Business Data Management for Business-to-Business Electronic Commerce

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ABSTRACT

Business-to-business electronic commerce (B2B EC) opens up new possibilities of trade. For example, new business partners from around the globe can be found, their offers can be compared, even complex negotiations can be conducted electronically, and a contract can be drawn up and fulfilled via an electronic marketplace. However, a sophisticated data management is required to provide such factilities. In this paper, the results of a multi-national project on creating a business-to-business electronic marketplace for small and medium-sized enterprises are presented. Tools for information discovery, protocol-based negotiations, and monitored contract enactment are provided and based on a business data repository. The repository integrates heterogeneous business data with business communication. Specific problems such as multi-linguality, data ownership, and traceability of contracts and related negotiations are addressed and it will be shown that the present approach provides efficient business data management for B2B EC.

1. INTRODUCTION

Business-to-business applications have become increasingly important in recent times. The area of Business-to-Business Electronic Commerce (B2B EC) is expected to grow dramatically in coming years [10]. In that area, business partners from many different domains, from different countries or even continents interact and cooperate in order to get the best deals, to find new allies, to exchange expert opinions etc.

One form of applications in B2B EC are electronic marketplaces. These types of marketplaces provide a forum for bringing together buyers and sellers with the aim of enabling and supporting trade. In recent years we have seen different implementations of the concept of an e-marketplace [13, 14]. For example, some approaches (such as [www.baunetz.de]) concentrate on providing facilities for finding new partners. Interactions leading to a business deal and fulfilling the related contract are not supported and thus need to take place outside the marketplace. Other approaches automate the interactions (e.g. [www.chemunity.com]). No search is possible but a request is directly sent to approved suppliers in an auction-like manner.

In general, we can abstract from the different implementations onto a general model of a business transaction [14]. Starting with a *search* for new business partners, successful *negotiations* lead to a contract which needs to be *fulfilled*. Such a three-phase model (search, negotiate, fulfil) has been used in many facets [13].

In this paper we will present an approach to efficient information management in the different phases of a B2B EC process which is based on our experiences in the European MEMO project (MEdiating and MOnitoring Electronic Commerce, [1]). The goal of the MEMO project was to facilitate B2B EC for small and medium-sized enterprises (SMEs) by providing a broker system that acts as a mediator and monitor. Round tables have been set up in three different countries for interaction between companies as future users and the technology partners as system developers. The results have shown that existing system solutions are insufficient to solve problems present in the area of B2B EC, especially for SMEs [12].

It has to be mentioned that XML alone is not the solution for the problems in B2B EC. XML and related standards (e.g., XML Schema, XQuery) are technologies which allow the easy development of applications that exchange data over the internet. However, XML simplifies only the task of syntactically understanding the data and not the semantic interpretation of the data. There are several efforts in different industry domains (and also domain-independent) to standardise the documents and messages for B2B EC based on XML. One example of a domain-independent standardisation effort is ebXML [2] which aims at developing a domain- and application-independent standard for exchanging business data. One problem of ebXML is that it provides only a high-level specification of documents and messages (e.g. only tags and terminology is defined) but does not define the structure of business documents. Such structure has to be defined by the business partners or by the industry branch. Such an approach does not provide many benefits in contrast to the EDIFACT standard which has been used for several years for B2B EC since the standards will still be set by the big business partners. Furthermore, the co-operation between SMEs is not simplified, as they have to support different variants of the ebXML standard.

The paper is structured as follows. In section 2 we will first discuss the requirements for a business data management system. Solutions for the efficient management of business data in the three phases will be sketched. Section 3 discusses the problem of organising business data in such a way that sophisticated semantic search mechanisms are possible. In section 4 we will present an approach to information management for business communication that includes an integrated approach for the management of documents and messages. Such an enhanced communication system can be used for the negotiation support in EC and for the communication aspects of the fulfilment phase. The reader should bear in mind that negotiations are conducted between human agents and that the goal is to *support* such negotiations rather than to *automate* them. The paper will not deal with issues related to security such as secure data storage, secure payment, etc. Finally, section 5 will conclude our paper.

2. REQUIREMENTS FOR BUSINESS DATA MANAGEMENT

During a commerce process, the involved participants usually go through three phases [14]. Firstly, a party looks for potential business partners. A buyer wants to find relevant suppliers of the product (s)he is looking for; a seller might want to find potential customers for the products (s)he can supply. After locating potential (new) partners, the second step is to come to an agreement that

is acceptable to all partners. Partners might bargain about the price, might find a compromise about the delivery dates, might negotiate about quality aspects of the products etc. The aim is to finalise a contract that specifies the business deal. Therefore, this second phase concerns negotiation about details of the agreement. If the negotiation is successful then a business deal is struck and the outcome is a contract which will then have to be processed by the partners in the third phase, e.g. concerning logistics, payment etc. The general model that can be extracted from the above observations is one of three phases, namely search-negotiate-fulfil.

In each of these phases, efficient business data management is required. The search phase deals with the problem of how a company can find relevant information such as product and company profiles. An electronic marketplace should provide search mechanisms that go beyond the standard keyword based search techniques. An electronic marketplace for a specific industry sector can use an ontology of concepts of this sector to classify products and related information. Such ontologies are already available in various sectors as they are a prerequisite for standardisation and international exchange of products. Another problem in the search phase that arises especially in the European context are multiple languages. A similar problem is the use of different terminologies within one industry sector. For example, an architect uses a different terminology than a window manufacturer. Therefore, the system needs to support different languages as well as different terminologies.

The ontologies provide the context for the information which will be searched by the users of the electronic marketplace. In addition, the member companies of the marketplace have to provide information about their company and their products. This information has to be organised according to the structure defined by the ontology. To achieve this, the data has to be extracted from or provided by external information sources such as product databases of companies or company databases of umbrella organisations. In the context of the MEMO project, we have noticed that companies consider product and company information as an important and valuable resource. Thus, the companies want to retain full control over their data. Therefore, existing data integration techniques have to be extended to satisfy the needs of the companies.

The negotiation phase requires the management of messages and documents. We consider here more complex negotiation protocols than are usually supported in electronic marketplaces such as auctions or electronic catalogues. Both auctions and electronic catalogues have successfully been used in the area of business-to-consumer EC. However, B2B EC requires often more complex negotiation protocols as the companies are usually interested in building long-term relationships with a supplier or customer (e.g. negotiations concerning frame contracts have to be conducted). Highly interactive exchanges that occur in traditional commerce can be transferred to electronic commerce where, on the one hand, the potential of information technology can be exploited to offer new functionalities and to support effective interactions and, on the other hand, information technology cannot (and indeed should not) replace the human negotiator by an automated software agent but rather *support* human negotiators in their tasks [16].

In this paper, a negotiation is seen as a sequence of message exchanges with the goal to agree on a business contract. During this process, the contract will be changed by all parties involved in the negotiation. The messages exchanged provide the arguments why a certain item in the contract has been changed. For example, a change of the delivery date can be explained by the supplier in a message stating that (s)he is not able to deliver the product earlier because of the workload. In case of a later conflict, this information can be used in the discussion about the conflicting meanings of certain contract items. Discussions with companies in a round table have shown that such negotiation support is an innovative feature that would seriously enhance current practices.

Another problem of the current state-of-the-art in B2B EC systems are the fixed data structures. The widely used EDI standard is based on fixed and thus inflexible structures. Such systems are used in settings where one company is able to enforce certain rules for their business partners (e.g. the automotive industry). However, small and medium-sized enterprises have more flexible business relationships and are doing business with several companies at the same time. Therefore, they require more flexible solutions [12].

To summarise, a business data management system for B2B EC should fulfil the following requirements: (i) maintain business ontologies that are multi-lingual to support enhanced search techniques; (ii) integrate data from external sources and classify it according to the ontologies of the marketplace; (iii) retain the ownership of data and leave the information providers in complete control of their data; (iv) manage messages and documents of a negotiation process in an integrated way; (v) use extensible data structures for all types of business data.

3. INTEGRATION AND CLASSIFICATION OF PRODUCT DATA

A basic functionality of a business data repository for an electronic marketplace is the integration of external data sources to provide access to product databases and company profiles. In addition, the market owner has to offer additional services such as news services, monitoring of the fulfillment, or processing of the payment. Electronic commerce via a marketplace becomes profitable for the member companies if it is integrated with the ERP systems of the suppliers and buyers because several steps in the procurement process can be replaced by information technology.

Thus, electronic marketplaces require the integration of several systems (e.g. product databases, order processing systems), as the interoperability of these systems across multiple organisations is necessary. The problems faced in this environment are similar to the problems in other areas where data integration plays an important role, such as data warehousing. However, we have identified a number of points that distinguish data management in electronic commerce from traditional database problems. Firstly, electronic commerce is a highly dynamic environment. Companies will become (new) members of marketplaces, others will drop out and focus on other areas. Secondly, the data flow is bi-directional, i.e. data has to be transferred back to market participants as well (e.g., orders, requests). Thirdly, as the electronic marketplace may be used in many countries with different languages and different legal regulations, the system must be adaptable for different environments.

Furthermore, there is no (and probably never will be) common and unified technology that covers all problems of electronic commerce systems, although several standards, frameworks, and technologies such as BizTalk, CommerceNet, XML, Java, etc. have been developed. Thus, a flexible solution for the problem of data integration in B2B EC is required.

The solution we have developed in the MEMO project consists of two steps. First the data has to be made available by extraction and virtual integration techniques. Second the data has to be semantically integrated into the ontologies by a classification mechanism.

3.1 Data Integration

Our approach to the problem of data integration is based on the idea of federated database systems [17]. A key component of our

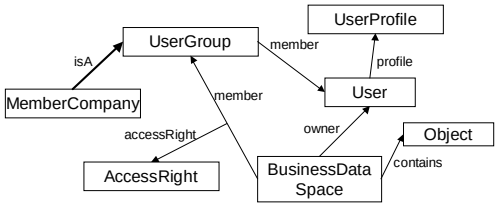

Figure 1: Business Data Space

federated system is a business data repository which plays the role of an information trader: all requests by the client applications are sent to the repository. The repository then looks up the metadata of external sources and sends the query to the appropriate source. The result is received by the repository and then sent back to the client application in the desired format.

The advantage of a federated architecture is that local databases can remain unchanged while allowing application programs to operate on a central virtual database providing the data of all participating databases. Such an architecture is especially useful for a loosely-coupled system we envision for the EC broker system. The external data sources are not controlled by the administrator of the EC broker system, and access to these sources might be limited.

Our technical solution to the problem is as follows. The repository stores the metadata about the location of the source data, how it can be accessed, and its schema. To be able to access the heterogeneous databases, these systems must either offer a standard interface to their data (e.g., JDBC, XML) or a *wrapper* has to be implemented that provides access to the source data (details in [12]).

As the access to remote sources might slow down the overall performance of the system, the external data can be materialised in the business data repository. However, as it has been discussed in section 2, companies are not easily willing to give their data away. It is important to make clear which company is the owner of the data, so that the company can remove its data from the business data repository if it is no longer a member of the marketplace.

For this reason, we have developed the concept of *business data spaces* (BDSs) which is sketched in figure 1 [6]. A BDS is a data container with an owner and a restricted number of members which have access to the data of the BDS. For example, a company publishing product data in the marketplace can make the data available to a limited number of users using a BDS. Furthermore, the access rights may specify that only the company is allowed to modify the data in a BDS.

Basically, the technical architecture presented here is not different from that what is currently presented and applied in research and practice. However, we want to stress that beside the technical problems of integration (e.g. access methods, interfaces) the semantic problem is also important, in some cases it is even more important. Therefore, we do not merely present a technical architecture for data integration but also a methodology for managing the semantic information of product databases.

3.2 Product Classification and Ontologies

Business data is information about a business entity or activity that is stored on some media. Business entities are among others companies, products, employees playing a certain role, contracts, money, rules, and regulations. The main purpose of business data is its usage in the operational systems which in turn support business processes.

The goal of this section is to propose a method for classifying business data in such a way that it can be used in the early phases of electronic business, i.e. the search for potential business partners and their products. The classification can be used by a search engine which provides semantic search techniques based on ontologies and supports multiple languages such as English and Dutch. The classification idea is taken from the domain of digital libraries: a document is indexed by appropriate keywords. The keywords are terms regarded by the author and readers of the document to characterise the content of the document. If the reader's set of terms differs from the author's set of terms, it is unlikely that the document is found by the reader simply because (s)he would not enter the right search terms.

The case of product catalogues is a variant of this classification problem. Each tuple in the product catalogue describes a product and needs to be indexed by keywords. As the electronic marketplace is multi-lingual, the classification must also be multi-lingual. Even more important is that a product profile has to address members of electronic markets who play specialised roles in the market: an architect expects a product classification that is completely different from the product classification of a wholesaler. Hence, we need to be able to link product profiles towards multiple sets of keywords (ontologies).

Besides the (digital) library domain, ontologies have been used to facilitate data integration [9]. Ontologies are powerful structures since they contain information about the interrelationship of terms, such as 'related term', 'narrower term', 'part term' etc. There are industry domains that have developed specialised ontologies to describe the concepts necessary to communicate in the market.

3.3 From documents to business data

As part of the requirements analysis within the MEMO project, we examined business data and their representation in web portals of the Dutch construction industry. The construction industry is subdivided vertically into different roles such as producers (e.g. of tiles), wholesalers (packing products and making them locally available), architects (planning construction projects), and contractors (executing construction projects).

The Dutch construction sector is characterised by a relatively high level of organisation, close cooperation between partner companies in project consortia, a high number of product suppliers, contractors, and other commercial partners such as architects. The standardisation in this industry is pursued by non-profit organisations such as HCP-EDIBOUW, a Dutch organisation with the goal to enable electronic business in the construction industry. The "Branchemodel Elektronische Communicatie" [4] defines a product sheet specifying relevant features to describe a product. The features are grouped into categories which may have sub-categories. For all categories, references to further descriptional documents are possible.

In the following, we will discuss how product catalogues can be implemented in a repository to support extended search facilities based on the semantics of the products rather than a keyword-based search. A generic ontology schema is proposed that provides the basis for our repository-based implementation.

3.3.1 A Generic Ontology Schema

The goal of the ontology schema is to represent products and their attributes in a semantically rich way and to provide different perspectives on the ontology. A *perspective* is defined as a set of ontology elements (concepts, lexicals, strings) which are interrelated in a semantic network. The same concept can have multiple denotations, i.e. lexicals in different languages. Attributes of concepts, e.g. the size of a door, are also considered as concepts. The generic ontology schema is shown in figure 2.

The class `Perspective` is used to specify what elements belong to a given ontology because different stakeholders use differ-

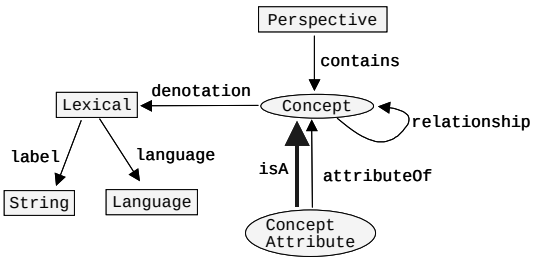

Figure 2: Generic Ontology Schema

ent ontologies. The main type of ontology element is `Concept`. A concept is denoted by a `Lexical` and may have relationships to other concepts. For example, a concept can be part of another concept or be a narrower term of another concept. If a concept (e.g. a door) in the ontology is related to another concept (e.g. a knob) by a part-of relationship, then, at the instance level, a real door can have a part which is a real knob. The narrower-term relationship is used to express specialisation or generalisation relationships. For example, a front door (as a concept) is narrower than a door (as a concept) since not all doors are front doors but all front doors are doors. More formally, the extension (or semantics) of a concept is defined as the set of objects it represents. If two concepts are related by the narrower-term relationship, then the extension of the narrower concept must be a subset of the extension of the more general term. There may be other relationship types between concepts as well.

The class `ConceptAttribute` is a special kind of concept. It shares all properties of ordinary concepts and adds a new relationship `attributeOf`. This is equivalent to the product features mentioned in section 3.3. A lexical is the denotation, i.e. a natural language expression, for a concept and is part of a language.

3.3.2 Product catalogues and profiles

A *product catalogue* [5] is a list of product descriptions, usually from a single supplier. The way products are described depends on the product category (identifiable with the concepts of a product ontology). Some products are described by physical properties (e.g. size, weight, geometry) while others are described more by the way they can be used to solve a task.

This diversity creates a problem for product data representation in a business data repository [8]. Existing business-to-business systems use often a very general schema for product description consisting of product code, description, supplier code, etc. Such a simple product data structure is not suitable for the purposes of modern electronic marketplaces to enable efficient searching. A purely textual description supports only keyword-based search and does not support any advanced semantic searches. The remaining issue to be solved is the mapping of any product catalogues to the above data structure for generic ontologies which does not have these limitations.

We assume that a product catalogue is provided by a company in a relational structure, i.e. a table where each tuple represents a product and the columns are attributes of the products. A product catalogue schema is defined as follows. We assume that companies are aware of the proposed attributes for product descriptions in their industry sector, e.g. the model of HCP-EDIBOUW for the construction industry. The product catalogue has to be accompanied by classification instructions which specify the meaning of the attributes according to the product ontology, more specifically the classification of product catalogue fields into concept attributes.

[1]The top part is an excerpt of a product ontology. The empty ovals symbolise that the concepts are part of a network relating concepts and concept attributes. The lexical labels (here: in English) are attached to the concepts to improve the readability.

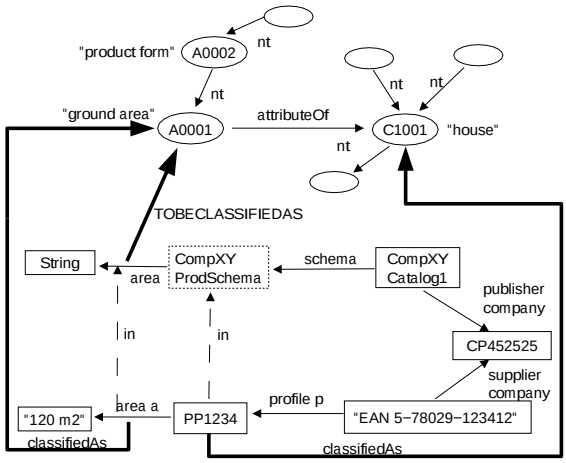

Figure 3: Example of a product classification[1]

This classification is used as follows (see figure 3). A product catalogue of a company `CompXY` has a schema `CompXYProdSchema`. A tuple of a product catalogue is decomposed into a set of reified attribute objects (like in [3, 11]) which are either classifying the product into a product group or describung properties of the product such as colour and shape. Each attribute object at the schema level is mapped into the product ontology (link TOBECLASSIFIEDAS in figure 3). The classification at the instance level (e.g., for product PP1234) can then be derived from the classification at the schema level. In the example, the attribute `area` of the product schema is classified as concept attribute `ground area` of the concept `house`. At the instance level, the attribute `120 m2` is also classified as ground area. The individual products can also be classified automatically based on certain rules. For example, the product PP1234 is classified as `house`. Technically, the classification is done using a metadata repository that stores the information about the classification rules.

3.4 Discussion

One achievement of the work described in this section is the linkage of (multi-lingual & multi-perspective) product ontologies with product profiles whose descriptional attributes are user-definable in a so-called catalogue schema. A company that wants to publish its product catalogue needs to define only its schema (including the classification of schema fields into the concept attributes). Additionally, it has to provide rules which specify the classification of products into the concept hierarchy. As mentioned earlier, the same product may be classified into more than one concept of multiple ontologies. For example, a manufacturer would classify a product into different concepts for wholesalers than for architects.

The classification of attribute objects supports searches for products of a certain product groups for which certain attributes are known. The name of the attributes are taken from the ontology and are thus reflecting the professional language of the user group for which the ontology was created. Hence, the user of the system does not need to know about the data structure of the heterogeneous product catalogues. The result of a search can be transformed into XML documents and be processed by modern semantic search engines that offer more sophisticated search techniques than classical keyword-based search engines. Overall, a marketplace which uses such technologies can offer more efficient services to find and classify information to its customers.

4. DATA MANAGEMENT FOR NEGOTIATIONS

Once a business partner has identified and located a potential (new) partner, negotiation starts. Information technology can help to manage the communication among business partners effectively. This section will present a framework for effective communication and document management in B2B EC. A more detailed discussion about the theoretical concepts behind the conceptual model presented here can be found in [16].

4.1 Document and Communication Management: A Conceptual Model

As it has been discussed in section 2, both documents and communication processes are vital parts of the negotiation process. However, an important point is missing in most systems supporting communication *or* document management. Documents are initiated through the exchange of messages in electronic negotiation processes. Traditional document management systems do not provide the reason for the communicative acts specified in the documents, e.g. they do not provide facilities to track the message which are exchanged during the evolution of a document. On the other hand, communication management systems are not concerned with documents as the result of message exchanges. We argue that there can be no separate communication and document management if business exchanges are to be supported effectively. Both messages and documents are an essential part of the negotiation process and both are interlinked. Therefore, a combination of document and communication management is required [16].

Figure 4 presents a conceptual model for capturing the relationship between documents and messages. The conceptual model is the basis for system support for electronic negotiations. An electronic negotiation is composed of messages and documents. It starts with a message sent from one company to the other, typically either a request or an offer. In general, a message in the present context has got a type (e.g. whether it is a request, a counter-offer, an assertion etc.) and a (semi-structured) content. It is sent at a certain time by one of the business partners acting as sender to the other business partner acting as recipient. Both partners will of course play both roles during a negotiation. The messages exchanged are linked in a content-based sequence: When sending a message, the business partner answers a message sent by the other partner. One message can of course have many answer messages, e.g. questions can be answered in parts, some information can be provided at a later point etc.

Each message is linked to a document, i.e. when sending a message, a new document is created. Each document is a version of the contract between the business partners. The content of the document is filtered out from the message content which contains additional information such as explanations, greetings, formal assertions etc. that are not relevant for the contract itself. If the document is agreed on by both partners, its status changes to final, i.e. it becomes the business contract. This leads to the (successful) termination of the negotiation.

Documents can be ordered in a tree-like structure, i.e. each document can be the successor of many other documents and each document can have many predecessors. A current negotiation step might turn out to be a dead-end in terms of continuing the negotiation. Therefore, it is possible to turn back to a certain earlier document and to continue the negotiation from there, i.e. a new version of the contract is created as the child of the original version. Thus, it is necessary to keep track of the time of the successor relationship. Thereby it is possible to keep the documents in a temporal sequence [16].

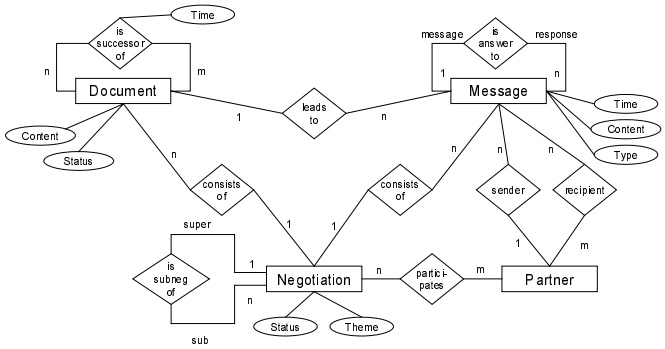

Figure 4: Conceptual Model of Combined Document and Communication Management

The link of message content and document content enables the tracing of all contractual items. It is possible to find out why a particular item is included in the contract through the link to the related message that specifies the reasons (such as preliminary agreements, justifications etc.) for the decision.

4.2 Traceability and Monitoring

In traditional commerce, most of the documents and messages exchanged during a transaction are kept for evidence in case of conflicts. Furthermore, offers and invoices from previous transactions contain valuable information, e.g. they might be useful for pre-calculations and cost estimates for new projects.

The conceptual model presented in the previous section provides this information for negotiations in EC. The history of documents shows information about offers, requests, and contracts. The contract formalises the obligations of each partner. The history of messages can be used to find out which partner included a certain item in the contract. In addition, the messages might give more information about the reason for a specific contract clause and clarify ambiguous statements. Thus, the history behind an agreement can be seen by the business partners involved.

In addition to the information about the negotiation phase, the traces of the fulfilment phase may also be recorded in the repository. For example, a company can find out which obligations it still needs to fulfil because of signed contracts, which obligations of other business partners have not yet been fulfilled, and which obligations the company itself has not yet fulfilled although the deadline is already past.

All this information about messages, contracts and their execution can be used for evidence in legal conflicts which is one of the most important uses of such information. Companies will only make business with other companies if all obligations of each partner are written down in a contract and signed by each partner.

Documents and messages of the negotiation and fulfilment phases can be stored at the site of each partner as long as the partner uses the information only internally. In case of a conflict which is brought to trial, the data about the negotiation cannot be used as an evidence as it could easily have been manipulated by any partner. Neither the business partners nor the court will trust the data.

Therefore, the negotiation process must be monitored by a third party which is trustworthy for all participants [15]. Such a party is called a trusted third party (TTP). A TTP must be objective and independent. This means that there must not be a direct relation to any of the participants with respect to the business interaction. The main task of the TTP is the monitoring of business transactions. If there is a conflict between two business partners, the TTP has to provide reliable information about the transaction between the

partners. Furthermore, a TTP can provide companies with information about potential business partners, e.g. turnover, shareholder capital, authorised person for signing contracts etc.

4.3 Discussion

In this section we provided the conceptual basis for the negotiation support that is an integral part of B2B interactions in the area of EC. We have shown that the information recorded during the negotiation and the fulfilment phase is necessary to have evidences if conflicts occur. To ensure that the information in the business data repository is not illegally modified by the business partners, the data has to be recorded by a TTP. Therefore, the data model presented in this section can also be used by a TTP.

The issue of data ownership is also important in the context of negotiations. If a company leaves the marketplace, the data about its negotiations should also be removed. Therefore, we have extended the concept of business data spaces to cover also the negotiation data. For each business partner in a negotiation, a business data space will be created that contains all data (including messages, documents, and personal annotations) related to the negotiation process.

5. CONCLUSION

In this paper, we have presented the main issues of data management in business-to-business electronic commerce. Based on the requirements gathered through discussions with user groups, we have developed a business data repository that addresses the problems of the users. Data ownership has been identified as one of the most important issues for the companies and was taken into account in different aspects of the business data repository. The data integration methodology provides a virtual integration enabling the data to remain in the data sources. Furthermore, the concept of business data spaces was introduced to manage data ownership and access rights in the business data repository. The classification mechanisms can be used to enrich the semantics of product catalogues to enable a more efficient search but the presentation of product catalogues can still be performed individually by each company. Finally, the framework for negotiation support allows the user to record his/her negotiation data independently of what the business partner decides to do, i.e. every business partner has his/her own business data space to record negotiation data. The business data repository has been prototypically implemented using the ConceptBase system [7]. It serves as the data management component in the electronic marketplace developed in the MEMO project.

There are currently many standards under development that address problems in the area of B2B EC such as UDDI, BizTalk, ebXML, RosettaNet, or cXML. These standards mainly provide frameworks that simplify the development of (domain-independent) B2B applications. However, data from legacy applications will also have to be integrated in the future. Therefore, we think that the problem of (semantic) data integration is not solved by new standards alone.

Future work will extend the integration and classification techniques to the new upcoming standards around the semantic web. The negotiation component will be extended to enable more sophisticated reasoning about the obligations of a business contract. This also includes the integration of ERP systems to answer questions such as “Do I have enough products in stock to deliver them on time?” Based on our empirical evaluations, we are confident that the approach presented in this paper provides an improvement of existing electronic marketplaces and thus enables more efficient business transactions in the future.

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