Generic Process Models for e-Business Transactions in Heterogeneous Systems

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Abstract

Research seems to have dealt with the problem of interoperability in various business domains, however the issue of interoperability in heterogeneous business domains – Enterprises, Governmental and Banking Institutions of different countries (cross-border) or Enterprises of different interests (cross-sector) - remains still a big challenge to be tackled.
This paper presents generic models of the most common business transactions carried out mainly by Small and Medium Enterprises. These models are constructed using state-of-the art notations ans methodologies which facilitate the Application-to-Application interconnection and the automated business documents exchange between enterprises, governmental and banking institutions. Those models cover not only national or sector specific business domain transactions but also cross-border and cross-sector processes, which imply different requirements as apart from the differences in the execution way, different legal rules and data entities, are also present. The modelling methodology is briefly presented, a complete list of the examined transactions (like Invoicing, VAT Statement, Fund Transfer) and the most important generic models are presented, followed by a complete comparison between the findings regarding each sector.

Keywords: Modeling cross-enterprise business processes, Enterprise modeling for interoperability, Meta-data and meta-models for interoperability
Designated track: Case Study

1. Introduction

During the last years there has been substantial technological progress in the area of e-Business. However, despite the fact of e-Business evolution, the adoption of new internet-based technologies in the business environment is still limited, especially in the sector of small and medium (SMEs) or very small enterprises (VSEs) [Androutselis et. Al. (2005)]. In parallel, the to-date efforts for developing and adopting e-Business solutions has been targeted more towards the Business-to-

Consumer (B2C) and the Business-to-Business (B2B) of same interests –same business sector– area and not so vitally towards the area, which this paper addresses to. This area comprises the Business to Business (B2B), Business to Government (B2G) and Business to Intermediaries (B2I) –such as Banks and Public Insurance Instituitions– transactions between Enterpreneural, Governmental and Banking Organizations of different countries (cross-border) or of different interests/operation domains (cross-sector).

Interoperability is defined in as "… the ability of two or more systems or components to exchange information and to use the information that has been exchanged". Thus achieving Interoperability is considered as the key factor which will drive e-Business to the next level by offering fully automated transactions that will be carried out without the need of any further actions; it will indicate the final adoption of e-Business in heterogeneous business domains (cross-border / cross-sector business domains).

The European Commission considers the development of interoperability of enterprise applications as a strategic issue for European Business environment, so that Enterprises can raise their collaboration and gain competitiveness in the global market. Towards facilitating such issues and proposing interoperability solutions that involve enterprise application integration and interconnection [Charalampidis et. Al. (2004)], a number of research projects are already undergoing funded by European Commission aiming at providing solutions in the key area of electronic transactions. Such projects are: Interop-NoE[http://www.interop-noe.org.], ATHENA-IP[http://www.athena-ip.org], FUSION[http://www.fusionweb.org/fusion], en-VISION [http://www.e-nvision.org] , Abilities Project etc.

The project GENESIS [http://www.genesis-ist.eu] (Enterprise Application Interoperability – Integration for SMEs, Governmental Organizations and Intermediaries in the New European Union) is also funded in the context of the EU Framework Program 6 (FP 6) and its main goal is the research, development and pilot application of the needed methodologies, infrastructure and software components that will allow the typical, usually small and medium, European enterprise to conduct its Business transactions over Internet, by interconnecting its main transactional software applications and systems with those of collaborating enterprises, governmental bodies, banking and insurance institutions with respect to the EC current legal and regulatory status and the existing one in the new EU, candidate and associate countries.

The present paper derives from a thorough research in the European business environment regarding the most common business transactions carried out mainly by European SMEs. A list of the common B2B, B2G and B2I transactions used by enterprises of different sectors and countries, has been formed, in accordance with an evaluation framework constructed for the identification of the most important

processes, which can be modeled and further automated. For each one of these transactions, a generic process model facilitating interoperability was designed using state-of-the-art Modeling Notations and Methodologies [Bussler et. Al. (2001)]. This paper presents three generic process models of transactions, covering the core of the above mentioned transactions' list.

Regarding the structure of this paper, Section 2 identifies and discusses briefly the process modeling methodology which has been followed; Section 3 defines the list of the common SMEs' transactions and presents analytically the generic process models of core transactions; Section 4 presents issues that have arisen during the modeling proceeding and compares the models for different sectors signifying the relativity to legal rules & data issues. Finally Section 5 concludes.

2. Process Modeling Methodology

The Process Modeling Methodology, regarding the heterogeneous domain interoperability requirements, has to incorporate the following issues:

- "Cross-Enterprise, Cross-Sector" processes: Refers to the ability to support "Cross- Enterprise, Cross-Sector" processes and transactions between enterprises and organizations that belong to the private sector, to the public administration and to the banking sector. Those transactions have different parameters, depending on each transaction and those processes are identified as "cross-enterprise, cross-sector" ones.
- "Cross Border" Transactions: The ability to manage models representing international transactions..Such transactions have their own characteristics and their own parameters, which vary among same transactions carried out between different countries.
- "Legal Issues": The ability to deal with and to model various legal aspects which are present in cross-border, cross-enterprise transactions. Such models should include amongst others different rules and business documents.

During the Process Modeling Methodology definition, three different levels of process modeling are used; the private, the public and the generic (collaboration) process modeling view [Dayal et. Al. (2001)]. The need for this discrimination is to build structured models which can describe fully a transaction, from the internal enterprise level up to the collaboration level between different transaction parties.

The *Private Process View* incorporates the "private processes" of one transaction party, which are inner-organizational processes from the business point of view i.e. an internal process of an organization or an enterprise. Private processes are used to identify the context of how and when certain documents for collaborating with other parties are produced or consumed. These documents are the interfaces for the public process.

Public Process View. The public process is a coarse description of process steps which represent the interface of an organization to collaborate with other parties. Only those activities that are used to communicate outside the private business process, plus the appropriate flow control mechanisms, are modeled in the public process view. A public process, as seen from the transaction point of view, presents the sequence of messages that are required in order to interact with other parties.

Collaboration Process View. Both of the above process modeling views are defined as national and sector specific. In the collaboration process modeling view, abstract, generic process models are built. They derive from the appropriate consolidation of the public processes of the collaborative parties without any country specifications. These generic process models are designed at the highest abstraction level possible, so as to be able to fit easily to different countries without interfering with the internal private processes of the parties involved.

Advance and state-of-the-art modeling notations and methodologies have been selected for the process modeling phase in the three different view levels of modeling. Namely, the Business Process Modeling Notation (BPMN) has been used in order to extract executable code from the designed models using the Business Process Execution Language (BPEL).

3. Generic Business Process Models

3.2 Transaction List

In order to identify the most common and important transactions carried out by SMEs which can and worth being fully automated, an evaluation framework has been used. This framework consists of the assessment of the following criteria:

- Frequency of use.
- Time for the process execution.
- Cost of the process.
- Level of support of the process with the existing Enterprise Applications.
- Legal and statutory framework supporting the execution of the process. More specifically, the end user must also determine if the specific transaction is obligatory under the legislation or not.
- Value added in the Enterprise (e.g. is it core business or supportive?).

This framework was used on an initial transaction list which had various transactions for each sector. More specifically, the initial B2B transactions were identified with the use of the UBL 2.0 standarts for B2B Processes, B2G transactions were identified by studying the eEurope 2005 and IDABC initiatives and Banking transactions were identified by studying financial exchange standarts like OFX.

All those transactions were evaluated with the use of the framework in eight (8) different countries (Greece, Cyprus, Italy, Turkey, Romania, Bulgaria, Lithuania and Czech Republic) and the final evaluation has been concluded to a of automatable transactions presented in Table 1. This list includes the most common Business to Business, Business to Governmental Agencies and Business to Banking Institutions transactions, which should be considered when talking about Enterprise Applications Interoperability, as they are the most frequently used and are possible to get automated. The transaction list is accompanied of specific evaluation results for each transaction according to the evaluation criteria. Figure 1 is presents a representative diagram of the evaluation results for Ordering of B2B Transactions. Figures 1 and 2 present representative diagrams of the evaluation results for the Ordering (B2B Transaction) and the VAT Declaration (B2G Transaction) processes.

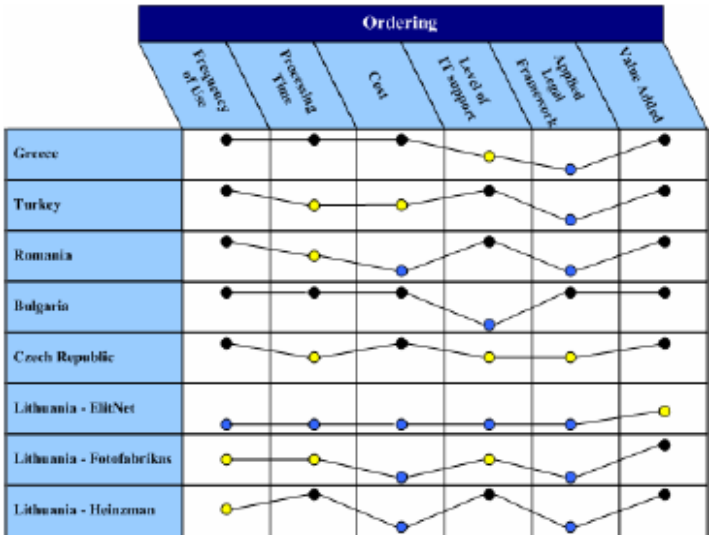

Figure 1. Evaluation Results for Ordering

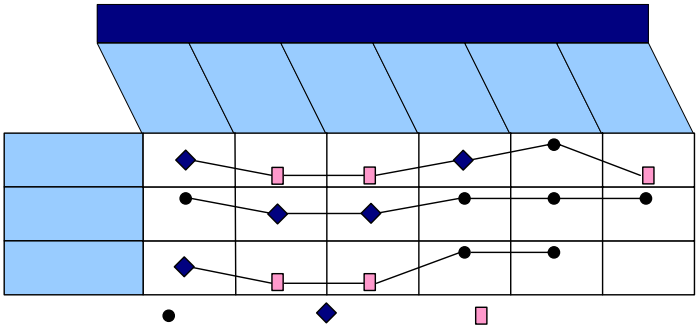

Figure2. Evaluation Results for VAT Declaration

Table 1. Transaction List of Modeled Processes

Category	Business Process / Transaction
B2B	Catalogue Provision (Request, Issue/Get, Handle)
	Quotation (Request, Issue/Get, Handle)
	Order (Request, Issue/Get, Handle)
	Packing Slip (Issue/Get, Handle)
	Invoice (Issue/Get, Handle)
	Billing (Credit/debit, Reconcile, Handle)
	Fulfillment Collaboration (Despatch/Receive through 3rd Party)
B2G	VAT Statement (periodic)
	VAT Statement (annual or cumulative)
	Enterprise Income TAX Statement (annual)
	INTRASTAT Statement (annual)
	Social Security Statement – Contribution (periodic)
	Transactions Reporting (intra-EU/national, periodic)
	Various VAT sub-statements and reports
	Declaration of hiring new employee
B2Banking	Account Status
	List of Account Transactions
	Fund Transfer (intra-bank, inter-bank)
	Specific Payment (VAT, tax, other)
	Payment Check (Credit Note) Issuing
	Payment Check (Credit Note) Status
	Loan Status Inquiry

All these transactions (Table 1) have been modeled up to the generic process view, by taking into consideration the different processes from the different counties. More

specific, as far as it regards the B2B transactions, 6 countries were selected for gerenaring the genic process models (Greece, Turkey, Romania, Bulgaria, Lithuania and Czech Republic), whereas B2G and Banking generic models were based on the public view models of 4 countries (Greece, Cyprus, Italy and Turkey). For each sector, a mix of EU member states, newly added members and candidate members was selected. From this list, three transactions have been selected and their process models are presented below. These processes have been selected as the representative core of the transactions' list.

3.2 B2B Models

Figure 3 presents the generic model for the Ordering process. All required documents which are exchanged between the collaborating parties during the process flow are present, from the Order document to the Order Cancellation document. Rules or time events are also present. The process models which are presented in this paper are modeled using BPMN notation. Table 2 presents the Model's Meta-Data.

Table 2. Ordering – Generic Model Meta- Data

Involved	A. Buyer B. Seller	**Pattern**	A-B-A-A
No. of Exchanged Documents	8	**No. of Decision Points (complexity)**	5
Country fit	6 (GR, TR, RO, BG, LT, CZ)	**No. of Activities**	14
Subproccesses present (Decomposition)	none	**Legal Framework Interference**	Medium

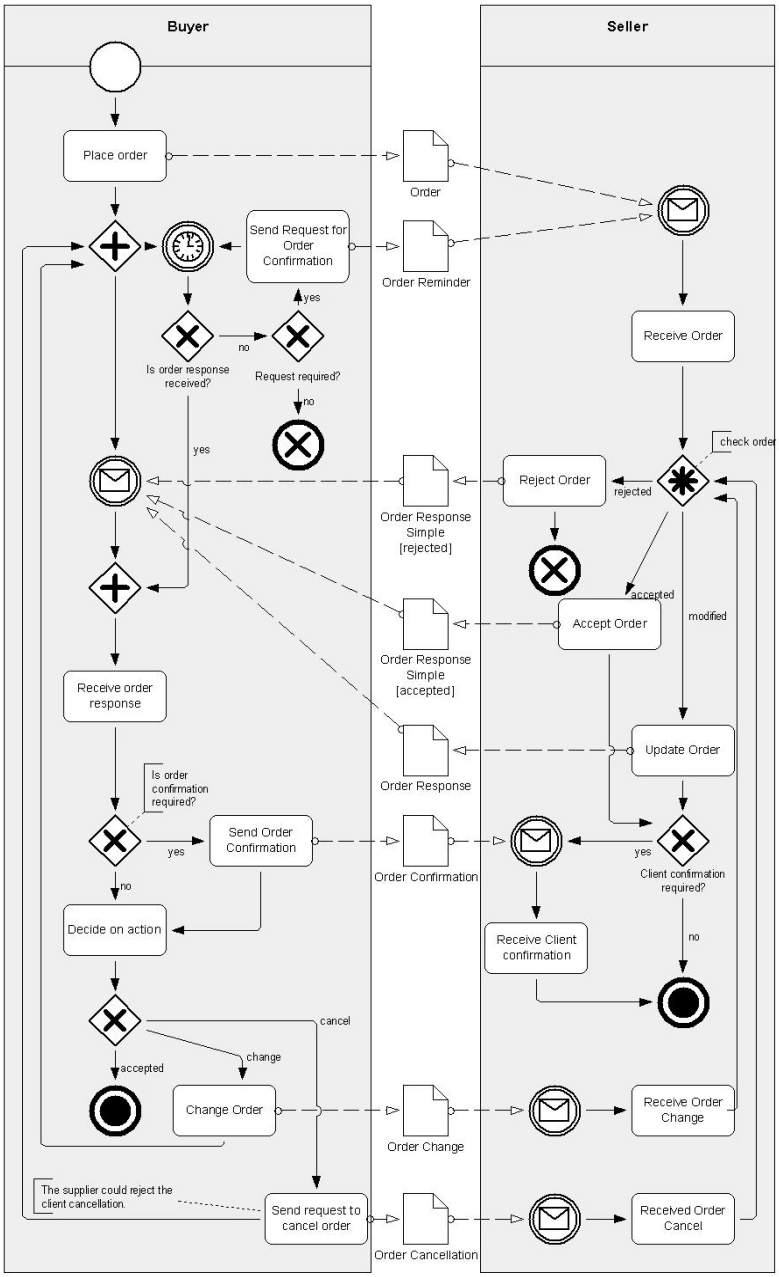

Figure 3. Ordering Process – Generic Model

3.3 B2G Models

The periodic VAT Statement process between an enterprise which declares and pays its VAT and the VAT Service who is the recipient of the declaration and of the payment is shown in figure 4 This process includes two subprocceses, namely "Specific Payment", that resides under the "Payment Settlement" activity shown in the figure and "Account Status" which is performed by the VAT Service under the activity "Check VAT Statement and potential Payment".

Table 3. VAT Statement (periodic) - Generic Process Meta- Data

Involved	A. Enterprise B. VAT Service C. Bank (hidden "as sub process")	**Process Flow Pattern**	A-B-A
No. of Exchanged Documents	3	**No. of Decision Points (complexity)**	2
Country fit	4 (GR, CY, TR, IT)	**No. of Activities**	6
Subproccesses present (Decomposition)	1. Specific Payment 2. Account Status	**Legal Framework Interference**	High

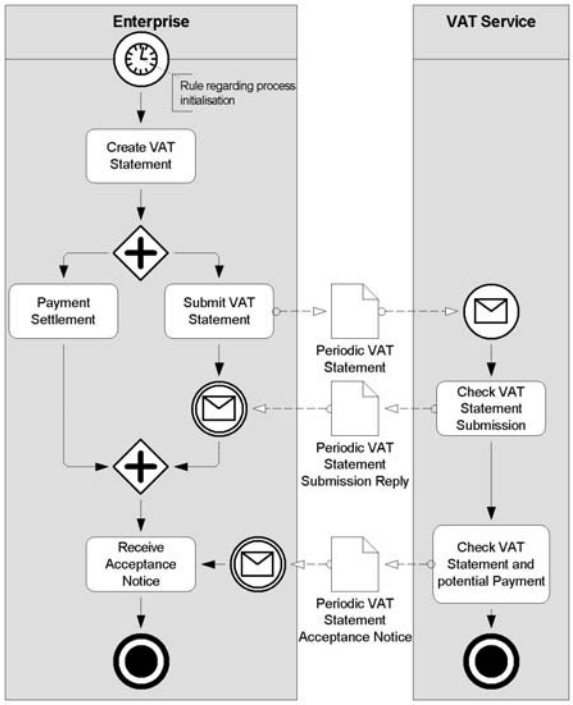

Figure 4. VAT Statement Process – Generic Model

3.3 Banking Models

The Specific Payment Process of an enterprise issuing a payment order to the bank is shown in figure 5. This process includes the subprocesses of "Account Status" which is being done by the Bank to determine if the enterprise possesses the required balance in its account in order to carry out the order and the "Fund Transfer" which is an intra or inter-bank process that deals with the actual money transfer. The following table (Table 4) presents the model's Meta-Data.

Table 4. Specific Payment - Generic Process Meta – Data

Involved	A. Enterprise B. Bank	**Pattern**	A-B
No. of Exchanged Documents	2	**No. of Decision Points (complexity)**	1
Country fit	4 (GR, CY, TR, IT)	**No. of Activities**	4
Subproccesses present (Decomposition)	1. Account Status 2. Fund transfer	**Legal Framework Interference**	Low

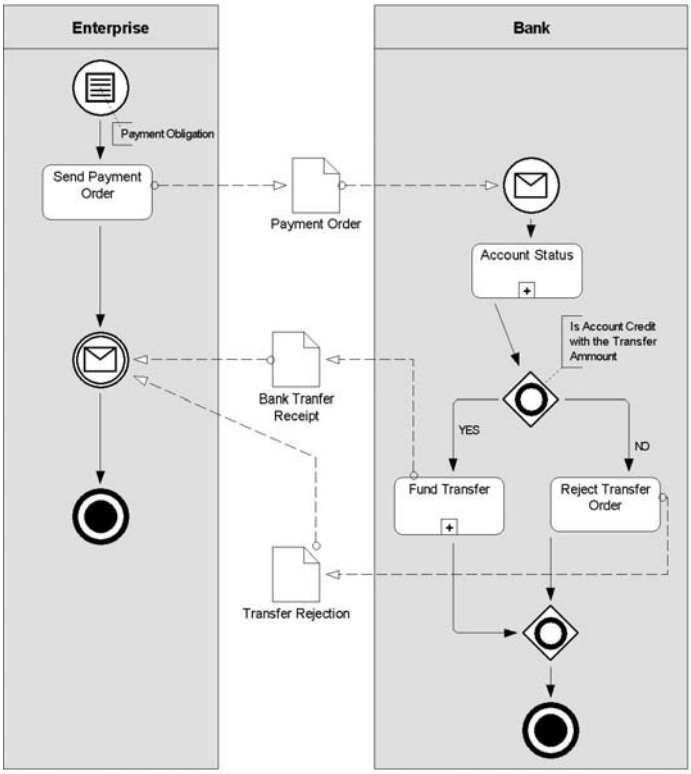

Figure 5. Specific Payment Process – Generic Model

3. Findings based on the different models

During modeling many issues have arisen, which mainly involved the legal rules and the data entities that accompany each transaction in each country. Moreover, the way each transaction is carried out differs from country to country as the business logic is not the same. Those issues are by defacto not taken into consideration when trying to design interoperable systems for conducting transaction in country specific domains, as all enterprises operating in the same country follow the same legal rules and have the same data requirements.

However, when trying to extend the environment of e-business by comprising cross-border and cross-sector transactions, all the above issues come up to the surface. Therefore, we have created several private and public processes; each one of these represents a specific transaction with different requirements than in other countries' specific models. A consolidated generic process model has to respect all the underlying exceptions and has to aggregate all the underlying business logic, legal rules and data requirements into a unique model so as to satisfy all the needs which spring out of the public processes.

In order to meet these demands and to finally reach the ultimate goal which is no other than proposing an approach for cross-border and cross-sector interoperability, those generic process models have to be designed at the highest abstraction level that could be reached. This way, the generic models represent the service orchestration which has to be established between the different parties in order to carry out their transactions successfully. The abstraction level chosen defines the obligatory business document exchange which must take place but at the same time does not interfere with the different internal processes of each party. However, several rules regarding the legal issues or the data entities have to be applied, which may or may not affect the internal of the parties' processes, depending of the architecture that will be selected upon the system implementation process.

As far as it concerns the execution way or the process flow of a transaction itself, based on the examined countries there seem to be only small differences in the business logic of the transactions. Therefore the generic models could easily fit to all the examined countries, as the chosen abstraction level is able to cover the core process flow of the examined transactions.

Business to Business (B2B) transactions have almost similar business logic and follow the same business rules, with small differences. The way of conducting business seems to follow a globally accepted process flow, which is present from the smallest to the largest enterprises. Therefore the service orchestration between two business parties can be easily designed. However, the legal rules and the data entities that encompass these transactions present a high grade of differentiation. This fact springs from the national laws and from the historical and social conditions which

have shaped throughout the years the national business domain, based upon the domestic needs and requirements.

Business to Government (B2G) transactions possesses a higher differentiation grade than B2B transaction in the terms of process flow and legal rules. However, as far as it concerns the data entities included in those transactions, they slightly differ from each other between different countries, as the low level information which is required by those transactions remains the same for each country (e.g. person details, address details, specific transaction details).

Business to Banking Institutions transactions seem to posses the smallest grade of differentiation not only in the process flow but also in the legal rules and in data requirements. This situation derives from the fact that every bank respects and follows an internationally agreed way of conducting business [Nikolaidou et. Al. (2001)], which is nowadays used globally. This behaviour evolved from the need of forming a unified banking environment for interconnecting the global markets. The results from these efforts produced common agreed banking processes with the same data entities and with almost identical legal frameworks that were adopted by the different governments.

The following figure (Figure 6) describes the differentiation between the processes' categories regarding the data entities and the legal rules in a 3D diagram. Banking transactions have low differentiation in all three dimensions. B2G transactions have low to medium data differentiation and high differentiation regarding the legal rules, whereas they have also medium to high differentiation Process Low differentiation. B2B transactions have medium to high data differentiation but medium process flow and legal rules differentiation.

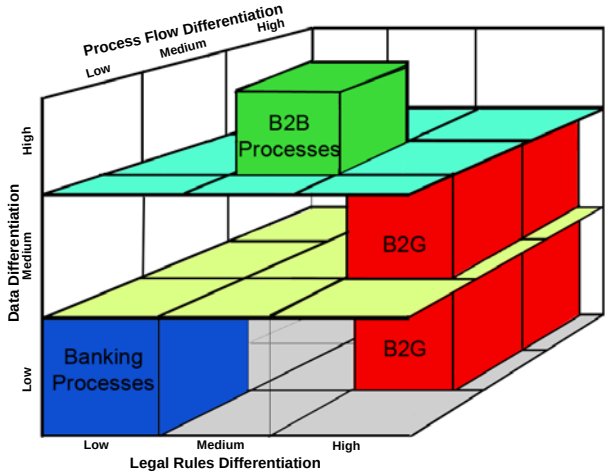

Figure 6. Process Flow, Data & Legal rules differentiaton between different transactions types

4. Conclusions

This paper presented generic Business to Business, Business to Government and Business to Bank transaction models that are constructed by a methodological approach for enabling interoperability for processes in heterogeneous business domains by defining service flow orchestrations. These models can be used by enterprises in different countries and heterogeneous business domains in order to model and revise their business transactions so that they can implement interoperable interfaces for expanding their business environments.

Still, there are significant issues, such as legal rules integration, business documents standards for Business to Governmental and Banking Institutions transactions, which should be challenged in the future for providing a fully interoperable environment.

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