



# Integrating ERP and e-business: Resource complementarity in business value creation

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## ABSTRACT

We investigate the complementary effect between ERP and e-business technologies, and the impact of such effect on business value creation. Previous studies have examined the effects of ERP and e-business technologies independently, and show positive effects on business value from their use. However, both the resource based view and microeconomic theory as well as practitioner experience suggest that the impacts from their joint and complementary use should be much greater, but this proposition has not yet been examined empirically. We use two different approaches (product term and direct measure approaches) to measure the complimentary effect. Comparing results using firm performance accounting data with self-reported survey data of 150 U.S. manufacturing firms, we provide confirming empirical evidence that the complementary effect between ERP and e-business technologies in creating business value is stronger than the main effects of ERP or e-business technologies alone. We further find that the complementary use of these IT resources to build system and business integration capabilities can extract the most complementarity value for firms. These findings provide empirical support for the theory of competitive advantage that the resource based view (RBV) proposes. Furthermore, these findings provide practical guidance to firms on how to utilize and deploy ERP and e-business technologies in a mutually reinforcing manner.

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## 1. Introduction

Enterprise resources planning (ERP) systems are large commercial software packages that standardize business processes and integrate business data throughout an organization [21,47,74]. These systems codify and organize an enterprise's business data into an integrated database, and transform the data into useful information that supports business decisions [68]. The ability to access information from various parts of an organization has helped firms to streamline their business processes and reduce inefficiencies [75]. In both large and medium size firms, ERP systems represent the largest portion of the application budget and about one-third of their IT budgets [41,53].

Although the benefits of ERP are considerable, traditional ERP systems that streamline and integrate internal processes improve efficiency only within the boundaries of an enterprise [21]. Because firms' value chains increasingly extend beyond their boundaries and include other firms within their business ecology, it is important to improve operational performance along the whole supply chain. Inventory turnover, asset utilization, and profitability depend on improved processes and information flows not only inside the focal firm, but also those "between" firms [50]. The full potential of an ERP system cannot be realized if its integration and coordination capabilities are confined within the walls of a firm [75].

E-business technologies have exploded on the scene in the last decade, and some advocates claim that they are the ultimate solution to the information exchange problem among firms' enterprise systems. Consistent with previous studies [5,26,87], e-business technologies are defined as the Internet-based technologies, such as Extranets, Websites, and EDI communication technologies that link two firms for performing e-business functions such as online selling, online purchasing, online coordination and online information sharing. Because of their lower cost and greater ease of implementation/use, e-business technologies hold the promise of enabling information made from ERP systems to be shared among firms in the extended supply chain [4,75]. E-business technologies serve to extend the original value proposition of ERP [27,36], offer an ERP-based organization the opportunity to build interactive relationships with its business partners [3,4], and bring together their previously separate information at a very low cost [55]. E-business technologies comprise the external part of the extended enterprise, and ERP comprises the internal portion [55].

From a technical point of view, Fig. 1 shows how ERP fits with e-business. In the middle is a focal firm's ERP system that was originally used only inside the firm. From the left hand side, with middleware software that is based on industry pre-defined standards such as RosettaNet, XML (extensive markup language) and more recently web services and service oriented architecture (SOA), information generated by ERP systems can be shared via the Internet/EDI directly with suppliers' ERP systems. If a supplier does not have an ERP system, it can still receive and exchange business information through an

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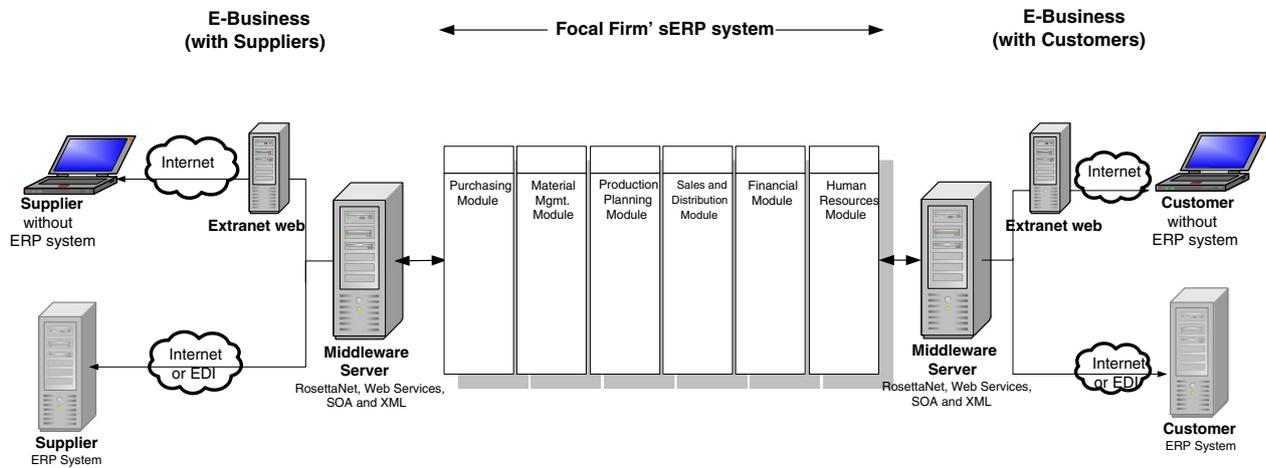


Fig. 1. How ERP fits with e-business.

Extranet website. Therefore, useful information such as inventory levels, production planning and materials purchasing can be exchanged between the focal firm and suppliers via ERP and e-business technologies, as referred to business to business integration. Similarly, on the right hand side, the focal firm can exchange valuable business data with its customers, such as order status, invoice, and online order fulfillment.

As more and more established organizations realize that they need to form alliances with their customers and suppliers over electronic networks, integrating e-business technologies with ERP systems become a critical issue [3,4,47]. Several IS researchers have identified ERP and e-business integration, as one of the most important IS areas for future research [11,32,75]. Others indicate that reconfiguring and integrating ERP systems with front-end web-based systems to support e-business initiatives should be at the top of the list for IS executives [67,73].

However, the extant literature investigating the value of ERP focuses on its internal integration capability only (see literature review below), and neglects the potential huge value from external integration enabled by the e-business technologies. Thus, this study brings a more complete assessment of ERP value by focusing on both internal and external integration. In other words, although existing studies have already addressed the importance and examined the benefits of using ERP and e-business technology individually, they are limited in consideration of integration between the two technologies as an important factor for firms to fully extract the benefits of IT. Our study investigates the complementary effect between ERP and e-business technologies.

In summary, there are two gaps in our understanding that need more research efforts. First, how to complementarily integrate the two technologies is not well understood. We need a theoretically rigorous framework and an empirically validated measure to calibrate the complementary level of the two technologies. Based on resource based view (RBV) and microeconomic theory that provide theoretical rationale for complementarity, this study develops a theoretical framework and proposes two different approaches to measure the complementary effect—the product term approach and direct measure approach. Second, whether the complementarity between ERP and e-business technologies contributes to business value has not been assessed empirically. Whether ERP's full potential can be better realized in the e-business era has not been confirmed. Our study intends to use large scale data to validate the theoretical framework and confirm the benefits of integrating ERP and e-business technologies.

## 2. Literature review

In this section, we first review two streams of existing studies that build our knowledge: (1) Business value of ERP and (2) business

value of e-business technologies. We then draw from resource based view and microeconomic theory to develop a theoretical framework and hypotheses for understanding the complementary effect of ERP and e-business technology.

### 2.1. Business value of ERP

The Business value of ERP can be categorized into three facets, *intangible*, *operational*, and *financial*. At intangible level, Mabert et al. [42,43] reported that the most improvements after using ERP were in intangible areas such as increased interaction across the enterprise, quicker response time for information, integration of business process, and availability and quality of information. Gattiker and Goodhue [25] showed that ERP can deliver intangible benefits to firms including better information, more efficient internal business process, and better coordination between different units of a firm. At operational level, Banker et al. [5] found that ERP systems have positive impact on plant performance including product quality, product time to market, and plant efficiency, while Mabert et al. [42,43] indicated there were also operational improvements in order management, on-time deliveries, and customer interaction. Cotteleer and Bendoly [20] used longitudinal data from an ERP implemented firm to show that order fulfillment lead-time was significantly improved after ERP system deployment. Lastly, Karimi et al. [33,34] found that ERP implementation is associated with process efficiency, effectiveness, and flexibility.

At financial level, mixed results are found in previous studies. Hitt et al. [31] compared data of 350 ERP adopters and non adopters and found that ERP adopters showed positive but not consistent performance results on productivity, profitability, and market value measures. They found that while ERP adopters showed a better performance on productivity, Return on Assets (ROA), inventory turnover, and profit margin, they have a significant negative performance on Return on Equity (ROE). They also found some evidence of a decline in productivity and business performance shortly after completion of the implementation. Partially replicating Hitt et al.'s work, Aral et al. [2] collected financial data of 623 US firms that were ERP adopters over a 7-year-period (1998 ~ 2005) to investigate the business value of ERP. Their results showed that using ERP systems improves productivity, inventory turnover, and asset utilization, but had no association with ROA, ROE, and Profit margin. Poston and Grabki [59] compared 54 ERP adopters and non adopters and found that ERP implementation was associated with an unexpectedly significant cost increase — Cost of Goods Sold (COGS) and Selling, General and Administrative Expenses (SG&A) — one year after implementation, and no association was found with income changes. Ranganathan and Brown [62] found that firms implement greater ERP functional scope or greater physical scope receive greater

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