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Conceptualizing Architectures for E-Business Systems

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Abstract

E-Business (E-Commerce) infrastructure requires organizations and their IT systems to be flexible and adaptive to changes in the dynamic business environment. Component-based development is seen to be the solution for rapidly creating modifiable and maintainable e-Business systems. Organizations have attempted to strategically align their IT and organizational goals in developing mission-critical e-Business systems. In this research we propose a architecture for designing such systems based on the notion of business capabilities and technology capabilities. This tiered architecture provides a formal framework for understanding the cohesive relationships between IT and business capabilities in organizations. It allows for rapid "what-if" analysis for managing IT investments and offers the flexibility needed to manage changes in designing and developing information systems for e-Business. The architecture supports the packaging of existing legacy systems and links them to the e-Business systems to create outward facing mission-critical information systems demanded by the e-Business infrastructure.

Introduction

The Internet and e-Business (e-Commerce) have radically redefined how organizations use information technology (IT). E-business systems are IT systems that are designed, implemented and/or engineered to support business activities over Internet**.** E-Business provides an infrastructure that helps organizations transform their inward focused business processes and systems by extending these to open outward towards their partners including partners in trade, customers, suppliers, and distributors (Fingar, Kumar, & Sharma 1999). This often implies linking the core business processes of organizations with that of their partners and hence IT systems that support this initiative become mission-critical. Organizations attempt to develop such mission-critical information systems by focusing on the notion of capabilities. A business capability is a distinctive attribute of a business unit that creates value for itself and its partners (Kulatilaka, Bala, & Storck 1999). We define a technology capability as a set of technology components together with business-specific rules, which delivers a business capability. A technology component (or a software component) performs a specific functionality. Technology capability conceptually captures a set of functions along with the business or application specific rules. In our architecture we use technology capability as a conceptual construct that defines an intermediate step in translating the business capabilities (a strategic construct) into functions that can be implemented.

E-Business infrastructure requires organizations to be flexible and adaptive to changes in the business environment. Organizations need to be able to change or modify both their business and technology capabilities in the dynamic environment created by e-Business. Organizations have recognized the futility of attempting to build complete systems to deliver a new or changed business capability from scratch. Using "software components" organizations must assemble together pieces of application functionality to create complete business applications that deliver specific IT and business capabilities. A software component is an independent software unit that provides a specific functionality while supporting well-defined interfaces using which the component may be assembled onto an IT system. We use the term (information) technology component instead of software component in this research to better relate it with the IT capability it supports. We extend this notion of software components to define business components. A business component may be loosely defined as a logical modeling unit that represents some specific business functionality. We use business components to model business capabilities and hence we do not attempt to define the business component rigorously. Rapid application development of customized applications and improved modifiability and maintainability are some of the advantages offered by component-based application development.

In this research we present a component-based architecture for designing information systems for e-Business using the notion of capabilities. We develop this layered architecture starting with one (or more) business capability, identifying the business components required to deliver this business capability, and linking the business components with the specific technology capabilities required to support it. This architecture offers the following advantages: (1) It provides an intuitive method for tracking and identifying technology components needed to deliver business capabilities in

organizations. (2) It provides a formal framework for understanding the cohesive relationships between IT and business capabilities in organizations. (3) It allows for rapid "what-if" analysis for managing IT investments and offers the flexibility needed to manage changes in designing and developing information systems for e-Business. (4) It supports the packaging of existing legacy systems and their linking to the e-Business systems to create outward facing mission-critical information systems demanded by the e-Business infrastructure.

Summary of Related Work

Architecture implies a planned and controlled approach in identifying and integrating the different pieces of an information system (Cook 1996). Weill and Broadbent define architecture as a integrated set of technical choices used to guide the organization in satisfying business needs (Weill & Broadbent 1998). In this paper we use the term architecture to describe the integration of the set of different technology components that are identified and assembled together in a systematic fashion by organizations to deliver one or more technology capabilities.

Fingar et. al. have proposed a distributed component architecture for E-Commerce applications (Fingar, Kumar, & Sharma, 1999). In this architecture, they classify application components into three types: cross-application, application specific, and industry specific. They further describe how these components may be served by application servers, and use standards-based (CORBA, EJB, D-COM) interfaces to link e-Business applications with legacy systems. We have learned extensively from this work. We have adopted the capability-based approach in defining our architecture for designing e-Business systems while emphasizing knowledge management as an important technology capability that is a must for almost all e-Business systems. The architecture described by Fingar et. al. is much more general and we have attempted to better structure it using the top-down approach.

Kara characterizes components based on their function(s) within applications as technical and business components (Kara 1998). The former supports technical features in an application such as user-interface controls. The latter is closely tied to the way in which a business works (e.g. Purchase-Order). While our definition of a technology component is similar to the above, we define business component as a business process or functionality rather than just a business object (e.g., P.O. management is business component and not just P.O).

To illustrate the use of the architecture in designing e-Business systems we examine customer- relationship management (CRM) as an example. We briefly describe CRM before examining the architecture in detail. CRM systems help automate the business functions of customer service and support. They help organizations increase customer base while retaining existing customers. The Internet is the primary medium over which customers experience these services today. Key requirements of CRM systems include improving service quality while keeping costs low (encouraging self-service and providing options for it), gaining customer loyalty, and tracking customer behavior and targeting customers for new products/ services. To achieve this organizations must adopt a customer centric business model requiring all organizational functions to have a consistent view of customer relationship.

Capability-based Architecture for Designing E-Business Systems

The top tier of the architecture defines the business capability that the organization desires. Such capabilities are usually determined by the strategic initiatives, market conditions, and/or analyzing the value chain of the organization. Let us consider the CRM as the business capability that some organization needs. Once the capability is identified, it can be divided into a set of business components represented in second tier. Each business component here contributes some specific business functionality towards achieving the business capability in tier-1. Identifying the business components for a given business capability is a strategic modeling process. One way to do this is by analyzing the factors critical to successfully of achieving the business capability (Rockhart 1979). Another is the use of case tools with process modeling capabilities. The business components that are needed to address CRM may include managing customer accounts, retaining customers and increasing customer loyalty (via market intelligence), and supporting existing/new customers in terms of information and services. Next a set of technology capabilities required to implement the functionality in each business component in tier-2, is captured in tier-3. Let us consider the account management business component of CRM. Technology capabilities required may include personalization of account information, order tracking, account status tracking, and billing and payment management to list a few. Similarly customer profiling, customer segmenting to target promotional offers and advertising, market intelligence are some technology components required to address "customer loyalty" business component. Each business capability (tier-2) may require one or more technology capabilities (tier-3) and each technology capability may be part of one or more business capabilities. For example, the technology capability of knowledge management in tier-3 may be related to both customer support and customer retention business components in tier-2. The specific technology functions or components required to implement each technology capability in tier-3 are captured in tier-4. The process of identifying the technology components for a given technology capability involves decomposing the

capability into specific functional requirements. Technology components can then be created or picked from an existing set of reusable components and customized to deliver the functional requirements identified. The technology components are the pieces that now need to be assembled to create a system that would deliver the capability in tier-1. For CRM technology components may include profile tracking systems, security and authentication, personalization systems, order management systems, accounts payable and receivable systems, event notification systems, discussion management systems, bulletin boards, information filtering systems, document management systems, workflow management systems, besides intelligent searching and sorting systems. These components are the building blocks that need to be assembled to create a system for e-Business focusing on CRM as a capability. The schematic representation of the architecture for CRM is shown in figure 1.

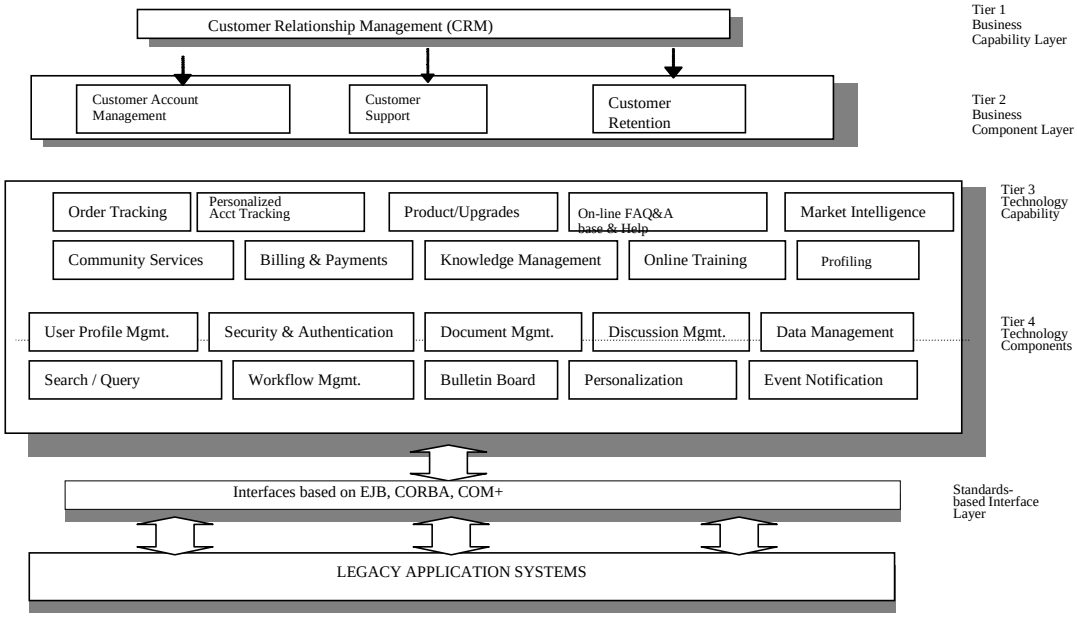
Discussion and Directions for Future Work

In the preceding section we have presented a architecture for designing mission-critical e-Business systems. The design is based on the notion of a business capability and therefore helps align IT and organizational goals and offers several advantages. First, it helps organizations to intuitively understand the technological requirements for acquiring some business capabilities. Second, it helps organization evaluate and identify the re-deployable technological components as well as components that need to be acquired or built when considering a shift in business capability. Over time, as organizations acquire new technology components, a change in business capability would only require a new assembly of existing components. The e-Business infrastructure posits that new e-Business systems must be linked to existing legacy systems, and databases. The application components must be designed adopting standards such as EJB, CORBA, or D-COM so that the new e-Business system(s) designed with these components can link to legacy systems and databases in the organization. The final piece to the design of e-Business systems is the issue of incorporating specific business rules and application specific rules/requirements. It is at this layer that Organizations, using their distinctive business rules, can differentiate the e-Business system (and themselves) to gain competitive advantages. Both the standard-based middle ware layer and the layer with application specific rules enclose the set of assembled components.

We are currently attempting to validate the architecture described here by applying it to develop e-Business systems for organizations. This would help us formally define a methodology for designing and developing e-Business systems.

Knowledge management is a critical technology capability needed to deliver most business capabilities including CRM. A distinguishing feature of knowledge management is that it is application specific and cannot be treated as a general component. We are also examining the component-based design of knowledge management systems (KMS) and issues related to linking KMS with mission-critical e-Business systems.

Figure 1: Capability-based Architecture for CRM



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