IT-Enabled Reengineering: Productivity Impacts

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INTRODUCTION

IT-enabled business process reengineering (BPR) is defined as the redesign of business processes by leveraging potential benefits of information technology (IT) and the Internet to gain significant improvements in key areas of firm performance such as service, quality, cost, and speed. In general, IT-enabled BPR comprises replacing manual labor with computer-based automation systems, adopting innovative workflow management systems, streamlining existing operations with the new systems, and digitizing inter-firm communications through the use of emerging exchange standards such as extensible markup language (XML). Firms have been reengineering various business functions for years, ranging from customer relationship management to order fulfillment, and from assembly lines to research and development. Although the very definition of BPR has not changed much, its nature has evolved over time, expanding both the range and depth of services being reengineered.

In this article, we first discuss the effects of IT-enabled BPR on firm productivity by providing both empirical and theoretical evidence from the literature. We then highlight past experiences of several major firms in the United States with the IT-enabled BPR implementations. Finally, we comment on expected future trends in this area.

BACKGROUND

In this section, we provide a detailed survey on two main streams of related research from the literature: the work on the business value of IT and the more specialized literature on the value of IT-enabled BPR implementations.

Business Value of Information Technology

The roots of the literature on the business value of IT can be traced back to 1990's when available data from 1980's failed to show evidence of improved firm productivity from investments in IT in the manufacturing sector (Morrison & Berndt, 1990). This result, later called the "productivity paradox of IT," was found to be even more pronounced in the service sector which had used over 80% of IT products during 1980's (Roach, 1991). Researchers attempted to resolve the paradox by pointing out that the inability to show significant returns may be because of (1) measurement errors of outputs and inputs due to rapid price and quality changes in IT equipment, (2) the time necessary for learning and adjustment, and (3) mismanagement of IT resources by firms due to insufficient expertise to take advantage of using IT in traditional business environments.

Most researchers rejected this paradox by presenting empirical evidence that shows a positive relationship between IT investments and firm productivity (Bharadwaj, Bharadwaj & Konsynski, 1999; Brynjolfsson & Hitt, 1996; Kudyba & Diwan, 2002). Brynjolfsson, Malone, Gurbaxani, and Kambil (1994) showed that the effects of IT on firm productivity are substantially larger when measured over long time periods. This is because long-term returns represent the combined effects of related investments in organizational change.

Not all studies were able to show a clear payoff from IT investments. For example, Barua, Kriebel, and Mukhopadhyay (1995) found that even though IT spending improves intermediate variables of firm performance such as capacity utilization, inventory turnover, or relative price, it does not necessarily lead to improvements in higher-level productivity variables such as Return on Assets (RoA) or market share. Devaraj and Kohli (2003) emphasized the importance of actual usage in driving the impact of IT on firm performance. Consequently, researchers still debate on how the rela-

tionship between IT investment and firm productivity can be measured and analyzed (Anderson, Banker, & Ravindran, 2003).

Compared to the general effects of IT investments on productivity, however, much less is known about how value is actually created *within* the firm. In search for an answer, Kohli and Devaraj (2003) recommend that academic studies explicitly report which complementary changes in business practices have accompanied IT investments, including IT-enabled BPR and Enterprise Resource Planning (ERP). Such analyses are believed to isolate and identify the effectiveness of complementary changes leading to IT payoffs.

Payoff from IT-Enabled Business Process Reengineering

The literature on the impact of IT-enabled BPR on productivity is small but growing. Brynjolfsson and Hitt (2000) argued that a significant component of the value of an IT investment is its ability to enable complementary changes in business processes and work practices of firms, which may eventually lead to productivity increases by reducing costs or improving intangible aspects of existing products, such as timeliness, quality, and variety.

Researchers using historical data from banking industry found that the impact of IT investment on bank performance was realized after a certain time lag, and the level of impact depended on the extent to which firms supported their IT investments with organizational redesign (Murnane, Levy, & Autor, 1999). Additionally, Devaraj and Kohli (2000) showed that IT investment contributes to higher revenue after certain time lags, and the effect is more pronounced when combined with Business Process Reengineering initiatives. Bresnahan, Brynjolfsson, and Hitt (2002) studied the effect of three related innovations (information technology, workplace reorganization, and new products and services) on demand for skilled labor. They found firm-level evidence that the demand for skilled labor is positively correlated with all the three innovations. Bertschek and Kaiser (2004) analyzed a cross-sectional data set to investigate the possible relationship between investment in IT, non-IT investment, labor productivity, and workplace reorganization. They found that workplace reorganization induces an increase in labor productivity that is attributable to complementarities between various input factors, including IT and workplace reorganization.

In outlining future research directions in this field, Devaraj and Kohli (2000) commented:

...the literature in BPR implementation is rife with anecdotal evidence and short on rigorous empirical evidence of performance impacts of BPR. There is a definite need to better measure BPR implementations through objective measures, and to relate BPR to organizational performance ...

All of the studies briefly surveyed in this section collectively suggest that there are substantial benefits for firms if they can successfully manage the associated structural transformations during Business Process Reengineering implementations. In order to achieve this, firms can employ several established methodologies, including but not limited to, change management, risk management, and knowledge management.

NOTABLE EXPERIENCES WITH IT-ENABLED REENGINEERING

Firms have been implementing numerous IT-enabled reengineering projects since the use of mainframes and personal computers became popular in many industries. While some of these projects are enterprise-wide (e.g., reorganization or focusing on core competencies), others are more restricted in their scope and directed toward a specific business function (e.g., accounting or manufacturing).

Anecdotal business experience shows that the benefits of investments in IT may be more than outweighed by negative interactions with existing organizational practices. Moreover, investments in IT and reengineering cannot succeed in isolation. As a result, the main driver of the most of IT-enabled BPR projects during the 1990's was the belief that firms needed to adopt IT in their business units as part of an organizational change. Therefore, earlier applications of IT-enabled BPR were directed toward significant process changes accompanied by a reduction of personnel costs in labor-intensive operations of firms including accounting, purchasing, and payroll. Such organizational changes cost firms nearly $1.6 trillion in IT-related intangible assets during the 1990s as opposed to a total of $167 billion spending in IT equipment (Brynjolfsson & Yang, 1997). Since then, the use of IT as a supporting tool for BPR