<td>Announcements of IT Investments in IT Infrastructure and Applications</td>
<td>Stock Returns on Days 0 and +1 (where 0 is the date of the press release)</td>
<td>Abnormal stock returns of 1.06% and 0.43% for IT infrastructure and IT application investments, respectively.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Im et al. 2001</td>
<td>Announcements of IT Investments</td>
<td>Stock Returns on Days −1 and 0 (where 0 is the date of the press release); Trading Volume on Days −1 and 0</td>
<td>Contextual factors such as size and time lag effects help explain the stock price reaction to all IT investment announcements. Stock price and volume reactions relate negatively to firm size and become more positive over time.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Richardson and Zmud 2001a</td>
<td>Announcements of IT Investments</td>
<td>Stock Returns on Days −1 and 0 (where 0 is the date of the press release)</td>
<td>Strategic IT role helps explain the stock market response to IT investment announcements. Firms in Transform (Informate) strategic IT role have a 0.98% (0.93%) stock market reaction.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Oh and Kim 2001</td>
<td>Announcements of IT Investments</td>
<td>Stock Returns on Days −1 and 0 (where 0 is the date of the press release)</td>
<td>Financial environment of the firm affects the stock market reaction to IT investments. Price-to-book ratios (negative) and the variability of stock returns (positive) are both explanatory variables in explaining abnormal stock returns.</td>
<td>1, 5</td>
</tr>
</tbody>
</table>

(Continued on next page)
<table>
<thead>
<tr>
<th>Author and Year</th>
<th>Focus of Study</th>
<th>Performance Measure</th>
<th>Summary of Major Finding(s)</th>
<th>Fig. 1 Path(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitt and Brynjolfsson 1996</td>
<td>Relation between IT Stock and Shareholder Return</td>
<td>One Year Total Return to Shareholders</td>
<td>A positive relation between IT Stock and one-year total return in only one year out of the five years examined.</td>
<td>1</td>
</tr>
<tr>
<td>Tam 1998</td>
<td>Relation between IT Stock and Shareholder Return</td>
<td>One Year Total Return to Shareholders, Market Capitalization</td>
<td>No relation between one-year shareholder return and computer capital in any of four countries. Computer capital is positively related to the market value of the firm in Malaysia, but insignificant in three other countries.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Bharadwaj et al. 1999</td>
<td>Market Valuation of IT Investments</td>
<td>Tobin’s q</td>
<td>The coefficient on IT spending varies from a low of 1.7 to a high of 10.3 in five, single-year regressions.</td>
<td>1</td>
</tr>
<tr>
<td>Brynjolfsson and Yang 1999</td>
<td>Market Valuation of Computer Capital</td>
<td>Market Capitalization</td>
<td>One dollar of computer capital is valued at ten times one dollar of conventional capital.</td>
<td>1</td>
</tr>
<tr>
<td>Brynjolfsson et al. 2000</td>
<td>Interaction of Organizational Characteristics with the Market Valuation of IT Expenditures</td>
<td>Market Capitalization</td>
<td>Overall, one dollar of spending on IT is associated with approximately a five dollar increase in the market value of the firm, higher than the value placed on other capital expenditures.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Krishnan and Sriram 2000</td>
<td>Market Valuation of Y2K Expenditures</td>
<td>Market Value Using the Ohlson (1995) Model</td>
<td>Market value of the firm is positively related to Y2K expenditures, but the coefficient is less than for earnings or book value, and less in IT-intensive industries.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Anderson et al. 2001</td>
<td>Market Valuation of Y2K Expenditures</td>
<td>Market Value Using the Ohlson (1995) Model</td>
<td>Market value of the firm increases by 20.3 times the amount spent on Y2K when the firm spent more than the industry median. Industry median Y2K spending was associated with an increase in the market value of firms within the industry of 123.5 times the industry Y2K spending.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Author and Year</td>
<td>Focus of Study</td>
<td>Performance Measure</td>
<td>Summary of Major Finding(s)</td>
<td>Fig. 1 Path(s)</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------</td>
<td>---------------------</td>
<td>----------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td><strong>IT Spending: Accounting Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hitt and Brynjolfsson 1996</td>
<td>Relation between IT Stock and Profitability Ratios</td>
<td>ROA, ROE</td>
<td>A positive relation between IT stock and ROA in 1988, 1989, and 1990, no relation between IT Stock and ROE. IT benefits productivity and causes an increase in consumer surplus.</td>
<td>1</td>
</tr>
<tr>
<td>Tam 1998</td>
<td>Relation between IT Stock and Profitability Ratios in Four Asian Countries</td>
<td>ROA, ROE, ROS</td>
<td>Positive relation between computer capital (CC) and ROA in Singapore, a negative relation between CC and ROA in Taiwan, a positive relation between CC and ROE in Singapore and Malaysia, a negative relation between CC and ROE in Taiwan, and a negative relation between CC and ROS in Hong Kong.</td>
<td>1</td>
</tr>
<tr>
<td>Barua et al. 1995</td>
<td>Relation between IT Capital and Various Measures of Productivity and Performance</td>
<td>Capacity Utilization, Inventory Turnover, Inferior Quality, Relative Price, ROA, and Market Share</td>
<td>IT capital relates positively to capacity utilization, inventory turnover, inferior quality, and relative price. Marketing IT purchases relate negatively to relative price. Capacity utilization and inventory turnover relate positively to ROA, and relative price relates negatively to ROA. Relative price, inferior quality, and new products relate negatively to market share.</td>
<td>2, 3</td>
</tr>
<tr>
<td>Mitra and Chaya 1996</td>
<td>Relation between IT Spending, Productivity and Efficiency</td>
<td>OPEXP/SALES, GM%, SG&amp;A/SALES, LABOR/SALES</td>
<td>Higher IT spenders have lower OPEXP/SALES, COGS/SALES, and higher SG&amp;A/SALES. Large companies spend a larger percentage of their revenue on IT than smaller firms do.</td>
<td>1, 2</td>
</tr>
</tbody>
</table>

(Continued on next page)
<table>
<thead>
<tr>
<th>Author and Year</th>
<th>Focus of Study</th>
<th>Performance Measure</th>
<th>Major Finding(s)</th>
<th>Fig. 1 Path(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IT Spending: Accounting Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shin 1997</td>
<td>Relation between IT Spending and Coordination Costs and IT Spending and Coordination Costs and Output</td>
<td>Coordination Costs, Output</td>
<td>IT spending is related to lower coordination costs. Increased IT spending and coordination costs relate positively to increased output.</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Rai et al. 1997</td>
<td>Relation between Multiple IT Spending Measures and Performance and Efficiency Measures</td>
<td>Value, Sales, ROA, ROE, Labor Productivity, Administrative Productivity</td>
<td>Positive relation between firm output and all spending measures, a positive relation between IT capital and ROA, and between client/server expenditures and ROA. Labor productivity relates positively to IT capital, IT budget, client/server expenditures, IS staff expenditures, and hardware expenditures. Administrative productivity relates negatively to hardware expenditures, software expenditures, and telecom expenditures.</td>
<td>1, 2</td>
</tr>
<tr>
<td><strong>IT Strategy: Market Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strassmann 1997b</td>
<td>Relation between IT Spending and Performance</td>
<td>ROE, Sales Growth, Market Share Gain, Effectiveness, Quality, Productivity</td>
<td>No correlation between IT spending per employee and ROE. No correlation in any industry between IT spending and sales growth, market share gain, effectiveness, quality, or productivity. A positive relation between IT spending on order-entry and back-office operations and sales growth and productivity.</td>
<td>1, 2, 5</td>
</tr>
<tr>
<td>Sircar et al. 2000</td>
<td>Canonical Analysis of IT Spending and Performance Measures</td>
<td>Sales, Total Assets, Shareholder’s Equity, Shares Outstanding, Market Share, Stock Price, Net Income Before Taxes</td>
<td>Numerous significant correlations between IT measures and firm performance measures.</td>
<td>1</td>
</tr>
</tbody>
</table>

(Continued on next page)
### FIGURE 2 (Continued)

<table>
<thead>
<tr>
<th>Author and Year</th>
<th>Focus of Study</th>
<th>Performance Measure</th>
<th>Summary of Major Finding(s)</th>
<th>Fig. 1 Path(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IT Strategy: Market Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hayes et al. 2000</td>
<td>Announcements of Information Systems Outsourcing</td>
<td>Stock Returns on Days 0 and +1 (where 0 is the date of the press release)</td>
<td>Significant standardized abnormal stock market returns of 6.279 for service firms and 8.983 for small firms. Insignificant abnormal stock returns for nonservice and large firms.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Hayes et al. 2001</td>
<td>Announcements of ERP Implementation</td>
<td>Stock Returns on Days 0 and +1 (where 0 is the date of the press release)</td>
<td>Significant standardized abnormal stock market returns of 17.480 for all firms and 16.389 for ERP vendors SAP and PeopleSoft.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Ettredge and Richardson 2001</td>
<td>Hacker or Denial of Service Attacks</td>
<td>Stock Returns on February 6–8, 2000</td>
<td>Abnormal stock market return of –8.3% for B2C firms 2001 and –3.0% for B2B firms.</td>
<td>1, 5</td>
</tr>
<tr>
<td><strong>IT Strategy: Accounting Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floyd and Wooldridge 1990</td>
<td>Relation between Strategy, IT, and Financial Performance in Small Retail Banks</td>
<td>ROA</td>
<td>Product breadth is a predictor of the use of product technology, and segmentation is a predictor of process technology. Product technology is a predictor of ROA, whereas process technology is not. Human resources differentiation relates negatively to ROA, and product differentiation relates positively to ROA.</td>
<td>1, 3, 5</td>
</tr>
<tr>
<td>Kettinger et al. 1994</td>
<td>Determinants of the Factors that Lead to an IT-Enabled Competitive Advantage</td>
<td>ROS, Market Share</td>
<td>Strong discriminating factors between firms that sustain their competitive advantage from those that do not are investment intensity, cash flow, and industry competitiveness. Moderate factors are R&amp;D intensity, times interest earned, and cost efficiency. Asset base and working capital are weak, but still significant discriminating factors.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Poston and Grabski 2002</td>
<td>Affect of ERP Implementation on Firm Performance</td>
<td>SG&amp;A/SALES, COGS/SALES, #EMP/SALES, Residual Income</td>
<td>On an interfirm basis they find increases in SG&amp;A/SALES and COGS/SALES the year after implementation, a decrease in COGS/SALES three years after implementation, and a decrease in #EMP/SALES all three years after implementation.</td>
<td>2</td>
</tr>
</tbody>
</table>

(Continued on next page)
### FIGURE 2 (Continued)

<table>
<thead>
<tr>
<th>Author and Year</th>
<th>Focus of Study</th>
<th>Performance Measure</th>
<th>Summary of Major Finding(s)</th>
<th>Fig. 1 Path(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IT Capability and IT Management: Market Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chatterjee, Richardson, and Zmud 2001</td>
<td>Announcements of Newly Created CIO Positions</td>
<td>Stock Returns on Days −1, 0 and +1 (where 0 is the date of the press release)</td>
<td>Abnormal stock returns of 1.16% around the date of the announcement of the newly created CIO position. Those announcements made for firms in industries with high level of IT-driven transformation have a 2.97% return.</td>
<td>1, 5</td>
</tr>
<tr>
<td>Richardson and Zmud 2001b</td>
<td>Announcements of Board of Director Nominations of Internet Companies</td>
<td>Stock Returns on Days −1, 0 and +1 (where 0 is the date of the press release)</td>
<td>Shareholders of Internet startups seem to value board nominees with e-commerce experience (9.7%) and other corporate directorships (4.8%).</td>
<td>1, 5</td>
</tr>
<tr>
<td><strong>IT Capability and IT Management: Accounting Measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bharadwaj 2000</td>
<td>Relation between IT Capability and Firm Performance</td>
<td>ROA, ROS, OPINC/ASSETS, OPINC/Sales, OPINC/#EMP, COGS/Sales, SG&amp;A/Sales, OPEXP/Sales</td>
<td>High IT Capable firms have higher profitability ratios in all four years, lower OPEXP/SALES in all four years, and COGS/SALES lower in two out of four years.</td>
<td>1, 2</td>
</tr>
<tr>
<td>Dehning and Stratopoulos 2002</td>
<td>Relation between IT-Enabled Strategies, and Profitability and Efficiency</td>
<td>ROA, ROS, TAX</td>
<td>CWP100 companies have higher ROA for all seven years. ROS is higher four out of the seven years, and TAX is higher all seven years.</td>
<td>1, 2, 3</td>
</tr>
</tbody>
</table>

**Administrative Productivity** = VALUE divided by Selling, General, and Administrative Expenses;  
COGS/SALES = Cost of Goods Sold as a percent of Sales;  
COORDINATION COSTS = Selling, General, and Administrative Expenses minus Research and Development, Advertising, Software, Bad Debt, and Pensions Expenses;  
#EMP/SALES = Number of Employees divided by Sales;  
GM% = Gross Margin Percentage;  
LABOR/SALES = Total Labor Cost as a percent of Sales;  
LABOR PRODUCTIVITY = VALUE divided by Total Employees;  
OPEXP/SALES = Operating Expenses as a percent of Sales;  
OPINC/ASSETS = Operating Income divided by Assets;  
OPINC/SALES = Operating Income divided by Sales;  
OPINC/#EMP = Operating Income divided by Number of Employees;  
OUTPUT = Sales plus Change in Inventory;  
ROA = Return on Assets;  
ROE = Return on Equity;  
ROS = Return on Sales;  
SG&A/SALES = Selling, General, and Administrative Expenses as a percent of Sales;  
TAX = Total Assets Turnover; and  
VALUE = Sales minus Labor Expenses.
In the first event study of market reactions to IT investment announcements, Dos Santos et al. (1993) find no abnormal returns for the overall sample of 97 IT investments from the finance and manufacturing industries from 1981 to 1988. However, the authors observe a positive stock market reaction to what the authors characterize as “innovative IT investments.” This suggests that stockholders carefully consider the nature of announced IT investments and the likely impact of such investments on a firm’s net present value of future cash flows, and then buy or sell accordingly.

Dos Santos et al. (1993) define an innovative IT investment as a first use of a technology, a new product or service, or a new IT application within an industry. While “first-to-market” is generally a highly regarded competitive strategy, being first-to-market does not necessarily guarantee ultimate marketplace success, particularly with new technologies. Characterizing an IT investment as innovative, thus, may very well be capturing other, more generally applicable, contextual elements under which IT investments promote positive returns.

Chatterjee, Pacini, and Samhurth (2001) study whether there is a difference in stock market reaction to investments in IT infrastructure vs. IT applications. They hypothesize that investments in IT infrastructure will be more likely to capture a competitive advantage for the firm than investments in IT applications. Their findings confirm this hypothesis.

Brynjolfsson (1994) theorizes, and Im et al. (2001) present evidence that company size influences returns to IT investments (Path 5 in Figure 1). Im et al. (2001) expand the Dos Santos et al. (1993) data set and find positive returns for announcements of IT investments for small but not large firms. Further, they find evidence of increasing returns over the more recent 1991–1996 sample period as compared to the earlier 1981–1990 sample period. In the most recent sample period, they also find increasing returns from IT investment announcements in financial but not manufacturing firms.

Richardson and Zmud (2001a) extend this work by proposing an overarching construct—the strategic IT role within an industry—to account for factors previously found by Im et al. (2001) to affect the stock market response to IT announcements. The authors postulate that when firms make IT investments that are likely to transform the fundamental business, shareholders react positively to IT investment announcements. The authors suggest that companies that use IT to transform their business processes most often do so in order to position themselves more favorably within an industry, or to develop a new industry niche by radically changing the industry’s processes, practices, and business models. The results provide support for the value of capturing the nature of an industry’s IT intensity (or level of IT expenditures relative to sales) to understand the conditions under which IT investments are likely to produce positive abnormal returns. They find evidence that suggests that firms in industries in the midst of IT-driven transformation have higher stock market returns around the IT investment announcements than firms in industries at lower levels of IT-driven transformation.

Oh and Kim (2001) is an example of yet another contextual effect that affects the overall stock market reaction to IT (Path 5 in Figure 1). The authors show that financial conditions facing the firm affect the stock market reaction to IT investments. They show that the price-to-book ratio and variability of daily stock returns affect the investor’s reaction to IT investment announcements.

In summary, Dos Santos et al. (1993) and Richardson and Zmud (2001a) show that on average, IT investments have no abnormal stock market reaction. However, research shows that where innovative IT investments are made specifically in IT infrastructure, relevant contextual factors produce a positive relation between IT investments and abnormal stock market returns. Future research should continue to study the contextual elements affecting the relationship between IT spending and stock market performance.

**Other Market Measures**

In this section we examine seven recent studies that use market performance measures other than event studies to investigate Path 1 in Figure 1. Two studies, Hitt and Brynjolfsson (1996) and Tam (1998), examine the relation between the value of a company’s IT and one-year market return. Hitt and Brynjolfsson (1996) measure the IT Stock of a company as the market value of a company’s IT systems plus three times the company’s spending on IT labor. They find a positive relation between IT Stock and one-year return in only one of five years examined. Tam (1998) performs a similar test in four Asian
countries: Hong Kong, Malaysia, Singapore, and Taiwan. He estimates the stock of computer capital for companies in these four countries using data from the *Asia Computer Directory*. He finds no relation between one-year shareholder return and computer capital in any of the four countries, nor between one-year shareholder return and a one-year lagged value of computer capital. In additional tests Tam (1998) finds that computer capital is positively related to the market value of the firm in Malaysia, but insignificant in the other three countries.

The fact that these two studies found few significant relations between IT and annual returns is unsurprising. There is a problem in using market returns to gauge firm performance because the test is a joint hypothesis. The first hypothesis is the relation between IT and firm performance. The second hypothesis is the market’s knowledge of the relation between IT and firm performance. Finding differential returns could be due solely to changes in the market’s knowledge regarding firm performance (and no change in actual performance). Likewise, there may be multiyear differential firm performance, but no difference in market returns due to market participants’ anticipation of that performance advantage.

Five studies investigate Path 1 in Figure 1 using the market value of the firm to measure firm performance. Each study finds a positive relation between IT spending and market value. Where these studies differ is in their approach to measuring market value and the effect of contextual factors (Path 5 in Figure 1) on firm performance.

Bharadwaj et al. (1999) examine the relation between spending on IT and Tobin’s q, i.e., the ratio of the market value of a firm’s assets to the replacement cost of those assets. Using 631 firms from 1988–1993, they find that the coefficient on IT spending varies from a low of 1.7 to a high of 10.3 in five, single-year regressions. Their model controls for four industry factors (industry concentration, industry capital intensity, industry average Tobin’s q ratio, and industry regulation) and five firm specific factors (market share, advertising expenditures, R&D spending, diversification, and size). Interestingly, the R&D spending measure was significant only in two out of the five years. In both of these years, the coefficient was negative, meaning that after controlling for other factors, increased R&D spending results in lower market value of the firm.

Brynjolfsson and Yang (1999) and Brynjolfsson et al. (2000) regress the market value of computer capital, other assets, and numerous control variables (e.g. R&D, advertising) on the market value of the firm. Brynjolfsson and Yang (1999) find that one dollar of computer capital is valued at ten times one dollar of conventional capital. Brynjolfsson et al. (2000) add an additional explanatory variable, work practices, to the model of Brynjolfsson and Yang (1999). They posit that work practices such as the greater use of teams, broader decision-making authority, and increased worker training are complements to IT spending. Combining these work practices into a single factor, they find that one dollar spent on computer capital is six dollars higher for firms that are one standard deviation above the average score on this factor. Overall they find that one dollar of spending on IT is associated with approximately a five-dollar increase in the market value of the firm; significantly higher than the value placed on other capital expenditures.

Two studies in this line of research examine Path 1 in Figure 1 using the market’s valuation of Y2K expenditures. Krishnan and Sriram (2000) and Anderson et al. (2001) use an Ohlson model (Ohlson 1995) to measure the market value of Y2K expenditures. The Ohlson model uses accounting data to determine market value, and allows researchers to control for current earnings, book values, and other value-relevant factors. Krishnan and Sriram (2000) find that the market value of the firm relates positively to Y2K expenditures, but the coefficient is less than the coefficient on earnings or book value, and less in IT-intensive industries. Anderson et al. (2001) take a slightly different approach by examining Y2K spending relative to the median industry spending on Y2K compliance. They hypothesize that the reward for spending more than the industry median will be higher relative market values, and spending less than the industry median will result in lower relative market values. They find that on average the market value of the firm increases by 20.3 times the amount spent on Y2K when firms spend more than the industry median. The market value of the firm decreases by 40.5 times Y2K spending when firms spend less than the industry median. Industry median Y2K spending was associated with an increase in the market value of firms within the industry of 123.5 times the industry Y2K spending. They interpret
their results to show that not only does the market value IT, but also that the market values the development of an IT-enabled industry value chain. Their results were robust to a wide variety of robustness checks.

These studies provide strong evidence that the market values IT investments. Perhaps the most intriguing result on the relation between IT spending and market valuation is the large coefficient on IT spending, specifically, market values increase by 5 to 20 times the amount spent on IT. Anderson et al. (2001) refer to this as a “new” IT paradox, and one that warrants additional investigation. Future research can help us understand the causes and pervasiveness of this “new” IT paradox.

**Accounting Performance Measures**

In this section we examine six studies that use accounting performance measures to investigate Path 1 and Path 2 in Figure 1. Each of these uses IT spending measures to classify IT investments. There are three primary sources of IT spending data for this type of research. The first is from a survey done by the International Data Group (IDG) consulting firm from 1988–1992. A subset of this data, the *Computerworld* Premier 100, was published annually in *Computerworld* magazine from 1989–1993. From 1994–1998 (except 1996), *Computerworld* continued to publish a Premiere 100 issue, but the data came from other sources, primarily consultant Paul Strassmann. The data from these years is less useful due to ranges used in lieu of actual amounts, and large amounts of missing data. The other commonly used data source for IT spending is the *InformationWeek* 500 survey. *InformationWeek* has published this list annually since 1989. Lichtenberg (1995) found a high correlation between the amounts reported for companies appearing on the *Computerworld* and *InformationWeek* lists, which lent support to their accuracy, as the data comes from different sources. One problem with using such lists is that the *Computerworld* and *InformationWeek* companies are unrepresentative of the market as a whole. These companies are the largest of all publicly traded companies, and the *Computerworld* companies are primarily from the manufacturing sector. In addition, *Computerworld* and *InformationWeek* do not randomly select these companies; therefore, these samples limit the generalizability of research results.

In addition to the market tests mentioned above, Hitt and Brynjolfsson (1996) and Tam (1998) examine Path 1 in Figure 1 using the relation between levels of IT and firm performance. Using United States data, Hitt and Brynjolfsson (1996) find a positive relation between IT stock (the market value of a company’s IT systems plus three times the company’s spending on IT labor) and ROA in three out of five years, but no relation between IT stock and ROE. Tam (1998) uses data from four Asian countries (Hong Kong, Malaysia, Singapore, and Taiwan) and finds similarly mixed results. He finds a positive relation between computer capital (CC) and ROA in Singapore, a negative relation between CC and ROA in Taiwan, a positive relation between CC and ROE in Singapore and Malaysia, a negative relation between CC and ROE in Taiwan, and a negative relation between CC and ROS in Hong Kong.

These studies suggest an interesting question. Specifically, given the increasing investment in IT by firms, why do researchers not find a stronger relation between IT stock and financial performance? The following studies attempt to answer this question by examining the relation between IT spending and financial performance. Most researchers do this by investigating Path 1 and Path 2 in Figure 1 (e.g., Mitra and Chaya 1996; Rai et al. 1997; Strassmann 1997b). If researchers find a significant relation between IT and both business process performance measures (Path 2) and overall firm performance measures (Path 1), then they make inferences regarding Path 3 even if there is no direct test of Path 3. A seminal study by Barua et al. (1995) follows a different approach. Barua et al. (1995) identify relations between various IT and non-IT inputs and business processes (Path 1), and relations between these business processes and overall firm performance (Path 3). They find a positive impact of IT on business processes, and that certain business processes relate positively to overall firm performance. Very few studies have followed a similar approach, despite the compelling nature of this research method.

Three studies follow the more common approach of examining Path 1 and Path 2 in Figure 1. With the exception of Shin (1997), each of these studies relates IT spending with business process performance and overall firm performance, making inferences about Path 3 without testing Path 3 directly. The first of these, Mitra and Chaya (1996), examines the relation between IT spending and various measures
of productivity and efficiency. They find that higher IT spenders have lower operating expenses and cost of goods sold, and higher selling, general, and administrative expenses (SG&A). They also find that large companies spend a larger percentage of their revenue on IT than smaller firms. Shin (1997) finds a very different result, using the same basic data. Shin (1997) finds that IT spending relates negatively with coordination costs, which are SG&A minus non-administrative expenses such as advertising and research and development (R&D). This implies that the positive relation between IT spending and SG&A that Mitra and Chaya (1996) find is due to non-administrative expenses, despite Shin's (1997) findings that advertising and R&D are positively related to coordination costs. There are enough differences in the research design, such as Mitra and Chaya (1996) scaling by sales and Shin (1997) scaling by number of employees, that it is impossible to resolve this apparent contradiction without additional empirical tests. Reconciling these conflicting results and providing clearer understanding of the relation between IT spending and SG&A and coordination costs would be important research contributions.

In addition to the tests mentioned above, Shin (1997) examines Path 3 in Figure 1. By combining IT spending and coordination costs with capital, labor, and R&D expenditures, Shin (1997) attempts to explain firm output (sales plus change in inventory). He finds IT spending, coordination costs, capital, and labor and R&D expenditures all positively related to firm output. Rai et al. (1997) generally confirm this finding. They examine the relation between various spending measures (IT capital, IT budget, client/server expenditures, IS staff expenditures, hardware expenditures, software expenditures, and telecom expenditures) and performance measures (firm output, ROA, ROE, labor productivity, and administrative productivity). They find a positive relation between firm output and all spending measures. In addition, they find a positive relation between IT capital and client/server expenditures and ROA. In productivity tests Rai et al. (1997) find labor productivity is positively related to IT capital, IT budget, client/server expenditures, IS staff expenditures, and hardware expenditures, while administrative productivity is negatively related to hardware expenditures, software expenditures, and telecom expenditures.

A contradiction to the above results is an extensive study by Strassmann (1997b). He does not find any of the significant relations of other researchers. Strassmann (1997b) examines Path 1 and Path 2 in Figure 1, using IT spending data from 539 U.S., European, and Canadian companies to examine the relation between IT spending and firm performance. Using a single year (1994), he found no correlation between IT spending per employee and ROE. Breaking down the data into 54 industries did not improve the results, as there was no correlation in any industry between IT spending and sales growth, market share gain, effectiveness, quality, or productivity. The only significant results reported are a positive relation between IT spending on order-entry and back-office operations and sales growth and productivity. Although this study is widely cited in the Productivity Paradox literature, it must be interpreted cautiously, as the data collection methods are unspecified, and the research appears in a non-peer-reviewed journal.

Sircar et al. (2000) take a slightly different approach to this line of research. In an exploratory study they use Canonical Correlation Analysis to examine the relation between various IT spending measures, various business process measures, and overall firm performance measures. They find numerous correlations between IT measures and firm performance measures, but are unable to determine causality.

The overall conclusion of these studies is that the relation between IT spending and financial performance is tenuous. It is possible that on average IT has increased productivity or output, but not profitability. One explanation for productivity increases without corresponding profitability increases is that the cost of IT investments offsets the increase in productivity. If the cost of IT exactly equaled its benefit, then success would depend on IT use and not merely on its acquisition. Studies that classify IT investments based on IT use (IT strategy or IT management/capability) attempt to provide insight into this issue. The following sections review this type of research.

**IT Strategy**

**Stock Market Reaction to Strategic IT Investments**

In this section we consider the stock market reaction to various strategic IT investments. The studies in this section examine Path 1 and Path 5 in Figure 1. As opposed to simply announcing that a firm is investing in information technology, recent studies analyze specific IT investments that affect a firm’s
overall or IT strategy. The first three event studies consider various strategic IT investments such as e-commerce initiatives, outsourcing contracts, and ERP implementation announcements. In general, the stock market reaction is positive, suggesting that investors value these strategic IT investments. The final study considers the additional risks and costs of e-commerce and information technology by studying the stock market impact of hacker attacks on February 6–8, 2000. As expected, the stock market reaction is negative, suggesting that there are additional costs borne by those who engage in electronic commerce.

A study by Subramani and Walden (2001) considers firms that are undertaking a growing number of e-commerce initiatives and making increasingly significant investments required to participate in the online market. They use an event study to assess the cumulative abnormal returns to shareholders for 251 e-commerce initiatives announced by firms between October and December 1998. The results suggest that e-commerce initiatives do indeed lead to positive excess returns for firms’ shareholders. While abnormal returns for conventional firms are not significantly different from those for Internet firms, the abnormal returns for business-to-business (B2B) announcements are higher than those for business-to-business (B2B) announcements. In addition, the abnormal returns of e-commerce initiatives involving tangible goods are higher than those involving digital goods. This paper presents some of the first empirical tests of the “dot-com” effect, which validates popular anticipations of significant future benefits to firms entering into e-commerce arrangements.

In another form of strategic IT investment, Hayes et al. (2000) consider the impact of IS outsourcing announcements on the market value of contract-granting firms. Research findings indicate positive market value gains for smaller vs. larger firms and service vs. non-service industry firms. The paper uses an event-study method to identify the underlying determinants of IS outsourcing decisions. Hayes et al. (2001) look at the stock market reaction to ERP implementation announcements. They study the extent to which the market deems that ERP systems add value to business organizations. They find an overall positive reaction to initial ERP implementation announcements. They also find this reaction to be most positive for small/healthy firms and those that engage larger ERP vendors (such as PeopleSoft and SAP).

While Subramani and Walden (2001) show the benefits of IT investments in electronic commerce, Ettredge and Richardson (2001) employ an event study to measure whether e-commerce activity imposes additional risks or costs on the firm. They investigate investors’ reactions to “hacker” or “distributed denial of service” attacks launched against several of the best-known Internet firms in February 2000. There is an association between the extent of the negative abnormal returns and several e-risk metrics. Investors appear to relate the likelihood that a firm will be subject to similar attacks to the firm’s self-disclosed vulnerability to e-risks, and to its designation by outsiders as an Internet firm. In general, these studies suggest that shareholders value strategic IT investments, and that strategic IT investments impose additional costs or risks on the firm.

Future research can investigate both the benefits and costs of strategic IT investments by considering other paths in Figure 1. For example, the effect of strategic IT investments on intermediate business processes (Path 2) would help us understand the ultimate effect of strategic IT investments on firm performance. Other research might continue to assess the impact of contextual elements (Path 5) on the relationship between strategic IT investment and firm performance. One of the biggest impediments to future research is data availability. Other than the Computerworld and InformationWeek IT spending data, there is no widely available data source.

**Accounting Performance Measures**

By examining the accounting and finance literature, we expect that studies examining strategic IT investments would investigate some type of IT deployment, and the effect on performance pre- vs. post-implementation (e.g., Poston and Grabski 2002). However, there are very few studies in the IS literature that take this approach.

Floyd and Wooldridge (1990) jointly examine Paths 1, 3, and 5 in Figure 1—the interactive relation between strategy, IT, and financial performance. Using path analysis on seven strategy measures and two IT measures, they find that product breadth is a predictor of the use of product technology, and that segmentation is a predictor of process technology. Product technology is likewise a predictor of ROA,
whereas process technology is not. Two strategies relate significantly to ROA; human resources differentiation relates negatively to ROA, and product differentiation relates positively to ROA. They conclude that the strategic context enhances the IT-ROA relation, and that successful strategies might require the adoption of certain IT.

Kettinger et al. (1994) examine Paths 1 and 5 in Figure 1. They survey the popular press, academic literature, and case studies and find strategic deployments of IT that lead to competitive advantage. Using ROS and Market Share, they identify companies that gain and sustain a competitive advantage due to their IT deployments for five- and ten-year periods after implementation. This classification allows them to perform discriminant analysis to see what factors distinguish sustainers (15 companies) from the non-sustainers (13 companies). They find that the strong discriminating factors were investment intensity, cash flow, and industry competitiveness. Moderately discriminating factors were R&D intensity, times interest earned, and cost efficiency. Asset base and working capital were weak, but still significant discriminating factors.

Poston and Grabski (2002) examine Path 2 in Figure 1: the effect of ERP implementation on business process performance. They compare performance before implementation to one, two, and three years after implementation. On an interfirm basis they find increases in SG&A/SALES and COGS/SALES the year after implementation, a decrease in COGS/SALES three years after implementation, and a decrease in #EMP/SALES all three years after implementation. However, in all cases, the matched control group of firms had superior performance relative to the firms implementing ERPs.

The strategic use of IT is probably the least-developed area that examines the relation between IT and performance. The literature on the strategic uses of IT has given little insight into why some firms are able to leverage their investments in IT into competitive advantage while others are not. For example, Floyd and Wooldridge (1990) demonstrate an interaction between IT and strategy, but their study is limited to a single industry. Kettinger et al. (1994) identify contextual factors that discriminate firms with a sustained competitive advantage from non-sustainers, but they have a small sample of primarily large companies, and do not consider which IT factors lead to a sustained competitive advantage. To see if the results hold in a broader context, researchers can replicate and extend their work with other samples of companies with a sustained competitive advantage, and include IT-related factors. Poston and Grabski (2002) find little benefit from the adoption of ERP systems, despite the continued popularity and adoption of ERP systems by companies, and a positive market reaction to ERP implementation announcements (Hayes et al. 2001). Each of these studies provides an opportunity for additional research to complete our understanding of the relation between IT, strategy, and competitive advantage.

**IT Management**

**Stock Market Reaction to Appointments of IT Positions and Executives**

Mata et al. (1995) argue that of the commonly cited sources of sustainable competitive advantage from IT, only managerial IT knowledge can be the source of sustainability. One way to see the impact of this IT management capability and knowledge is through event studies. In this section we examine two studies that consider the stock market reaction to the creation of an executive IT position within the firm and to the naming of directors to the board of Internet companies. These studies all examine the market effects of the investment in IT management (Path 1 of Figure 1) as well as the contextual effects surrounding these investments in IT management (Path 5 of Figure 1). The studies find positive market reaction to investments in IT management capability. The first study also suggests that IT executives are most highly valued in companies that are undergoing IT transformation within their firm.

In the first study, Chatterjee, Richardson, and Zmud (2001) argue that the strategic importance of a firm’s IT capabilities is prompting an increasing number of companies to appoint Chief Information Officers (CIOs) to effectively manage these assets. These moves reflect changes in top management thinking and policy regarding the role of IT and firms’ approaches to IT governance. Chatterjee, Richardson, and

---

4 “The importance of employee development, motivation, and retention to strategy” (Floyd and Wooldridge 1990, 52).
Zmud (2001) find a positive abnormal stock market reaction to the creation of a CIO position. In particular, their findings support the notion that announcements of newly created CIO positions provoke positive market reactions for firms competing in industries undergoing IT-driven transformation.

The second study of investments in IT management comes from a recent event study of the nomination of members to the Board of Directors of Internet companies. Richardson and Zmud (2001b) examine the differential impacts of the experiences or abilities of new board members within Internet companies. Past studies of the stock market reaction of more seasoned companies find that board nominees are valued for their ability to monitor or oversee management. However, this study finds strong support for the notion that shareholders of Internet startups value new board members capable of aiding the executive team in developing and/or refining the innovative strategies in the e-business economy. In particular, they find that before the NASDAQ crash of April 2000, shareholders valued board nominees who had e-commerce experience. Following the NASDAQ crash, shareholders valued board nominees who had IT experience.

These studies suggest that investments in IT management are value-relevant. Shareholders apparently realize the importance of executive-level status for IT management and the importance of board members with e-commerce and IT experience. It is clear that the transformation of IT investments, i.e., funding directed toward acquiring hardware, software, and skills, as well as developing capabilities and processes into value-adding outputs requires what is increasingly recognized as a very complex production engine that involves an enterprise’s custodians of IT resources (i.e., IT managers and IT professionals) in the support of business strategies and operations. Future research must continue to understand how IT management can affect this transformation from IT investment to firm performance.

**Accounting Performance Measures**

Various studies assert that managing IT assets is more important than the amount of money spent on IT (e.g., Strassmann 1997a; Stratopoulos and Dehning 2000). Two studies use this motivation to examine the relation between IT and firm performance without focusing on IT spending. These studies attempt to provide insights into the advantage granted by the successful management or use of IT by focusing on companies with high organizational IT capabilities.

Bharadwaj (2000) examines Paths 1 and 2 in Figure 1 by comparing “High IT Capable” companies to a matched control group. She defines High IT Capable companies as the best users of IT, which *InformationWeek* magazine chooses each year from their *InformationWeek 500*. She compares the two groups on numerous business process performance measures and overall firm performance measures over four years. She finds that the High IT Capable firms have higher profitability ratios in all four years, lower operating expenses as a percentage of sales in all four years, and lower cost of goods sold as a percentage of sales in two out of the four years. She concludes that increasing IT capability increases a firm’s competitive advantage.

Dehning and Stratopoulos (2002) take a similar approach to examine Paths 1, 2, and 3 in Figure 1 by comparing a group of companies with a competitive advantage due to an IT-enabled strategy (the Computerworld Premier 100 or CWP100) to a matched control group of companies for seven years on ROA, ROS, and Total Assets Turnover (TAX). They find that the CWP100 companies have higher ROA for the entire time period covered. In addition, ROS is higher four out of the seven years, and TAX is higher all seven years. To provide a context for interpretation, they identify 87 companies with a competitive advantage not due to an IT-enabled strategy. This second group of companies has higher ROA and ROS over the seven years examined, but in no year was TAX higher for this group of companies. They conclude that competitive advantage due to IT-enabled strategies differs from that due to non IT-enabled strategies.

These studies help explain the findings of a positive reaction to firm announcements of appointment of IT executives. Effective management of IT assets can provide substantial performance advantages over direct competitors. The market’s ability to recognize and impound this into stock price is evidence of an efficient market with respect to IT investments.
IV. RELATED LITERATURE IN ACCOUNTING AND FINANCE

By examining related literature in accounting and finance, we hope to show how accounting researchers can leverage their existing skills into successful research on the returns on investments in IT. To accomplish this we review literature in accounting and finance that parallels IS research and literature in accounting and finance that provides examples of opportunities for research in IS.

Parallel Research in Accounting and Finance

The Productivity Paradox suggesting zero or slightly negative returns on IT spending is not dissimilar to the early research associated with R&D and advertising expenditures. The early research performed by Johnson (1967), Newman (1968), and Milburn (1971) detected no relation between R&D or advertising and future earnings. Studies that are more recent establish a relation between R&D or advertising and performance (Bublitz and Ettredge 1989; Chauvin and Hirschey 1993; Kim and Lyn 1990; Lev and Sougiannis 1996; Ravenscraft and Scherer 1982; Sougiannis 1994).

Hirschey (1982) found that both advertising and R&D have positive market value effects, while Hirschey and Weygandt (1985) and Sougiannis (1994), among others, demonstrate that the market treats R&D as an intangible asset, and find a relation between market values of common equity and R&D expenditures. Researchers could apply this research method to the IT environment to determine if IT expenditures represent an intangible asset of the firm.

Chan et al. (1990) and Doukas and Switzer (1992) find positive abnormal returns associated with increased R&D spending. They find positive announcement-day returns in the case of R&D intensive, “high-tech” firms that devote substantial resources to R&D. This might suggest that the shareholders who expect significant increases in cash flows due to R&D activities will value announcements of increased R&D spending. Drawing on comparisons between R&D spending and IT investments suggests that shareholders of firms with high IT intensity are likely to positively value announcements of IT investments more than the announcements made by firms of lower IT intensity.

Researchers use Tobin’s q to examine the market valuation of R&D (e.g., Cockburn and Griliches 1988; Griliches 1981; Hall 1993; Hsieh et al. 2000) and investments in IT (e.g., Bharadwaj et al. 1999). Researchers generally find that the stock market values R&D expenditures positively (e.g., Chauvin and Hirschey 1993) and IT expenditures positively (Bharadwaj et al. 1999). Other techniques used in both the IT and R&D literature include the Ohlson model (Ballester et al. 2000) and market value models (Cockburn and Griliches 1988; Hall 1993). These studies demonstrate that the skills accounting researchers have used to perform research in other areas can be used to evaluate the returns on investments in IT.

Similar to R&D and IT expenditures, many believe that advertising expenditures result in improved firm performance, benefit multiple periods, and are valued by the market. Advertising expenditures have been shown to have significant performance benefits, but for a shorter period than R&D expenditures (Bublitz and Ettredge 1989; Ravenscraft and Scherer 1982; Hall 1993). Research on R&D and advertising can be adapted to the IT environment by continuing to use market valuation models of IT expenditures. A plausible research question is to compare IT, R&D, and advertising expenditures to understand which has the largest benefits and why, and to measure their relative persistence.

Research in Accounting and Finance that Could be Adapted to IS

Although much of the research in accounting and finance parallels the work in IS, there is some work that does not have an equivalent research stream in IS that could be adapted to study the returns on investments in IT. For example, Kothari et al. (1998) find that current R&D expenditures relate to future earnings variability at a rate that is about three times as large as investments in PP&E. Lev et al. (2000) find that accounting profitability (ROA and ROE) is biased away from economic profitability when the growth rate in R&D expenditures diverges from the firm’s ROA, ROE, and earnings momentum. Lev et al. (2000) go on to show how this causes a bias (underpricing) for firms with a higher growth rate in R&D as compared to the growth rate in profitability. Researchers can perform similar studies in an IT context to see if IT expenditures have similar characteristics as R&D expenditures.
IT expenditures are similar to R&D and advertising in that they are input measures, rather than output measures. Researchers use patents as one way to examine the output of R&D activities (Griliches et al. 1987; Trajtenberg 1989; Austin 1993). These studies find that, on average, patents have weak explanatory power beyond R&D expenditures. To our knowledge, no such parallel work exists in IS—providing an opportunity for future research to investigate the relation between output measures of IT and firm performance.

**Research in Managerial Accounting that Could Be Adapted to IS**

Research in the accounting and finance literature on the performance effects of management accounting systems, leveraged buyouts, mergers and acquisition, etc., provide an opportunity for researchers in accounting to use their skills to make a meaningful contribution by answering some of these questions posed by the research in IS. This is especially true in the managerial accounting field. For example, Mak (1989) measures the relation between financial performance and the fit between environmental uncertainty and various management systems within the company, and the relation between financial performance and the fit between systems within the organization. Firm performance is measured by standardized ROE, ROA, and growth in net assets measured relative to industry, averaged over a five-year period and combined into one factor. Using a two-step procedure to measure fit and relate that to performance, Mak (1989) finds the fit between perceived environmental uncertainty (PEU) and strategic-planning systems (SP) weakly related to performance. However, Mak (1989) also finds the fit between PEU and operational control systems (OCS) and management control systems (MCS) is not related to performance. In the tests of internal consistency between systems, Mak (1989) finds that consistency between OCS and MCS is related to performance, as is consistency between MCS and SP, but fit between OCS and SP is not related to performance. Thus, there is strong support for the internal consistency proposition, but no support for contingency theory. Mak’s (1989) study can be adapted into a systems context. Using Mak’s (1989) model to examine IS instead of management systems could account for the varied success of IT investments due to external and internal firm characteristics.

Balakrishnan et al. (1996) use ROA, ROS, TAX, and a variety of inventory turnover measures to see if adopting Just-in-Time (JIT) inventory control systems positively affect firm performance. Their sample includes 46 JIT adopters, and they use interfirm comparisons and matched control-group comparisons to assess firm performance. They find that JIT adopters are significantly able to improve inventory turnover measures, but the superior inventory turnover does not translate into increased ROA gains relative to competitors. They find that JIT adopters in industries with a lower level of customer concentration have significantly better performance than JIT adopters in industries with higher levels of customer concentration. In addition, firms with lower work-in-process inventory turnover before adopting JIT show an improvement in ROA relative to firms with higher work-in-process inventory turnover before adopting JIT. The additional Contextual Factors that Balakrishnan et al. (1996) examine are similar to Path 4 and Path 5 in Figure 1. Applying the theory and measures used in this type of study to IS provides numerous opportunities for future research to account for the diverse performance of IT investments on account of contextual factors.

Hoque and James (2000) examine the affect of Balanced Scorecard (BSC) usage on Return on Investment (ROI), ROS, Capacity Utilization, Customer Satisfaction, and Product Quality. All of these performance measures were self-reported by the companies in the sample, and combined into one factor to measure firm performance of 66 Australian manufacturing companies. They find that BSC usage relates positively to firm size, early product lifestyle stages, and firm performance. They stress that the causality of these relations is not determinable.

These studies demonstrate that research in accounting and finance provides opportunities for future work in IS, particularly in process measures and the contextual factors surrounding IT investments. In the following section, we expand upon this concept to make additional suggestions regarding areas for future research.
V. OPPORTUNITIES FOR FUTURE RESEARCH

We can derive opportunities for future research on the returns on investments in IT by examining three things: the framework that we developed to classify and review research in the area (Figure 1), the studies that use market measures to assess firm performance, and the related literature in accounting and finance.

Opportunities Derived from the Framework

Opportunities for future research on the return on investments in information technology will probably have two characteristics: a focus on areas where researchers interested in market-level analyses of systems and technology issues have particular expertise, and where that expertise coincides with gaps in the IS literature. The framework for Figure 1 provides a basis for this analysis. Some of the gaps in the literature appear to be in direct measures of changes in business process outcomes due to IT (Path 2), and the effect of business processes on the ultimate financial performance outcome (Path 3). Most of the research we review examines the relation between IT and firm performance (Path 1 in Figure 1), bypassing the underlying business processes. Barua et al. (1995) and Ragowsky et al. (2000) argue that this approach is often inappropriate, as the true relation between IT and business processes may be obscured due to measurement problems or confounding effects. Both studies demonstrate the benefit of examining business processes directly. With an understanding of how IT affects the intermediate business processes, and in turn, how those processes impact firm performance, researchers would be able to make critical contributions to this research stream.

In addition, the studies we examine here all use a single approach to assess IT, whether IT spending, IT strategy, or IT management/capability. An area of research that is likely to develop is a triangulation approach: a combination of various IT measures and their relation to firm performance. For example, to determine if the amount spent on IT relates positively to performance only when pursuing certain strategies, or if the firm has the capability to properly manage IT investments implies an interaction between IT spending, IT strategy, and IT management/capability.

Numerous opportunities present themselves when examining the Contextual Factors used in previous work. For example, we found only two papers (Strassmann 1997b; Tam 1998) that use any international data, suggesting a potential opportunity for researchers to see if returns to IT investments depend on cultural factors, legal environment, financial markets, national infrastructure, and other contextual factors examined in international accounting and finance research. Most studies control for some Contextual Factors like firm size, but do not make any predictions about the differential performance or use of IT within different sized firms. One would expect that firms of different sizes or in different industries would use IT in different manners, and derive very different results. Few studies perform this analysis.

Opportunities Derived from the Market Measures of Firm Performance

In the area of the market reaction to IT investments announcements, future research might be done to further specify the context where IT investments are expected to be successful and value-relevant to stock investors. IT as a strategic choice is more important for some firms than for others. Identifying the firms for which IT is a competitive advantage may help predict the stock market reaction to some IT investments. For example, strategic IT alliances and partnerships are an important mechanism for enhancing IT opportunities in business today (Neill et al. 2001). The type of contextual characteristics (small-large, IT intensity, past experience with alliances, joint project vs. buy or sell, etc.) for both companies may be key to the ultimate success of the partnership.

The market valuation of investments in IT has shown promising early results, but there are numerous opportunities for further work in this area. Brynjolfsson et al. (2000) show how other firm-specific factors can affect the value of IT investments, and Anderson et al. (2001) demonstrate that the value of IT is affected by industry characteristics and the spending of other firms within a company’s supply
chain. This is in line with the evidence presented in Hendricks and Singhal (2000) that suggests public announcements of supply chain problems are associated with an 8.6 percent decline in shareholder value. Additional work could focus on other firm and industry characteristics that influence the value of IT. For example, Mata et al. (1995) theorize that managerial IT skills are the only source of sustainability for a firm with an IT-enabled competitive advantage. This theory leads to research questions such as: Is there differential market valuation between IT hardware expenditures, IT software expenditures, and IT personnel salaries and training expenditures?

Opportunities Derived from Related Accounting and Finance Literature

Most of the IS studies cited in this paper are recent. This suggests the return on investments in information systems as a growing research area. We see this as an opportunity for interested accounting researchers to explore the crossover between accounting and IS. Consider the accounting for IT expenditures in a similar light to that of R&D expenditures; some appropriate questions might be: Is the current accounting treatment of IT expenditures and software capitalization appropriate given the recent findings? Research shows that the market value of IT expenditures is high; should companies report more IT-related assets by capitalizing IT expenditures?

These studies and numerous others in the accounting literature demonstrate that accounting researchers have long performed the kind of research that is still in its infancy in IS. In addition, many of the theories and techniques developed have yet to be applied in an IS context. Accounting researchers have the technical skills to perform such research, and may also have access to the theories developed in management accounting research, in particular, that might apply directly to the research on the strategic use of IT.

VI. CONCLUSIONS

This paper explores opportunities for accounting researchers to investigate the returns on investments in information technology. Never before has IT played such an important role in the existence of companies, yet the overall impact of IT on performance remains largely an unexplained puzzle. We see this as an opportunity for accounting researchers to contribute to both academic research and current business practice.

Accounting researchers can leverage critical skills and prior research findings to take research in new directions. This has the additional benefit of affecting practice. For example, in a recent Computerworld article (Harreld 2001), Lee Kelsey of Proctor & Gamble attributes their newly integrated ERP system with “significant inventory reductions, while at the same time having less business losses due to out-of-stock situations.” This directly contradicts the Poston and Grabski (2002) findings of little benefit from the adoption of ERP systems. Reconciling the findings of the anecdotal evidence presented in the popular press with the empirical results of the academic literature should be a priority for researchers in this area. The impact on practice will come from what managers can learn to help them to make better decisions about the type and timing of investments in IT. They can also learn what contextual factors need be present to maximize the returns on investments in IT.

For example, the recent increased interest in ERP systems (Harreld 2001) seems at least in part an attempt to overcome the “stove pipe” accounting systems mentality criticized in most AIS textbooks. The intimate knowledge by accounting researchers of business processes, managerial and financial accounting systems, and contextual factors could lead to a breakthrough in research on the returns on investments in IT.

---

REFERENCES


Dehning and Richardson—*Returns on Investments in Information Technology: A Research Synthesis* 29


Hendricks, K. B., and V. R. Singhal. 2000. The effect of supply chain glitches on shareholder wealth. Working paper, the University of Western Ontario and the Georgia Institute of Technology.


———, and ———. 2001b. Wealth effects accompanying appointments of outside directors to the boards of Internet companies. Working paper, University of Kansas.


