

AN ANALYTICAL APPROACH FOR COMPARING COLLABORATIVE BUSINESS FRAMEWORKS

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Several collaborative business frameworks have been developed in order to support organizations to attain interoperability in today's networked business arena. However, the diversity of frameworks generates selection problems. The goal of this article is to present an analytical method supporting the comparison of collaborative business frameworks, which may also be used by decision makers in the framework selection process. The results obtained by comparing four collaborative business frameworks are discussed.

1. INTRODUCTION

Due to recent developments of information and communication technologies (ICTs) and turbulent market conditions, businesses have migrated from traditional practices to e-business, which represents an enabler for interoperability in a collaborative networked environment (CNE), e.g., (Chituc, Toscano, Azevedo, 2007a).

Although active research is pursued in the area of interoperability in a CNE and on the emergence of collaborative business frameworks and standards, few studies aiming at comparing them are available.

The objective of this article is to present an analytical method for collaborative business frameworks comparison, which may also be used by decision makers (DMs) in the framework selection process.

The rest of the article is organized as follows: the next section presents four relevant collaborative business frameworks. An analytical method for collaborative business frameworks comparison is introduced in section three. Then, the comparison results are discussed.

2. COLLABORATIVE BUSINESS FRAMEWORKS

2.1. Introduction

In this article, the term collaborative business framework represents a fundamental structure which allows the definition of a set of concepts to model an organization or a network of organizations while performing e-business. Several cross-industry and industry-specific collaborative business frameworks have been proposed by industry and interest organizations, e.g., CibFw, ebXML, RosettaNet, papiNet.

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2.2. Collaboration Interoperability Framework

The Collaboration Interoperability Framework (CIBFw) aimed at supporting seamless interoperability in a CNE has been introduced by (Chituc, Toscano, Azevedo, 2007b). The CIBFw has been elaborated to answer the general requirements for interoperability and the gap analysis presented in (Chituc, Toscano, Azevedo, 2008). It comprises six elements: (1) a messaging service, which assures communication among organizations; (2) a collaboration profile/ agreement definition and management service, responsible for the definition and management of the organizations' collaboration profiles and agreements; (3) five main clusters of collaborative business activities, which model inter-organizational activities; (4) a centralized repository; (5) a set of business documents and supporting documents; (6) a performance assessment service. The CIBFw relies on the concept of Business Enabler, which is an entity from the CNE with the sole purpose of easing organizations in performing e-business by providing different services, e.g., messaging, performance assessment. The CIBFw supports two types of communication over the Internet: through the messaging service provided by the BE's system, or directly on P2P basis.

The specifications of the CIBFw serve as basis for the development of two ICT platforms targeting two industry sectors in Portugal: the footwear, and textile, cloth and yarn industries. The ICT platforms are implemented within the scope of TECMODA R&D national project (www.tecmoda.org) pursued in partnership with the Portuguese Technological Transfer Associations (CITEVE, CTCP, ANIVÉC) and INESC Porto. The messaging service relies on ebXML messaging specifications, ebMS.

2.3. ebXML

ebXML (www.ebxml.org) is a modular suite of specifications aimed at enabling e-business over the Internet, targeting enterprises of all sizes and from any sector. It comprises the following elements: messaging (ebMS); registry/ repository; business process specification schema; collaboration partner profile/ agreement; and core components. It offers a strong conceptual base and the number of software implementations is relatively high (e.g., Hermes MSH: www.cccid.hku.hk). The ebMS defines a standard communication protocol for the reliable and secure exchange of messages between e-business partners over the Internet and uses the SOAP.

2.4. RosettaNet

The RosettaNet consortium (www.rosettanet.org) develops universal standards for the high-tech and electronics industry global supply chain, and supports their implementation and adoption. It consists of a multiple messaging service, Partner Interface Processes (PIPs) and PIP Directory; dictionaries and RosettaNet Implementation Framework (RNIF). RosettaNet's standards are XML-based, defining message guidelines and business process (BP) interfaces.

2.5. papiNet

papiNet (www.papinet.org) is an international paper and forest industry e-business initiative. It provides a set of standard electronic business documents which facilitate the flow of information among parties engaged in buying, selling and distributing paper and forest products. The papiNet interoperability guidelines are based on the ebMS. It includes

a common terminology and standard business documents to use in both domestic and international electronic transactions.

3. COMPARATIVE ANALYSIS

3.1. Related Work

Most of the research studies on collaborative business frameworks are more descriptive than comparative, e.g., [Shim *et al.*, 2000], [Li, 2000]. A general and component-based comparison of eCo, RosettaNet, BizTalk and e-speak frameworks has been elaborated by (Kim *et al.*, 2003). However, this comparative analysis only tackles technical aspects related to interoperability. Several studies focus only on standardization in general, such as: conceptual framework targeting vertical e-business standards; standards developing organizations, e.g., (Zhao *et al.*, 2005).

For the properties of the XML-based e-business frameworks, three technical variables have been identified by (Medjahed *et al.*, 2003), (Numilaakso, Kotinurmi, 2004), and (Numilaakso *et al.*, 2006): business documents, BPs, and messaging. The comparison results obtained illustrated that most of the e-business frameworks complement each other in some aspects (e.g., ebMS is a complement of papiNet), competing in others (e.g., ebMS and RNIF).

However, to compare and assess collaborative business frameworks better, an analytical model is necessary. Research in this area is scarce. A comparison and evaluation of ebXML and RosettaNet based on a decision model specified for small and medium sized enterprises (SMEs) has been introduced by (Pusnik, Juric, Rozman, 2002). A general overview and a formal comparison of ebXML and RosettaNet is available in (Pusnik *et al.*, 2003). The two frameworks have been compared based on a 'utility function'. This study has two main limitations. Firstly, the criteria identified are limited. Secondly, the presented model does not admit a hierarchy of preferences. Also, some of the criteria may be useful to compare technologies, but they are not adequate to compare frameworks.

3.2 Criteria Definition

A set of twenty two criteria has been identified to support the analytical comparison of the collaborative business frameworks. These criteria and their scale definitions are presented in *Table 1*. Seven groups of criteria have been determined: (1) Description and Publication; (2) Search/ Browse Information; (3) Collaboration; (4) Management; (5) Performance Assessment; (6) Specifications; (7) Implementations.

The selection of these criteria is based on an extensive literature review, the views and attributes for seamless interoperability and the general requirements for interoperability presented in (Chituc, Toscano, Azevedo, 2008).

Table 1. Criteria description and scale definition

Criterion Id	Name	Description	Scale definition
C1	Description	It evaluates the ability of a framework to address aspects related to the description of an organization (e.g., specification of the information to be included in an organization's collaboration profile).	1 – Yes/ 0 – No
C2	Publication	It evaluates the ability of a framework to address issues related to the publication of an organization's collaboration profile.	1 – Yes/ 0 – No
C3	Identification of potential business partner/ opportunity	It evaluates the ability of a framework to address issues related to the identification of potential business partner(s), or opportunity (e.g., search for a potential business partner in a centralized repository).	1 – Yes/ 0 – No
C4	Messaging	It evaluates the ability of a framework to address issues related to the communication between two organizations/ systems, e.g., message exchange.	1 – Yes/ 0 – No
C5	Inter-organizational collaborations	It evaluates the ability of a framework to address issues related to the description/ specification of inter-organizational collaborations.	1 – Yes/ 0 – No
C6	Negotiation and agreements	It evaluates the ability of a framework to address issues related to the negotiation and establishment of a collaboration agreement between two organizations in order to perform e-business.	1 – Yes/ 0 – No
C7	Semantics	It evaluates the ability of a framework to address issues related to semantic interoperability, e.g., cross- and intra-industry semantic interoperability.	2 – Cross- & intra-industry semantic interoperability/ 1 – Intra-industry semantic interoperability/ 0 – It does not tackle interoperability issues.
C8	Information management	It evaluates the ability of a framework to address issues related to information management.	1 – Yes/ 0 – No
C9	Conflict solving	It evaluates the ability of a framework to address issues related to solving potential conflicts.	1 – Yes/ 0 – No
C10	Rights and obligations	It evaluates the ability of a framework to address aspects related to the rights and obligations of an organization in a CNE/ CN (e.g., access rights).	1 – Yes/ 0 – No
C11	Roles/ Tasks fulfillment	It evaluates the ability of a framework to address aspects related to organization's roles/ tasks fulfillment.	1 – Yes/ 0 – No

Table 1. Criteria description and scale definition (cont.)

Criterion Id	Name	Description	Scale definition
C12	Learning	It evaluates the ability of a framework to address aspects related to an organization's/ CN's ability to learn.	1 – Yes/ 0 – No
C13	Performance assessment	It refers to the ability of a framework to address issues related to performance assessment.	1 – Yes/ 0 – No
C14	Technical specifications	It evaluates the amount of supporting literature and examples (e.g., technical reports, scientific articles) available, which facilitate the learning and understanding of a framework.	3 – High number/ 2 – Average/ 1 – Low number/ 0 – Zero.
C15	Comprehensibility	It evaluates the effort (e.g., time, work) necessary to understand all the features of a framework.	3 – Low effort/ 2 – Average/ 1 – High amount of effort.
C16	Generality	It characterizes the degree of generality of a framework (e.g., considering the possibility to adapt it to the requirements of a certain industry).	3 – High/ 2 – Average/ 1 – Low.
C17	Targeted enterprises (by size)	It refers to the type of enterprises targeted by a framework.	3 – Supporting enterprises of all sizes/ 2 – Mostly for SMEs/ 1 – Only for large enterprises.
C18	Maturity	It evaluates the maturity or recognition of a framework, based on the number of years since the first technical specification has been published.	Number of years since the first specification has been published or presented.
C19	Policy	It characterizes the degree in which the specifications of a framework follow national/ international legislation and recommendations.	3 – High/ 2 – Average/ 1 – Low.
C20	Accessibility	It characterizes the degree in which the specifications of a framework are available for different organizations.	3 – High/ 2 – Average/ 1 – Low.
C21	Tools support	It refers to the quantity of support tools designed and implemented to facilitate the development of infrastructures considering a certain framework as basis.	3 – High number/ 2 – Average/ 1 – Low number/ 0 – Zero.
C22	ICT platforms	It refers to the quantity of ICT platforms developed by following the specifications of a framework.	3 – High number/ 2 – Average/ 1 – Low number/ 0 – Zero.

3.3. Interoperability Characterization Function

A weight coefficient may be assigned to each criterion since a certain enterprise manager or DM may prefer certain criteria over the others. With these considerations, an interoperability characterization function C_f has been defined to support the analytical comparison of collaborative business frameworks, as follows:

$$C_f: F \rightarrow \mathfrak{R}^*_+ \text{ and } C_f(F_j) = \sum_{\substack{i \in I \\ \max(c_i(F_j)) \neq 0}} \frac{C_i(F_j) * w(c_i)}{\max(c_i(F_j))} + \sum_{i \in P} c_i(F_j) * w(c_i)$$

where: C_i is criterion i , and $i \in \mathbb{N}^*$; F_j is the framework alternative, $F_j \in F$ (F is the set of frameworks) and $j = \overline{1, n}$; $n \in \mathbb{N}^*$ is the total number of frameworks to be compared; $w(c_i)$ is the weight associated to criterion i and $w(c_i) \in [0,1]$; $I = \{7, 14, 15, 16, 17, 18, 19, 20, 21, 22\}$ and $P = \{1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13\}$

Table 2 portrays the results obtained by the comparison of four frameworks: CibFw, ebXML, RosettaNet and papiNet. For simplicity, the weight assigned to each criterion was 1, that is: $w(c_i) = 1 \forall i \in \mathbb{N}^*$. This means there is no preference of one criterion over the others.

4. DISCUSSION

The value obtained for the C_f is higher for ebXML when compared to the other three frameworks. It is followed by CibFw. The lowest value has been obtained with papiNet.

Analyzing the results attained for each group of criteria, the CibFw specifications tackle better the first five groups of criteria. In fact, the CibFw is the only framework addressing G5) Performance groups Assessment. However, ebXML provides more detailed technical specifications and a higher number of implementations (reflected by G6 and G7). Concerning the number of implementations (e.g., tools, ICT platforms), the lowest values have been obtained by CibFw. This can be explained by the fact that ebXML, RosettaNet and papiNet are more mature initiatives (e.g., RosettaNet specifications have been published eight years before the first presentation of CibFw specifications).

The mean values and the standard deviation have been calculated. The standard deviation (5,17) illustrates a relatively high distribution of the data from the mean value (12,2). Also, the coefficient of variation is 42,37 %, which shows a relatively high degree of data heterogeneity.

The results attained must be carefully interpreted, since the selection of the comparison criteria is based on the definition of seamless interoperability proposed by (Chituc, Toscano, Azevedo, 2008), and the requirements for interoperability identified. Also, the weighted values associated to each criterion were considered to be constant. Thus, the values obtained for the C_f are specific to the numerical values assumed for the parameters. For example, C17 may have a different weighted value in different countries. In Europe, the industry is dominated by SMEs, so for the European industry it might be of higher relevance to have a framework targeting SMEs rather than one supporting enterprises of all sizes.

Different values can be assigned to the weight associated to each criterion $w(c_i)$, considering, for instance, $w(c_i)$ between 0,1 and 0,9. The results obtained for four simulation experiments are illustrated in Figure 1. This model may be used by a DM in the selection of a collaborative business framework: the framework for which the highest value of the C_f has been obtained is selected. However, the value obtained for the C_f depends on the importance associated to each criterion. For example, a certain DM may assign a higher importance to criteria related to specifications or implementations, than to management. This situation is reflected by *Case B* (Figure 1), where the highest value of C_f is obtained for ebXML. For the *Case D*, where higher importance has been assigned to performance assessment and management, the CibFw should be selected.

Table 2. Results for frameworks comparison

Criterion		C _r (CibFw)	C _r (ebXML)	C _r (RosettaNet)	C _r (papiNet)
G1) Description and Publication		2	2	0	0
C1	Description	1	1	0	0
C2	Publication	1	1	0	0
G2) Search		1	1	0	0
C3	Identification of potential business partner/ opportunity	1	1	0	0
G3) Collaboration		4	4	2,5	2,5
C4	Messaging	1	1	1	1
C5	Inter-organizational collaborations	1	1	1	1
C6	Negotiation and agreements	1	1	0	0
C7	Semantics	2	2	1	1
G4) Management		3	1	0	0
C8	Information managemet	1	1	0	0
C9	Conflict solving	1	0	0	0
C10	Rights and obligations	0	0	0	0
C11	Roles/ tasks fulfilment	0	0	0	0
C12	Learning	0	0	0	0
G5) Performance Assessment		1	0	0	0
C13	Performance assessment	1	0	0	0
G6) Specifications		4,44	6,88	4	4,11
C14	Technical specifications	1	3	2	2
C15	Comprehensibility	3	3	2	2
C16	Generality	2	3	1	1
C17	Targeted enterprise (by size)	2	3	1	2
C18	Maturity	1 (2006)	8 (1999)	9 (1998)	7 (2000)
C19	Policy	2	3	1	1
C20	Accessibility	3	3	2	2
G7) Implementations		0,66	2	1,33	0,66
C21	Tools support	1	3	2	1
C22	ICT platforms	1	3	2	1
Interoperability Characterization Function		16,1	16,88	7,83	7,27

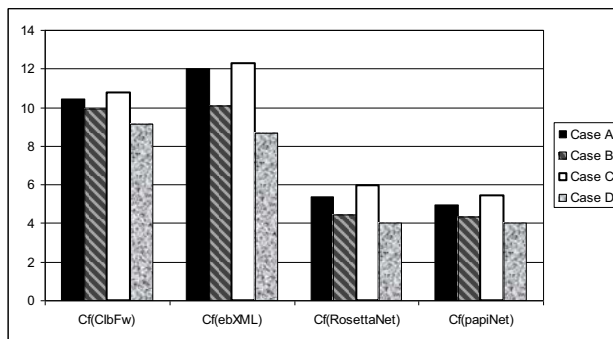


Figure 1. Results for weights associated to each criterion

5. CONCLUSIONS

Several collaborative business frameworks and standards have been developed, based on which different ICT platforms have been implemented. The relatively high number of collaborative business frameworks proves their importance. At the same time it creates selection problems for decision makers.

Research aiming at the comparison of collaborative business frameworks is challenging. The challenges are related to the difficulty in tracing the adoption of these initiatives, frequent changes on the specifications of a specific framework, the disappearance of a certain initiative and the emergence of new approaches.

The analytical comparison performed based on the twenty two criteria and the C_f proposed showed a slight advantage of ebXML over the CibFw, RosettaNet and papiNet, when the weighted values associated to each criterion were equal. However, these results have to be interpreted carefully, since the obtained values are specific to the associated numerical values. This model may be useful for decision makers in the process of selecting a collaborative business framework. Further work will be pursued to validate the proposed model with real data from industry.

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