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## E-Business Enabled ERP II Architecture

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### ABSTRACT

*The economy of the 21<sup>st</sup> century that succeeds the service and production economies has significant impact to business strategies. In this new economy, businesses compete as integral parts of a global value network fueled by the Internet and globalization. Critical to the competitive strategy are efficient real-time operations and the exploitation of relationship and knowledge assets across the value network. ERP II is a competitive strategy that extends a firm's value chain to a value network that includes a firm's customers, suppliers and channel partners in a collaborative environment. This paper describes a conceptual model for ERP II and discusses the role of e-business technologies in ERP II. It brings together the concepts of e-business, enterprise resource planning, value chain management, relationship management and knowledge management in an integrated architecture for ERP II.*

### INTRODUCTION

Business strategies have changed alongside the change of the economies, from the production focus of the industrial age, to the internal integration focus of the information age, and to the external integration focus of the relationship age (Galbreath 2002). The value chain of a firm is extended to a value network to include the value chains of the customers, suppliers and channel partners. Knowledge and relationship assets have become key ingredients of value creation in the relationship age. Globalization that widens the market and increases collaboration has created new competitions and opportunities. E-business technologies, utilizing computer networks, including the Internet, and other information technologies, provide the platform for business transactions among business entities in the extended enterprise around the globe, transcending business operations beyond the time and space confined by geographical and national boundaries.

To succeed in this new economy, businesses need an enterprise strategy that exploits relationship and knowledge assets in real-time business operations across the extended enterprise. ERP II provides a competitive strategy that integrates ERP with knowledge management and relationship management in the entire value network. This paper describes a conceptual model for ERP II and discusses the role of e-business technologies in ERP II. It brings together the concepts of e-business, enterprise resource planning, value chain management, relationship management and knowledge management in an integrated architecture for ERP II. The structure of this paper is arranged as follows. Section 2 provides a review of the literature. In section 3, a conceptual model for ERP II is described. Section 4 describes the e-business enablement of ERP II. In section 5, an e-business enabled ERP II architecture is presented. The paper concludes in Section 6 with an outline of future research directions.

### LITERATURE REVIEW

The enterprise architecture proposed in this paper provides an integrated framework for the e-business enabled ERP II processes in enterprise resource planning, value chain management, relationship management and knowledge management. A literature review of these topics is provided below.

Enterprise resource planning (ERP) systems focus on the integration of enterprise-wide resources and have evolved from manufacture resource planning (MRP II) systems, an extension of material requirements planning (MRP) systems (Mohamed & Fadlalla, 2005; Xu, Wang, Luo, & Shi, 2006). ERP integrates various intra-enterprise functions that include marketing and sales, manufacturing and production, finance and accounting, and human resources (Laudon & Laudon 2007). ERP II was introduced as the next generation of ERP in the early 2000s. The Gartner Group (2000) defined ERP II as "a business strategy and a set of industry-domain-specific applications that build customer and shareholder value by enabling and optimizing enterprise and inter-enterprise, collaborative, operational and financial processes." Mohamed (2002) characterized ERP II as a competitive strategy that integrates a centralized, core ERP system with highly specialized solutions such as supply chain management (SCM), CRM and knowledge management (KM). It further described that in ERP II, "the company's supply chain process is integrated with the supplier's supply chain system". ERP II provides the platform for collaborative integration of the entire value network.

Porter (1985) described the value chain as a systematic way of examining all the activities of a firm and how they interact. Primary value chain activities include inbound logistics, operations, outbound logistics, marketing and sales, and service. Support value chain activities include procurement, technology development, human resource management and firm infrastructure. Porter (1985) further extended the value chain concept to a value system to include the value chains of the suppliers, channels and buyers. In discussing the impact of the Internet to value chain management, Porter (2001) described the evolution of technologies in overlapping stages of automation, functional enhancement, cross-activity integration, integration of the entire value chain and the optimization of value chain activities in real-time. ERP II extends this concept to the real-time optimization of the entire value network.

Galbreath (2002) described enterprise relationship management as “a business strategy for value creation based on the leveraging of the network-enabled processes and activities to transform the relationships between the organization and all its internal and external constituencies in order to maximize current and future opportunities.” Enterprise relationship management extends beyond customer relationship management (CRM) to include partner relationship management (PRM) and supplier relationship management (SRM). Greenburg (2002) described CRM as “a comprehensive set of processes and technologies for managing the relationships with potential and current customers and business partners across marketing, sales, and service regardless of the communication channel.” Meta Group (2000) described the CRM ecosystem to comprise three integral parts: operational CRM, analytical CRM and collaborative CRM. A firm may sell to end customers indirectly through channel partners. Tanoury & O’Leary (2000) indicated that more than 50 percent of the high-tech industry’s sales go through indirect channels. It emphasized the importance of channel partners in industries selling high-ticket items. PRM can be viewed as an extension of CRM in the roles that it plays in marketing and distribution. Tanoury & O’Leary (2000) articulated that PRM emerges from the shadows of CRM and has a B2B focus. While previous focus of relationship management has been on CRM, supplier relationship management is becoming increasingly important. The Aberdeen Group described procurement as the single largest expense at most organizations (Aberdeen Group, 2001; Lang, Paravicini, Pigneur, & Revaz, 2002). Through deep and long-term relationships with suppliers, companies can better meet their daily production requirements, achieve faster production times and reduce manufacturing costs (Magretta, 1998; Carey, 2005). ERP, CRM, PRM and SRM are integral components of ERP II.

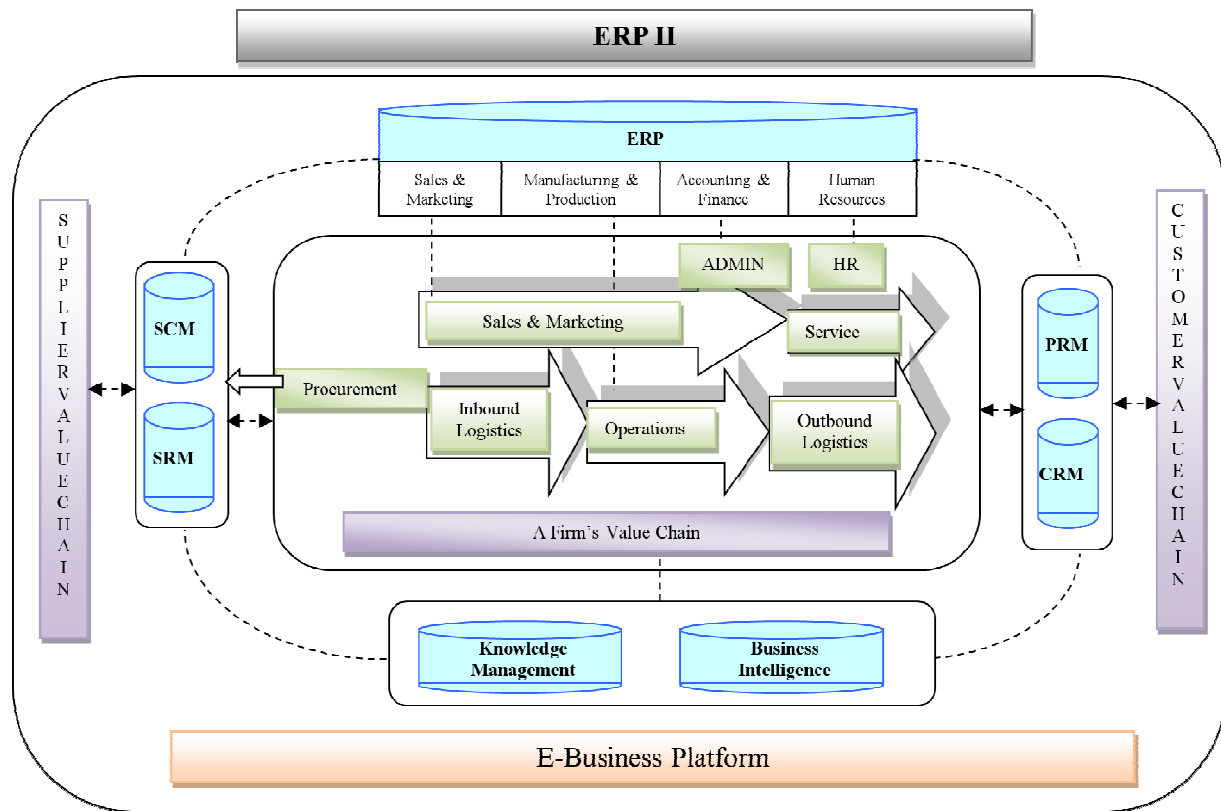
Drucker (1993) described the physical and knowledge assets as the two major types of enterprise assets. Knowledge management (KM) focuses on the innovation and utilization of knowledge assets in an enterprise. Knowledge management systems (KMS) emerged in the 1990s in support of knowledge management processes. Becerra-Fernandez, Gonzalez, and Sabherwal (2004) described knowledge management to consist of processes in the discovery, capture, sharing and application of knowledge. Sagsan (2006) described the knowledge management life cycle to consist of creation, sharing, structuring, using and auditing of knowledge. Nonaka & Takeuchi (1995) described the SECI model for knowledge creation through the continuous process of socialization, externalization, combination and internalization. Marwick (2001) described the technologies that support the SECI knowledge creation model. With the emergence of enterprise knowledge management (EKM), knowledge management becomes an enterprise-wide concern. O’Leary (1998) described the use of knowledge management systems to capture and disseminate company-wide knowledge. Correlation between knowledge management and CRM can be found in the literature, particularly in customer knowledge management (Gebert, Geib, Kolbe, & Brenner, 2003; Bueren, Schierholz, Kolbe, & Brenner, 2004). In describing ERP II, the next generation of ERP systems, Mohamed and Fadlalla (2005) pointed out that incorporating KM capabilities into ERP systems is a major driver behind ERP II. While a body of knowledge exists in the literature concerning enterprise resource planning, value chain management, customer relationship management, knowledge management and e-business, there is a lack of research in integrating these disciplines for the business enterprise. This paper utilizes these key concepts in the construction of an integrated ERP II architecture for the enterprise.

### A CONCEPTUAL MODEL FOR ERP II

Enterprise resource planning II (ERP II) has evolved from material requirement planning (MRP) in the 1970s, manufacturing resource planning (MRP II) in the 1980s, and enterprise resource planning (ERP) in the 1990s. MRP systems deal with the planning and scheduling for batch production of assembled items whereas MRP II expands MRP to include capacity requirement planning, and other functions such as marketing and finance (Stevenson, 2005). ERP systems extend MRP II to include various intra-enterprise functions of sales and marketing, manufacturing and production, finance and accounting, and human resources. In the 1990s, many companies were replacing their corporate systems with ERP systems to comply with the Y2K requirements. ERP II extends the core ERP systems to systems supporting the value chains of suppliers, partners and customers.

While ERP systems focus on managing the physical assets of an enterprise, knowledge management systems (KMS) focus on innovation and utilization of knowledge assets (Newell, Huang, Galliers, & Pan, 2003; Xu et al. 2006). As a parallel trend to the proliferation of ERP systems, knowledge management (KM) and knowledge management systems emerged in the late 1990s into the new millennium. In spite of the difference in orientations where ERP focuses on efficiency and KM focuses on innovation, Newell et al. (2003) emphasized the complementariness of both systems allowing an organization to gain efficiency and innovation simultaneously. The mutual existence and benefits are noted by Xu et al. (2006), O’Leary (2002) and Kennerley & Neely (2001), where ERP systems provide a key channel and platform for KM, and KM systems provide ERP transaction processing support. ERP II leverages the extended knowledge assets in a distributed knowledge network to meet the market demands of the extended enterprise.

**Figure 1** illustrates a conceptual model for ERP II. The key concept of ERP II is the integration of the firm’s value chain with the value chains of its customers, suppliers and channel partners. Intra-enterprise value chain activities are supported by the core ERP systems and the inter-enterprise value chain activities are supported by SRM and SCM systems for upstream supplier management and by PRM and CRM systems for downstream channel partner and customer management. ERP II operations are supported by knowledge management and business intelligence across the extended enterprise. As ERP II extends the core internal enterprise processes to the integration of processes across an enterprise and trading partners, it forms the basis of Internet-enabled e-business and collaboration commerce (Mohamed, 2002). In the following, an e-business enabled ERP II architecture is presented.



**Figure 1: A Conceptual Model for ERP II**

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## E-BUSINESS ENABLEMENT OF ERP II

E-business refers to the use of computer networks, and other information technologies to facilitate e-commerce and other business transactions within and across organizations. It provides an electronic platform linking all constituents in the extended enterprise for core processes in enterprise resource planning, value chain management, relationship management and knowledge management. In the following, the e-enablement of each of these processes will be discussed.

### *E-Business Enabled Enterprise Resource Planning*

ERP provides the integration of the core enterprise functions in marketing and sales, finance and accounting, manufacturing and production, and human resources. E-business technologies utilizing intranets provide the electronic platform where users within the enterprise can conduct ERP transactions. With the emergence of ERP II, ERP is transformed from an inwards solution to an outwards solution (Gartner Group, 2000; Mohamed & Fadlalla, 2005). Mohamed and Fadlalla (2005) described that ERP II accomplishes its outwards solution through “componentization and integration of the front-office tools such as CRM, SCM, and collaboration and coordination platforms with the back-office represented by the core ERP system.” E-business technologies utilizing extranets facilitate the integration of customer and supplier processes with the ERP system.

### *E-Business Enabled Value Chain Management*

Activities of a value chain can be grouped in terms of supply and demand in the supply chain. The supply value chain consists of activities in procurement, inbound logistics, and operations. The demand value chain consists of activities in demand creation that comprises marketing and sales, and demand fulfillment that comprises outbound logistics and after-sales services. In the e-business enabled value chain management model, the e-business platform, via the use of computer networks and other information technologies, provides the means for real-time business transactions, communications, and collaboration for the entire value chain. In the following, the e-business enablement of core value chain activities is described.

E-Procurement: Utilizing e-business technologies, e-procurement systems which emerged in the 1990s have transformed the inefficient and labor intensive traditional procurement processes, allowing procurement activities be conducted in real-time via computer networks. E-procurement systems provide online services that cover major activities in sourcing, cataloging, tendering, requisitioning, purchase orders approval and generation, receiving, invoicing and payment. Via private e-marketplaces and public exchanges, e-procurement ties buyers and sellers to a unified open platform where they can exchange information and conduct transactions. A business can participate in e-procurement in different ways: implementing e-procurement as a buy-side e-marketplace, through purchasing-oriented consortia, through a third party intermediary (aggregator), and participating in public exchanges. Large buyers such as GM can open up their own buy-side e-marketplaces, and invite sellers to browse and fulfill orders (Turban, King, McKay, Marshall, Lee, & Viehland, 2008). Companies in an industry may form purchasing-oriented consortium exchanges for procurement. A notable example is Covisint, which in 2002 united equity partners that included auto manufacturers and technology firms with many tier-one suppliers and thousands of second and third tier suppliers (Applegate, Austin, & McFarlan, 2003). Buyer aggregation is a form of group purchasing, where a third party aggregator groups requests from multiple buyers and conducts e-reverse auction and negotiation to meet the requested prices (Turban et al. 2008). The buyer aggregation model allows SMEs to enjoy quantity discounts and more supplier selections. A business can also participate in e-procurement via public exchanges owned by a dominant industry entity, a third party intermediary or a consortium.

E-Logistics: Logistics are primary activities in the value chain that deal with the incoming and outgoing shipments of materials and goods. Inbound logistics include all activities in the receiving, storing and distribution of incoming items such as raw materials or parts for production. Outbound logistics include all activities in the final storage of goods from the last production process to the distribution of outgoing items to the customers. E-logistics utilize e-business technologies to support material acquisition, warehousing and transportation, routing optimization and inventory tracking. For inbound logistics, incoming items can be identified using technologies in bar-coding and RFID in the receiving dock, and can be automatically reconciled with the purchase order information in the e-procurement system, authorizing online payment. Warehousing and production systems are updated when received inputs are stored and distributed for production. The receiving function also includes rejection and return processing for erroneous shipments or defective parts from suppliers, facilitated by the use of extranets. Key components of outbound logistics operations include transportation and warehousing. Transportation management handles the scheduling and shipping methods of outgoing goods. Utilizing mobile networks and global positioning systems

(GPS), carriers and cargos can be tracked in real-time during transportation. Movements of items within and between warehouses can be tracked using technologies in bar-coding and RFID and reconciled with inventory systems via computer networks. Route optimization takes on different factors such as distance, cost, and specific customer requirements. Automated optimal routing can be developed based on changes in the delivery schedules. InterGis (2009) described the use of visual routing to calculate the shortest distance between each stop. Real-time adjustments in delivery can be made based on real-time customer demands utilizing postponement strategies in logistics (Knaack, 2001). E-logistics support on-demand deliveries, real-time management of scheduling of shipment, route optimization, and unloading quantities at each destination. Stevenson (2005) described the use of distribution requirements planning (DPR) systems for inventory management and distribution planning for multi-echelon warehousing systems. E-business technologies utilizing EDI are used to link other organizations in the supply chain to leverage logistics performance to achieve a competitive advantage (Stevenson, 2005).

E-Operations: Operations deal with activities associated with production which transforms inputs into the final product. They include production scheduling, inventory management, manufacturing, assembly, packaging, equipment maintenance, and facility operations. Production planning can utilize real-time customer order information, where actual customer orders trigger activities in manufacturing and assembly. Linking customers' orders with production using e-business technologies facilitates the pull-based, just-in-time production strategies. E-business technologies facilitate the real-time exchange of production requirements and fulfillment information between a firm and its suppliers. Critical to the success of operations is the effective management of inventory, which tracks the movements of items in the inventory, knowing when and how much to order, and knowing the suppliers' capability of fulfilling the demand. Utilizing computer networks, bar-coding and RFID technologies, movements of items during work-in-progress in the manufacturing process, and within and across warehouses can be tracked in real-time. In the vendor-managed inventory model, a retailer's point-of-sale system can be connected to suppliers' inventory system via extranets to facilitate continuous replenishment of inventory.

Connected by computer networks, real-time monitoring of inventory along the supply chain provides the capability of sense and response in supply and demand. E-business technologies can facilitate collaboration in product design and development between a firm and its suppliers and customers. Real-time manufacturing enabled by e-business technologies allows manufacturers to track manufacturing processes to ensure quality control and regulatory compliance. Monitoring of production data around the clock is enhanced by the **always on** connection over high-speed communications networks to gain real-time manufacturing intelligence (Smith, 2002), that can be used for real-time process control to optimize performance, minimize unscheduled downtime and improve quality.

E-Marketing and Sales: E-business technologies have been used to enable activities in online marketing and sales of a firm's products and services. E-marketing includes online activities in advertising, marketing campaigns, lead generation, surveys and marketing research. The Internet has changed marketing and sales in many ways, from mass production to mass customization, from static customer interactions to dynamic and interactive customer interactions. Mass advertising through traditional media such as TV, radio, newspaper and direct mail is replaced or supplemented by target interactive Internet advertizing. Web-based surveys, online focus groups, and Web mining are commonly used for marketing research in lieu of traditional data collection methods based on paper surveys and phone calls. A firm can sell directly to the consumer on the Internet in the business-to-consumer (B2C) model. A notable example is e-tailing where retailing is conducted online, over the Internet, bypassing physical distribution channels. Many new business models have emerged using the B2C model, including recent trends in music and video on demand. In the business-to-business (B2B) model, a firm can sell to an intermediary such as a distributor or directly to a business bypassing any intermediaries. A business can participate in B2B sales in different ways: implementing a B2B sell-side e-marketplace, through selling-oriented consortia, through a third party intermediary (aggregator), participating in public exchanges, and through direct sales from catalogs. Private B2B sell-side e-marketplace are frequently implemented using extranets, providing functions in cataloging, configuration and customization, inventory checking, making sales transactions, order tracking and customer service (Turban et al. 2008). Companies in an industry may form selling-oriented consortium exchanges. Businesses can sell through a third party intermediary (market aggregator), who aggregates multiple supplier's catalogs for buyers. The aggregated catalogs integrate with internal procurement systems for large buyers, or with hosted service provided by application service providers (ASPs) for SMEs (Turban et al. 2008). A business can also sell their products through public exchanges operated by market makers, which match buyers with sellers and facilitate the buying and selling transactions. Similar to B2C, a firm using the B2B model can sell directly from its online catalogs with configuration and customization capabilities.

E-Services: A firm provides value-added services during and after sale to enhance the sales opportunity, maintain the value of the product, and improve the relationships with prospects and customers. Quality and timely value-

added services can provide the competitive differentiation for a firm in a market saturated with product offerings. Online services supporting a sale may include e-catalog, online order processing, shopping carts, electronic checkout, providing product information, and resolving issues with customer orders. After-sale services may include installation, maintenance, repair, warranty, technical and account support, training, providing information and resolving issues. E-business technologies have enabled rapid service deployment and instantaneous delivery of information to customers. Real-time services such as automatic underwriting in insurance, online banking, online billing and payment, and online customer care have become normal business operations. Many online services include real-time chat service that connects online shoppers with customer service representatives, e-mail service that uses routing technology to deliver messages to the most appropriate operator, and self-service FAQ (Bacheldor 2002). E-service intelligent technologies are used in customer service and call center operations, including automatic email responses, collaborative Web browsing, problem resolution, directing customers to different information sources including Web pages and a real person if necessary (Turban et al. 2008).

### ***E-Business Enabled Relationship Management***

Relationship management is a strategy for value creation in the new economy where operational efficiency and product differentiation alone no longer provide the competitive edge. Galbreath (2002) described enterprise relationship management as a business strategy for value creation based on the leveraging of network-enabled processes to transform the relationships between the organization and all its internal and external constituencies to maximize opportunities. In the following, CRM, PRM and SRM and their e-enablement will be discussed.

Customer relationship management (CRM) has been a dominant business strategy for over a decade where companies focus on customer satisfaction and loyalty to create long-term business benefits. E-CRM utilizes e-business technologies in the e-enablement of the entire CRM ecosystem. In addition to e-CRM operations that consist of e-marketing, e-sales and e-services, e-CRM includes e-CRM analytics and e-CRM collaboration. Through the use of computer networks, customer data can be captured at various operational touch points such as the point-of-sale, the Web and call centers in CRM operations, which provide the input for customer data warehouses for analytic processing. Conversely, business intelligence generated by the analytical process of customer data can be deployed via computer networks to enhance CRM operations at the various touch points. Response to real-time customer situations requires the real-time analysis of a combination of real-time and historic data. Facilitated by real-time communications network, real-time analytics provides the customer intelligence to support time-sensitive decisions in CRM.

As customers may interact with a firm through many channels and touch points. An important factor of providing better customer service is the alignment and integration of the organization processes from the point of customer contact through the supply chain (McKenzie, 2001). Poor customer experience can be caused by the disparate views of customers and the lack of real-time collaboration among organizations. E-CRM collaboration synchronizes various customer touch points and provides the real-time communication, coordination and collaboration between customers and organizations, as well as between organizational entities dealing with customer information.

In many industries, such as the high-tech industry, a high percentage of sales go through channel partners (Tanoury & O'Leary 2000), which may include distributors, retailers, value-added resellers (VARs) and independent agents. PRM can be viewed as an extension of CRM in the downstream supplier chain management. Similar e-business technologies can be deployed in the e-enablement of the PRM ecosystem of PRM operations, analytics and collaboration. While similar to CRM in many respects, Tanoury & O'Leary (2000) emphasized the B2B focus of PRM. E-PRM provides the B2B platform for a firm to conduct PRM activities with its partners, such as joint marketing, lead management, sales forecasts, order management, technical support, invoicing and payment.

While CRM took the center stage for relationship management in the 1990s, relationship management on the supplier side has gained momentum in the 2000s. In SRM, the e-business platform links suppliers to a firm in business transactions, collaboration and communication. E-SRM utilizes e-business technologies in the enablement of the SRM ecosystem of SRM operations, analytics and collaboration. In operational SRM, e-marketing focuses on promoting the firm's requirements to attract qualified suppliers and e-service focuses on services received from suppliers. The e-sales function in CRM is replaced by e-procurement. E-procurement provides an online platform for buyers and suppliers to facilitate procurement activities from sourcing to payment. Online, real-time services such as catalogs and requests for quote can be provided utilizing global procurement networks (Waters & Fitzgerald 2001), and remote real-time routing and approval of RFQs can be provided utilizing wireless mobile networks (Ferguson, 2001). Utilizing computer networks, purchase orders can be issued electronically from the firm to suppliers, and the matching of received items from the suppliers to purchase orders can be done automatically at

receiving, authorizing electronic payment. Through the use of extranets, a firm can share its point-of-sale data, production schedules and requirements with its suppliers to facilitate continuous replenishment and just-in-time delivery. In analytical SRM, the e-business platform provides the medium for collecting supplier information for analytical processing and the application of supplier intelligence in SRM operations. In collaborative SRM, collaboration between a firm and its suppliers is facilitated by the e-business platform utilizing technologies in email, e-conferencing, Web-based document management and groupware.

### ***E-Business Enabled Knowledge Management***

A parallel strategy to relationship management in value creation in the new economy is knowledge management. Knowledge management concerns the processes of creation, acquisition, dissemination and sharing, representation, storage and utilization of knowledge within and across organizations in the enterprise. Nonaka and Takeuchi (1995) described a continuous process of knowledge creation through socialization, externalization, combination and internalization. Knowledge acquired by organizations is disseminated and shared in the enterprise. Knowledge can be stored in knowledge repositories and knowledge bases and retrieved by human and machine processes enhancing business operations. There exists a feedback loop between knowledge management and business processes. Knowledge created in the KM processes is utilized in knowledge-oriented business processes, and conversely, knowledge captured in business processes provides the input to KM processes. E-business technologies facilitate both knowledge management and knowledge-oriented business processes. Computer networks can link knowledge sources from various parts of the organizations in the extended enterprise. E-business technologies provide a networking platform for knowledge creation utilizing technologies in groupware, collaboration and knowledge capture. Sagsan (2006) described the use of communication channels such as information networks, technical communities, the Internet, intranets and extranets to facilitate knowledge sharing. Through computer networks, knowledge can be deployed in knowledge-oriented business processes to enhance business operations.

## **AN E-BUSINESS ENABLED ERP II ARCHITECTURE**

The key concept for the e-business enabled ERP II architecture is the e-enablement of business processes in enterprise resource planning, value chain management, relationship management and knowledge management as described in the previous section. The architecture consists of the e-business platform, e-business front-end systems, back-end systems, ERP II business processes, e-marketplaces and business entities. **Figure 2** provides an illustration of the e-business enabled ERP II enterprise architecture. In the following, each of these components will be described.

The *business entities* consist of organizations in the extended enterprise that comprises the firm, its customers, suppliers and channel partners. The *e-business platform* utilizes networking and information technologies to facilitate the communications and business transactions within and across organizations in the extended enterprise. Using the *front-end systems*, an external business entity can interact with a firm's business processes directly or through intermediaries such as *e-marketplaces*, which are connected to the back-end systems utilizing the e-business platform. Front-end systems provide the mechanisms through which a business entity interacts with a firm. They may include enterprise portals, Web stores, search engines, call centers, emails, wireless systems, phones, and online communications such as real-time chats (Turban et al. 2008; Tiwana, 2001). A front-end system may or may not involve human interactions. A virtual front-end system such as a Web-based self-service customer support system requires no human intervention, whereas a phone customer support system may require human intervention.

*ERP II business processes* of a firm consist of processes for enterprise resource planning, value chain management, relationship management and knowledge management. ERP processes support a firm's intra-enterprise business operations and integrate business functions of marketing and sales, manufacturing and production, finance and accounting, and human resources. An example of enterprise resource planning process is the order fulfillment process that integrates the business functions of sales, accounting and production. *Value chain management processes* can span within and across value chain activities in the extended enterprise supporting upstream and downstream supply chain management. An example of a cross value chain management process is continuous replenishment where a firm's point-of-sale activity is linked to its suppliers' inventory and outbound logistics activities via extranets. *Relationship management processes* consist of processes in CRM, PRM and SRM. CRM processes include campaign management, lead management, offer management, contract management, complaint management, and service management (Gebert et al. 2003). PRM processes are similar to those in CRM with the addition of partner recruitment management and lead referral management. In SRM, the buy-side process of procurement management replaces the sell-side process of offer management. *Knowledge management processes* support the knowledge management life cycle of knowledge creation, acquisition, dissemination and sharing,



representation, storage and utilization of knowledge in an organization. The e-business platform facilitates knowledge dissemination and sharing within and across the extended enterprise. Internal and external business entities can participate in ERP II business processes supported by back-end systems such as enterprise resource planning (ERP) systems, supply chain management (SCM) systems, customer relationship management (CRM) systems and knowledge management (KM) systems via the e-business platform.

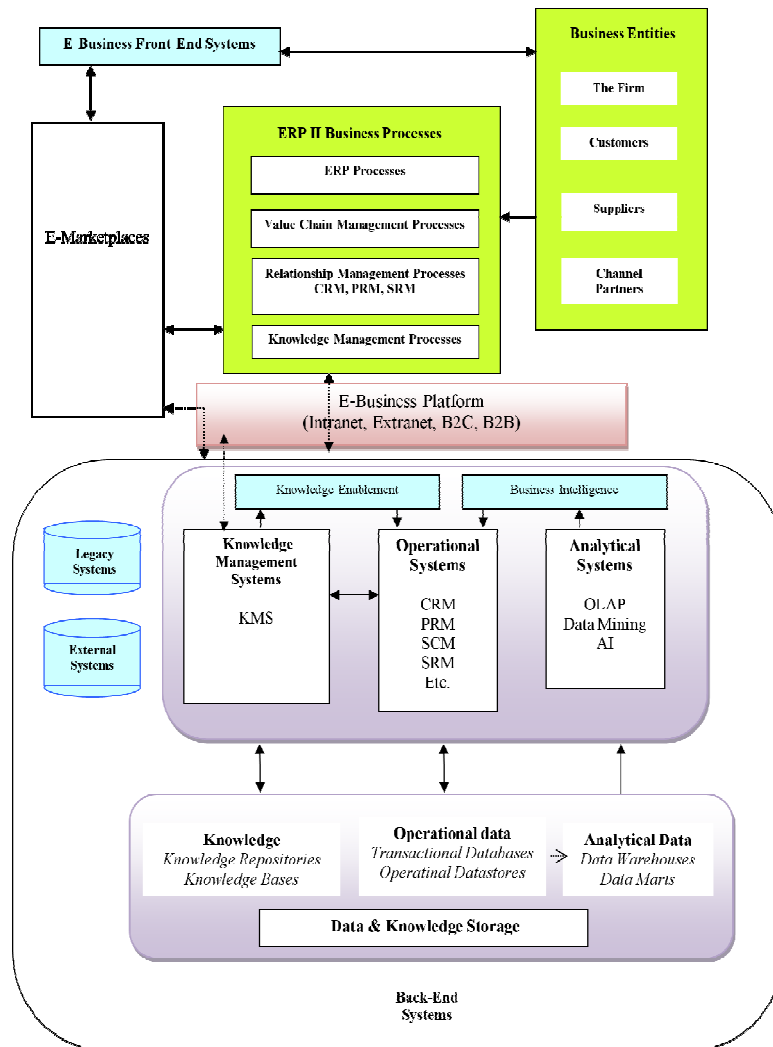


Figure 2: E-Business Enabled Enterprise Architecture

Business intelligence generated by analytical systems can enhance business processes, and conversely, operational data captured in business processes can provide the input to data warehouses for analytical processing. For example, customer intelligence created by analytical processing of data from a customer data warehouse can enhance the cross-selling process for a call-center operation, and conversely, operational data collected in a call-center operation provide further input to analytic processing to create new business intelligence. Business processes can also be enhanced by knowledge generated in the knowledge management processes, and conversely, knowledge captured in business processes can provide the input for knowledge management processes. For example, knowledge for a supplier generated in the KM processes can be utilized by the business process of procurement, and knowledge from a supplier captured in the response to an RFP can provide the input to the KM processes to create further knowledge about a supplier.

The *back-end systems* consist of operational systems, analytical systems, knowledge management systems, data and knowledge storage, legacy systems and external systems. *Operational systems* are online transactional systems (OLTP) that support business operations. Operational systems are supported by *operational data*, which are stored

in *transactional databases* and *operational data stores*. Operational systems may consist of enterprise systems such as ERP, CRM, SCM and other transactional systems. *Analytical systems* consist of applications and tools for analytical processing utilizing methods such as statistical processing, online analytical processing (OLAP), data mining and artificial intelligence. Analytical systems utilize data from *analytical data storage* such as *data warehouses* and *data marts*. *Business intelligence* is created from analytical processing to enhance operational systems in support of business processes. *Knowledge management (KM) systems* consist of applications and tools for knowledge creation, capture, dissemination and sharing, representation, storage and utilization. Knowledge is captured and transformed, represented and stored in *knowledge repositories* and *knowledge bases*, to be utilized by knowledge retrieval systems and artificial intelligence systems for human or machine processes, enabling operational systems to enhance knowledge-oriented business processes via the e-business platform. Back-end systems support front-end systems across various operational touch points. For example, an order-entry transactional system may support the customer order processes via a telephone customer service operation or via Web-based self-service operation. Seamless integration of front-end systems and back-end systems utilizing the e-business platform is critical to providing accurate real-time responses to users in the extended enterprise.

### CONCLUSIONS

The new economy fueled by the Internet and globalization brings opportunities as well as challenges for businesses. The Internet has reduced the barrier to entry, diminished the relevance of physical location and firm size, and lowered transaction and agency costs, while globalization has increased the market reach. The forces of the Internet and globalization also create new competitions for markets, resources and innovations. Businesses no longer operate as isolated business entities, but rather as integral parts of a global supply chain. Efficient real-time operations and the capability of exploiting relationship and knowledge assets across the global value network are key ingredients for success. Enterprise strategies have evolved from the internally focused ERP to ERP II, which integrates the core ERP systems with enterprise systems that are oriented towards the management of relationships of suppliers, customers and channel partners in the value network, and exploits the knowledge asset across the value network. This paper discusses the key components of ERP II that consist of ERP, SRM/SCM, CRM/PRM, and knowledge management (KM) in the integration of the value chains of the firm, its suppliers, customers and channel partners. It describes the role e-business technologies in ERP II and presented an integrated architecture for the e-enabled ERP II. The architecture provides an integrated framework for businesses to deploy their strategies focused on the key critical success factors of efficient enterprise operations, real-time value chain management, enterprise relationship and knowledge management, through ERP II business processes enabled by e-business technologies.

The implementation of ERP II requires the inter-organization integration in many dimensions. The implications of future research include the study of inter-organization integration at the business process, conceptual and technology levels of the extended enterprise, the study of inter-organizational analytics and the study of inter-organization knowledge management. Further research can address the role of service oriented architecture (SOA) in ERP II to facilitate the assembly of processes and applications across multiple organizations.

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