A Framework for Processing Business Financial Rules

Fernando Cezar Reis Borges  
Salvador University  
Postgraduate Program, Master Degree in Systems and Computing, Brasil, Bahia, Salvador  
fcssa@yahoo.com.br

Paulo Caetano da Silva  
Salvador University  
Postgraduate Program, Master Degree in Systems and Computing, Brasil, Bahia, Salvador  
paulocaetano.dasilva@gmail.com

ABSTRACT
The processing of business rules usually occurs through its encoding in software applications, causing impacts that hinder their maintenance and reuse. In the financial area, the centralization of business rules represented in technology XBRL Formula promotes reuse by multiple applications and reduces these impacts. However, its use is not widespread and solutions that enable the applications reusing business rules with flexibility are restricted to proprietary solutions. This article proposes a framework for flexible processing of business rules defined with XBRL Formula from the use of services.

Categories and Subject Descriptors
D.3.3 [Language Constructs and Features]: Frameworks, Web-based services, Domain-specific architectures.

General Terms
Design, Languages

Keywords
XBRL, XBRL Formula, Services, Web Service, Framework.

1. INTRODUCTION
In the current globalized economic conjuncture of Brazil, the volume of negotiation carried on in the financial market has increased values and the competition, in this market, holds a success differential the demand of information with more and more quality, transparency, quickness and low cost. Therefore, the pursuit for reduction in enterprise processes complexity using Information Technology (IT) is a challenge sought by software developers. However, the solutions released in the market are not always able to reach the usability expected in the software of a certain domain with business complexity, because, in many cases, the solution aggregates a set of applications with different formats, released to the user, which do not relate with a single solution, creating difficulties in these resources management.

In the past, the exchange of information among financial market entities happened in an inefficient way, using paper-based or electronic-based forms, forwarded by the sender to the receiver, in a scenario of financial information with a great format diversity that mandatorily needed to be converted according to the needs of the information consumer (SILVA, SILVA E AQUINO JUNIOR, 2006). This scenario was changed by using marking languages that, according to Silva (2010), provide a flexibility that favors the creation vocabularies and grammars for specific domains, in which XML distinguishes itself, used as a format for data transmission that facilitates its extension and adaptation for diverse specializations, in different society segments.

One of these specializations is XBRL, a markup language derived from XML aimed at the financial market (HOFFMAN, 2010), which represented an advance for standardization and reduction of different financial report formats in financial information systems. XBRL Formula technology, an extension of XBRL, represents the basis for processing business financial rules (ENGEL ET AL, 2009). Some business rules are usually reused in different organizational processes, these rules processing takes place usually through codes rewriting in different systems. This makes the process more expensive and disposed to failures. In this context, this work presents a framework, in which, stages business rules processing, represented in XBRL Formula, are turned into services with the usage of WS-BPEL language and web services, eliminating, thus, the need for codes rewriting in the usage of such stages by other processes.

This paper is organized as follows: in Section 2, issues concerning the technologies used in this project are discussed, in Section 3, correlate works are reviewed, in Section 4, the presentation of the proposed framework is carried on, in Section 5, the considerations regarding the proposal and future works are presented.

2. ASSOCIATED TECHNOLOGIES
For comprehending the framework some technologies, thereby discussed, distinguish themselves as essential ones: XBRL, XBRL Formula, Services, Web Service and WS-BPEL.

XBRL: XBRL language was developed from XML to be used in financial data preparation and exchange. These technology functionalities are defined with XLink (DeRose, Maler e Orchard, 2001) and XML Schema (Ezell, Sperberg e Quin, 2001). In order to express financial data with XBRL, in files denominated instances, it is necessary to define a vocabulary, based on XML Schema, and the relation among their terms, defined with XLink.

Figure 1 illustrates XBRL technology set of specifications and its modules with different functions.
XBRL Dimensions allows one to restrict the dimensional information used in the instances, XBRL Formula allows the definition of business rules, XBRL Rendering provides a mechanism for transforming XBRL instances information, for a better understanding, in human language, XBRL Versioning communicates changes performed in XBRL taxonomy and Generic Linkbase allows the creation of new types of resources for the taxonomy or for relation networks (HOFFMAN, 2010).

**XBRL Formula:** The goals of XBRL Formula are related to a specific set of validations that are not available in the specification, 2.1 version, of XBRL language.

According to Hamscher, Shetrim e Kannon (2005), since the initial development of XBRL was recognized the need for expressing, not only specific numeric facts, but also relations among these facts and other relations. In this way, according to Fischer et al. (2008), to solve these issues, a XBRL Formula module was developed, which defines a syntax that can be used to document business rules, through information obtained from XBRL instances (ENGEL ET. AL., 2009). These rules documentation takes place through a grouping of links, denominated linkbase Formula, which provides the taxonomy creators with a collection of XPATH functions (CLARK E DEROSE, 1999), which allow one to accomplish more complex operations in relation to the addition ones, originally foreseen in XBRL specification. An institution business policy can be expressed in XBRL Formula through business rules, restricting or defining some of its aspects and providing an information source for decision making.

In the processing made from XBRL Formula, data input happens through a XBRL instance that specifies data contexts, units and financial facts. A XBRL Formula processor performs the definitions of formulae processing and produces results such as output declarations and facts in XBRL.

**Service:** In software systems domain, Erl (2009) defines a service as a repository of related capacities created from the decomposition of a business process. Services encapsulate the logic for a task or entity in a specific context, which in a standardized and governed collection represent, according to the same author, a service inventory. Once the knowledge of the components of a basic architecture is assimilated, the extraction of pieces necessary to the construction of an automatized solution oriented toward services is made with technology use, such as web service. (ERL, 2011)

**Web Service:** A web service is conceptualized by Kalin (2010) as a distributed application, in which its components can be applied and executed in distinct devices through the use of Simple Object Access Protocol, or simply SOAP, a communication protocol that congregates a set of rules necessary to message exchanges in a decentralized way, based on XML format (KALIN, 2010). SOAP protocol has its definitions established in a WSDL document (KALIN, 2010), which, according to Gomes (2010), represents the service contract elaborated in a XML file that describes the operations that compose web service.

**WS-BPEL:** Business processes based on web services can have their behavior specified by BPEL language (JORDAN, EVDEMON & TC, 2007). Their implementation is similar to programming language ones and can be used in business processes for an interaction focused on messages exchange, preformed thorough orchestration or choreography. According to Rabelo (2010), in orchestration, a central process controls the services and coordinates the execution of different operations. In choreography, the dependence of a central coordinator does not exist, instead of that, each service involved identifies when to execute its operations and with whom they should interact. All of the choreography participants need to identify the business process, the operations that will be executes and the messages that will be exchanged.

These technologies usage is based on the proposal of services usage as a basis for the framework construction. Web services and BPEL technologies represent the most used technologies for these services releasing and composition, by independence platform.

### 3. CORRELATE WORKS

A proposal denominated EFPIF (e-Financial Process Integration Framework) (HUANG, HUANG E TSAI, 2006) uses web services as a mean to integrate financial processes of different institutions with investments analysis. From this integration it is possible to provide information for improving investment environment evaluation, reducing risks and the investment loss. These goals are pointed towards the benefit of investors, companies of investment consultancy, dealers of real estate values, banks and financial companies. This proposal goal is to provide financial services through web services. Financial information would be made available in XBRL and the services would be constructed and made available through the usage of UDDI repository and register (https://www.oasis-open.org/committees/tc_home.php?wg_abbrev=uddi-spec), in a way that participant systems could easily access and find the information of their interest. The services are made available through the systems connected and integrated to the framework through web services and BPEL. Some ideas in this proposal are reused in this work: financial information integration, financial flow integration and reuse.

SBR (Standard Business Reporting) is an initiative from the Australian government oriented to the reduction of financial reports amount, through XBRL language, based on a taxonomy, in which XBRL definitions are established for the Australian financial environment. In this way, Australian companies prepare, store and send data straight from their account systems to government agencies (A.G., 2009). This project works with five main components: (i) a national taxonomy; (ii) a services nucleus; (iii) a regime of governmental authentication (Single Sign-on); (iv) reports standardization; and (v) marketing implementation, as well as of a new culture for Australian financial institutions. The most important advantage in this project is the rationalization of Australian financial environment information usage, with the reduction of unnecessary data and duplication of financial demonstratives forwarded by Australian institutions.

Some other projects were researched: XBRL Implementation Framework (XIF), a framework for developing XBRL report platforms. Its goals are based on: shared knowledge, risk reduction, organized processes integralization and implementation (http://www.br-ag.eu/xbrlimplementationframework). Besides this project, there is Integrated Framework for eChain Bank Accounting Systems, a framework for integrating bank accounting systems known as eChain, which goal is to integrate various financial/accounting softwares with web service, in order to facilitate standardized business electronic files exchange among banks and other institutions. (http://www.emeraldinsight.com/journals.htm?articleid=1463426 &show=abstract&).

In the evaluation of the projects researched, it was not possible to find, in none of them, an approach for business rule processing.
with XBRL Formula, but only a performance in the general context of XBRL 2.1 specification. Besides that, it was not observed an architecture oriented to services paradigm that could provide the flexibility and scalability necessary to the incorporation of new resources, without impacting the processes already defined.


Combining services of the business rule domain, defined in XBRL Formula, for the financial context, released in the form of web services, provides the conception of the proposed do framework, denominated WS–PBRF (Web Service – Processing Business Rules Framework). This framework has as its goal the processing of business rules expressed through XBRL Formula, based on services released in the form of web services. This framework use proposes to make business rules execution flexible, in a way that the services that represent the rules will be able to be reused and the users will have the option of using only the service necessary to their needs.

In this framework, each service acts independently, however they are able to compose other services together, favoring software applications interoperability, reusing information and reducing the need for accounting systems adaptation for any new requirement incorporated in the processing. The components are distributed in the three layers of this architecture, illustrated in Figure 2: presentation, application and data.

![Figure 2 - Service Framework for business rules.](image)

The first layer represents the interface for the consumers of the services provided by the framework: sending/receiving information (Input/Output) and the register of each consumer’s action when using the framework services (Output Log), this one controlled by Audit Log service. The communication between this first layer and the second is performed in Web, through HTTP protocol.

In the second layer are the services released by the framework through an application service. These services are focused on a services inventory, which propose is illustrated in Figure 3, in which it is possible to observe the higher layer containing some proposed services identified through the numeration 1, 2 and 3 and the service candidates identified through the numeration 4, 5, 6 and 7 that, although planned, are not finalized yet. In the lower layer, one can observe a service, identified by the number 8, created from the composition of services that already exist in the higher layer. Although to the final user this is a unique service, in practice, it is an interface to execute services 1, 2 and 3 orchestrated by the composition language, WS-BPEL.

![Figure 3 – Model of the proposed framework Services Inventory. Source: based on the model proposed by Erl (2009)](image)

This inventory logically congregates all services incorporated to the framework (it means that the services do not need to be physically at the same place – server –, the consumer only needs to know where and how to localize the service registers). In this layer are the services of: (i) Audit Log, responsible for registering the consumer’s actions, such as input to risk management (analysis of performance, safety, usability); (ii) Authentication, responsible for providing permission to the user in order to have access to the framework services; (iii) Authorization, which defines what services the authenticated user will be able to use; (iv) Structural Validation, which will analyze if the files (XBRL instance, taxonomy and linkbase formula) have their structures correctly defined, based on XBRL; (v) Data Extraction, responsible for capturing financial information contained both in the XBRL instance file and in the linkbase Formula, which specifies the processing rules of instance data; (vi) Formulae Calculation, responsible for processing formulae from the business rules (expressed in the linkbase Formula) and the forwarded data; and (vii) Data Validation, will validate the values from the formulae calculation obtained in linkbase Formula against the instance, the calculation service is encapsulated in this service as a subprocess. The last four listed services (iv, v, vi and vii) represent the main processing services, in this project, identified as XBRL Formula processing nucleus. XBRL Formula processing service is made available through the composition of three of the processing nucleus services (iv, v e vi) managed by WS-BPEL language.

The Data Extraction service uses a repository to storage the data extracted from XBRL instances and the formulae captured in the linkbase Formula. This repository is represented in the third layer of the model proposed for the framework.

In this process implementation, illustrated in Figure 2, the inventory was constructed and released through the application server, web TomCat – 7.0.4 version, in which services were inserted for the files structural validation (instance and linkbase Formula), data extraction of these files and formulae calculation. Client softwares consume each of these services through the forwarding of XBRL instance files and linkbase Formula. In the framework execution it is possible to identify the non-localized links both in the instance file and in the linkbase, besides the elements of the instance file absent in the taxonomy linked to the instance, performing the structural validation of the files in processing. The calculation processing takes place in the
calculation service and the result released to the consumer through the output web service (output). To perform the framework tests, the files of taxonomy, instance and linkbase Formula based on US Financial Reporting Taxonomy Framework (USFRTF) (http://xbrl.us/taxonomies/Pages/default.aspx) were used.

5. CONCLUSION
This paper presents a solution for flexibilization and reuse of business rules processing, through the usage of services and XBRL Formula. This focus enables the reuse of functionalities for other situations that are not restricted to the XBRL Formula, but for diverse XBRL technology modules. Besides that, the incorporation of a mechanism of services register facilitates the access to the service consumer (account-financial system of an institution or physical person) and can establish the possibility of distributing business rules processing, differently from how it was implemented the example of test, because such services would be registered in only one place and remotely executed. This register represents an indicator for the service released. Thus, both the development and the implementation of the services could be made and released in any other place. It favors the elaboration of an environment that provides the incorporation of new services without the need of changing the applications that use them.

This proposal, still in the elaboration phase, has as an activity to be developed for validation the incorporation of tests and the practical application in a real environment. Besides that, it is planned the incorporation of specific services for the business safety, including safe authentication with, at least, two phases, associated to audit and cryptography.

It is also a future pretension proposing a Service Oriented Architecture (SOA) with all the components that permeates this approach in the application of XBRL Formula with module. For starting, it is being researched the creation of a SOA repository and register, in which the employment of the service inventory already proposed in this paper is included.

6. REFERENCES