



Erasmus School of Economics

## Security in the XBRL Business Information Supply Chain

*An explorative study on integrity and authentication issues in the XBRL Business Information Supply Chain*

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**Master's thesis**

**Erasmus University Rotterdam**

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## **Abstract**

The (World Wide) Web is increasingly used by organizations for communication with their stakeholders. Around the year 2000 the eXtensible Business Reporting Language (XBRL) was introduced and is becoming de-facto the standard for business reporting. The introduction of XBRL enables publishing semantic documents, which enables users of financial information to process data in an automated manner and perform large-scale low-cost research. This makes it a relevant issue whether this data in XBRL format is accurate and reliable. As XBRL can be applied in several parts of the business information supply chain it becomes quite relevant to look at the integrity and authentication issues that arise when XBRL will be used on a large scale. This thesis investigates whether there are appropriate solutions available for the security issues that arise in the Business Information Supply Chain (BISC) when using XBRL. The research question is approached by performing an explorative case-study in which both XBRL projects and XBRL-enabled software are investigated. The results are presented by describing the differences that appear in the BISC with the introduction of XBRL and several security issues are identified. It is concluded that XBRL instance documents can serve as a complementary service to a human readable document.

**Keywords:** XBRL, semantic business reporting, business information supply chain, secure internet financial reporting, assurance.

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# 1 Introduction

## 1.1 Introduction to the subject

These days the (World Wide) Web is increasingly used by organizations for communication with their stakeholders. It is quite ubiquitous for medium and large companies to publish business information such as the annual report on their websites. Currently, most of these reports are (digital) copies of the paper reports solely intended for humans and thus are not machine-readable. In recent developments, often referred to as Web 2.0, the semantic web and its applications are gaining popularity. An example in the area of semantic languages is XBRL, which is an XML-based language that can be used for making business documents such as the annual report semantic and thus machine readable. As this trend is expected to grow in the near future, it becomes more relevant that the semantically presented information is accurate and reliable. Therefore, it is relevant to reveal which security issues can be expected when XBRL will be used on a larger scale as investigated in this thesis.

## 1.2 Research objective

The contribution of this thesis is that it aims to broaden knowledge and provide insight into the security issues that arise when XBRL is implemented on a large scale. As XBRL can be used at different locations in the Business Information Supply Chain and integrity and authentication are the most relevant security requirement (see also section 2.5), the research question is:

***“Are there appropriate solutions available for the integrity and authentication issues that arise in the Business Information Supply Chain when using XBRL?”***

The following four knowledge areas are relevant for this thesis:

- ***Business reporting;***
- ***eXtensible Business Reporting Language (XBRL);***
- ***Business Information Supply Chain (BISC);***
- ***Information Security.***

The next chapter will provide this theoretical background.

## 1.3 Scope

XBRL is an emerging standard and is currently being adopted by several companies and governments. These companies are commonly listed at stock exchanges. Therefore, this thesis will focus on medium and large public companies that are quoted at stock exchanges. Although the outcomes of this research can also be relevant to other organizations, these are

omitted from the research project. As research data need to be collected the focus will be on XBRL projects, which have information on its details publicly available.

#### **1.4 Relevance**

There are three main reasons why it is relevant to study the security aspects of XBRL. First of all, the popularity of the XBRL standard is increasing. The second reason is the increased attention for corporate governance. Finally, the third reason is trust in financial markets.

##### **Increasing popularity of XBRL**

It looks like the widespread adoption of XBRL is actually becoming reality. Several organizations, e.g. the Dutch government or the American SEC, are investing in XBRL projects. Also banks are starting to request company data in the XBRL format. Therefore, it is a plausible story that more and more information in the XBRL format will be available in the near future, which is supported by early findings that XBRL can decrease reporting costs and increase transparency (Pinsker and Li 2008). As this information might well be used for all kinds of automated transactions and research projects, it is very important that this information is accurate and reliable. As a result of this popularity gain accountants encounter integrity problems of XBRL instances for which they sign the auditor's report and security is becoming a relevant item on the agenda as mentioned by several authors (e.g. Heitmann and Öhling 2005; Debreceny and Gray 2001 page 68). More recent studies (Plumlee and Plumlee 2008; Boritz and No 2008) identify the assurance of XBRL documents as a serious concern and put it on top of the research agenda.

##### **Corporate governance**

The second reason to investigate XBRL security is the increased attention for corporate governance. Smith and Pierce (2005) investigated the integrity of internet financial reporting (IFR) and concluded that the governance framework surrounding IFR has received insufficient managerial attention. Several legal measures were taken such as the Sarbanes-Oxley (SOX) Act and the Basel II accord. Several scholars have discussed the relation between this decree and XBRL. Sel (2003) argues that XBRL is a particular technological aspect for representing financial information and is thus covered by this legislative measure. Gluchowski and Pastwa (2007) believe XBRL could help enforcing this kind of legislation and presented an approach in which XBRL and Web services were used for (semi-) automated Basel II-reporting. Akonoh (2006) concludes that XBRL helps companies comply with the mandates set forth by corporate legislation, and fills in many of the information deficiencies highlighted in revealed frauds. Others argue that XBRL could provide better monitoring possibilities for governmental regulators such as Otten and Kaymak (2007) who presented

an approach to detect suspicious accounting structures regarding chain participating (such as used in the Enron case) from XBRL reports.

### **Trust in financial markets**

The third reason why information security in the case of XBRL is so important is trust. To let financial markets work efficiently it is very important that market information is trusted by investors and other users of business information. As XBRL security is a topic that is scarcely covered in the academic literature it can be concluded that both from a social and academic viewpoint some research in the area of XBRL security is needed and therefore: “*The adoption of secure XBRL can further help us make Europe a competitive player on the global field*” (Sel 2003). A recent paper by Lin et al. (2008) discusses the possibility to use XBRL for crisis prediction using also non-financial indicators. This thesis contributes to the discussion by conducting explorative research.

### **1.5 Relation to the Master programme**

This thesis is part of the Master Economics & Informatics, more specific the Economics and ICT programme. XBRL was introduced in the Accounting Process Management course, which was discussed in Chapter 14 of the book *Accounting Information Systems* by Romney and Steinbart (2006). The topic of security was covered in the Security & ICT Audit course in which the book *Principles of Information Systems Security: text and cases* by Dhillon (2007) was used. Both graduate courses will serve as a starting point for this thesis as suggested by Van Asperen (2008).

### **1.6 Personal motivation**

Already before being a student a long term interest of security was developed. During my Bachelor education in Economics, XBRL was introduced to me by E.J. Stokking of the University of Groningen. This resulted in writing my Bachelor thesis for both Computer Sciences and Economics about the Dutch (XBRL) Taxonomy, which was combined with an internship at Dun & Bradstreet in Rotterdam. Being already an inhabitant of this city, it was decided to obtain my Master degree at the Erasmus university in Rotterdam. This thesis will be the final work.

### **1.7 Outline thesis**

After this introduction, which presented the research objective and relevance, the second chapter will discuss the theoretical background information regarding business reporting, XBRL, the business information supply chain and information security. Chapter 3 relates the research question to previous academic work and discusses the chosen research design and methodology. In chapter 4 the results of the performed explorative study can be found. The final chapter delivers the conclusions and limitations of the research project and gives



suggestions for future research. A bibliography completes this thesis and for reading comfort a list with used abbreviations and an overview of the figures, tables and examples can be found.

### **1.8 Summary introduction**

As the web is increasingly being used by organizations for communication with their stakeholders there is a rising need for semantic languages for business information such as XBRL. Due to the increasing popularity of XBRL, the increased attention for corporate governance and the required trust in financial markets, it becomes relevant to study the security problems that arise. This thesis investigates whether there are appropriate solutions available for the integrity and authentication issues that arise in the Business Information Supply Chain when using XBRL.

## **2 Theoretical Background**

### **2.1 Introduction**

The second chapter introduces the reader to the relevant background information about the area of research and serves as a basis for the remainder of this thesis. Therefore, it discusses the relevant literature on four topics, namely business reporting, XBRL, the business information supply chain and information security. Literature from the academic and professional literature was used. For this area of research two books were especially useful. The first book is a research monograph edited by Dr. Saeed J. Roohani of Bryant College. In *“Trust and Data Assurances in Capital Markets: The Role of Technology Solutions”* several papers deal with the (in 2003) new opportunities in business information reporting and assurances with a focus on XBRL. The second book *“New Dimensions of Business Reporting and XBRL”* by Debreceeny, Felden and Piechocki (2007) is more recent and discusses in the same academic format the general, domain and technical implications of XBRL. Both books provide a comprehensive overview of the academic literature about XBRL which has only a history of approximately one decade and is not very comprehensive. From both books several papers were used that can be found in the bibliography.

## 2.2 Business reporting

*“The annual report of the 21st century will not be annual report and it will not be a report: it will be an up to date informative permanent dialogue”* **(Alan Benjamin 1998)**

As mentioned before the (World Wide) Web is increasingly used for corporate reporting. The Web is becoming an important communication channel for companies to reach their stakeholders. Currently many (publicly listed) companies provide online business reporting, such as providing their annual report on their websites. In a Delphi study about financial reporting on the internet Jones and Xiao (2004) report a 100% consensus by experts that by 2010 the Internet will be the standard way for large and medium companies of communicating with their shareholders and that both the hard copy annual report and the electronic copy will coexist. In most countries companies are legally forced to disclose information such as their annual report. This might be because many companies are attempting to leverage the power of financial information by creating corporate websites to provide such information to employees, investors, and financial analysts (Boritz and No 2005). Another reason might be that financial reporting is a cornerstone in the functioning of the capital market (Sel 2003). This paragraph will introduce several related topics in the field of business reporting to the reader.

### 2.2.1 Accounting standards

Nowadays anyone with access to the internet can download and read published reports and do their own analysis, such as comparing the financial figures of similar companies. To make sure different companies use the same standards to publish their financial information, accounting standards have been developed. Many countries have their own accounting principles, often called Generally Accepted Accounting Principles (GAAP), e.g. US-GAAP which are the accounting principles used in the United States. As a result of the globalization of the economy in which multinational companies exist, a need for more international standards was raised. Since the year 2000 large public companies in the European Union have to report according to the International Financial Reporting Standards (IFRS), formerly known as the International Accounting Standards (IAS). These days many countries around the world have adopted IFRS as the accounting standard for public companies and even the United States of America are planning to adopt IFRS.

### 2.2.2 Use of business reports

In most countries companies are legally obliged to disclose corporate information such as financial statements to their stakeholders (e.g. shareholders, governments, suppliers, and the general public). A well-known example is the publication of the annual report, which can

consist of an income statement, balance sheet, and several other statements that provide information about the organization. In many cases a public accountant performs an audit and puts his findings in an Auditors' report to prove the figures in the report are according to the used accounting standards. Accounting standards enable humans to analyze and compare different companies. But for automated analysis or large-scale research this is not sufficient. Therefore data need to be presented in a semantic format. Hodge et al. (2004) suggest that search-facilitating technologies aid financial statement users by improving the transparency of firm's financial statement information and managers' choices for reporting that information. With emerging technologies sometimes called Web 2.0 or the Semantic Web, it is likely to be at the beginning of an era in which the Internet will be used for more sophisticated public business reporting. One standard that provides the possibility for semantic business reporting is XBRL. XBRL is becoming the de facto standard for business reporting (Williams et al. 2006) and will be discussed in the next paragraph. There are several organizations that interact as an intermediary by aggregating data from the different organizations, such as the governmental statistics departments, but also commercial companies that for example provide bankruptcy ratings.

### **2.2.3 Assurance**

In order to have strong and healthy markets it is relied on the public availability of financial statements such as the annual report. Many countries force companies to submit their annual report to the local Chambers of Commerce. In order to make sure that the information is reliable assurance practices have been developed. In most medium and large companies the figures in official business documents are audited by a public auditor. The auditor does not only checks whether the financial statements are correct (e.g. by checking whether the items listed on the balance sheet are actually there and valued correct) but also investigates whether the figures were retrieved correct by performing an audit-trail. As the (business) world is becoming a global marketplace and the world is changing rapidly more frequent reporting might be needed. In the United States already quarterly reports are required by the local authorities and there is much debate about so-called continuous auditing. Some authors even argue that the current annual report will be replaced by continuous auditing in the near future. In order to facilitate such continuous streams of information it is very practical to have some sort of standard, e.g. XBRL, and a solid technical infrastructure.

### **2.2.4 The current reporting process**

Companies need to report all kinds of information to their stakeholders. In the current reporting process a company generates from its internal data an external report of which the validity is audited by an accountant. Both paper and electronic version of the report are provided to the stakeholders. This audited version is submitted to the various authorities and is published on their website and stakeholders can request a paper copy to be sent by mail.

Several analysts around the world will use the information and in many cases the information will be keyed in by secretaries or data will be bought from data aggregators. In many cases a PDF version of the annual report is available on companies' websites. Smith and Pierce (2005) found that in many cases unsecured PDF-versions were used, while it is possible to secure your PDF for integrity reasons. Therefore it is possible that the content of the report has been altered after the audit sign off. Chapter 4 will focus more on this matter.

## 2.3 eXtensible Business Reporting Language (XBRL)

The eXtensible Business Reporting Language (XBRL), which was formerly known as XFRML, is an XML-based open standard developed for business reporting purposes. Since its early developments around the year 2000 (e.g. Debreceeny 2001) XBRL has received attention in both the professional and academic literature, but most of it is written in largely expository mode (Debreceeny 2007). This section introduces the reader to relevant aspects of XBRL. More detailed information can be found in the *Hitchhikers Guide to Understanding the IFRS-GP Taxonomy* (Egan 2005) or the current version of the XBRL specifications (Engel et al. 2006). In addition, there are numerous books available on the subject of XBRL.

### 2.3.1 Technical aspects of XBRL

XBRL is an extension of the eXtensible Markup Language (XML) of which its specifications are maintained by xbrl.org. The main idea behind XML is that data elements are given a meaning where the data and its presentation are separated. This is done using so-called tags, e.g.

```
<thesis>
  <title>Security in the XBRL Business Information Supply Chain</title>
  <author>
    <firstnames>Paul Anton Willem</firstnames>
    <lastname>Feitsma</lastname>
  </author>
</thesis>
```

**Example 2.1: A basic example of the usage of XML**

which defines in a semantic way who is the author of this thesis. Note that the information in this example is organized in a hierarchical way and ‘tags’ the content of the different data elements. It is easy to imagine that for automated processes (e.g. search engines) this makes much more sense than the name that is printed on the front page of this thesis, and that this becomes especially useful when all theses are described using the same semantic definitions. In order to make sure different parties use the same tags for a specific reporting purpose the concept of XBRL taxonomies have been introduced.

### XBRL taxonomies

An XBRL taxonomy could be seen as a dictionary in which the meta-data consisting of reporting elements and relations between these elements are defined. It is possible to create a company specific taxonomy, but for various jurisdictions taxonomies that cover the various

(accounting) regulations are publicly available<sup>1</sup>. Two general types of taxonomies are available. The first type is called financial reporting taxonomies (XBRL-FR) which deal with the specific accounting regulations and are meant for external reporting. The second type of taxonomies is called the global or general ledger taxonomy (XBRL-GL) and is meant for internal accounting purposes and provides a way to store a companies accounting information independent of the used information of the used information system. Currently XBRL-FR taxonomies are becoming used in several places around the world, while the adoption of XBRL-GL is rarely scarce. The elements which are defined in a taxonomy are ordered in the form of a tree as graphically shown in Figure 2.1. Taxonomies also consist of link bases of which several types are available. Although some taxonomies are very comprehensive, it is imaginable that organizations need internal more detailed information. For this purpose it is possible to extend a taxonomy. There has been some research in the field of taxonomies, e.g. Pijls (2007) concludes that there is a high rate of redundancy in the Dutch XBRL taxonomy.

Assets, Total
Assets, Non-Current, Total
Property, Plant and Equipment, Net
Investment Property
Intangible Assets, Net
Biological Assets
Investments in Subsidiaries, at Cost
Investments in Associates, at Cost
Investments in Joint Ventures, at Cost
Equity Method Accounted Investments, Total
Equity Method Accounted Investments in Associates
Other Equity Method Accounted Investments
Deferred Tax Assets
Assets Pledged as Collateral Subject to Sale or Repledging, Non-Current
Other Financial Assets, Non-Current
Hedging Assets, Non-Current
Trade and Other Receivables, Net, Non-Current
Prepayments, Non-Current

**Figure 2.1: Sample from the IFRS taxonomy**  
**source: IASB**

**Instance documents**

When a taxonomy is used by an organization to report information (e.g. publishing its annual report) a so-called instance document is created. This instance document is essentially a text-based file in which the company-specific reporting elements are mapped to the taxonomy. In example 2.2 a fragment of an XBRL instance document is shown. For humans it is quite hard to read this document, but when looking at the details some things might become clear.

<sup>1</sup> Approved taxonomies can be found on: <http://www.xbrl.org/Taxonomies/>

```

<xbrl xmlns="http://www.xbrl.org/2003/instance"
xmlns:xlink="http://www.xbrl.org/2001/XLink"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:iascf-pfs="http://www.xbrl.org/taxonomy/int/fr/ias/ci/pfs/2002-11-15/WINDOW"
xsi:schemaLocation="http://www.xbrl.org/taxonomy/int/fr/ias/ci/pfs/2002-11-15/
ias-ci-pfs-2002-11-15-WINDOW.xsd">
<link:schemaRef xlink:type="simple"
xlink:href="http://www.xbrl.org/taxonomy/int/fr/ias/ci/pfs/2002-11-15/ias-ci-pfs-
2002-11-15-WINDOW.xsd"/>
<!-- ... -->
<iascf-pfs:CurrentAssets precision="5" unitRef="u1"
contextRef="c1">354450</iascf-pfs:CurrentAssets>
<iascf-pfs:NonCurrentAssets precision="6" unitRef="u1"
contextRef="c1">325788</iascf-pfs:NonCurrentAssets>
<!-- ... -->
<context id="c1">
<entity>
<identifier scheme="http://www.MyHomePage.com/">MyPrivateConsulting</identifier>
</entity>
<period>
<instant>2003-12-31</instant>
</period>
</context>
<unit id="u1">
<measure xmlns:ISO4217="http://www.xbrl.org/2003/iso4217">ISO4217:EUR</measure>
</unit>
</xbrl>

```

**Example 2.2: Basic XBRL instance document.**

source: Poels (2004)

The instance document can be found between the <xbrl> and </xbrl> tags. First there are references to the XML and XBRL specifications that can be found elsewhere. In the second part of the example two balance sheet items can be identified. The current assets have a value of 354450 with a precision of 5 significant digits.

Element 'CashAndBalancesWithCentralBanks' has a value of 17896000000 in the currency EUR and has a significance of -6, which means that it has been rounded on millions of Euros. Every instance document links to both the XBRL specification and certain linkbases as shown in Figure 2.2. The XBRL instance uses the XML schema in which the basic XML



concepts are specified. XBRL uses linkbases for several purposes as described in the next paragraph.

### Linkbases

A taxonomy consists of a schema and associated linkbases, which are coupled to the instance document shown in figure 2.2. In XBRL there are several types of linkbases of which the label, presentation and calculation linkbases are the most important. The label linkbases link the individual concepts with labels in different languages. When a taxonomy is filled with different languages it is possible to show an XBRL instance document in the requested languages. The presentation linkbases are used for concepts that are aggregates for other concepts. Calculation linkbases provide the possibility for schemas which are an addition of other concepts, such as the “Assets, Total” in Figure 2.1.

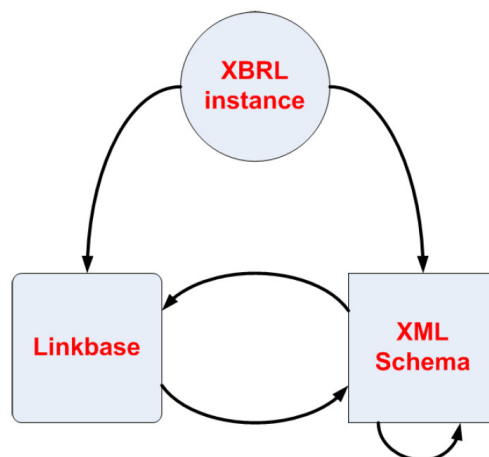


Figure 2.2: Graphical presentation of XBRL  
source: <http://sky.fit.qut.edu.au/~edmond/ddp/LectureMaterial/xbrlBeamer.pdf>

### Stylesheets

Instance documents contain the specific data elements of a certain organization structured according to the specifications in a taxonomy. The information in the instance documents is fairly difficult to read for human beings. In order to convert the data in the instance document to a human readable format (e.g. a PDF document or a HTML page) stylesheets can be used. For specific reporting purposes stylesheets have been developed.

### Validation

In order to make sure the instance document is correct according to the specifications of the XML, XBRL and specific taxonomy specifications instance documents need to be validated. That an instance document is valid means that it is validated according to the XBRL specifications, but that does not mean that the reported data elements are fully correct.

### 2.3.2 The organization behind XBRL

XBRL is being developed and promoted by a consortium of companies and organizations named XBRL International, which is comprised of local jurisdictions (e.g. XBRL Netherlands). Currently the consortium consists of more than 500 companies and agencies worldwide. All major players in the business information supply chain are participating. Members of the consortium meet regularly at international conferences and work together in working groups. Also several mailing lists are available to discuss XBRL related issues.

	AKZONOBEL	BUHRMANN	HAGEMEYER	HELDMANS	OPGGROEP	PHILIPS	AVERAGE
<b>Balance Sheet</b>	2004-12-31	2004-12-31	2004-12-31	2004-12-31	2004-12-31	2004-12-31	
<b>Income Statement</b>	2004	2004	2004	2004	2004	2004	
<b>Income Statement (Presentation)</b>							
<b>Profit (Loss) from Operations (Presentation)</b>							
<b>Gross Profit [by function] (Presentation)</b>							
Revenue, Total [by function]	12.833.000.000	5.553.000.000	5.426.745.000	2.672.194.000	2.071.302.000	29.346.000.000	9.650.373.500
Cost of Sales [by function]	6.825.000.000	3.882.000.000	4.174.442.000	2.442.354.000	1.684.208.000	19.516.000.000	6.420.667.333
<b>Gross Profit [by function]</b>	6.008.000.000	1.671.000.000	1.252.303.000	229.840.000	387.094.000	9.830.000.000	3.229.706.167
<b>Other Operating Income [by function] (Presentation)</b>							
Miscellaneous Other Operating Income [by function]	663.000.000		50.401.000	2.920.000	13.734.000	991.000.000	344.211.000
<b>Other Operating Income, Total [by function]</b>	663.000.000		50.401.000	2.920.000	13.734.000	991.000.000	344.211.000
<b>Operating Expenses [by function] (Presentation)</b>							
Marketing and Distribution Costs [by function]	3.254.000.000			24.400.000		4.558.000.000	2.612.133.333
Research and Development	816.000.000					2.326.000.000	1.571.000.000

Figure 2.3: A demonstration of the possibilities that XBRL provides

source: <http://xbml.rienks.biz/compare13.php>

### 2.3.3 Need for XBRL

Now there is a standard language for financial documents this raises the question whether there is a need for XBRL? Several organizations (banks, data aggregators, etc.) spend enormous amount of time and money on digitalizing financial documents. And once the information has been digitalized it is not shared with other organizations that need the same information/data. Note that XBRL documents are system independent, which means that an XBRL instance document can be used using various operating systems and programs. These only need to be able to read XBRL documents and its accompanying taxonomy. The widespread adoption of XBRL would mean that both humans and intelligent software agents could operate on financial information disseminated on the Web with a high degree of accuracy and reliability (Debreceny and Gray 2001). It also has the potential to enrich the data available to analysts and researchers (Teixeira 2002). These kinds of analysis are currently very expensive as all the data need to be made machine-readable first (there are actually companies which do this). Bernard Rienks shows on his website<sup>2</sup> some of the actual advantages of XBRL. With one easy click it is possible to compare different companies as shown in Figure 2.3. Unfortunately the main problem with these kinds of technology adoption is the network effect: XBRL will only be useful when everyone will use this standard. There is still a long road ahead. But if XBRL actually becomes de-facto a widely used standard the next step will be the rise and development of intelligent software agents.

<sup>2</sup> See also: <http://xbml.rienks.biz>

## 2.4 The Business Information Supply Chain

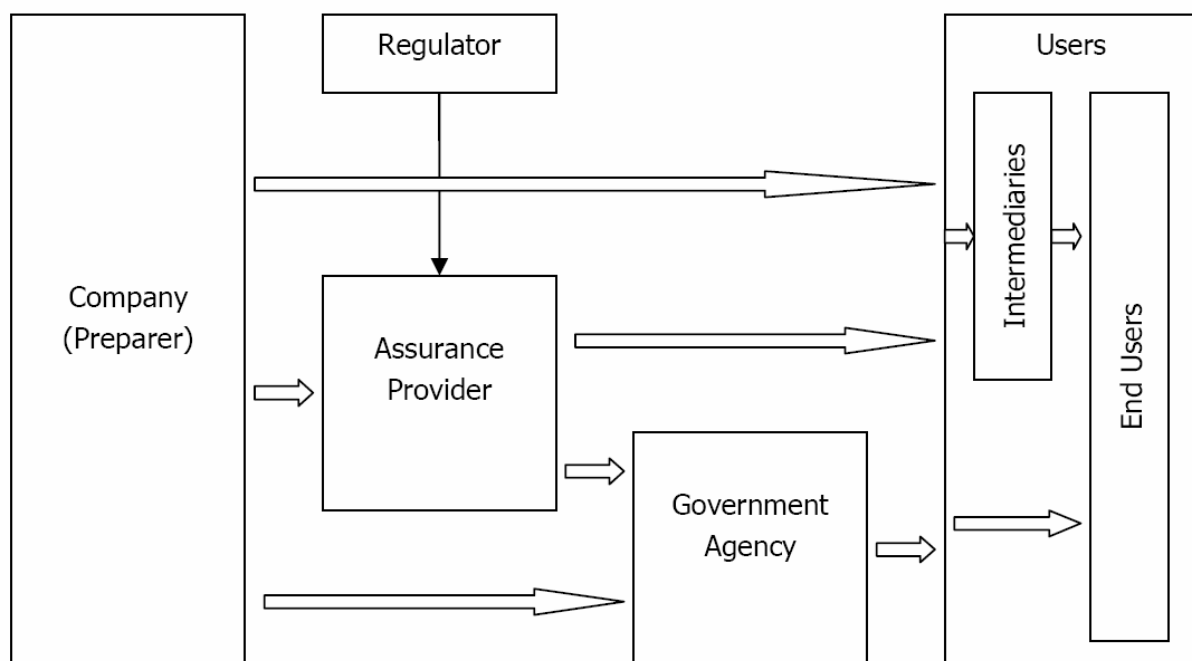
In order to understand how information flows from a company to its stakeholders the concept of the Business Information Supply Chain (BISC) is introduced in this paragraph.

### 2.4.1 Definition

The BISC is sometimes called the (Integrated IT-supported) (Corporate/Business/Financial) Reporting/Information Supply Chain (e.g. Debreceeny 2007; Heitmann and Öhling 2005). For this thesis the definition by Heitmann and Öhling (2005) is the most appropriate and will be used:

***“The Business Information Supply Chain explains the relations between stakeholders in a business environment and the flow of business information between them”.***

Figure 2.4 shows a graphical representation of the BISC. It can be noticed that several documents are transferred to the intended users directly while other documents first pass an intermediary, such as a government agency or an assurance provider.



**Figure 2.4: The Business Information Supply Chain**

source: Heitmann and Öhling (2005) who adapted it from Wagenhofer (2003)

In most countries there are several government agencies that request information from companies. An example is the regulatory filing of the annual report at the Chambers of Commerce. Whether the filed documents are available to the end users depends on the local

regulations and the purpose of the filing. An example is the difference between the filing of the information that is publicly available at the local Chambers of Commerce (CoC) and the information that is requested by the Tax authority. The goal of the filing at the CoC is to provide the public (e.g. other companies that do business with the specific company) information about the assets and liabilities of their trading partners. On the other hand the tax authorities need much more detailed information to make sure the figures in the received tax forms are reliable. Next to the information requested by the various governmental agencies companies sometimes voluntarily release information to the public, such as press releases. Larger organizations use an assurance provider (or public accountant) to proof the provided information is reliable and is audited according to the local regulations.

#### **2.4.2 Technological solutions in the BISC**

In order to let this information flow through the chain automated techniques are developed. A popular paradigm for doing this is the Service Oriented Architecture (SOA). Another paradigm that is gaining popularity is Software as a Service (SaaS). As the information will flow through this chain and the governments, intermediaries and other end-users will use these data-sources for all kinds of applications. Therefore controls need to be applied which are developed in the field of information security which will be dealt with in the next paragraph.

## 2.5 Information Security

This paragraph introduces several concepts from the information security field to the reader that are relevant for this thesis. First security requirements are discussed. Secondly security threats that can be found in the XBRL arena. Finally we discuss which solutions are available from the information security area.

### 2.5.1 Security requirements

There are several security requirements that are needed to protect your data. Dhillon (2007 pp. 19) mentions the following five data security requirements, namely:

- 1) **Confidentiality** ensures privacy of data;
- 2) **Integrity** ensures that data and programs are changed in an authorized manner;
- 3) **Availability** ensures proper functioning of all systems such that there is no denial of service to authorized users;
- 4) **Authentication** assures that the message is from the source it claims to be from;
- 5) **Non-repudiation** prevents an individual or entity from denying having performed a particular action related to data.

As XBRL instance documents are likely to be made public available (such as public disclosure at the Chambers of Commerce) confidentiality is not a major issue in the BISC. Although this might be a serious issue in the XBRL-GL area, but that is outside the scope of this thesis. That this instance document need to be accurate is obvious. Therefore integrity is a very relevant issue when considering XBRL security. The availability of XBRL-coded information is relevant, but is outside the scope of this thesis. Many other papers deal with availability issues. Authentication on the other hand is very relevant, because serious problems might arise when someone else can publish a document claiming to be another organization. Non-repudiation might be a serious issue in the XBRL-GL area, but not for this thesis. Although all five requirements are relevant in the XBRL business information supply chain, this thesis especially focuses on integrity and authentication.

### 2.5.2 XBRL related information security threats

What are the security threats to the usage of the XBRL standard? First of all we should notice that XBRL will be used generally on the Internet. There are several security related issues of public networks, such as the Internet, that are important to consider. Security issues related to the Internet are important due to the fact that the Internet is an insecure and unreliable public network (Boritz and No 2005). Second it should be noticed that XBRL was not developed from a security perspective. Paragraph 3.3 (Data integrity and confidentiality) of the XBRL specification contains:

*“There are many applications that require business information to be transmitted securely, with a particular emphasis on data integrity (leading to the use of hash totals, etc.) and with confidentiality (leading to the use of cryptographic means of protection). XBRL deliberately provides neither of these mechanisms, since its focus is on transmission of actual content in an agreed-upon format. It is assumed that, like any other block of data, data integrity can be enhanced by adding redundant error correction bytes, by cryptographic hashing and signing with a private key, etc. These mechanisms are all outside the scope of XBRL. An XBRL instance does not have to be aware of whether all or some of it has been manipulated to be signed, encrypted, canonicalised, compressed, etc. By the time XBRL processing has to take place, all of those manipulations will have been unwound, and the XBRL payload will be free of any evidence of those operations.”* (Engel et al. 2006)

In the upcoming chapters we will discuss the XBRL related integrity and authentication issues in more detail.

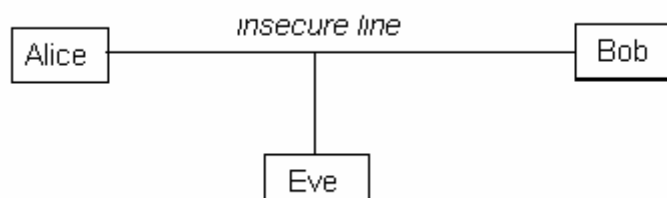
### **2.5.3 Solutions from the security field**

Over the years several solutions have been developed for the security threats of which the relevant ones will be discussed here. Cryptography is an important field that need to be introduced after which several applications are discussed.

#### **Cryptography**

A problem that is especially relevant on the internet is that information that is send from A to B can be intercepted and modified, such as shown in figure 2.6. One of the methods to secure your data is the usage of cryptography, which includes methods and techniques to ensure secrecy and authenticity of message transmissions (Dhillon 2007). Basically two types of cryptography exists. First, symmetric cryptography uses cryptographic methods in which both the sender and receiver need to have access to the same secret key. In practice (such as on the internet) it is very difficult to transmit this key secure and therefore the second type of cryptographic methods was developed. Second, asymmetric cryptographic methods use both a private and a public key, which are generated as a key-pair. Using the public key it is possible to decrypt a message which can only be deciphered using the private key which is only known to the owner. The other way around is also possible. When the integrity of a specific document need to be maintained it is possible to sign this document with a digital signature using a private key. With the public key anyone can verify whether the document was actually signed by this person and whether the document was not modified by a third party. Note that the scientific field of cryptography is very active. Due to the fact that computers are becoming faster some cryptographic algorithms can become weak. Therefore it is important to apply algorithms that are expected to be strong for the near future. Some authors even argue that the rise of quantum computers will make traditional cryptographic

techniques obsolete (e.g. Wehner 2008). This thesis is not intended to discuss the various types of cryptographic methods to be used. When considering to implement cryptography the help of an expert is recommended, because it is a very complex issue.



**Figure 2.5 : Insecure connection such as on the Internet**

### **Safe usage of the Internet**

As said before the internet is not a safe place. This is caused by the fact that the internet has not been developed from a security viewpoint. Data is being sent over the internet over several hops and can be intercepted or modified. To make sure no one can read the data stream solutions such as Secure Socket Layer (SSL) or Secure Shell (SSH) have been developed. SSL is implemented in many web browsers, which you can notice when you visit a website that starts with `https://`.

### **XML Security solutions**

As XBRL is based on XML the security of XML need to be discussed. The XML standard is maintained by the World Wide Web Consortium (W3C) and published the “XML Signature Syntax and Processing” (2008) on its website<sup>3</sup>: *“this document specifies XML digital signature processing rules and syntax. XML Signatures provide integrity, message authentication, and/or signer authentication services for data of any type, whether located within the XML that includes the signature or elsewhere”*. XML signatures can be both inside the XML document (so-called enveloped signatures) and a resource outside the XML document. This seem to be a quite difficult process in practice.

### **Security in PDF documents**

According to the PDF specifications (Adobe 2006 section 3.5) *“a PDF document can be encrypted to protect its contents from unauthorized access”*. For business information it is quite relevant to use this to ensure corporate documents are not modified by a third party and are distributed.

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<sup>3</sup> See also: <http://www.w3.org/TR/xmlsig-core/>

## 2.6 Summary Theoretical Background

In this chapter the theoretical background of this thesis was covered, discussing four topics.

- **Business reporting** these days is becoming more and more an online and global activity. International accounting standards have been developed to make the financial information of different companies comparable. In order to guarantee the reliability of the figures in a financial statement assurance is provided using a public auditor. Several documents need to be disclosed to the public.
- **XBRL** is an XML-based open standard developed for business reporting purposes. It uses tags to make data elements semantic, which are defined in a taxonomy in which meta-data consisting of reporting elements and relations between these elements are defined. An instance document contains the data of a specific reporting entity and contains the actual figures. Using stylesheets the information in an instance document can be transformed to a human readable format (e.g. PDF or HTML).
- The **Business Information Supply Chain** (BISC) explains the relations between stakeholders in a business environment and the flow of business information between them. XBRL can cause several changes in the BISC.
- **Information Security** is a serious issue in the XBRL BISC. There are several threats can harm the integrity and authentication security requirements of XBRL documents. Integrity ensures that data and programs are changed in an authorized manner. Authentication assures that the message is from the source it claims to be from. There are several solutions available such as cryptography and XML security.

The next chapter discusses the academic research that already has been performed in this area and discusses our approach.



## 3 Security in the XBRL Business Information Supply Chain

### 3.1 Introduction

This chapter discusses integrity and authentication issues that are related to the usage of XBRL in the business information supply chain. The upcoming paragraph discusses which XBRL-related security threats are relevant to study. Paragraph 3.3 gives an overview of the work that already has been performed in this research area. After that the research approach of this thesis is being discussed. The chapter is concluded with a summary.

### 3.2 XBRL-related integrity and authentication threats

As we learned from Chapter 2 there are several threats in the XBRL business information supply chain. Mainly it is relevant to study the integrity and authenticity issues of instance documents. Poels (2004) already identified several questions the receiver of an XBRL instance document might have, namely:

- *Does this report really originates from MyPrivateConsuting?*
- *How reliable are the figures in this document?*
- *Who audited these figures?*
- *How much can I trust the effectiveness and independence of this audit?*

There are several issues that could be added, such as:

- How do we know this taxonomy is correct?
- How do we know the mapping process went correct?
- How do we know the figures have been modified afterwards?

Some real world examples:

- 1) A company files its financial information using the XBRL standard at its local regulator and this regulator provides the information to the public. Somewhere in the process the instance document was modified and the end-users are provided with inaccurate information, which can result in legal claims. (integrity issue)
- 2) A company provides on its website an instance document with information from the annual report for annalists to analyze. A hacker modifies the instance document on the corporate website. This can result in wrong analyses. (integrity issue)
- 3) Someone makes an instance document claiming that it contains the authentic information provided by some company. This information can be used by several data users who believe this information is provided by the organization. (authenticity issue)
- 4) The annual report of a company is accompanied with an XBRL instance document. A public accountant has falsified whether the information in the instance document is correct, but after the publication online the document differs from the printed version.
- 5) The taxonomy that an instance document refers to has been modified and therefore the labels that are presented to the reader are different.

### 3.3 Related work

As XBRL is becoming mainstream technology, XBRL security is becoming a more relevant topic on both the research and professional agenda. This is reflected by a growing number of publications in both the academic and professional literature (e.g. Knoop, 2008). Regulators around the world are promoting the usage of XBRL and thus professionals in the assurance industry are getting aware of potential assurance related security threats. Several scholars took the time to discuss these problems and came up with solutions. Security of information systems, in our case especially the integrity and authentication issues, is generally approached from both a technical and a more social perspective. In the case of XBRL a third perspective could be added namely the assurance perspective. Poels (2004) discussed some of the issues which will be elaborated on in this paragraph. Smith and Pierce (2005) investigated the integrity of internet financial reporting (IFR) and concluded that the governance framework surrounding IFR has received insufficient managerial attention. In a recent article by Boritz and No (2008b) they mention *“Although there has been growing awareness about assurance issues related to the use of XBRL, current audit practices and standards fall short of providing the needed guidance for the provision of assurance on XBRL-related documents”*. This view is supported by Pluplee and Plumlee (2008) who believe that *“investors are likely to demand assurance on the tagging process”*. Several authors, both from the professional and academic community performed research in the field of the assurance of XBRL. According to Pols (2006), who did his Master thesis work on the impact of XBRL on IT audit, should the auditor also check that integrity of the mapped data is correct, can not be manipulated afterwards and that the XBRL document is presented in the right way. Heitmann and Öhling (2005) conclude in their thesis on the same subject that XBRL adoption will have decisive impacts on the work tasks that assurance providers have to execute in providing services. As the problem of assurance is becoming real it is becoming a serious problem. The current auditor’s report gives an opinion about the annual report as a whole. But with XBRL we are reporting specific information based on a specific taxonomy. There is some debate about assurance on item level. Should the auditor give his opinion about a specific item? Boritz and No (see below) came up with XARL as a specific implementation of the item level assurance concept. Several authors came up with concrete solution to the XBRL security issues. We will discuss a few from the technical perspective.

The eXtensible Assurance Reporting Language (XARL) was developed by Boritz and No<sup>4</sup> (2003, 2004a, 2004b and 2005) to enable assurance providers to report on the integrity of XBRL documents distributed over the internet. XARL is an extension to XBRL which use the XARL taxonomy, digital signatures and a PKI-infrastructure to contribute to the reliability

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<sup>4</sup> See also <http://accounting.uwaterloo.ca/uwcisa/XBRL-XARL/>

of the information provided by using XBRL. XBRL documents that are coded with XARL provide evidence that the information was audited by a public accountant and that it has not been tampered with, uncertainty about the reliability of the financial information is significantly reduced (2003). In their second article (2004a) XARL was improved by reconceptualizing the idea of XARL as a stand-alone service for potentially any XML-based information being shared over the Internet and moves XARL into the Web services arena. In their third article (2005) the Service-oriented architecture (SOA) was added to the idea of XARL.

Sel (2003) demonstrated solutions to sign a XBRL instance documents using a cryptographic smartcard and the XMLDSIG toolkit to calculate the digital signature. As both these kind of security tokens, but also biometrical solutions are becoming mainstream these days it is very likely that these can help in solving security issues in the BISC using XBRL. On his website<sup>5</sup> more information and examples can be found.

There are still several unsolved issues, especially in the practice of auditing. There is simply a lack of experience with the auditing of XBRL instance documents. In a very recent paper Boritz and No (2008b) one of the first real-world audits on an XBRL instance document has been performed. Sel (2003) introduces also some relevant questions: *“Who will store the instance documents, the taxonomy, schemas, the linkbases, etc. – what goes where, and how will it be stored? And for how long? Also what about style-sheets, canonicalization and WYSIWYS? Finally, how about selective access to parts of the XBRL information?”* Other issues that are relevant to look at are the problems that arise in the BISC. Is it possible to reverse engineer the data? Could users of the instance document use information from the taxonomy in order to derive more information. Who is going to host the taxonomies and how do we know whether these taxonomies are the original one (e.g. a man-in-the-middle-attack). It is concluded that current XBRL security research focuses on the assurance issues and minimal research has been performed on the complete information chain.

### **3.4 Research approach**

The goal of this thesis is to provide insights in the integrity and authentication issues that arise when XBRL is used in the business information supply chain on a larger scale, which essentially makes the goal of the this research project exploration. This approach typically occurs when a researcher examines a new interest or when the subject of study itself is relatively new (Babbie 2007 page 88). The XBRL standard exists about one decade, developments are still continuing and the real-world adoption of the standard is rising it can be said that the subject of study is relatively new. According to van Asperen (2008) in the thesis project two essential criteria should be met: academic value and the enclosure of some form of empirical research. The first chapter argued the relevance of the thesis subject.

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<sup>5</sup> See also: <http://www.marcseleu/>

Two types of research are appropriate to answer the research question. First a simulation could be build in which the BISC is simulated. Second an explorative case study in which the security aspects of the various XBRL projects and software solutions are explored. The author believes the second approach is more feasible and also has empirical elements in it as case study research is suitable for exploratory research (Blumberg et al 2005). Therefore it is chosen to perform an explorative case-study supported by a solid literature review to answer the research question. This paragraph describes the research design and the used methodology.

### **3.4.1 Literature Review**

During the development of the research proposal a literature review has been performed. In extension to that additional literature as presented in the previous chapter was studied. A great deal of the literature originates from the academic literature such as journals, conference proceedings, books and theses. Professional literature is used to become familiar to the subject area and to provide background when no academic literature is available on specific details. All used literature is referenced according to the guidelines of the HBS Citation Guide (HBS 2007) and can be found in the bibliography. Several articles that were encountered were written in Chinese or Spanish (which is not mastered by the author) and are left out the literature review.

### **3.4.2 Development of the research (sub) questions**

Based on the literature review a gap in the current literature was identified and the following research question was developed:

***“Are there appropriate solutions available for the integrity and authentication issues that arise in the Business Information Supply Chain when using XBRL?”***

In order to answer the research question it is split up in several sub questions:

1. Which integrity and authentication issues arise in the BISC when using XBRL?
2. What type of XBRL projects are currently undertaken?
3. Which integrity and authentication measures are applied to these XBRL projects?
4. What type of software in the BISC is currently XBRL enabled and what kind of security measures have been implemented?

### **3.4.3 Methodology**

In order to answer the (sub) questions case study research has been performed. Yin (1989) defines a case study as *“an empirical inquiry that investigates a contemporary phenomenon*

*within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used*". There is a lot of academic debate about the number of cases that need to be investigated in order to make the study relevant. It was decided to study multiple cases of which public information was available in languages mastered by the author (Dutch and English). Two types of cases were studied namely XBRL projects and XBRL-enabled software. Data was collected from several sources as described in the next section.

#### **3.4.4 Data collection**

The case study approach permits the combination of different sources of evidence which can be categorized in roughly three categories: (1) interviews; (2) documents and archives; (3) observation (Bloomberg et al. 2005 page 193). Already during the Bachelor thesis project several unstructured interviews have been performed in the XBRL area and an internship at a business information aggregator was completed which serves as background information for this thesis. Most of the documents written about XBRL are available on the internet and can be downloaded free of charge although sometimes access need to be requested. Most of the XBRL implementations are accessible through the Web and therefore it is possible to conduct online observation. Although many experts are not located geographically nearby information can be obtained using email or telephone if more detailed information is required. Experts will be identified by reading the several public mailing lists that are available in the XBRL community on which ideas are discussed and resources are shared. By identifying lead-users it is possible to identify security problems before these are encountered by the mass of users. Although most of the XBRL-enabled software is not freely available, descriptions about the functionality and sometimes trial versions are available.

#### **XBRL projects**

Through studying several projects generalizations can be made and changes in the business information supply chain that are caused by the introduction of XBRL can be identified. On the [xbrl.org](http://xbrl.org) website<sup>6</sup> some very basic case studies were found. The process from the beginning to the end in which XBRL can be used will be analyzed and risks will be identified. The following projects were investigated:

- Dutch Taxonomy Project;
- SEC Voluntary Filing Program;
- Belgium Central Balance Sheet Office.

More detailed information about the projects can be found in paragraph 4.3.

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<sup>6</sup> See also <http://www.xbrl.org/CaseStudies/>

### **XBRL-enabled software**

As most implementations of XBRL are using existing software it is relevant to investigate the security elements of this software. Information about the currently available software will be collected in order to analyze the security aspects. Relevant questions are whether the software provides adequate security in the BISC. The following software vendors were included in our investigation:

<b>Software Vendor</b>	<b>Website</b>
Semansys	<a href="http://www.semansys.com/">http://www.semansys.com/</a>
UBmatrix	<a href="http://www.ubmatrix.com/">http://www.ubmatrix.com/</a>
Fujitsu	<a href="http://www.fujitsu.com/nl/services/finance/xbrl/">http://www.fujitsu.com/nl/services/finance/xbrl/</a>
Batavia Business Reporting	<a href="http://www.batavia-xbrl.com/">http://www.batavia-xbrl.com/</a>

**Table 3.1 Overview of software vendors**

### **3.5 Summary**

This chapter discussed integrity and authentication issues that are related to the usage of XBRL in the business information supply chain and links this to the research project. Through several examples potential threats and issues have been identified. Several scholars performed research in this area such as Boritz and No who developed the eXtensible Assurance Reporting Language and Sel demonstrated practical implementations of applying a digital signature to an instance document. Recently several authors published articles about auditing instance documents. This thesis tries to broaden knowledge and provide insights in the integrity and authentication issues that arise in the XBRL business information supply chain. In order to answer the research question four sub questions have been developed. It is chosen to perform an explorative case study on both XBRL projects and XBRL-related software. This is supported by an extensive literature review.

## **4 Results explorative study**

### **4.1 Introduction**

This chapter presents the results that were found during the research project. The goal of this chapter is to present the collected data needed to answer the research (sub) questions. In order to present the information in a logical manner, the chapter is divided into several paragraphs. After this introduction, the second paragraph describes the BISC without the usage of XBRL. Paragraph 4.3 describes several XBRL projects that were studied during the research project and what type of XBRL projects are currently undertaken. In 4.4 the changes that occur by introducing XBRL into the BISC are discussed. The fifth paragraph deals with XBRL-enabled software and answers what type of XBRL enabled software is currently available and what kind of security measures are implemented. Paragraph 4.6 covers the various integrity and authentication issues that were identified at real-world XBRL projects. At the end of the chapter a summary can be found.

## **4.2 The Business Information Supply Chain without XBRL**

The Business Information Supply Chain (BISC) before the introduction of XBRL will be discussed in this section. The Dutch situation will be used as a starting point to describe the BISC, although generalization will be used in order to make it possible to come up with conclusions that are broadly applicable as similar situations occur around the world. The process of business reporting is divided in three parts namely the business part, the regulator part and the tail of the BISC.

### **4.2.1 The Business' perspective**

Nowadays more and more information is requested by the stakeholders of a company, such as shareholders, governments, trading partners, analysts etc. In many cases organizations use some sort of accounting software to perform their bookkeeping for which numerous solutions are available. Data is stored according to a business specific model of general ledger accounts. Several times per year reports for both internal and external purposes need to be delivered to the various stakeholders. An example is the annual report, which is a statement that consists of an income statement and a balance sheet, but contains in many cases also a cash flow statement and all kinds of information about the future perspectives of the organization. Mostly, when the accounting period (in many cases the calendar year) is completed the various statements are prepared using various tools and in many cases spreadsheet programs (such as Microsoft Excel) are used to compile these reports. This can be a very extensive and time-consuming process and it is difficult to make sure the presented statements are fully correct, because during the construction of the information things can go wrong such as errors introduced by summarizing various spreadsheets or interpretation errors.

In order for external stakeholders to make sure the presented information can be relied on the statements are audited by an external auditor. In the auditor's report, which is mostly added to the annual report, the accountant guarantees that the presented information is accurate and reliable according to the accounting standards used in the specific jurisdiction. Due to the fact that all the information is stored in a computer system auditors are assisted by IT-auditors who form an opinion about the IT systems that are used for accounting purposes. These days many companies use a website to deliver information to their stakeholders. Not only the annual report (which is delivered as a PDF-document in many cases) but also press releases, historical stock quotes and other information for investors is available to anyone interested.

Next to informing stakeholders, banks also request information from their customers. For example when credit is given, banks require at least an annual report in order to calculate the



risk that can be expected from the specific customer. Therefore the information is being digitalized. According to Pasmooij (2008) Dutch banks spend annually between 30 and 40 million Euros on the processing of annual reports received from their customers. As a result of the local legislation companies also need to deliver all kinds of regulatory filings to the governmental authorities, which will be discussed in the next paragraph.

#### **4.2.2 Regulatory filings**

Organizations need to deliver all kinds of information to governmental regulators. For example in the Netherlands companies need to deliver information to the Tax Administration, Chambers of Commerce and Statistics Netherlands. When a company is also listed at a stock exchange several extra reports need to be filed, which are demanded by the authorities related to the stock exchanges such as the SEC in the United States. As it is sometimes very time-consuming to generate these reports, this causes an administrative burden for organizations. The governmental institutions do not always cooperate and demand information from companies of which some is redundant, such as the company's address information. Even items from the income statement can have different definitions for different regulators. This is for example the case in the Netherlands where the Tax administration requests information based on fiscal foundations and the Chambers of Commerce based on commercial foundations (Jacobs 2007). Recent legal developments in the Netherlands enable companies to deliver the same annual report to the Tax Administration and the Chambers of Commerce for small and medium sized companies.

Many countries have Chambers of Commerce in order to provide the public access to financial information about their (potential) customers. An example are the Dutch Chambers of Commerce that annually collect around 500.000 annual reports (NTP 2007b). In Belgium the Balanscentrale performs this activity. The filings that are received at the Dutch Chambers of Commerce are currently digitalized and stored in the PDF format. Anyone who is interested can obtain a copy for a small fee. Some important items from the balance sheet are entered into a digital format and are sold to data aggregators. The Dutch Chambers of Commerce currently has a web based interface to obtain official filings. Several agencies use the collected data to generate aggregated overviews and makes these available to the public.

#### **4.2.3 The tail of the business information supply chain**

The information that has been received by the various regulators is distributed in several forms and various organizations use the information to compile aggregated reports. Examples are the various companies in the business information industry (e.g. Dun & Bradstreet) who collect information about numerous companies and calculate for example ratios that indicate the chance of bankruptcy. The statistics agencies around the world also

provide information that they believe is relevant to the public. Also all kinds academic research is being performed by the various universities worldwide. In many cases research is now limited to a specific small data set, because it is very time-consuming to collect business data.

Also other governmental organizations such as the European Commission perform research to identify fraud, such as the cartel fraud investigations led by Ms. Kroes. Next to financial oriented organizations business information is also used for legal reasons. Lawyers use official filings in court cases, which are obtained from the Chambers of Commerce. Journalists use data found in annual reports for their publications. For this thesis it is important to understand that the various regulatory filings are used way beyond the scope of the regulators.

### 4.3 XBRL projects

There are several XBRL projects of which this paragraph discusses those that were studied during the research project. As the adoption of XBRL is rising more and more authorities are stimulating the usage of XBRL. An example is the Dutch government which decided at October 24<sup>th</sup> 2008 to invest 22.4 million euros in the Dutch Taxonomy<sup>7</sup> Project and other open standards. Also banks are promoting the XBRL standard. This paragraph answers what type of XBRL projects are currently undertaken. There are several types of XBRL projects, mainly driven by governmental organizations. Some governments use XBRL for governmental filings. In the case study data from three projects was used, namely the SEC Voluntary Filing Program, The Dutch Taxonomy Project and the Belgium Central Balance Sheet Office.

#### 4.3.1 SEC Voluntary Filing Program

The Securities and Exchange Commission (henceforth SEC) is also experimenting with what they call Interactive data. This is basically XBRL and other related technologies that allow companies to publish performance information in a structured, machine-readable format (Turner 2007). At October 2004, the SEC proposed a rule that would allow registrants to voluntarily file certain mandated filings in the XBRL format (Debreceeny et al. 2005) and more recent news<sup>8</sup> shows the SEC is planning to make XBRL-filings mandatory. According to the website<sup>9</sup> of the SEC was *“the SEC’s XBRL Voluntary Filing Program created to encourage public companies and mutual funds to use interactive data to make it easier for investors to get and use information from the SEC filings”*. Filings can be submitted to the SEC’s Electronic Data Gathering, Analysis and Retrieval (EDGAR) system. Anyone interested can download<sup>10</sup> and use the submitted XBRL documents as shown in the example of Figure 4.3. Stimulated by the SEC’s initiative several software products became available to analyze the XBRL instance documents.

#### 4.3.2 Dutch Taxonomy Project

The Dutch Taxonomy Project (NTP) is centered around the Dutch taxonomy: *“As of the first of January 2007, businesses and intermediaries can report their financial data to the government using the Dutch XBRL taxonomy. Efficient exchange of information on a large scale is possible with the Chamber of commerce, the Tax department and Statistics Netherlands, using XBRL”*<sup>11</sup>. The project is a joint effort of the Ministry of Finance and the

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<sup>7</sup> The press-release in English can be found on [http://www.xbrl-ntp.nl/Nieuws/NTP\\_nieuwsbrief\\_081028a\\_eng.pdf](http://www.xbrl-ntp.nl/Nieuws/NTP_nieuwsbrief_081028a_eng.pdf)

<sup>8</sup> Source: <http://sec.gov/spotlight/xbrl/xbrl-news.shtml>

<sup>9</sup> <http://www.sec.gov/xbrl>

<sup>10</sup> XBRL documents can be found on <http://www.sec.gov/Archives/edgar/xbrl.html>

<sup>11</sup> Source: <http://www.xbrl-ntp.nl/english>

Ministry of Justice. It is part of bigger governmental goal to reduce the administrative burden of businesses with 25 percent. To achieve this goal cooperation between the public and private sector is needed. In a covenant<sup>12</sup> more than eighty companies and governmental organizations agreed on the use and governance and its infrastructure. This so-called *Process infrastructure* enables companies to submit their XBRL instance documents to the governmental regulators as shown in Figure 4.1.

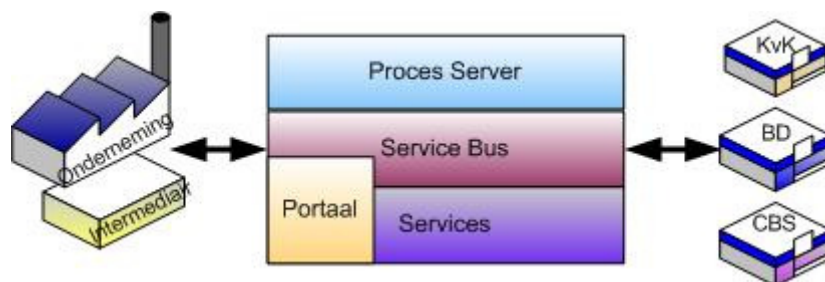


Figure 4.1: The NTP process infrastructure  
source: <http://www.xbri-ntp.nl/PI/procesinfra4.jpg>

For this thesis the chamber of commerce part is especially interesting, because this is the part where instance documents could be publicly available. It should be noted that the chain is a bit larger than depicted in Figure 4.1. Several companies use the data that has been filed at the Chambers of Commerce. The Dutch taxonomy project is especially relevant, because several governments around the globe are interested in copying the idea of the Dutch taxonomy project.

#### 4.3.3 Belgium Central Balance Sheet Office

The National Bank of Belgium promotes at the Central Balance Sheet Office the usage of XBRL. A taxonomy has been developed for non financial companies which is based on the Belgium accounting principles (BE-GAAP). The annual accounts can be filed using the internet. Consultation of the last five years of annual accounts is free using the online consultation. 90% of the filings were in the XBRL format. More information can be found on [xbri.be](http://xbri.be). Recently the usage of XBRL has been made mandatory in Belgium.

#### 4.3.4 Other XBRL projects

There are several other XBRL projects around the world. Although these projects are not used to collect research data, it is interesting to mention them anyway. There are taxonomies available to report according to all major accounting standards such as IFRS, US-GAAP, etc. As a result of the Basel II accord and the International Finance Reporting Standards (IFRS) European banks need to report all kinds of regulatory information to the committee of

<sup>12</sup> An unofficial translation of the covenant can be found on <http://www.xbri-ntp.nl/convenant/covenant>

European banking supervisors. Therefore the FINREP<sup>13</sup> (Financial Reporting) and COREP<sup>14</sup> (COmmon solvency ratiOn REPorting framework) have been developed. Also Banks are currently experimenting with XBRL. Turner (2007) mentions some securities regulators and companies registrars around the world such as the Canadian Securities Administrators, Spain's CNMV, the UK's Companies House and the Swedish Bologsverket, as well as securities regulators in Japan, Korea and China. In general we can conclude that most XBRL projects have a governmental nature. Some countries decided to make XBRL mandatory, while others are still in the experimenting phase. The application areas for XBRL are unlimited, but not many application areas outside governments and banks have been encountered.

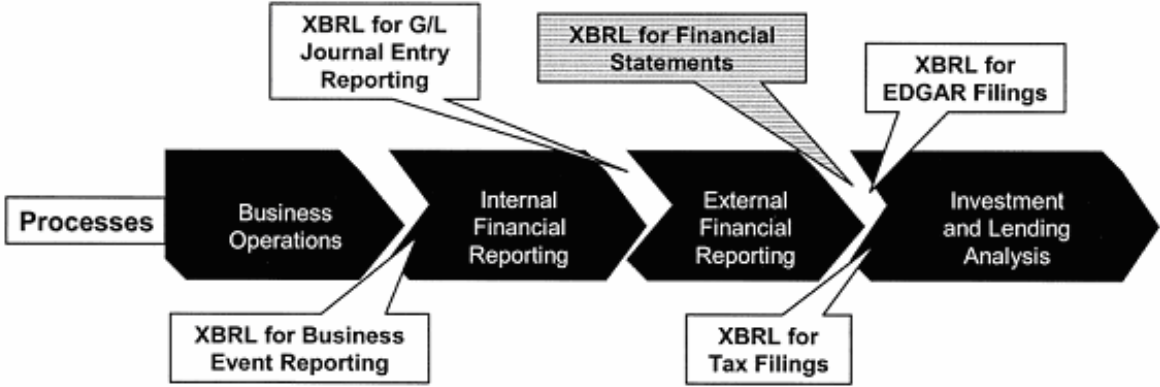
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<sup>13</sup> <http://www.finrep.info/>

<sup>14</sup> <http://www.corep.info/>

**4.4 The introduction of XBRL in the Business Information Supply Chain**

The introduction of XBRL might cause many processes in the BISC to change and introduces potential integrity and authentication issues. Basically for the accountant and auditor the whole accounting and audit process changes from a paper-based to a digital process. As covered in chapter 2 some scholars even believe that continuous auditing will be the future. During discussions with accountants it was noticed that many of them lack fundamental knowledge of IT. Also for the IT-auditor this might have significant consequences with most likely legal elements in it. An introduction into the daily accountant practice and how XBRL influences was written by Jacobs (2007) which serves as a basis for this paragraph, which discusses the business' perspective, regulatory filings and the tail of the BISC in which we will closely examine the introduction of XBRL. XBRL can be used in various places in the BISC. Figure 4.2 shows the BISC for an average (American) public listed company. At many places in the chain XBRL can be used. As said before the XBRL-GL taxonomy (internal reporting) can be used just as the for external purposes XBRL-FR taxonomies that have been developed. There are even taxonomies available for invoices. Note that is not obligatory to use XBRL-GL when an external XBRL-FR document will be used: many accounting software programs map their internal (proprietary) reporting elements to the elements in the taxonomy. Also it is possible that one company need to report according to multiple taxonomies (e.g. for tax purposes and public disclosure). Therefore it can be said that XBRL can be used at various places in the BISC as shown in Figure 4.2.



**Figure 4.2: XBRL can be applied in many places in the BISC**  
 Source: Debreceeny and Gray (2001)

**4.4.1 The business' perspective**

As said before most businesses use some sort of software to perform their bookkeeping. XBRL can be used here in two places. First of all financial reporting taxonomies can be used to publish business information. Second XBRL-GL can be used for internal accounting, although this is currently not widely used and therefore we focus on reporting using financial

reporting taxonomies. In order to report the items that are listed in the taxonomies, the internal accounting system need to be mapped to the external XBRL taxonomy that is related to a legal accounting standard. Of course the business document can also be manually transformed to an instance document. This introduces the possibility of errors. It is very well possible that an organization need to use multiple taxonomies to report to the different regulators.

The second issue that arrives is how to perform an audit. The accountant should audit the paper-based annual report. But should it also audit the instance document and how should he perform this audit? This is currently an unsolved issue encountered by auditors around the world. Recently Boritz and No (2008b) described the case of auditing an instance document. They developed XARL for this purpose. But this does not solve the problem that there is currently no legislation about the audited XBRL coded information. This raises the question whether the instance document should be linked to the paper-based document.

#### **4.4.2 Regulatory filings**

This is the part where currently a lot of things are happening in the XBRL area. Already several countries are starting to implement some sort of usage of XBRL for the regulatory filings. In the Netherlands the government decided to combine the three main streams of regulatory filings and combined them into one XBRL taxonomy namely the Dutch Taxonomy. One of these receiving regulators are the Chambers of Commerce which currently only accepts filings from companies that do not need an auditor's report. Companies that need an auditor's report cannot file in the XBRL format because there is currently no legislation available in the Netherlands (Pasmooij 2008). The received instance document is than automatically converted to a PDF which is made available to the public. This reduces a lot of rekeying as described in the previous paragraph.

#### **Filing of instance documents**

In order to collect all the instance documents some sort of infrastructure need to be developed. In the Dutch Taxonomy Project a so-called 'process-infrastructure' (PI) has been developed. To secure the integrity of the XBRL instance document it will be signed using a digital signature<sup>15</sup>. The PI validates whether the instance document is a valid XML, XML schema and XBRL document. To answer the research question it is quite relevant to look at the process of delivering an instance document to the regulator. These processes are quite detailed described in several documents. The Dutch government uses a so-called process infrastructure for this, which is based on the concept of Web Services. When documents are delivered to the regulator several actions need to be performed in order to present the

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<sup>15</sup> See also: <http://www.xbrl-ntp.nl/PI/folder.2007-08-28.7025941394/Signerenxbrldocumenten>.

information to the public. In the Dutch case instance documents are checked whether these are compliant with XML, XBRL and the specific taxonomy standards. The instance document is then converted to a PDF document (using a style sheet) which is made available to the public. One of the interesting questions that arises is who is the legal author of this PDF document. The filing company needs to acknowledge the generated PDF document.

The screenshot shows the 'Filing Detail' page for a Form 8-K filed by PepsiCo. The page header includes the SEC logo and navigation links. The main content area is divided into sections for filing information, document format files, and data files.

**Filing Information:**

- Form 8-K - Current report
- SEC Accession No. 0001157523-08-008055
- Filing Date: 2008-10-15
- Period of Report: 2008-10-15
- Items: Item 8.01: Other Events; Item 9.01: Financial Statements and Exhibits
- Accepted: 2008-10-15 17:01:13
- Filing Date Changed: 2008-10-15
- Documents: 8

**Document Format Files:**

Seq	Description	Document	Type	Size
1	PEPSICO, INC. 8-K	a5800659.htm	8-K	18846
2	INTELLIGENT FINANCIAL STATEMENT(TM)	pep-20080906.pdf	8-K	441533
	Complete submission text file	0001157523-08-008055.txt		968998

**Data Files:**

Seq	Description	Document	Type	Size
3	XBRL REPORT INSTANCE DOCUMENT	pep-20080906.xml	EX-100 INS	44731
4	XBRL TAXONOMY EXTENSION SCHEMA DOCUMENT	pep-20080906.xsd	EX-100 SCH	7650
5	XBRL TAXONOMY PRESENTATION LINKBASE DOCUMENT	pep-20080906_pre.xml	EX-100 PRE	66623
6	XBRL TAXONOMY CALCULATION LINKBASE DOCUMENT	pep-20080906_cal.xml	EX-100 CAL	43467
7	XBRL TAXONOMY LABEL LINKBASE DOCUMENT	pep-20080906_lab.xml	EX-100 LAB	115023
8	XBRL TAXONOMY DEFINITION LINKBASE DOCUMENT	pep-20080906_def.xml	EX-100 DEF	61605

**Company Information:**

- PEPSICO INC (Filer) CIK: 0000077476 (see all company filings)
- Business Address: 700 ANDERSON HILL RD, PURCHASE NY 10577, 9142532000
- Mailing Address: 700 ANDERSON HILL ROAD, PURCHASE NY 10577-1444
- IRS No.: 131584302 | State of Incorp.: NC | Fiscal Year End: 1229
- Type: 8-K | Act: 34 | File No.: 001-01183 | Film No.: 081125609
- SIC: 2080 Beverages
- Assistant Director 9

Figure 4.3: The XBRL filing of PepsiCo at the SEC’s EDGAR system

source: <http://www.sec.gov/Archives/edgar/data/77476/000115752308008055/0001157523-08-008055-index.idea.htm>

**Public availability of instance documents**

In order to provide the filed information to the public this can be made available in several forms. The SEC provides the XBRL instance documents on their website<sup>16</sup>. It uses a so-called “PRIVACY-ENHANCED MESSAGE” which is based on asymmetric cryptography which ensures the integrity of the submitted information of which some of it is XBRL-encoded. The Dutch Chambers of commerce use a more sophisticated web interface as the request a small fee to download the information. According to their website they provide electronic PDF documents with a digital signature, which are not legally valid when printed. In an interview with an attorney it was said that he uses documents from the Chambers of Commerce in his court cases. This raises the question whether he can use documents that have been derived from an XBRL instance document. XBRL-coded information is currently not available on the website of the Chambers of Commerce, while the SEC provides the original XBRL data.

<sup>16</sup> See <http://www.sec.gov/Archives/edgar/xbrl.html> for the XBRL SEC filings



Balans (Geconsolideerd)	31-12-2002	31-12-2003	31-12-2004	30-12-2005	30-12-2006	'05 -> '06
	x € 1.000	x € 1.000	x € 1.000	x € 1.000	x € 1.000	%
<b>Activa</b>						
<b>Vaste activa</b>						
Materiële vaste activa	474.777	439.519	36.273	33.717	34.215	1%
Financiële vaste activa	945	968	3.161	383.140	269.203	-30%
	475.722	440.487	39.434	416.857	303.418	-27%
<b>Vlottende activa</b>						
Voorraden	-61.953	-45.472	-136.201	-144.994	-246.932	-70%
Overige vorderingen	20.417	18.258	490.920	67.218	106.002	58%
Handelsdebiteuren	116.306	108.683	129.977	186.035	285.529	53%
Liquide middelen	44.499	90.087	107.082	116.467	393.722	238%
	119.269	171.556	591.778	224.726	538.321	140%
<b>Totaal Activa</b>	<b>594.991</b>	<b>612.043</b>	<b>631.212</b>	<b>641.583</b>	<b>841.739</b>	<b>31%</b>

Figure 4.4: Several data aggregators provide the possibility to export XBRL data

source: <http://company.info/id/24193233>

### Other XBRL sources

It should be noted that the filed XBRL instance documents are not the only source of XBRL encoded information. For example IQinfo<sup>17</sup> writes: "on Jaarverslag.info we provide you with the Balance Sheets and Income Statements of major listed Dutch Companies in XBRL.". It uses historical data (which does not come from authentic XBRL sources) and converts this to the XBRL format. A closer look at the instance documents provided tells us that the documents are created using "IQ Info XBRL Instance Generator 1.2.0". Also on its commercial website company.info it offers the possibility to export data from their database to the XBRL format. This means that errors that were generated when the data was added to the database are transferred to the XBRL-coded exported data. The SEC is planning to offer similar functionality using the data that is stored in EDGAR, just like the Dutch Chambers of Commerce. This raises the question what the source is of your XBRL-encoded information. There are numerous data aggregators that might be planning to export their databases in the XBRL-format. If they decide to map their internal database to for example the IFRS taxonomy, but some of the data reports were presented using other accounting regulation, this cannot be recovered. This might have consequences for the users in the tail of the BISC as covered in the next paragraph.

### 4.4.3 The tail of the business information supply chain

Note that XBRL instance documents can be used in much more places than initially expected. For example data aggregators might use instance documents to do their own analysis and generate overviews or aggregated reports. Governments and universities can

<sup>17</sup> Source: <http://jaarverslag.info/xbrl>, accessed on 5 December 2008

use XBRL information for all kinds of research purposes. Rating agencies can use it to calculate their ratings and search engines can use it collect data about the various companies. Therefore it can be said that the XBRL business information supply chain may be much longer than initially expected. As we learned in the previous paragraph the XBRL-coded information about one company can have different sources. In a recent article in the Dutch *Automatisering Gids* (Zaal 2008) Semansys (one of the XBRL software vendors) introduces the idea to use XBRL to let similar companies analyze and benchmark each other using XBRL data. Semansys want to make sure no critical and secret company will be revealed using so-called trusted third parties.

#### **4.4.4 Consequences of the introduction of XBRL**

There are several consequences by the fact that information in the information supply chain becomes of a semantic nature instead of being human-readable documents. One of them is the legal value. It is questionable whether an XBRL instance document has the same legal value as paper-based annual report. A parallel can be drawn with the banking industry, where you can get a digital bank account without paper account receipts. Who is responsible when something goes wrong and how can you prove this? Another discussion that might start triggered by the introduction of XBRL is the role of regulators. Currently the auditor is responsible for the content of audited business documents. But in the case of continuous XBRL reporting this role might be shifted to the governmental regulators. Will auditors be working for the government in the future?

## **4.5 XBRL enabled software**

Although it is possible to edit instance documents and taxonomies with basic text editors, the XBRL standard is only useful when there is software available that is XBRL enabled and provides the possibility to easily work with XBRL instance documents, taxonomies and stylesheets. This paragraph discusses what type of software in the BISC is currently XBRL enabled and what kind of security measures have been implemented. The first paragraph describes what kind of XBRL enabled software is currently available in the market. In 4.5.2 the usage of software in XBRL projects is discussed. Finally the integrity and authentication in XBRL enabled software is discussed.

### **4.5.1 Types of XBRL enabled software**

There are several companies that provide software for the XBRL market. Currently the key players are UBMatrix, Semansys, Fujitsu<sup>18</sup> and Batavia XBRL. These software vendors provide all similar types of software such as:

- 1) Reporting tools including accounting software;
- 2) taxonomy development software;
- 3) Processing software.

Most software is centered around an XBRL processor which validates and processes XBRL documents. There are a few open source XBRL solutions available such as ABZ's business processor ABRA<sup>19</sup>, but the majority of software does not come with its source code.

#### **Reporting tools including accounting software**

Reporting tools help organizations to report in the XBRL standard. There is a wide variety of tools available in the market. Some tools provide the possibility to map a Microsoft Excel document to one or more taxonomies and generates instance documents of which some solutions operate as a Microsoft Office plug-in. Other software provides the possibility to map the data in your accounting system to a specific XBRL taxonomy, such as shown in Figure 4.5 using Semansys XBRL reporter. Most of the major accounting software (including ERP) vendors claim that their software is (becoming) XBRL enabled, but are quite vague about the actual implemented features. More research in this area is suggested, but unfortunately a lot of XBRL tools are not freely available for (academic) testing purposes. Good mapping to an XBRL taxonomy is of course dependent on the organization of general ledger account at an organization. Accountants and (online) accounting solutions are trying to standardize this in order to generate scale advantages when mapping internal data to XBRL taxonomies.

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<sup>18</sup> See also: <http://www.fujitsu.com/nl/services/finance/xbrl/>

<sup>19</sup> See also: <http://www.abz-reporting.com/>

Period name	Annual data				
	Period	2008-01-01		2008-12-31	
	Balance	debit	credit	debit	credit
Intangible Fixed Assets	n.a.		n.a.	n.a.	n.a.
Goodwill		219000	n.a.	257360	n.a.
Patents		129000	n.a.	151600	n.a.
Intangible Fixed Assets, Total		348000	n.a.	408960	n.a.
Fixed Assets, Total		1221000	n.a.	14349192	n.a.
Current Assets	n.a.		n.a.	n.a.	n.a.
Accounts Receivable		49000	n.a.	57940	n.a.
Cash and Cash Equivalents		24000	n.a.	20204	n.a.
Inventories		5000	n.a.	5076	n.a.
Stock		3500	n.a.	41132	n.a.
Current Assets, Total		81500	n.a.	95770	n.a.
Assets, Total		1302500	n.a.	1530690	n.a.
Equity and Liabilities	n.a.		n.a.	n.a.	n.a.
Equity	n.a.		n.a.	n.a.	n.a.
Common Stock		n.a.	449000	n.a.	5276
Reserves		n.a.	249000	n.a.	2926
Equity, Total		n.a.	698000	n.a.	8202
Liabilities	n.a.		n.a.	n.a.	n.a.
Long-term Liabilities	n.a.		n.a.	n.a.	n.a.
Notes Payable		n.a.	39000	n.a.	49

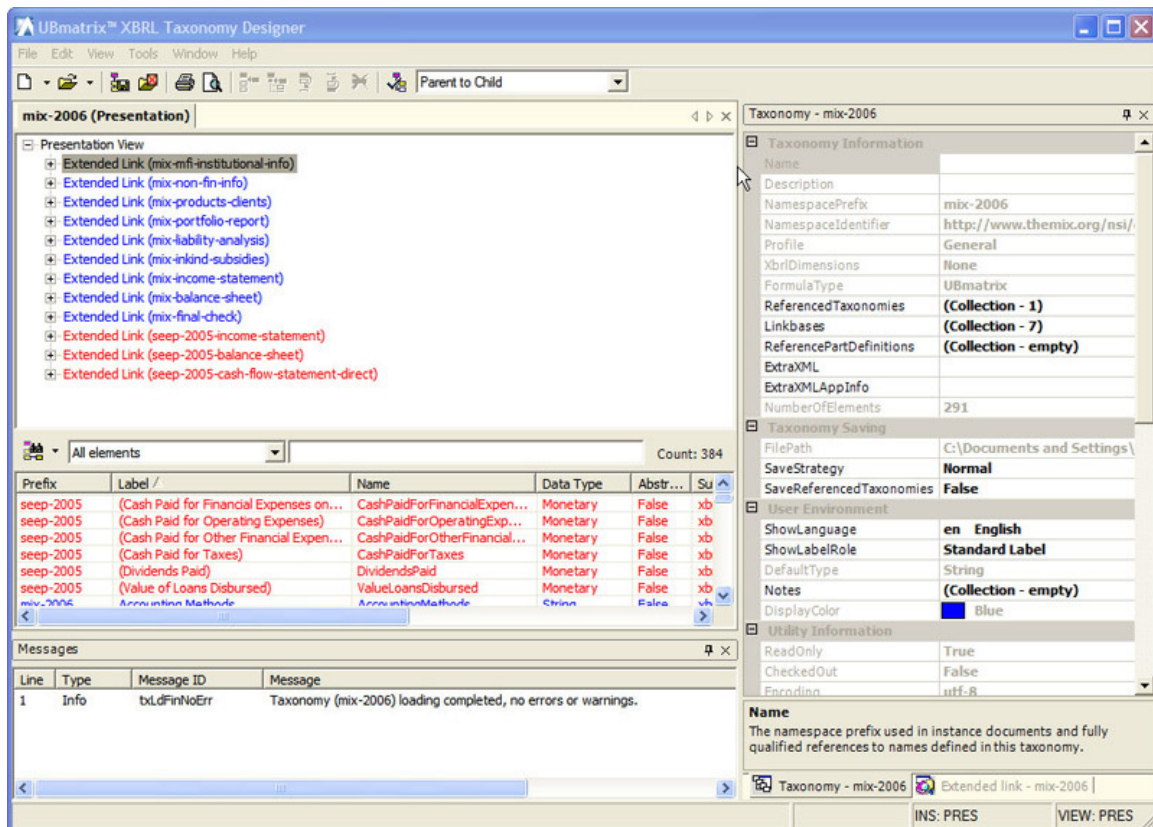
Figure 4.5: Screenshot of Semansys XBRL reporter

source: <http://www.semansys.com/images/SXR-screen-shots-step-3.gif>

### Taxonomy development software

This type of software can be used as desktop software to build and view taxonomies. In order to understand how a taxonomy has been designed both the documentation that comes with the taxonomy and a taxonomy viewer are very helpful. Most taxonomy viewers present graphically the structure and details of a taxonomy, for example using different colors for different element types. Regulators and organizations that want to build, maintain or extend an XBRL taxonomy need to use taxonomy building (or designing) software. This enables regulators to construct their own taxonomy according to the local accounting regulations. An example is shown in Figure 4.6 that shows a screenshot of UBmatrix XBRL taxonomy designer. Because some taxonomies are designed in cooperation with the stakeholders (e.g. accounting firms) most products offer multi-user functionality. There are also online solutions available, that enable discussion of taxonomy related issues without the need for everyone to buy taxonomy development software. For example the Dutch Taxonomy can be approached and reviewed using the Taxonomy Review And eXploration<sup>20</sup> (TRAX) using a standard web browser.

<sup>20</sup> See also: <http://www.xbrl-ntp.nl/Taxonomie/trax>



**Figure 4.6: Screenshot of UBmatrix XBRL taxonomy designer**  
 source: [http://www.ubmatrix.com/img/taxonomy-designer\\_screen\\_lg.jpg](http://www.ubmatrix.com/img/taxonomy-designer_screen_lg.jpg)

## Processing software

Organizations that receive instance documents need processing software. This software processes the received instance documents by validating the instance documents whether these are valid according to the XML, XBRL and taxonomy specifications. Basically in all the other XBRL software this processing engine is under the hood. For large-scale projects (such as regulatory filing projects) consulting services are provided to implement their software. The XBRL software vendors are cooperating with others to get their software into existing business software in order to make this software XBRL enabled. Examples are the various accounting and ERP packages. Most of the XBRL processors enable to transform XBRL instance documents into all kinds of format such as Microsoft Excel, CVS, XML or HTML. According to the software vendors their software is easily to integrate in existing Java or .NET applications.

#### **4.5.2 Usage of XBRL software in XBRL projects**

The XBRL projects examined use a custom-build infrastructure in which they use processing software from external software vendors. In many cases consultants from the software vendors are involved in the implementation process. When the instance documents are received these are checked for XML, XBRL and taxonomy validity. This certainly will improve the quality of the reported elements.

From the perspective of the filing company less sophisticated software solutions have been encountered. There are basically two ways in order to make instance documents. Firstly, instance documents could be directly generated from the accounting software in place. This means that the software need to be XBRL-enabled and that the internal accounting standards need to be mapped to the specific taxonomy being used. The second method to generate instance documents using special software. Several products such as Fujitsu's Online Instance Creator<sup>21</sup> provide the possibility to use a web-based form to input data in order to generate an instance document. Even stories that organizations use a template instance document that is edited using e.g. Notepad to comply to the XBRL standard. The obvious drawback from this solution is the cost reduction is mainly present at the receiving party and the administrative burden for companies will not be reduced.

#### **4.5.3 Integrity and authenticity in XBRL-enabled software**

The main focus of the examined software is functionality and not security. In XBRL projects the integrity of the filed information should be delivered by the infrastructure and not the XBRL processing software. To make sure the instance documents are correct the various reporting tools use all kinds of checks and validations. Unfortunately there are still several possible mapping problems that are difficult to prevent using software. No software have been encountered that provides possibilities to for an end-user to check whether an instance document has been modified or that the author is really the author, similar to SSL certificates used in web browsers. The next paragraph will focus more on integrity and authentication issues.

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<sup>21</sup> See also: See also: <http://software.fujitsu.com/en/interstage-xwand/activity/xbrltools/othertools/webic.html>

## **4.6 Integrity and authentication issues**

This research project focused on integrity and authentication issues that arise in the XBRL business information supply chain. It is tried to identify potential sources of security problems and discuss possible solutions. That security in the BISC is becoming a major issue is reflected by the messages that can be found on the websites of various regulators. The SEC writes: *“Notice - the XBRL data should not be relied upon for making decisions about a company's filing. You should refer to the official filing if you need to see what has been filed with the SEC”*<sup>22</sup>. The Dutch Chambers of Commerce do not accept filings in the XBRL format from organizations that need an auditor's report (Pasmooij 2008). This section discusses various integrity and authentication issues in the BISC. Although the list of issues is not exhaustive, it is hoped that it covers the main issues. First the integrity issues will be discussed, followed by the authentication issues. We conclude this section by discussing the consequences of the integrity and authentication issues.

### **4.6.1 Integrity issues**

As discussed in Chapter 3 the introduction of XBRL raises several integrity related issues. These issues can be divided in four categories, namely:

- Mapping related issues;
- Taxonomy related issues;
- Internet related issues;
- End user related issues.

These issues will be discussed in more detail.

#### **Mapping related issues**

Several security issues occur when internal values are not correctly mapped to the used taxonomy. This can be caused because the internal reporting elements are not well mapped or do not match with the elements in the taxonomy. Because the accounting system is not correctly mapped to the taxonomy incorrect instance documents will be generated. Turner (2007) discussed several mapping and data quality related issues giving several examples, such as wrong usage of currency identifiers, precision measures and scenario identifiers. This can cause instance documents to be incorrect and thus not valid XBRL documents or even worse valid documents with incorrect information. This might also occur when an instance document refers to a local copy of the XBRL specifications instead of the official ones. Boritz and No (2008a) found in a recent study on quality assurance figures higher than 50% of instance documents that did not pass validation. Redundant elements, or elements that encountered as other elements than expected (and thus wrongly mapped) are also

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<sup>22</sup> Source: <http://www.sec.gov/Archives/edgar/xbml.html>

relevant issues when taxonomies are not carefully constructed. This will be discussed in the next section.

### **Taxonomy related issues**

An instance document links to the related taxonomy that has been used. In this taxonomy the labels in the different languages can be found. This taxonomy is mostly publicly available on the website of a regulator. By retrieving this taxonomy several internet related security issues might be present, which will be discussed in the next section. In this section specific taxonomy related issues will be covered. Turner (2007) divided these issues into risks that are associated with fixed (or closed) and risks associated with extensible (open) taxonomies. When a regulator decides to use fixed taxonomies to make sure all filers report the same elements, it might happen that an individual company extends the taxonomy for internal purposes and accidentally reports using the extended taxonomy. To mitigate this regulators need to check whether all the reported elements are covered in the original taxonomy. As taxonomies evolve over time new elements might be added to the taxonomy which might interfere with local extensions of the taxonomy. It might also be possible that companies use an old taxonomy to report their current figures while the instance document refers to the correct version of the taxonomy. Also with open taxonomies there are several possible issues. When a taxonomy has been extended, next to the instance document also the extended taxonomy needs to be filed to a regulator. It might be possible that a duplicate element has been created or that labels or calculation linkbases will be overridden. This makes it fairly difficult to compare different companies who use different extended versions of the same taxonomy. It might be possible that a company discloses more information than it intended when using an extended taxonomy by publishing the extended taxonomy. Other issues that might be introduced are similar to the mapping related issues, such as the introduction of unnecessarily duplicated items or misleading or inaccurate labels. Turner also mentions several problems with XBRL calculations such as not disclosing a component of the calculation or a sub-total. Many of the taxonomy related issues might be mitigated by forcing companies to report with a fixed taxonomy, but an open taxonomy enables companies to report information that represents the company more closely.

### **Internet related issues**

XBRL is a standard that will mainly be used on the internet or the internet will be used as a channel to deliver instance documents to a regulator's network. As discussed in section 2.5 the internet is an insecure network. Instance documents and taxonomies are basically simple text files and modifications can be made using basic text editors such as Microsoft Notepad or vi at one of the UNIX platforms. During the transmission of XBRL data over the Internet many things might occur, such as a man-in-the-middle attack or a spoofed website. An



example would be to intercept the transmission of an XBRL taxonomy that has been stored at the website of an accounting standards committee. An attacker could make changes in the label linkbase that could result in displaying incorrect labels in the generated document. A solution would be to store the used taxonomies on the local computer. This might result in the usage of an outdated taxonomy. When an instance document that gives balance sheet information is being analyzed it would be inject some extra cash on the balance sheet to make the company more attractive. A basic solution to solve these kind of integrity problems is to calculate a cryptographic hash or use a digital signature to assure the integrity of the documents (this can be applied to both taxonomies or instance documents). Sel (2003) demonstrated this using the encryption technology that comes with the XML standard. Next to network related threats, activities on the internet are also vulnerable to computer viruses and all kind of related threats. Therefore it is suggested to add some sort of integrity control into XBRL-enabled software.

### **End user related issues**

In most of the literature about XBRL security is approached from the perspective that both a paper-based document and an XBRL instance documents are filed as a complementary set of information. During the case study we came across an end-user (an attorney) who used regulatory filings in court cases. For official legal usage signed copies from the (Dutch) chamber of commerce were used. This raises the question what to do when only XBRL instance documents are filed. Do regulators need to convert them to human readable documents for court cases. This raises the interesting question who is liable for this translation process when an error occurs. Some legal research in this area is suggested. Another issue might become relevant in the near future when analysts will use XBRL data streams for automated analyses. When attackers maliciously modify the content (such as adding extra cash to a balance sheet) this might have consequences for the automated decisions being made. A solution might be to use digital signatures to assure the integrity.

#### **4.6.2 Authentication issues**

Although there are almost no examples yet of audits done at XBRL instance documents, Boritz and No (2008b) wrote an interesting working paper about a case in which an XBRL instance document was audited. Note that the Dutch taxonomy project does not allow companies to file their annual report when an auditor's report is required (NTP, 2007). Basically with XBRL instance documents there are two main authentication issues, namely:

- Who is the author?
- Who is the auditor?

That these questions are relevant is supported by John Turner (2007) who says that *"it seems inconceivable that companies will publish and that market participants will accept data*

*without independent external assurance*". In this section both issues will be discussed separately.

### **Who is the author?**

Basically anyone can claim that he or she is the author of an XBRL instance document. Therefore a company need to secure somehow that the author who claims to be the author is really the author. This can be accomplished using a digital signature. The second issue that has been identified happens when an XBRL instance document is filed to the regulator. If the regulator decides to use a style sheet to render a human readable document (e.g. a PDF file) it is the question who the legal author of the newly created document is. When something goes wrong in the process and the document is used for legal purposes (such as in a court case) this might be a difficult problem. This might need some legal research in the future.

### **Who is the auditor?**

Many companies are legally forced to use an external auditor to audit their filed information. In the case an old-fashioned annual report was submitted to the regulating authorities an auditor's report was added to the document, which said that the document was correct according to the specific accounting regulations. For the case of an XBRL instance document this is a bit more complex. Would the audit be based on element level or on the whole instance document? Should the auditor also check the whole mapping procedure? Or can one instance document be audited by several auditors. Only a few solutions (which are currently not used in practice) are currently available such as Boritz and No's eXtensible Assurance Reporting Language. More research in this area is suggested.

### **4.6.3 Consequences of the integrity and authentication issues**

The main question in this thesis is whether there are appropriate solutions available for the integrity and authentication issues that arise in the BISC when using XBRL. Before answering this question it might be inspiring to sketch a possible XBRL future. As discussed in Chapter 2 there is currently a trend of more and more frequent disclosure of (financial) business information to the public. Due to the introduction of XBRL this is becoming semantic data that can be interpreted by software. Therefore it might be likely that stakeholders such as analysts will use in the near future automated software to analyze these streams of data to generate for examples advices to buy stocks of a certain company. Incorrect information such as extra cash on the balance sheet (cash fool) might result in extreme advices. As this example shows, integrity and authentication issues will become more relevant issues in the future when the adoption of XBRL will be increasing.

In this paragraph we identified four types of integrity related security issues, namely mapping related, taxonomy related, internet related and end user issues. Also two main authentication issues have been identified, namely who is the author and who is the auditor. For some of the security issues there are solutions available and others are still open to be solved. As XBRL has not been developed from a security perspective the various XBRL-enabled software solutions did not implement all solutions to prevent all security issues in the whole Business Information Supply Chain. Therefore it is concluded that there are currently no appropriate solutions available for the integrity and authentication issues that arise in the BISC when using XBRL. On the other hand XBRL enables semantic business reporting that comes hand in hand with numerous advantages such as improved data quality and the lack of re-keying information. Therefore it could be said that an XBRL instance document could serve as a complementary service to a human readable document. To solve the various security issues the XBRL standard need to mature and more research need to be done to converge to workable solutions.

#### **4.7 Summary explorative study**

This chapter presented the results of the explorative research. It discussed the collected data needed to answer the research (sub) questions. The Business Information Supply Chain (BISC) can be divided into three parts namely the business part, the regulator part and the tail of the BISC. Businesses need to report all kinds of information to their stakeholders. Regulatory filings are a major part of the information to the governmental regulators. In the tail of the BISC the business information industry and researchers can be found. Most XBRL projects have a governmental nature. In this thesis three XBRL projects were investigated. The SEC started a voluntary filing program in which filings can be submitted to EDGAR in the XBRL standard. The Dutch government started the Dutch Taxonomy Project in which organizations can report to the Chambers of Commerce, Tax administration and Statistics Netherlands using one taxonomy. In Belgium the Central Balance sheet office made the usage of the XBRL standard mandatory. The introduction of XBRL might cause many processes in the BISC to change. For the business' perspective XBRL-GL can be used or the internal data need to be mapped to a taxonomy. Currently regulators around the world enable filings in the XBRL standard. There are only a few companies that provide software for the XBRL market. Mainly the supply of software consist of taxonomy development software, reporting tools and processing software. No software has been encountered that enables users of XBRL instance documents to check whether the integrity is still correct. Several integrity and authentication issues have been identified. The integrity issues can be divided in mapping related, taxonomy related, internet related and end user issues. The two authenticity issues are concerned with the questions who is the author and who is the auditor? Currently there no appropriate solutions available to solve these issues. On the other hand XBRL comes hand in hand with numerous advantages. Therefore it is concluded that an XBRL instance document could serve as a complementary service to a human readable document.

## 5 Conclusions, limitations and suggestions for future research

### 5.1 Introduction

This final chapter presents the findings of the research project through answering the research questions, discussing the limitations of the research project and gives suggestions for future research. The next paragraph will answer the sub questions and then conclude with answering the main research question. Paragraph 5.3 discusses the limitations of our research. The last paragraph gives suggestions for future research.

### 5.2 Conclusions

The goal of this thesis is to answer the research question, which is:

***“Are there appropriate solutions available for the integrity and authentication issues that arise in the Business Information Supply Chain when using XBRL?”***

For those who skipped directly to this chapter the various elements of this question will be discussed. The eXtensible Business Reporting Language (XBRL) is an XML-based open standard developed for semantic business reporting purposes. The Business Information Supply Chain (BISC) explains the relations between stakeholders in a business environment and the flow of business information between them. Integrity ensures that data and programs are changed in an authorized manner and authentication assures that the message is from the source it claims to be from. First the four sub questions will be answered after which an answer to the research question is given.

#### ***Which integrity and authentication issues arise in the BISC when using XBRL?***

In paragraph 2.5, 3.2 and 4.6 several integrity and authentication issues have been discussed. The integrity issues can be divided in four categories, namely (1) mapping related issues; (2) taxonomy related issues; (3) Internet related issues; (4) end user related issues. There are basically two authentication issues, namely (1) who is the author? and (2) who is the auditor? Several integrity issues can be omitted by using cryptographic techniques such as digital signatures or SSL. Mapping related issues can partly be solved by implementing solutions into software such as suggestions by Turner (2007), but errors that are introduced by humans are difficult to prevent. Because XBRL is and will be used mainly on the internet, related security issues should be considered when implementing or using XBRL. Because XBRL documents can be found at many different places in the BISC, end user related issues should also be given attention. Although many scholars do not focus on integrity issues, authentication issues are starting to get some attention in both the professional and academic literature. This is caused by the fact that the accounting industry start to think

about the practical implementation of XBRL. Auditors start to question themselves how to audit an XBRL instance document and what kind of consequences the introduction of XBRL can have. Currently there are no industry-wide solutions available to solve the issues that come with the introduction of XBRL.

***What type of XBRL projects are currently undertaken?***

There are several XBRL projects around the world of most of which are initiated by governmental organizations. More and more governments are stimulating the usage of XBRL by investing in XBRL and related open standards programs. During the explorative study three projects were investigated, namely the Dutch Taxonomy Project, The SEC voluntary filing program and the Belgium Central Balance Sheet Office. Most projects focus on digitalizing large streams of company related data. Some regulators are experimenting with voluntary filing (e.g. SEC and the Dutch government) while in other countries such as China, Korea, Japan and Singapore listed companies are mandatory to file their information in the XBRL standard (see also Pasmooij 2008). In some projects XBRL-encoded information is delivered to the public (e.g. the SEC that calls this interactive data) while others only provide documents that are derived from the XBRL data to the public in more human readable forms (e.g. a PDF or HTML document). There are currently taxonomies available for all major accounting standards such as IFRS and US-GAAP and as a result of the Basel II accord European banks need to report all kinds of regulatory information to the committee of European banking supervisors. Banks are also currently experimenting with XBRL, which might increase the adoption of the XBRL standard.

***Which integrity and authentication measures are applied to these XBRL projects?***

XBRL has not been developed from a security perspective and the infrastructure in the businesses information supply chain need to deliver integrity and authentication measures. For the filing of instance documents the submissions are signed using a digital signature. In most cases the content is transferred using an encrypted connection (SSL). After the instance document has been received it is validated according the XML and XBRL specifications to make sure the instance document can correctly be processed. Some regulators provide raw XBRL data to the public, while others only provide documents generated from the instance document such as a PDF document. Most PDF documents use a digital signature, but it is currently unknown who is the legal author of this document. The SEC provides raw XBRL data to the public, which uses a digital signature to ensure the integrity of the document.

***What type of software in the BISC is currently XBRL enabled and what kind of security measures have been implemented?***

In order to work conveniently with the XBRL standard, XBRL enabled software is needed. Several companies provide XBRL enabled software. There are basically three types of XBRL enabled software available. Firstly, reporting tools help organizations to report in the XBRL standard. Most of these provide the possibility to map your internal accounting data to an XBRL taxonomy, sometimes as a Microsoft Excel plug-in. Most of the major accounting software (including ERP) vendors claim that their software is (becoming) XBRL enabled, but are quite vague about the actual implemented features. The second type of software is taxonomy development software. This type of software can be used as desktop software to design, build, maintain and view taxonomies. Although most packages provide multi-user functionality, there are also online solutions available, that enable discussion of taxonomy related issues without the need for everyone to buy taxonomy development software. The third type is processing software that is meant for organizations that receive instance documents. The software processes the received instance documents by validating them and transform them to all kinds of formats such as PDF or HTML. As the XBRL standard has not been developed from a security perspective, most software focuses on functionality. In order to prevent integrity and authentication issues this need to be controlled in the business information chain, such as the custom-build infrastructures by the various regulators. From the perspective of the filing company less sophisticated software solutions have been encountered, such as organizations that simply edit a template instance document to comply to the XBRL standard. Several mapping problems could be reduced by implementing better checks into software. No software has been encountered that enables to validate the integrity of a received instance documents.

**Answer to the research question**

In this thesis several integrity and authentication issues in the BISC were identified. During the case study research we identified several security measures that had been applied to solve these issues. XBRL has not been developed from a security perspective. Also the various XBRL-enabled software solutions do not provide solutions that solve the various security issues in the whole Business Information Supply Chain. Therefore it is concluded that there are currently no appropriate solutions available for the integrity and authentication issues that arise in the BISC when using XBRL. On the other hand XBRL enables semantic business reporting that comes hand in hand with numerous advantages such as improved data quality and the lack of re-keying information. Therefore it could be said that an XBRL instance document could serve as a complementary service to a human interpretable document. To solve the various security issues the XBRL standard need to mature and more research need to be done to converge to workable solutions.

### **5.3 Research Limitations**

When considering this thesis several limitations need to be kept in mind. First of all it should be noticed that the research only used a small amount of cases and that in the future more sophisticated XBRL projects might be available. Secondly, it should be obvious that the discussed security issues are observed from a theoretical perspective. More research is needed to simulate the possible security problems. Finally it should be noted that the research has been performed by an independent student with no professional experience in the accounting industry.

### **5.4 Suggestions for future research**

The purpose of this research is to broaden knowledge and provide insight into the integrity and authentication issues that arise when XBRL will be implemented on a large scale (see also chapter 1). Although this thesis provides more insight, there are still some areas that need to be explored in more detail of which a few are discussed here.

#### **Extended research**

Over time various new XBRL projects will arise. As XBRL can be implemented virtually everywhere and for all kinds of purposes it is very likely new security issues might arise. Therefore it is suggested to perform similar case-study research including new projects. Especially projects that have specific innovative characteristics are interesting to investigate. There are several XBRL projects in countries such as China, Korea, Japan and Singapore, where public companies are mandatory to file their financial information in the XBRL standard (Pasmooij 2008). It is very interesting to perform case study research in these countries as there is not much information available about these projects in English.

#### **Simulation research**

In this thesis several theoretical weaknesses in the XBRL business information supply chain have been identified. It would be interesting to test the feasibility of them doing experiments. This could be done by simulating the BISC. Also more specific case studies from the accounting practice (e.g. Boritz and No 2008b) would be helpful to acquire knowledge about XBRL security issues.

#### **Perceived value of XBRL**

It is currently unknown how users of financial information currently perceive the value of XBRL instance documents. Has an XBRL instance document and its automatically generated PDF-document the same value for the user as a PDF-document that has been made by the issuing organization? Should an XBRL document really be complementary to a PDF-



document as suggested by this thesis? Will the perceived value be improved when security measures are applied?

### **XBRL-GL**

XBRL-GL is likely to become implemented more and more in the various accounting software packages available on the market. This raises new possibilities for IT-auditors to perform audit trails. Data mining techniques from the artificial intelligence field can be applied by e.g. tax authorities. It is also very interesting whether it is possible to reverse engineer public information to internal accounting data.

### **Legal research**

Due to the introduction of XBRL several new legal issues arise. One example that has been identified in this thesis is who is the legal author of a document that has been generated from an instance document use a style sheet. Also several other legal issues arise in the audit field of XBRL-coded information.

### **Adoption of XBRL in software**

As discussed in paragraph 4.5.1 most of the major accounting software (including ERP) vendors claim that their software is (becoming) XBRL enabled, but are quite vague about the actual implemented features. It would be interesting to test the actual functionality of the various software solutions and compare different packages. This could be studied from different perspectives, such as the time and work it takes to make an organization publish their financial information in XBRL. It would also be interesting to look how software interacts with different versions of taxonomies or the usage of multiple taxonomies.

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## Abbreviations

BISC	Business Information Supply Chain
CoC	Chambers of Commerce
COREP	COmmon solvency ratiON REPorting framework
EDGAR	Electronic Data Gathering, Analysis and Retrieval (system)
FINREP	FINAncial Reporting framework
GAAP	Generally Accepted Accounting Principles
HTML	HyperText Markup Language
IAS	International Accounting Standards
IASB	International Accounting Standards Board
ICT	Information Communication Technology
IFR	Internet Financial Reporting
IFRS	International Financial Reporting Standards
NTP	National (Dutch) Taxonomy Project
PDF	Portable Document Format
PI	Process Infrastructure
PKI	Public Key Infrastructure
SBR	Standard Business Reporting
SEC	U.S. Securities and Exchange Commission
SaaS	Software as a Service
SOA	Service Oriented Architecture
SOX	Sarbanes-Oxley Act
SSH	Secure Shell
SSL	Secure Socket Layer
TTP	Trusted Third Party
W3C	World Wide Web Consortium (See also: <a href="http://www.w3.org/">http://www.w3.org/</a> )
XARL	eXtensible Assurance Reporting Language
XBRL	eXtensible Business Reporting Language
XBRL-FR	XBRL Financial Reporting taxonomies
XBRL-GL	XBRL General (or Global) Ledger taxonomies
XML	eXtensible Markup Language
XMLDSIG	XML Signature

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