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PROSPECTS OF USING SERVICE ORIENTED ARCHITECTURE IN INTERORGANIZATIONAL INTEGRATION

Abstract: Service oriented architecture (SOA) is usually considered to be a method of integrating IT systems within an organization and stress is placed on advantages resulting from faster and cheaper adopting of applications to the business needs of an organization. Instead, the article presents the discussion of prospects of using SOA in the integration of IT systems of separate organizations. The author argues that implementing SOA in the interorganizational integration would create a new model of integration which can be named interorganizational services bus, and integrating both internal and external systems using the same architectural approach can generate large savings in information systems management.

1. Introduction

A term integration refers to many aspects of computer science and information systems. Horizontal integration enables cooperation of subsystems operating on the same functional level. Five levels of the horizontal integration can be distinguished [Polak 2004, p. 421]:

- information technology level,
- data integration level,
- operational processes level,
- decision processes level,
- information level.

Some publications mention also a level of application integration, however, it is omitted in this paper because it only represents the technical aspects of data and process integration.

The information technology integration allows to exchange any kind of files or messages between computers. It is a common feature in private, interorganizational and public computer networks.

The data integration means the possibility of automatic data passing between information systems. In organizational systems this level of integration is supported by shared access to databases by different applications. In interorganizational systems it is supported by the mechanisms of electronic data interchange (EDI).

The operational process integration means coordination and optimization of activities. It is a common feature of integrated information systems, for example ERP (Enterprise Resource Planning) systems. This level is a target of many approaches to interorganizational integration, for example supply chain management (SCM) or partner relationship management (PRM). The operational process integration is addressed below in the article as process integration, following common usage of this expression in literature.

The decision process and information integration refers to a wide range of complex activities involving human cognition and decision making. However those levels of integration are not discussed in the paper.

Despite the fact that the process integration within organization reached high level of maturity with integrated information systems being an essential solution for many types of organizations, new solution and technologies are constantly developed. Latest achievements include service oriented architecture (SOA). Instead of building large integrated systems it integrates independent application without changing their inside. Similar approach is natural in integration of systems belonging to different organizations. Therefore this article investigates prospects of using service oriented architecture in the interorganizational integration.

2. Service oriented architecture

Service oriented architecture is an information systems architectural style based on business processes, organized as services [Newcomer,Lomow 2005]. It enables the creation of applications that are built by combining loosely coupled and interoperable services in order to allow different applications to exchange data and participate in business processes. These services can be distributed over a network and can be combined and reused to create business applications [Erl 2005].

One of the most important features of SOA is clear separation of a business layer and an applications (or services) layer. It leads to two main advantages of this architecture, important from the process integration point of view:

- swift implementation and reorganization of business processes based on existing services,
- easy integration of systems based on different technologies.

However currently popularization of SOA is slowed by the presence of existing mature integrated systems in majority of medium and large enterprises. Companies are not willing to take risk of changing entire architecture of theirs systems. Therefore in many cases SOA approach is used only to integrate some side applications previously poorly integrated with mainline information system.

3. Interorganizational integration of information systems

The concept of information systems linking independent organizations was first discussed in 1960s [Kaufman 1966]. However the expression “interorganizational information system” was used for the first time nearly 20 years later [Barret, Konsynski 1982]. At that time large, successful interorganizational systems like SWIFT or SABRE were already in operation. Initially interorganizational information systems were defined as systems built and used by two or more independent organizations. In that approach stress was placed on functionality and participation of independent parties but not on integration with information systems of respective organizations. Despite that, necessity to develop telecommunication standards and data exchange formats to expand popularity of interorganizational systems was obvious.

In 1960s, changes in the world economy caused an increase of importance of business links between organizations. Business partners were considered an element of a chain creating value for customers. Attention was focused on integration of information systems with outer environment. The interorganizational information systems were defined at that time as systems utilizing computer networks, reaching behind borders of enterprises [Konsynski 1993]. Also today this type of integration is considered to be one of the most important directions for enterprise development. Such management methods like SCM or CRM (Customer Relationship Management) are extensively discussed in theoretical literature and in case studies. This trend is represented in a contemporary definition of the interorganizational information systems as systems automating information flows between an organization and its customers, partners, suppliers and relevant authorities.

This phenomenon also includes a concept of X-engineering [Champy 2002]. Based on business process reengineering (BPR), which was aimed on comprehensive internal processes, X-engineering expands reorganization and integration on other organizations. Enterprises can make a profit not only from improving their own processes but also from ones of their partners. Therefore X-engineering requires participation and close cooperation of all involved parties. Nevertheless both business process reengineering and X-engineering are based on the utilization of information technology. However the concept never gained popularity as it was stamped with relationship to BPR which had been already largely criticized and rejected at that time.

Currently network structures are gaining importance in the interorganizational relations. Companies can play a role of an information hub. They do not carry out any production activities, but their competence lies in finding and knowing partners' expertise and linking together their activities in value chain (see e.g. [Hagel 2002]). Effectiveness of such business model is based on close integration of business processes leading to the implementation of a concept of virtual organization [Carter 2001; Kisielnicki 2001].

Based on types of relations between companies and tightness of integration four basic models of the interorganizational information systems integration can be distinguished [Kamiński et al. 2005]:

- corporate system,
- supply chain coordination system,
- standalone information systems integration,
- integration with information node.

The term corporate systems relates mainly to integrated information systems (e.g. ERP systems) applied into its subsidiaries. These subsidiaries can be a part of one supply chain or can carry independent activities. Although subsidiaries can be independent companies from a legal point of view, they are a subject to one managerial strategy. In this case usually centralized systems are implemented, however distributed application can also be used, provided that data can be consolidated for managerial purposes.

The model of supply chain coordination system refers to integrated systems including B2B (business-to-business) functionality, for example SCM, CRM. This model is usually built around a leader of a supply chain. Its business partners are independent companies, however they have weaker position and therefore are forced to follow standards imposed by the leader.

The model of standalone information systems integration refers to integration of independent and different systems used by partners. However in this case none of the parties can impose its solution on other partners. It usually requires implementing systems dedicated to automation of relations with partners.

In the model of integration with information node partners do not communicate directly but through independent party serving as a main node of an information system. Electronic markets follow this model. They not only support data exchange but are also able to search for suitable partners and to perform other value added services. The main node usually imposes data exchange standards and other procedures.

4. Standards in interorganizational integration

The information technology level of integration allows to exchange any kind of messages or files, e.g. e-mails, data files etc, and is common feature in the Internet. However effective integration of information systems requires achieving the data level integration. The data integration requires agreement on a structure of exchanged documents. Local systems must contain interfaces enabling data conversion between formats of exchanged documents and locally used formats, which are usually a relational database file. In case of integration between only two organizations they can develop their own interface dedicated for formats used in both companies. However in case of more participants it would not be an economic solution.

In order to utilize data exchange on a large scale, common standards of EDI (Electronic Data Interchange) need to be accepted. In 1970s a large number of na-

tional (e.g. ANSI X.12 in the United States and TRADACOMS in the United Kingdom) and industrial standards (e.g. ODETTE in automotive industry, SWIFT in banking) were created. Gradually the biggest share were won by EDIFACT standard developed by UN/EDIFACT Working Group and accepted by International Organization for Standardization (ISO 9735 standard).

In the middle of 1990s EDIFACT dominated electronic data interchange. The most important interorganizational systems were using that standard, for example TradeNet in Singapore, Elixir in Poland. Apart from EDIFACT global significance reached only a couple of industry standards (e.g. SWIFT) and one national (ANSI X.12). Organizations responsible for development and maintenance of other standards enounced migration to EDIFACT. That situation continued as long as the main beneficiaries of interorganizational information systems were large companies especially in supply chain coordination system model.

The EDI standards popular in 1990s did not satisfy the needs of middle and small enterprises, mainly due to high cost of implementation and integration with organizational information systems. That situation caused development of new initiatives, for example Lite-EDI or Open Buying on Internet (OBI). The first proposed reduction of EDIFACT standard complexity. An OBI consortium developed a new schema for low cost transactions, however, formats of documents were related not to EDIFACT but to ANSI X.12.

Rapid development of the Internet and electronic business called for new solutions. The simplest and most popular is data inputting in electronic forms. However, it requires typing in and therefore is in practice limited to business-to-customer relations and is no alternative for traditional EDI. New concept came from XML (eXtensible Markup Language). At the beginning XML was ignored by large corporations which had made significant investments in traditional EDI systems. However in the end of 20th century large projects on using XML for business data exchange were already on the way. They are based on three main concepts:

- XML functional equivalents of EDIFACT and ANSI X.12 messages,
- adding in XML documents reference tags identifying functionality of data known from already accepted standards,
- new XML-based standard.

The last concept proved to be the most effective. It allowed to create quickly and easily new standards and consequently new application fields for electronic data exchange. However such approach leads to emergence of large number of standards, difficult to manage for organizations involved in various and complex relation with partners, clients or authorities.

Attempts to solve that problem led to the development of more complex methods covering not only data definition but also schemes dealing with processes accompanying data exchange. Those solutions can be classified into three groups:

- universal integration platforms,
- general framework standards,

- industrial standards.

The most popular example of universal integration platform is MS BizTalk. It is implemented by individual companies. The platform allows to define data transformation specifications as well as information flow channels. It supports XML and traditional EDI standards. MS BizTalk also contains interfaces to the most popular standard business applications, e.g. SAP ERP [Kamiński 2005].

The purpose of general framework standards is to provide universal architecture covering all aspect of electronic data interchange. The leading solution in this field, ebXML (electronic business eXtensible Markup Language) separates clearly two perspectives [Kotok, Webber 2002]:

- business perspective,
- technical perspective.

Business perspective does not define business processes and messages, but offers a mechanism enabling partners to harmonize processes and data exchange procedures. Nevertheless ebXML documentation includes a catalogue of hundreds business processes which however are only references to processes defined in other standards, e.g. RosettaNet, EDIFACT (Electronic Data Interchange For Administration, Commerce, and Transport), OAG (Official Airline Guide), AIAG (Automotive Industry Action Group) [*Business Process...* 2001].

Industrial standards provide detailed definition of reference public processes, such as Partner Interface Processes in RosettaNet (electronic industry) standard, as well as procedures, documents and technical details [Badakhchani 2004]. The main setback of industrial standards is their limitation to specific industry or type of activity.

5. SOA in interorganizational integration

Global business environment is very dynamic. It requires from the enterprises to adapt quickly to clients' demands and business occasions. Using electronic communication companies can swiftly build networks of partners to respond to the demands. However this kind of cooperation is mostly based on the data integration directly by electronic data exchange or through B2B services. Process level cooperation is limited to typical well defined processes like reference public processes defined as a part of industrial standards. The development of interorganizational systems has proven to be a complex and expensive application of information technology [Chiu, Chen 2005]. Moreover, in order to achieve competitive advantage it is sometimes necessary to implement new business processes. However it can be impeded by too slow adoption of information systems to the changes in business needs. That problem was already addressed in organizational systems by SOA which allows to implement efficiently new processes.

Hitherto interorganizational integration was based on different standards and models than internal integration. But how technically close is internal and external

integration shows occasional usage of the same tools in both areas. For example a platform originally designed for external integration – MS BizTalk is currently offered as a hub in internal integration [Kamiński et al. 2005]. On the other hand Web services were already considered as useful tool for integrating heterogeneous systems not only within organization but also between partners in the supply chain [Pavlou, Karakostas 2005].

The foregoing examples lead to a hypothesis that service oriented architecture can be used as a basis for developing interorganizational systems. SOA would allow easy implementation of the process integration. Using SOA in the integration model of the supply chain coordination system was already proposed by Cherbakov and others [Cherbakov et al. 2005]. However their model is based on close, well establish relations involving long time cooperating partners. Full implementation of the service oriented architecture should allow to integrate information systems with new business partners in adoption of newly created business processes. Services provided by applications of different companies can be used to establish a process the very same way there are used in the integration inside organizations.

Consequently, as the same architecture and technology can be used in the internal and external systems integration, it increases potential positive effects of SOA implementation by:

- improving business process support,
- simplifying IT management.

Using service oriented architecture in the interorganizational integration is more difficult because of managerial and organizational reasons then technical. It requires from organizations interested in participating in partnerships to publish a catalog of public services offered by their computer applications. Such approach requires implementing high security of message exchange.

6. Summary

Service oriented architecture is an advanced but flexible method of integrating applications. So far in practice its implementations are mostly limited to large companies mainly in finance field and state administration.

The process oriented integration in interorganizational systems naturally leads to adopting information systems building technologies supporting this approach. Independent organizations use different systems so naturally SOA paradigm address this area.

Implementing SOA in the interorganizational integration would create a new model of the interorganizational information systems integration which can be named interorganizational services bus. Services could be easily reused to dynamically establish and change interorganizational business processes. Integrating both internal and external systems using the same architectural approach can generate large savings in information systems management.

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