

Enhancing ERP-Architectures for Business Networking – Case of Deutsche Telekom AG

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Abstract

Many organizations have ERP systems in place and are confronted with initiatives from their functional departments, consultants or software vendors that aim at implementing solutions for Business Networking. This concept includes the design and management of IT-enabled relationships between internal and external business partners. It provides a holistic perspective on strategies, such as electronic commerce, supply chain management, and customer relationship management. Since a new array of applications to address these inter-business relationships is swiftly implemented, architectural considerations are often left out. Reasons for this include time pressure, a lack of experience, methods, and concepts. Consequently, existing ERP-centric architectures are not modified or have to be modified after the fact. Using a case example from Deutsche Telekom, this article presents a possible proactive solution for a definition of a future application architecture as well as procedures to achieve a Business Networking architecture that meets business requirements.

Impact of Business Networking on ERP-centric Architectures

Systems for Enterprise Resource Planning, such as SAP R/3 or Oracle Financials, have spread in many companies. In supporting the operational aspects of the business they ensure integrated transactions and are the necessary backbone for business in the information age (Österle *et al.*, 2000, p. 25). However, during the last years the focus of many companies has moved from achieving an integrated (internal) information system to the support of processes in the extended supply chain. A concept which includes the development to the extended supply chain is Business Networking. As described by Österle *et al.* (2000) Business Networking comprises the design and management of IT enabled relationships between internal and external business partners. It focuses on business to business relationships and recognizes solutions like supply chain management (SCM), electronic commerce (eC) and customer relationship management (CRM) as main strategic options. It is supplemented with more internal oriented components like data warehousing (DW) and knowledge management (KM).

According to the different processes of the extended supply chain, various tools have evolved on the market which offer specific functionalities for these processes.

Examples for Business Networking systems (Alt and Fleisch, 1999) are electronic commerce tools (e.g. Inter-shop, Broadvision) which allow an efficient set-up of electronic catalogs, electronic procurement tools (e.g. Commerce One, Ariba) which easily integrate and individualize electronic product catalogs from multiple suppliers, and supply chain tools (e.g. i2, Manugistics) which offer sophisticated forecasting functionalities. Although systems for the extended supply chain use ERP data, they challenge the homogeneous ERP-centric application architectures and increase the heterogeneity of a company's application architecture. In the following we argue that systematic architecture planning helps to reduce the increased complexity resulting from heterogeneity and avoid problems like incompatibility of semantics and high costs of integrating new components due to a monolithic architecture thereby increasing flexibility.

Research Approach

The insights presented in this paper have emerged from several projects which have been undertaken during the last two years. Following the tradition of action research (Checkland and Holwell, 1998) the researchers participated in the projects of Deutsche Telekom AG, Robert Bosch GmbH, Bayer AG, Riverwood International Corp., Hoffman-LaRoche Ltd., ETA SA, HiServ GmbH and SAP AG. Together with researchers from the Institute for Information Management at the University of St. Gallen, these companies formed the Competence Center for inter-Business Networking (CC iBN)¹. The research addressed all areas of Business Networking, i.e. electronic commerce and supply chain management (Alt, 1999), electronic procurement (Dolmetsch, 1999), customer relationship management (Puschmann and Barak, 2000) as well as ERP integration and architectures (Huber 1999).

For a better illustration of the results, the challenges at Deutsche Telekom, headquartered in Bonn, Germany, will be described in more detail. In offering fixed line, mobile and Internet communication services in Europe with a turnover of € 35.64 billion (Telekom, 2000), Deutsche Telekom is a leading telecommunications provider in Europe and ranges third worldwide. During the last 12 years, Deutsche Telekom has implemented an ERP architecture which amounts to approx. 80 different

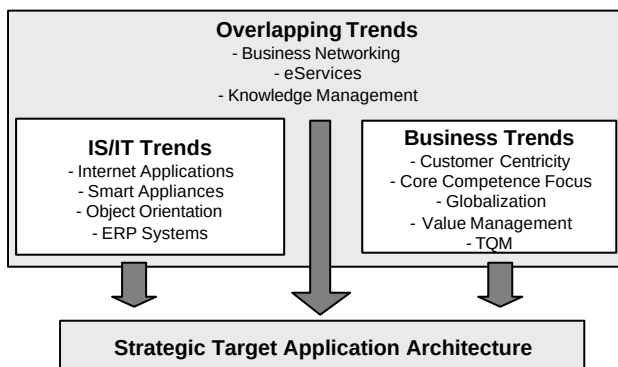
¹ See <http://ccibn.unisg.ch>

SAP installations with approx. 70 000 planned users. A centralized coordination unit, called SAP Management, has been created to plan and oversee the ERP systems throughout Deutsche Telekom.

In view of increased Business Networking needs on behalf of the divisions and functional departments, SAP Management is now confronted with a growing number of decentralized solutions from vendors, such as Commerce One, Intershop or Siebel. They mainly originate from the desire of the divisions/departments and “daughters” to take advantage of new functionalities and to better support their business.

SAP Management aims to manage heterogeneity by including Business Networking systems into its business application architecture. This means that reference installations with pre-configured processes, standards, and guidelines are offered to the departments. For example, integrating Siebel with SAP might require a tool for enterprise application integration which can handle the differences in semantics and application logic of the two solutions. In a workshop with Deutsche Telekom executives we have identified the following trends and assessed their influence on the future application architecture (see Figure 1).

Figure 1: Influences on the Future Application Architecture



The collaborative assessment of the workshop and further work with Deutsche Telekom elaborated two major questions to be answered in order to meet future challenges:

- How does a future application architecture that includes Business Networking systems look like? What are guidelines, rules and methods are useful for designing it?
- How do guidelines, rules and methods for implementing the future application architecture on the level of single implementation projects look like?

In the following, we will focus on the first question and present a solution towards a future application architecture at Deutsche Telekom.

Foundation of a Business Networking Architecture

Understanding of Architectures

Architecture is a widely used term which is used to describe the result and the activity of designing buildings (Alexander, 1977), business strategies (Hamel and Prahalad, 1994), and various aspects in information systems, such as database architectures, application architectures, networking architectures. Architectures are a salient tool to avoid getting too immersed with details. They can be the basis for planning and structuring of activities as well as to provide an holistic view of information systems (Wall, 1996).

In order to reduce scope and manage the complexity, we will focus on application architectures which are to date dominantly shaped by ERP systems. These systems are of high direct impact on business by constraining the flexibility of operations and building the basis for management information (Davenport, 1998).

We will deploy both perspectives on application architectures. From a *result* perspective that describes the result of an architectural design activity, we define architectures as technical components of an information system as well as the relationships between these components and between layers and views (adapted from (Tibbetts, 1995)). The intra layer relationships are formed by the exchange of information (Platt, 1998) whereas the inter layer relationships may only be logical mappings of different layers of abstraction. On each layer there can be views to focus on specific aspects of the architecture. We distinguish a strategic application architecture and an operative application architecture that is directly implemented.

From an *activity* perspective an architecture describes the path and the prerequisites to achieve an agreed upon architecture. This contains all rules, prescriptions, concepts and methods, which underpin the design, usage and development of an application architecture. This part can be supported by knowledge management tools and methods for designing strategic application architectures (cf. SISP (Galliers, 1994)). The process ideally starts with an internal goal definition and with the strategic alignment (Henderson and Venkatraman, 1992) with business goals to form strategic guidelines. The result is used for project portfolio planning which gets transformed into specific IS projects (Österle, 1993, p. 135).

Approaches towards Architectures for Business Networking

Several developments provide input for a redesign of ERP centric information systems towards a closer integration of business partners and customers.

Firstly, ERP system vendors have set-up initiatives to encompass solutions to integrate the Internet and inter-business challenges into their software packages. For example, SAP has started its mySAP.com initiative and presented its Internet Business Framework Architecture. Oracle has its Portal Framework and an Internet Platform for Internet components to name the most influential.

Secondly, vendors of enterprise application integration (EAI) software like Crossworlds or Tibco position themselves as solution providers for integrating ERP systems within and between companies.

Thirdly, the academic research in object oriented software architectures and framework architectures delivers considerable input on the design and the benefits of this investment (Fayad, 1999).

Fourthly, consultants like Gartner Group, Aberdeen Group or PWC offer support when integration ERP systems and designing E-Business architectures.

Finally, users like Cisco offer recommendations of how successful eBusiness architectures should look like from their experience (Hartman *et al.*, 2000).

The above arguments will be reflected in the following presentation of the strategic part of a future Business Networking architecture based on the collaboration with Deutsche Telekom. However, the potential benefits might also be a basis for other researchers and companies.

Proposal of a Strategic Application Architecture for Deutsche Telekom

Requirements of a Business Networking Architecture

An architecture for Business Networking has to take specific requirements into account which emerge from the cooperation intensity of Business Networking processes. As explained by Fleisch (2000), quickly and efficiently establishing relationships with business partners supported by IT, an ability referred to as networkability, becomes a key competitive factor. From project work with our partner companies we have identified that a future Business Networking architecture should follow three goals:

Higher flexibility which can be achieved by a higher degree of openness towards integrating new components of partners, faster response times towards changed requirements, and an increased reversibility, changeability and scalability of the solutions. Design recommendations to achieve that are a higher degree of standardization combined with a higher degree of componentisation.

Cost reduction which is possible through the reuse of components, customizing templates, early information

and fast decision making processes, as well as cost-benefit analysis and option pricing models (Favaro *et al.*, 1998). This aims at a reduction of the total cost including development and maintenance of the future Business Networking architecture.² It requires established knowledge management, early watch mechanisms, procedures and tools.

Higher transparency which is established by clear and understandable semantics, which serve as orientation for decentral decisions. It provides an up-to date information basis and arguments for the benefit of an architectural planning (Hamu and Fayad, 1998).

Elements for a Business Networking architecture

Based on the "Business Model of the Information Age" (Österle *et al.*, 2000), the basic elements of an architecture for Business Networking was discussed which included four main elements:

- A *Business Bus* which characterizes a set of standards that supports the exchange of information and services among business partners. It is a logical space where (complex) services and products are flexibly and efficiently exchanged with the support of service providers. Its naming was coined in analogy of technical computer bus systems that enable "plug&play" connections. Examples are standards for catalogs (e.g. RosettaNet, cXML) and processes (e.g. CPFR).³ The standardized infrastructure to exchange data is extended to exchanging business information, services and knowledge. This concept builds upon the increasing availability of modular eServices and standards for processes, data, and interfaces.
- *Business Port*: Applications and services, which denote a company's ability to interface with a large number of partners. Business Ports use the Business Bus standards and implement the physical connectivity to in-house systems. First solutions for Business Ports are already on the market (e.g. SAP Business Connector) and are expected to develop with the diffusion of XML-related standards.
- *EServices*: Modular Internet-based applications and services offered as individual products to solve a specific business. They derive their value from digital value creation, are often charged on a trans-

² $\sum \text{cost of single projects} + \sum \text{cost of Business Networking architecture} < \sum \text{cost of uncoordinated projects without architectural guidance.}$

³ cXML stands for Commerce Extended Markup Language and CPFR for Collaboration, Planning, Forecasting and Replenishment.

action basis, and may include physical elements and/or other eServices (recursiveness). Critical issues for eService providers include the selection of standards (i.e. communication or data) within the Business Bus and the specific functionality of the eService (Klueber *et al.* 1999).

- *Componentization* highlighted by specialized components for supply chain management (SCM), customer relationship management (CRM), electronic commerce (eC) and supplemented by knowledge management (KM) and data warehouses (DW) tools.

The implication for Business Networking architectures are that the model helps to stress the need for standardization in eBusiness (Hartman *et al.*, 2000; Buxmann, 1996; Berners-Lee, 1999), encompasses the evolution of eServices, new application components as well as facilitating new intermediaries (Hagel and Armstrong, 1997), which have to be reflected in a future oriented strategic application architecture. These elements are reflected in the result view of the strategic application architecture.

Result view

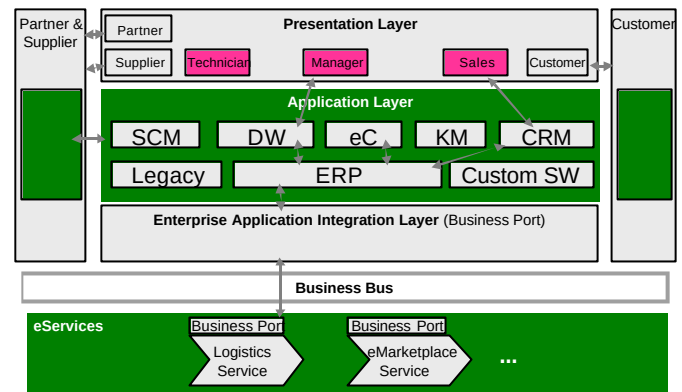
To depict that in a *result view* on a strategic application architecture, we have identified three important layers for Business Networking in projects with partners:

Firstly, the presentation layer which provides customized views on possible transactions for different employee roles. It also includes profiles for customers and business partners.

Secondly, the application layer which provides a structural and process view on its components, including object or data flow between components. eServices are simultaneously integrated. They are considered as outsourced applications or services. Examples for such services range from data services like the DUNs number for electronic marketplaces and knowledge services. They are integrated via agreed upon standards (Business Bus) which are implemented via Business Ports in the EAI layer.

This third layer defines the ports to interface with other applications or with customers and business partners and provides matching, messaging. It also includes data or object storage components (e.g. central product master data servers). Deutsche Telekom uses such servers to push the standardization of customizing and data. Our proposal for the result view on architectures is depicted in Figure 2.

Figure 2. Towards a Strategic BN Architecture



This application architecture is based on stable and standards based database and networking architectures. Tools to build a flexible middleware for Business Ports are available. EServices to deliver that functionality are under development or already existing (cf. Commercequest's e-Adapters).

Two further elements are necessary in order to reduce the complexity to make it manageable in complex environments like that of Deutsche Telekom and when moving towards lower levels of abstraction:

Firstly, the application architecture layer must be divided into sub-layers. This is done by a matching process that links the semantics of the business processes to IS application components.

Secondly, different views on the architecture are required. Next to the interaction view that includes organizational units and the static interaction between components there should be a process view to depict the dynamics of business processes which includes the required objects that reside on specific servers (e.g. master data or customizing templates server). In view of space and confidentiality restrictions, these more detailed views cannot be presented here.

Activity View

From the *activity view* we identified the need for an economic evaluation of the application architecture, established early warning mechanisms for technological developments as well as proven methods for both developing and enhancing strategic application architectures. The same holds true for implementing operative application software projects but on a more detailed and problem specific level. Examples for the former are modified strategic information systems planning processes and for the latter inter-Business Networking method, electronic Business Networking method (Pohland, 2000) or SAP's Global ASAP.

For the knowledge management component Deutsche Telekom uses a software system to manage the project portfolio and to harmonize terms and data. On the operative part this view also includes rules and

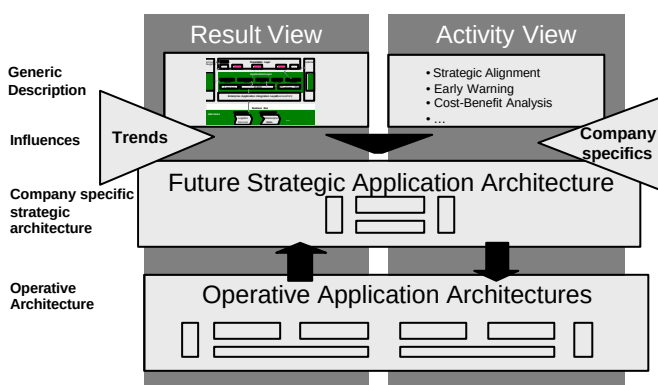
guidelines (e.g. master data standards to be used) and organizational issues and responsibilities. News about standards, research projects, templates and patterns developed have to be included and fully embedded into organizational routines like incentive systems in order to be accepted. Operative application architectures are embedded within integration areas of organization units (Österle *et al.*, 1993) but should have close logical links to the strategic application architecture.

Conclusions and Benefits of an eBusiness architecture

We have proposed an architecture for eBusiness that extends ERP-centric architectures to address the new challenges of Business Networking. This is achieved by adding new structural components like eServices, application components focusing on inter-organizational task like eC, SCM and CRM applications as well as EAI tools on the middleware layer and indicated how they interact with the ERP systems in place. Furthermore the Business Bus stresses the importance of the use of standards for the interchange of information between components and layers of the architecture. The clear cost-benefit focus of the architectural planning effort should lead to a higher management commitment and support. The architecture could serve as a vehicle to balance the efficiency needs of IT with the business support desires of the business side.

The overall view on application architectures for Business Networking is depicted in figure 3. It combines result and activity view of the architecture and is shaped by the trends and company specifics, such as networkability.

Figure 3. Application Architecture Overview



From an activity perspective, mechanisms to evaluate the value of an eBusiness architecture have been proposed as well as early warning mechanisms, the use of methods for strategic architecture planning and implementation of projects. The flexibility paradox of (Rollier, 1998, p. 539) *that implementing an effective infrastructure requires careful planning, and planning constraints flexibility*, is partially overcome by using components and eServices at the application level.

These considerations are necessary in order to prevent companies rushing into Business Networking initiatives that produce excessive architectural complexity and that limit the future viability of companies in the Internet Age - where high skills and competencies in IS seem to become ever more business critical. It should enable the business side to communicate with the IT side and build know-how and leverage resources to stay competitive. Future research will focus on the wider application and validation of the proposed application architecture from the result and activity perspective.

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