FEDERATED DATABASE SYSTEMS IN SUPPLY CHAIN MANAGEMENT

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Abstract

The article shows the possible ways of use of federated database technologies in data management in the logistic chains of companies. The architectures and components of software for creating the federated systems and some suggestions for the architecture of data management information systems for companies are presented in the text. The mentioned solution stands a proposal to resolve the difficult problem of cooperation between the computer information systems in companies, which refers to making the data of company available to the external users and managing data in the logistic chain. The authors included an overall review of commercial software, which can be used to build the software of data managing in the chains of cooperating companies.

Key words: soft computing, supply chain management, data bases, federated database systems, middle software

1 Introduction

Contemporary competitive global market economy demands a lot from companies. Particularly, it concerns the spheres of activity where speed and reliability of action are the most important factors and where transfer of information and decision-making support are decisive.Despite the rapid progress of software and computerization of the most important information processes in the companies, no effective means of managing a business has been created. Simultaneously, the wider range of functionality of information systems there is introduced, the more complicated it is to operate them. New problems arose, having an effect on exploitation and making a good use of systems. the complex, integrated data management and the safety of computer systems are of vital importance. While watching the very rapid growth of streams documents being processed and information technologies, it is easily noticeable that the formula of systems of MRP/ERP class, that has been do-

minant so far, is not able to meet the expectations of flexible process management. Undertaken modernization activities of the software in companies consist in implementation of subsequent modules and supported functions to former architecture of integrated computing system in a particular company. Even the high-tech solutions, which have been used in the ERP II - class systems, such as Electronic Data Interchange (EDI), Workflow or Business Intelligence modules, stand only a partial solution to the general problem of business management [Paszkowski, 2006].

Increasing competition makes the companies to ceaselessly improve the performance effectiveness, which is usually achieved by increasing the cooperation between the producers and the suppliers and informatization of processes. It is striven to reduce the cost per unit or optimize the economic results. The very basic method is the division of production tasks between the cooperators. For the sake of realization of such enterprises, some suitably effective structures of logistic chains of cooperating companies and computers systems that support cooperation are indispensable.

The traditional SCM (Supply Chain Management) systems that have been used so far do not solve all the problems fully. Especially, it concerns the provision of flexibility or making closer cooperation easier, directly on the level of integration of that computing systems [Paszkowski and others, 2012].

On account of that, it is inevitable to look for software solutions which would provide effective ways of making data available and exchanging it, as well as employing new effective methods of optimization and business decision making.

The main problem that appears when it comes to discuss designing enterprise computing which is to manage the logistic chains is the data exchange in the whole chain of companies.

The needed solution, besides providing suitable and reliable data to a specific place in specific time, is to provide necessary level of information systems safety, including respect of confidentiality and integrity of data [Lockhart, 2004]. The prerequisite of that system feasibility is the provision of needed protection of each company businesses and strong protection from the possibilities of likely abuse of direct access to date while downloading it or later on. On the one hand, the system is to provide a direct and rapid access to the data needed to manage business tasks but on the other hand, it is to ration the data we need to process, in order to reduce not authorized access and criminal use to minimum. It seems that the safest solution is use certificated software which task is to download data essential for computational procedures, along with access monitoring and review of conformity to the employed processes of management. By design, it would eliminate human direct access to the source data, especially those belonging to the other subjects (companies, departments and processes), monitoring the authority of each user in terms of access to the resources. In the article below, there is a review of se-

lected notions and problems concerning the technology of data management in computer systems in cooperating companies presented.

2 Characteristics of the actual state of informatization of cooperation between companies in chains of supplies and distribution

2.1 Assessment of the state of information technology of supply chains

At present, the basic architecture of systems of supplies relies on the basis of network that links companies, connected in terms of supplier - customer relations. In literature, there exist such terms as Supply Chain Management or Demand and Supply Chain Management System. Different ways and rules of creating the chains [Pacana, Perłowski, 2010] and traditionally they rely on the existent relations between the business partners or their information systems. So far, in the systems managing chains of supplies - SCM (Supply Chain Management), the exchange of information between suppliers, producers and distributors has been carried by means of teleinformatics technologies. In the very beginning, the EDI system were the only ones in use [Zieliński, 2007], and after that the communication services of the Internet started to be used wider and wider [Paszkowski, 2009, p. 93-97].

Supply Chain Management in the very basic architecture consists of two management sub-systems: SCP - Supply Chain Panning and SCE - Supply Chain Execution. Supply Chain Planning stands a set of information technology tools which offer, on the basis of historical transaction data of the company, creating the forecast of the demand for products and making production plans [Paszkowski, 2006]. The system might be used for the purposes of operational management (current activities) or for working out the long-term strategies (expansion of the manufacturing forces, investments, working out quarter annual business plans).

Supply Chain Execution uses the information generated in SCP for the purposes of production and operations management, storing goods, transport, assembly of components and delivery completion.

The mentioned sub-system communicates with SCP and the order management systems of each company in order to set the scale of production, taking into consideration time and financal restrictions as well as updating the final production plan. When analyzing the detailed architectural solutions in communication systems of business chains [Paszkowski, 2009], it might be stated that the key factor in flexible and effective information exchange system building between companies is the system integrating their data bases. The complexity and multidimensionality of the problem of connecting data bases issue many challenges to the designers of the system.

The biggest problem is the heterogeneity of computer information systems and software environments of data bases that support individual companies. In the process of connecting different systems, federated database technology systems come in handy [Sheth, Larson, 1990], [Subieta, 2000], [Rutledge, Medicke, 2001]. There is a very big chance of using the above-mentioned technology in logistic chains of companies [Paszkowski, 2012, p.1].

2.2 Techniques of Database Integration and Federated Database

The most frequent and the easiest method of integrating many databases is creating double connections between all the databases which are to communicate with one another. Such connections allow one database an enquiry to another database, formulated with the use of notations of the language that is supported by the target database. While integrating the access to databases their heterogeneity stands a problem. It is so due to the fact that the bases may differ in their functionality, form of data representation (form of metadata) and very often they use different dialects of SQL language. Because of that, the access from one database to the other is to be created by means of the software assigned to these databases. That software is called "a gateway". Its tasks include [Wrangler 2005]:
- transforming the structures and types of data used in a particular database into the structures of the target base,
- providing the mechanism for running transactions comprising the databases taking part in them,
- transforming the dialects of SQL used in the input database into the version used by the output database.

In software used for the gates special standards are employed which define the methods of access to the databases. In the employed systems of databases standards are implemented in the forms of drivers, which stand the Application Programming Interface (API) - the collection of procedures and functions that carry out data support. In the databases two types of drivers developed by Microsoft are used, namely:
- ODBC1 (Open Database Connectivity) - for accessing database management systems using SQL,
- OLE DB (Object Linking and Embedding Data Base) [http://en.wikipedia.org/wiki/OLE_DB]

API enables access to any data source. The producers of database software provide the needed drivers in installation packages or distribute them on their web portals.

Federated database system is able to link systems of databases inside and outside the corporations, and other federation systems that due to their gate-

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[1] DBC was originally developed by Microsoft during the early 1990s, source: wikipedia.

ways are seen just as a database of a virtual company. When it comes to the logistic chain of companies, its federated database would consist of gateways which are bridges connected to the systems of databases of particular companies and, hypothetically, to the system of federated database of cooperating supplies of suppliers or consumers chain.

The picture below depicts an example of the architecture of federated database for the chain of companies.
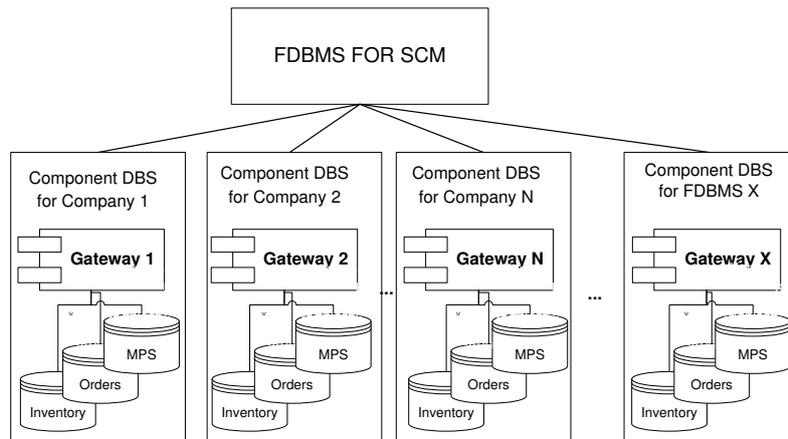

Figure 1. Federated Database Systems and its components

Own version according to [Sheth, Larson, 1990, p.185] and [Subieta, 2000]

The role of the System of Managing the Federated Database Systems may be fulfilled by a particular system of a database which has adequate technologies that enable to build and service of gateways and adequate resources and efficiency. In each case it is inevitable to design the information system that runs federated databases system of the chain. Such a system is to include a library of gateways software supporting particular types of database systems, used in individual companies, including databases used for Planning, Supplies, Sales, Distribution, Means of production and Investment Projects. That system would consist of two levels: the central level of Supply Chain Management System and the level of companies. That level would comprise autonomically working computer information systems of each individual companies linked by the processes of data exchange and coordination of logistic processes [Paszkowski, 2012, p. 2].

The examples of rules of data exchange in the two-level federal architecture of database of the system of Supplies Chain Management is shown in the picture 2.
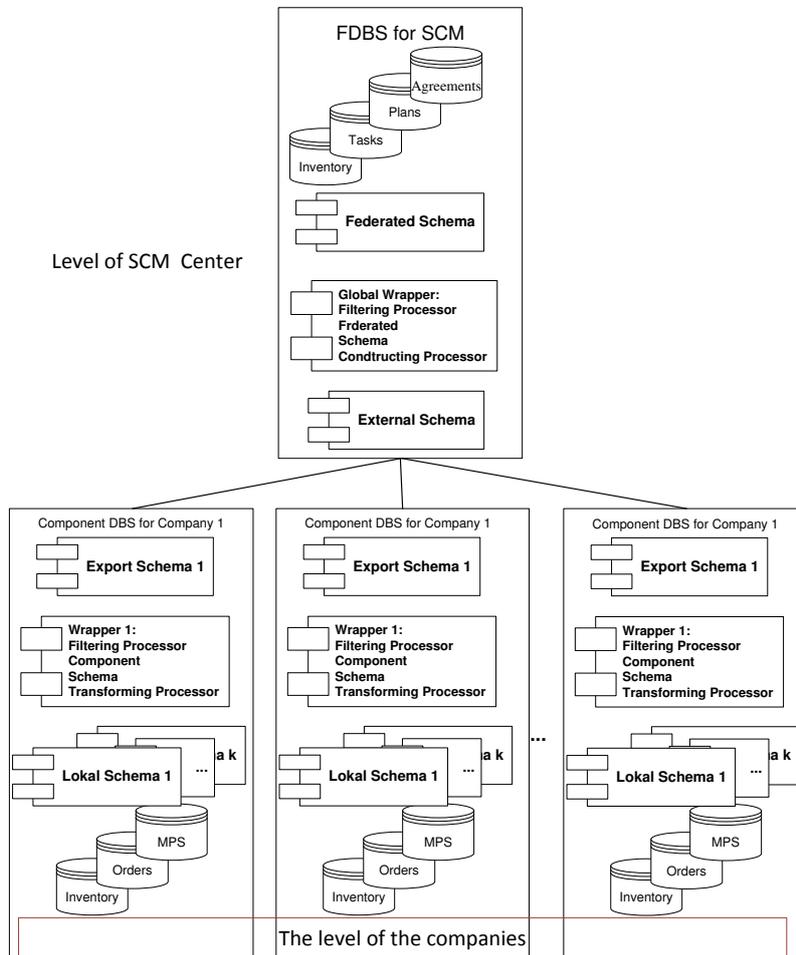
Figure 2. The architecture of Federated Database Systems in Supplies Chain Management

Own version according to [Sheth, Larson, 1990, p, 210]

In order to build the federated Database it is inevitable to design and implement a software that provides data exchange between individual applications and databases federated with them. That software, because of the need for flexibility of Supply Chain construction, should have a component structure that responds to elements of each process in the system of data management in the Supply Chain.

3   Components of the Federated Database

Picture number 3 shows an example of Federated Database architecture with the implementation of the Middle Software.
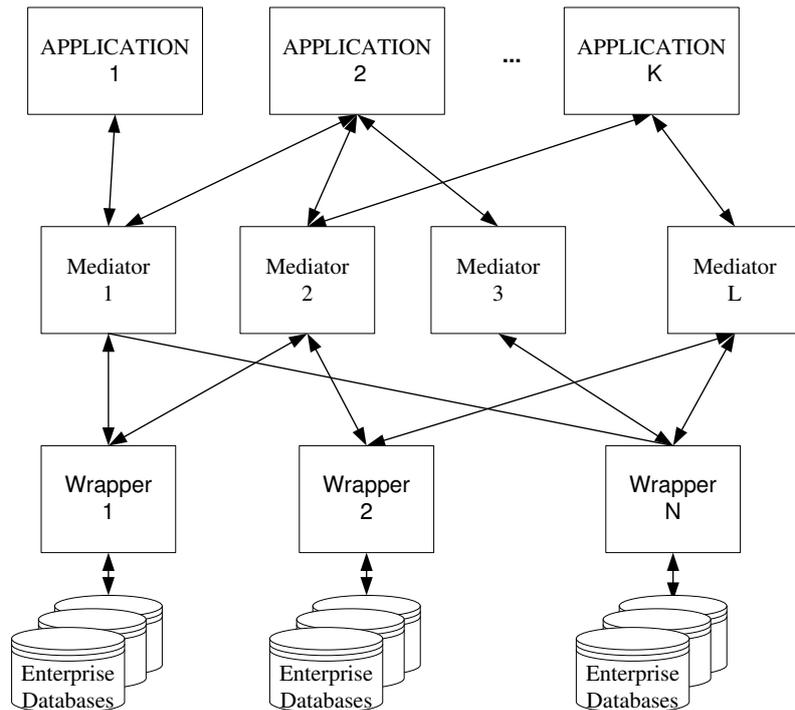

Figure 3. A diagram of architecture of the computer information system of companies chain with the use of the Federated Database.

Own version according to [Rutkowski, 2007, p.50]

In the literature there are a lot of terms for that type of software. Two of them are employed the most frequently. These are: Mediators and Translators (Wrappers) [Subieta, 2000], [Wrembel, 2005].

Mediators

Mediator is a software which depending on the needs of applications provides making a choice between the information sources and transformation of the obtained information in order to make it possible to process. Mediators

often transforms data to one model, changing notations or even terms, for example, they introduce the same units of mass, measurement or they fill in the missing data.[Subieta 2000]. In wholesale software companies mediators, thanks to the implantation in logic some elements of the Artificial Intelligence (AI), provide processing of various sources of information.

Wrappers (Translators)

Wrappers adjusts the local API of a given server to the canonical model and common enquiry language. In this way the heterogeneous data that are placed on different servers are adjusted to the processing with use of the enquiry language. The wrapper makes a simple copy of the data structures without changing their notional scheme. The module of enquiries processing installed on the server makes it possible to difine the perspective. used by the translators. In the simplest case, the translator in the relational database might take the form of perspective, especially, when there is an accordance between data schemata and dialects of databases language.

The perspective on a particular database server enables to search for necessary data and adjusts local databases structures to the scheme f federated database. It does not cause any perturbations in the local applications of the company. At most, the conditions of data integrity must be preserved. In literature, there can be often found some differences in definitions of Translator (Wrapper), Mediator and "a perspective", which are often blurred. In the work by [Subieta, 2004], specific standards for defining those notions are suggested.

For building the computer information system of Supply Chain, it is necessary to create a library of Mediators and Translators [Wrappers] for all applications and used databases in Federated Database SCM.

Each enterprise which joins the Supply Chain could be given a dedicated package of Mediators and Translators, within the supply actions, which are parametrized according to the owned architecture of systems of databases and structure of applications of data reprezentations chain which are predicted to be used. The problem with the software for that components often depends on the use of tools for the creation of Federated Database.With respect to the rules of supply chain building [Paszkowski, 2012, p.2] the software must use the software available on the market, mainly of COTS[1] type, which after parametrization can be used for systems of supply chain management.

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[1] Commercial Off-The-Shelf

4   Tools for Building a Federated Database

The most advanced tools for creating Federated Database can be found in commercial packages of the biggest producers of databases systems. There can be mentioned [Wrembel, 2005]:
- Transparent Gateways by Oracle. It provides access and exchange of data among most of the commercial systems of relational databases, for example IBM, Sybase, Microsoft.
- EnterpriseConnect Data Access by Sybase. It provides access to the Microsoft SQL Server and IBM DB2 databases.
- Enterprise Access by Ingress. It gives Ingness applications the access to the data of other relation systems of databases, for example Sybase, Microsofr SQL Server, CA-Datacom, Oracle, Informix, CA-IDMS, DB2, Rdb, Allbase SQL and to the non-relational databases, such as IMS, VSAM, CICS/VSAM, RMS.
- IBM DataJoiner by IBM. It provides reading and transforming of data into the format of DB2 base from the ralational and non-relational sources. The package called Data Propagator Relational in cooperation with Data Joiner makes it possible to reply either synchronically or asynchronically between databases by such producers as Oracle, Sybase. Microsoft, Informix.
- InfoSphere Federation Server (previously WebSphere Federation Server). Within the standard licence DB2 one can federate data with other DB2 and Informix databases [Drzymała, Welfle, 2011].

The tools enumerated above help to implement software by providing standard components for creation of federated database.To create the computer information system of supply chain different components, related to the data processing, are used. The software supporting the creation of data access and managing systems is very useful.

 Sap NetWeaver is a tool that helps to build the platform for multiprofile data management, access to applications and personalization of the users authority. One of the possible tools is the central authorisation management. The other one that helps to build the system of safe access to data is Coreid Federation software by Oracle.

Oracle COREid Federation is the autonomous federation server.It provides a safe connection between the users cooperating in the supply chain or on the platform of company portal or extranet. The platform that has built with use of the COREid Federation software gives safe common use of the data that is made available by individual company.

5   Conclusions

The crucial problem of cooperation between computer information systems of different companies, because of making some business data accessible outside the company and managing data in the supply chain, can be resolved by means of Federated Database System. That technology can provide a very high level of flexibility of joining and separating the companies and their databases, irrespective of their architecture and database systems which are in use. Simultaneously, thanks to the easy to implement and precise methods of downloading and gaining access to data, the unauthorized access to data can be eliminated or reduced to minimum. The system helps to automatize the processes of making available, sending and processing data. It also enables to post the rules of access to data, the level of authority to use data directly in the software of local bases and Federated Database System software.The necessary linking software such as gateways, in the form of individual components - wrappers, mediators and perspectives, can be provided with the software for basic, most common database systems and processes of supply chain and, what is next, it may be made available in the form of a library of parametrized standards (such as COTS). They would be installed in the system when the company was separated from the chain. For the computer information systems which relay on the dedicated software (written to order), non-compatible with the existing systems of the supply chain, the necessary integration components used for the creation of databases would be created on demand and they would stand the extension of the database software for a given system. The use of the Federated Database stands the extension of architecture in terms of one additional level of database (Middle Software type for databases). The used solution provides access to data at the level of application with the option of automatizing those processes and eliminating the direct access to data by the user. The use of federated database architecture is a great simplification to designing the computer information systems of supply chains and logistic chains functioning in companies in times of competition and constant changes [Paszkowski and others, 2012].

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