

XBRL Financial Reporting Supply Chain Architecture

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LIST OF ABBREVIATIONS

AAA	American Accounting Association
AIS	Accounting Information Systems
AktG	Aktiengesetz
AO	Abgabenordnung
BaFin	Bundesanstalt für Finanzdienstleistungsaufsicht
BilKoG	Bilanzkontrollgesetz
BörsG	Börsengesetz
BörsZulVO	Börsenzulassungs-Verordnung
BUS	Advanced Business Concepts
CD	Compact Disc
CEBS	Central European Banking Supervisors
CLOB	Character Large Object
COR	Core
COREP	Common Reporting
CRM	Credit Risk Management
DPR	Deutsche Prüfstelle für Rechnungslegung
DRS	Deutsche Rechnungslegungsstandards
DTS	Discoverable Taxonomy Set
ebXML	Electronic Business eXtensible Markup Language
EDIFACT	Electronic Data Interchange For Administration, Commerce and Transport
EHUG	Gesetz über elektronische Unternehmens-, Handels-, sowie Genossenschaftsregister
EPC	Event-Driven Process Chain

ERD	Entity-Relationship Diagram
ERM	Entity-Relationship Model
ERP	Enterprise Resource Planning
ERS	Exchange Reporting System
EStDV	Einkommensteuer-Durchführungsverordnung
EU	European Union
FFSA	Federal Financial Supervisory Authority
FINREP	Financial Reporting
FISC	Financial Information Supply Chain
FREP	Financial Reporting Enforcement Panel
FRIS	Financial Reporting Instance Standards
FRSC	Financial Reporting Supply Chain
FRTA	Financial Reporting Taxonomy Architecture
FSTE	Financial Services Terms Elements
GAAP	Generally Accepted Accounting Principles
GAMP	Generally Accepted Modelling Principles
GCD	Global/German Common Data
German AP	German Accounting Principles
GL	General/Global Ledger
GLFTA	Global Ledger Taxonomy Framework Technical Architecture
GLIS	eXtensible Business Reporting Language Global Ledger Instance Standards
HGB	Handelsgesetzbuch
HTML	Hypertext Markup Language
IAS	International Accounting Standards

IASB	International Accounting Standards Board
IASCF	International Accounting Standards Committee Foundation
IFRS	International Financial Reporting Standards
IFRS-GP	International Financial Reporting Standards for General Purpose
ISA	International Standard for Assurance Engagement
IT	Information Technology
KWG	Kreditwesengesetz
LRR	Link Role Registry
MaRisk	Mindestanforderungen an das Risikomanagement
MDA	Model Driven Architecture
MIS	Management Information Systems
MUC	Multi Currency
OMG	Object Management Group
PDF	Portable Document Format
PublG	Publizitätsgesetz
RTF	Rich Text Format
SEC	Securities and Exchange Commission
SMEs	Small and Medium-sized Enterprises
SOX	Sarbanes-Oxley Act
SRCD	Summary Reporting Contextual Data
TAF	Tax Audit File
TRP	Taxonomy Recognition Process
URI	Uniform Resource Identifier
US GAAP	United States Generally Accepted Accounting Principles
USB	Universal Serial Bus

USK	United States & United Kingdom
W3C	World Wide Web Consortium
WKWI	Wissenschaftliche Kommission Wirtschaftsinformatik
WpHG	Wertpapierhandelsgesetz
WpPG	Wertpapierprospektgesetz
WWW	World Wide Web
XBRL	eXtensible Business Reporting Language
XBRL FR	eXtensible Business Reporting Language for Financial Reporting
XBRL GL	eXtensible Business Reporting Language for General Ledger
XBRL US	XBRL United States
XDT	eXtensible Business Reporting Language Dimensional Taxonomies
XER	eXtensible Business Reporting Language for External Reporting
XFRML	eXtensible Financial Reporting Markup Language
XII	eXtensible Business Reporting Language International
XLink	eXtensible Markup Language Linking Language
XML	eXtensible Markup Language
XPointer	eXtensible Markup Language Pointer Language

Abstract

Recently the Internet with XML technologies and especially XBRL technology has impacted what is recognised as the financial reporting supply chain. Some claims in the market report that XBRL has the potential to reduce inefficiencies, automate and optimise the financial reporting supply chain. Nevertheless the real nature of the impact still remains unclear. The growing number of XBRL projects around the world together with strong interest from bodies such as the SEC in the United States, CEBS in the European Union and the IASB building XBRL taxonomies demonstrate the need for research in the area of XBRL application in the context of financial accounting and accounting information systems as well as in the financial reporting supply chain context. In order to answer the demand on the research in this area this research addresses financial reporting supply chain on the basis of financial accounting literature. With the introduction of information systems for enterprises, financial reporting was often discussed as a part of the AIS literature. Nevertheless the supply chain character and information systems context of financial reporting are rarely considered in the research literature in any theoretically constituent manner.

This study examines the impact of XBRL on the financial reporting supply chain architecture. First goal of this thesis is to properly state and set the boundaries of financial reporting supply chain. In order to realise the goal modelling of financial reporting domain as financial reporting supply chain architecture is conducted. The second goal is to critically assess impact of XBRL on the modelled financial reporting supply chain architecture components. This assessment is conducted by enhancing financial reporting supply chain architecture with XBRL components thus modelling XBRL financial reporting supply chain architecture. The secondary goal of the assessment is the construction of the reference model of XBRL financial reporting supply chain architecture.

1 Introduction

The objective of this thesis is to provide a comprehensible and reusable framework for assessing the impact of eXtensible Business Reporting Language (XBRL) on the financial reporting domain. Wagenhofer provides an economic perspective on the impact of XBRL on the financial reporting supply chain [Wage2007]. While Wagenhofer concentrates on the economic aspects, this study focuses on the information systems components of the financial reporting domain impacted by XBRL. Thus this thesis addresses the issues concerning the architecture of the financial reporting supply chain.

Felden states that information systems in the internal and external company information flow context are aligned to ensure information transfer mainly within the enterprises. Concerning information exchange between enterprises significant adaptation problems exist, since the internal communication forms are not suitable for external communication. Uniform transmission paths are missing within the heterogeneous system landscape, in order to arrange efficient inter- and extern-company data exchange. For the guarantee of optimal information supply the enterprises need additional numerous external data sources [Feld2002]. This thesis explores the financial reporting supply chain and addresses whether there exists a theory for the internal and external company data exchange and especially for the financial reporting flow from the management information systems¹ (MIS) perspective.

Pfaff et al. introduce the term financial supply chain which parallels the physical or material supply chain of the enterprise and represents all transaction activities related to the flow of cash from a customer's initial order through reconciliation and payment to the seller [PfSW2004, 21]. The financial supply chain understanding is stated in the definition of Pfaff et al., and also shared by Skiera et al., in the context of

¹ MIS refers in this thesis to the German term *Wirtschaftsinformatik*. *Wirtschaftsinformatik* demonstrates a number of similarities to the discipline of MIS, which can mainly be found in English speaking countries. But there are a few significant differences. *Wirtschaftsinformatik* encompasses information technology, with the relevant portions of applied computer science, to a much larger extent compared to MIS. *Wirtschaftsinformatik* has significant constructive features meaning that major focus is on the development of solutions for business problems rather than simply describing them. A comprehensive discussion on the differences between *Wirtschaftsinformatik* and MIS is conducted by Heinrich et al. [HeHR2007, 343-351]. This study does not go into detailed discussion between *Wirtschaftsinformatik* and MIS and uses the latter term in the German understanding of MIS.

the support of financial transactions between various parties [SKGW⁺2004, 14]. This understanding differs from the reporting supply chain understanding, which is the substantial part of this research. The domain of business reporting and especially financial reporting plays an important role when discussing internal and external information flows among organizational units. The research literature addresses the financial reporting domain often as a financial reporting supply chain (FRSC²) [Pins2007, 77; Wage2007, 103; Teix2007, 65; Cham2007, 184; Schm2007, 237; Klem2007]. The focus here is on the value added that is created along the supply chain of financial reporting [Debr2007, 5]. Recently the Internet with eXtensible Markup Language (XML) technologies and especially XBRL technology has impacted what is recognised as the financial reporting supply chain [DeCC⁺2005; Wage2007, 119]. Some claims in the market report that XBRL has the potential to reduce inefficiencies, automate and optimise the financial reporting supply chain [Hann2004, 55; Klem2007, 249-271; NuSt2002, 457]. Nevertheless the real nature of the impact still remains unclear [Sutt2006, 3]. The growing number of XBRL projects around the world together with strong interest from bodies such as the Securities and Exchange Commission (SEC)³ in the United States, Central European Banking Supervisors (CEBS)⁴ in the European Union (EU) and the International Accounting Standards Board (IASB)⁵ building XBRL taxonomies demonstrate the need for research in the area of XBRL application in the context of financial accounting and accounting information systems (AIS) as well as in the financial reporting supply chain context. In order to meet the demand for

² The financial reporting supply chain is often referred to as financial information supply chain (FISC) [FFFM2005, 1; GIPa2006, 69], business reporting supply chain [NuSt2002] or business data supply chain [Rami2007]. This study differentiates between data and information in the understanding of Felden which is common for MIS [Feld2002, 32; Feld2006b, 55] and recognises reports as a intersection of both, information and data. Thus throughout this study the term financial reporting supply chain is used in the context of both financial data and financial information. Also this study refers often to the financial information in the context of the goal-orientation on financial reporting.

³ U.S. Securities and Exchange Commission started in 2004 an initiative to assess the benefits of XBRL tagged data in commission filings [SEC2007].

⁴ Committee of Central European Banking Supervisors recommends XBRL standard for common reporting (COREP) and financial reporting (FINREP) in the supervisory scenarios for 27 member states of the EU [CEBS2007].

⁵ The Board of Trustees of the International Accounting Standards Committee Foundation (IASCF) announced a plan to "...ensure ... the appropriate quality control systems and structures in place to deliver an IFRS [XBRL] taxonomy with the same quality, in the same languages and at the same time as the annual bound volume of IFRSs." [IASB2007]

the research in this area this research addresses financial reporting supply chain on the basis of financial accounting literature [Higs2003]. With the introduction of information systems for enterprises, financial reporting was often discussed as a part of the AIS literature [SuAr2002, 2-3]. Nevertheless the supply chain character and information systems context of financial reporting are rarely considered in the research literature in any theoretically constituent manner [Sutt2006].

There are two important factors which need to be taken into consideration when discussing the financial reporting. First, the domain is characterised by a number of participants each having different motivations. For example, Baldwin et al. [BaBT2006, 106] as well as the International Financial Reporting Standards (IFRS) Framework [IASB2006a, 35-36] discuss the classification of receivers of financial reports. This research addresses such groups as companies, data aggregators, tax advisors, banks, auditors, regulators, investors, standard setters, governments and public bodies. Different goals and different needs of these participants make it difficult to trace dependencies and relationships among them in order to support their activities with the use of information technology (IT).

The second factor is that financial reporting as such represents a sophisticated domain from the legal perspective because of the number of different, partly overlapping regulations. The recently introduced regulations in this area, such as IFRS [IASB2006a], Basel II [Übel2004], Sarbanes-Oxley Act (SOX) [LiOC2007], 4th and 7th directives of the EU [EuCo1998a; EuCo1998b] or changes in local Generally Accepted Accounting Principles (GAAPs) [DRSC2007], indicate the dynamics of the financial reporting and create new requirements for information systems used to support the reporting activities. This research addresses the complexity of legal issues in the financial reporting domain strictly related to the financial data and structure for this data. Further this research analyses the functions and processes perspective of the financial reporting supply chain together with the time oriented view on the financial reporting domain.

This comprehensive analysis addresses also the serious inefficiencies in data exchange and data analysis which are reported for the financial reporting domain [Sutt2006]. Overwhelming amounts of reports are heavily paper-based and manually

processed. One of the main reasons for this state is the lack of unified electronic formats enabling electronic processing of financial reporting data. Many researchers report that the current business and especially financial reporting processes and information flows cannot be fully automated, are often not standardised and are identified as inefficient [Klem2007, 251; Wage2007, 119].

This research extends what is reported by many researchers. XBRL gains importance being indicated as the main means of electronic communication for financial and business reports [Feld2006a, 34; DeGr2001, 63-67; Berg2003, 13-15]. Although impact of XBRL on the financial reporting supply chain is often discussed in the literature, the way how XBRL impacts the financial reporting supply chain still remains questionable.

The above considerations lead to constitution of the research goals for this study. The goals are supported by the statement that there is high level of complexity requiring detailed studies in the area of XBRL and financial reporting from the MIS perspective [Debr2007, 5]. Also the context of financial reporting supply chain clarifies the necessity of systematic research in this area [Sutt2006]. This study examines the impact of XBRL on the financial reporting supply chain architecture. First goal of this thesis is to properly state and set the boundaries of financial reporting supply chain. In order to realise the goal modelling of financial reporting domain as financial reporting supply chain architecture is conducted. The second goal is to critically assess impact of XBRL on the modelled financial reporting supply chain architecture components. This assessment is conducted by enhancing financial reporting supply chain architecture with XBRL components thus modelling XBRL financial reporting supply chain architecture. The secondary goal of the assessment is the construction of the reference model of XBRL financial reporting supply chain architecture.

This thesis outlines the propositions and scientific approach in this section. Table 1 provides an overview of the research propositions set for this research.

Table 1. Research Propositions

P 1	Financial reporting supply chain architecture can be modelled for the financial reporting domain
P 1.1	Financial reporting supply chain architecture consists at the minimum of data, data structures, processes, participants and network components
P 2	XBRL introduction alters financial reporting supply chain
P 2.1	XBRL introduction alters not only data and data structure components but also impacts other components of financial reporting supply chain architecture
P 2.2	XBRL financial reporting supply chain architecture can be modelled and used as reference architecture

The above research propositions are built up in a structured way. The main propositions state that the *financial reporting supply chain architecture can be modelled for the financial reporting domain* (P 1) and second propositions communicating that *XBRL introduction alters the financial reporting supply chain* (P 2). The first proposition constitutes of one sub-proposition. This assumes that *financial reporting supply chain architecture consists at the minimum of the models for data, data structures, processes, participants and network components* (P 1.1). The second main proposition (P 2) is explained in detail by the use of the sub-proposition P 2.1 communicating that *XBRL introduction alters not only data and data structure components but also other components of the financial reporting supply chain architecture*. This proposition is derived from the fact that XBRL technology is claimed to represent data (reports) and data structures (taxonomies) components. This study refers to the use of XBRL in the whole financial reporting supply chain thus measuring impact on processes, participants and network components. Further the proposition P 2.2 summarises one of the research goals, which states that *XBRL financial reporting supply chain architecture can be modelled and used as reference architecture*. Over the course of research presented in this thesis the propositions listed in table 1 are addressed and verified.

The study proceeds as follows. Second chapter presents briefly the research framework together with the discussion on the underlying theory for the conducted research. The chapter is followed by two chapters, three and four, providing the analysis of the financial reporting domain and the analysis of the technical domain. The subse-

quent chapter five presents the results as a set of financial reporting domain models discussed in the context of the financial reporting supply chain architecture. This chapter continues with presenting the results discussing the impact of the XBRL components on the components of the modelled financial reporting supply chain architecture. The following chapter six provides the evaluation of the modelled architecture on the basis of reference modelling approach. The final seventh chapter presents the conclusions and the limitations of this study, and suggests opportunities for future research in the area of the XBRL financial reporting supply chain architecture.

2 Research Framework

This chapter presents the underlying research framework and discusses the theories as a base for further observations, analysis and modelling. The chapter is divided into six sections. The first presents research methodology in an organised and structured manner. The methodology is the basis for the structure of the study as well as indicating the course of the conducted research. The second provides the review of the literature relevant for the XBRL as well as financial reporting supply chain architecture. The next section provides a solution of this research which is demonstrated and briefly introduced in order to give the reader the understanding of the modelling process for the financial reporting supply chain architecture. The introduction of the solution at this stage supports also the discussion on the theoretical background presented in the next section. The fifth section discusses areas and themes which were excluded from this research and explains the reasons for these research limitations. This chapter is summarised with a conclusions section discussing the research framework.

2.1 Research Methodology

In order to analyse and verify the research propositions presented in the first chapter the scientific methods explained in this section are applied. Figure 1 provides an overview of the approach used in this research.

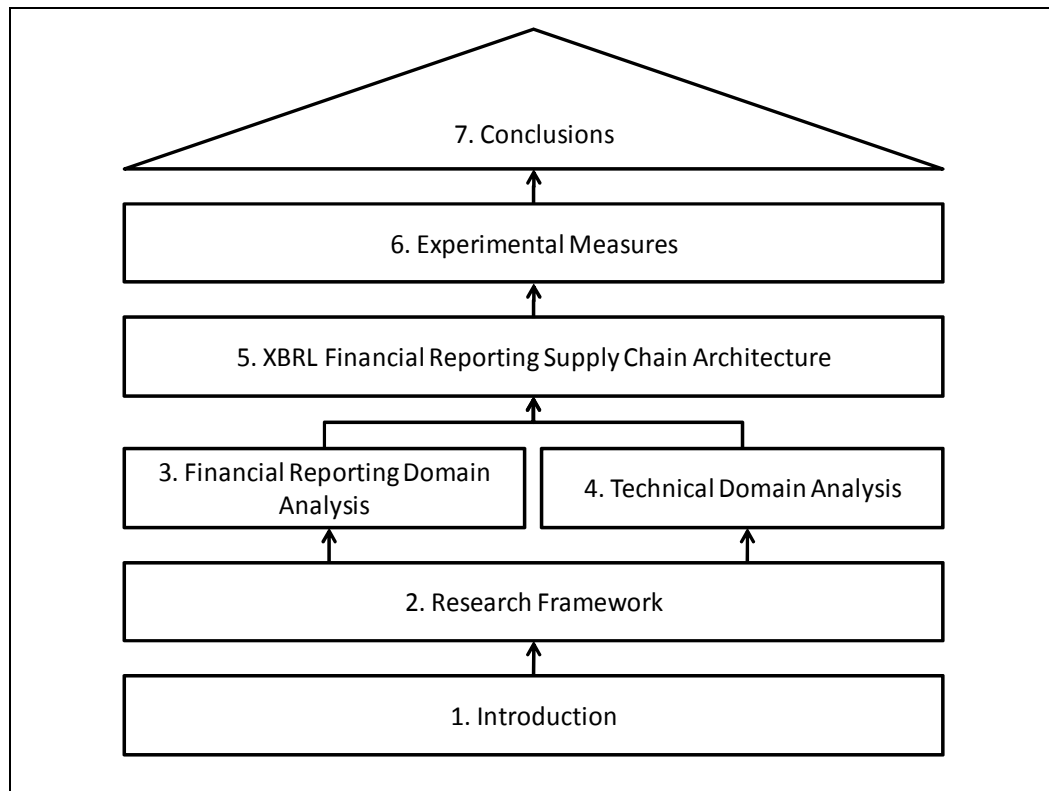


Figure 1. Course of Research

The first introductory chapter gave an overview of the issues that exists in the reporting domain, introduced the background for the research together with research questions and defined the goals of this thesis. Further the research propositions were listed in the first chapter.

The first part of the actual research is presented in this second chapter. The research framework constitutes the literature review and discussion of the extant research. Next it provides an overview of the basic concepts and definition used throughout this study. The presented solution enables the reader to understand the expected goals of this research and supports the choice of the underlying theoretical framework. This section is summarised by the research limitations.

Subsequent two chapters provide background analysis necessary for further modelling. Chapter three focuses on the analysis of the financial reporting domain. This analysis starts with the accounting part followed by the report preparation section. It is finalised with section discussing the reporting itself. The main goal of the financial reporting domain analysis chapter is to deliver the overview of the financial report-

ing supply chain components. It is conducted on the basis of available literature on financial accounting and accounting information systems and enriched with a set of interviews conducted across selected financial reporting scenarios in Germany. The analysis also encompasses the review of the legal sources regulating the financial reporting of entities in Germany.

The parallel chapter four discusses the technical domain. It focuses solely on the XBRL standard. The structure of this analysis chapter reflects the technical specifications of the reporting language. The first section encompasses the analysis of the XBRL 2.1 specification while the second section concerns the XBRL Dimensions 1.0 specification. Finally other XBRL developments are addressed, a classification of XBRL technologies is introduced and discussion on XBRL standardisation and adoption levels is conducted. The goal of the technical domain analysis chapter is to provide a solid and comprehensive overview of the XBRL technologies. It is also important to provide a critical consideration on the classification of these technologies as well as critical view on the XBRL adoption issues.

Both chapters provide a substantial basis for the construction of the financial reporting supply chain architecture in the first section of the fifth chapter and enhancing the architecture with the XBRL in the second section. The result of this approach is the reference XBRL financial reporting supply chain architecture. The structure of this chapter reflects the Zachman architecture framework and is conducted over six views each on both contextual and conceptual level.

Both architectures are evaluated in chapter five by the means of the GAMP. The financial reporting supply chain and XBRL financial reporting supply chain architectures are assessed according to the six GAMP principles. Each of the principles is discussed and a summary of evaluation option is demonstrated.

2.2 Literature Review

The review of the literature in the financial reporting supply chain and XBRL areas can be grouped into three themes. Firstly, prior research refers to the economic perspective of the impact of XBRL on the financial reporting domain. The second theme

is the technological perspective of the XBRL implementation. The third theme considers literature which directly concerns the financial reporting supply chain.

The first theme is focused on the AIS aspects [DaGM2002; RaKO2006; SuAr2005] and rarely deals in more detailed way with the inter-organisational reporting aspects [Teix2007; Sutt2006, 4]. For example Wagenhofer refers to accounting information flows. The presentation of his model and its brief explanation does not provide the reader with deeper understanding of the processes, participants, data and network for these information flows [Wage2007, 103]. Teixeira often refers to the reporting supply chain however does not explain the constitution of it [Teix2007, 57-70]. Debreceny as well as DiPiazza and Eccles each indicate how improved information technologies and in particular XBRL can have positive impact on the economics of the reporting supply chain. However DiPiazza and Eccles focus on the changes that XBRL causes to the financial reporting domain and do not analyse its architecture [DiEc2002, 105-128]. Debreceny and Gray provided some pointers to the particular features of XBRL but did not provide detailed guidance [DeGr2001].

The second discussed theme is the technological aspect of the financial reporting supply chain. Gassen [Gass2000, 164] as well as Cushing [Cush1989] discuss the database publication of financial reports. Their discussions concern possibility of structuring financial information in similar way to database schemas. Klement provides an interesting analysis of XBRL use for financial information supply chain automation but his research is very brief and does not provide a comprehensive view of the financial reporting supply chain architecture [Klem2007, 267-268]. Additionally Klement's analyses particular aspect of the financial information supply chain with the focus on XBRL implementation issues.

The third theme considers the literature discussing directly the financial reporting supply chain architecture components. Bergeron [Berg2003, 141-145] provides a good starting point in analyzing the XBRL financial reporting supply chain but without the detailed view on the various components of the supply chain. Hoffman and Strand [HoSt2001, 14-17] refer to information flow in the financial reporting supply chain but their approach provides only a very high level consideration. Also Baldwin et al. refer to the reporting industry supply chains however state that: "...how the use of XBRL

will change the nature of data and information is an open research question” [BaBT2006, 108-109].

Subsequently the conclusion can be drawn that academic and professional literature both refer to the financial reporting supply chain quite often however none of the sources mentioned discusses the comprehensive constitution or architecture of the financial reporting supply chain in a systematic manner. Also the definitions, scope and understanding of the financial reporting supply chain vary depending on the author’s perspective.

2.3 Modelled Architecture

Economics discussions concerning XBRL impact on financial reporting of Wagenhofer or Teixeira [Wage2007; Teix2007] are conducted on very high level of abstraction. Although they explain general mechanisms in the financial reporting supply chain a deeper understanding is necessary in order to focus such discussions. Thus this study attempts to provide a proper set of models explaining technical details of the supply chain. In this section a solution⁶ of XBRL financial reporting supply chain is presented. This part of the study should enable the reader to understand the matters discussed and analysed later. The presented solution explains also how the results of this study can be applied to a reporting scenario. The chosen reporting scenario in this section is financial reporting between a listed company and exchange supervisor⁷. Such a scenario can be found at almost every regulated stock exchange worldwide. To be able to understand such a reporting scenario it is necessary to provide several different views on it⁸ and try to separate its single components. For the needs of the modelled financial reporting supply chain this section identifies three different views. Figure 2 provides a graphical representation of each modelled view.

⁶ It is important to note that the presented solution addresses only a small part of the XBRL financial reporting supply chain architecture.

⁷ This section deals with a simplified supervisory reporting scenario with the aim to explain the reader to necessity of providing a set of models of the financial reporting supply chain architecture. The solution presented in figure 2 contains a number of simplifications and should not be regarded as a comprehensive view of the chosen reporting scenario.

⁸ The decomposition of the modelled object in several different views is known from many modelling approaches [Sche2001; Zach1987; BeSc2004, 71]. Most common views on the modelled object are data, process and organisation views.

The first stage deals with the analysis of the data and data structures. The relationships between data and data structures components are modelled with the use of Entity-Relationship Model (ERM)⁹. The XBRL taxonomy which is the basis for creation of the XBRL report is based on GAAP and defines the data structure for the XBRL report which should be submitted to the supervisor. The created XBRL report reflects the financial report of the company which needs to comply with GAAP.

⁹ The diagram presents only the simplified view of the ERM not considering the cardinalities of the relationships.

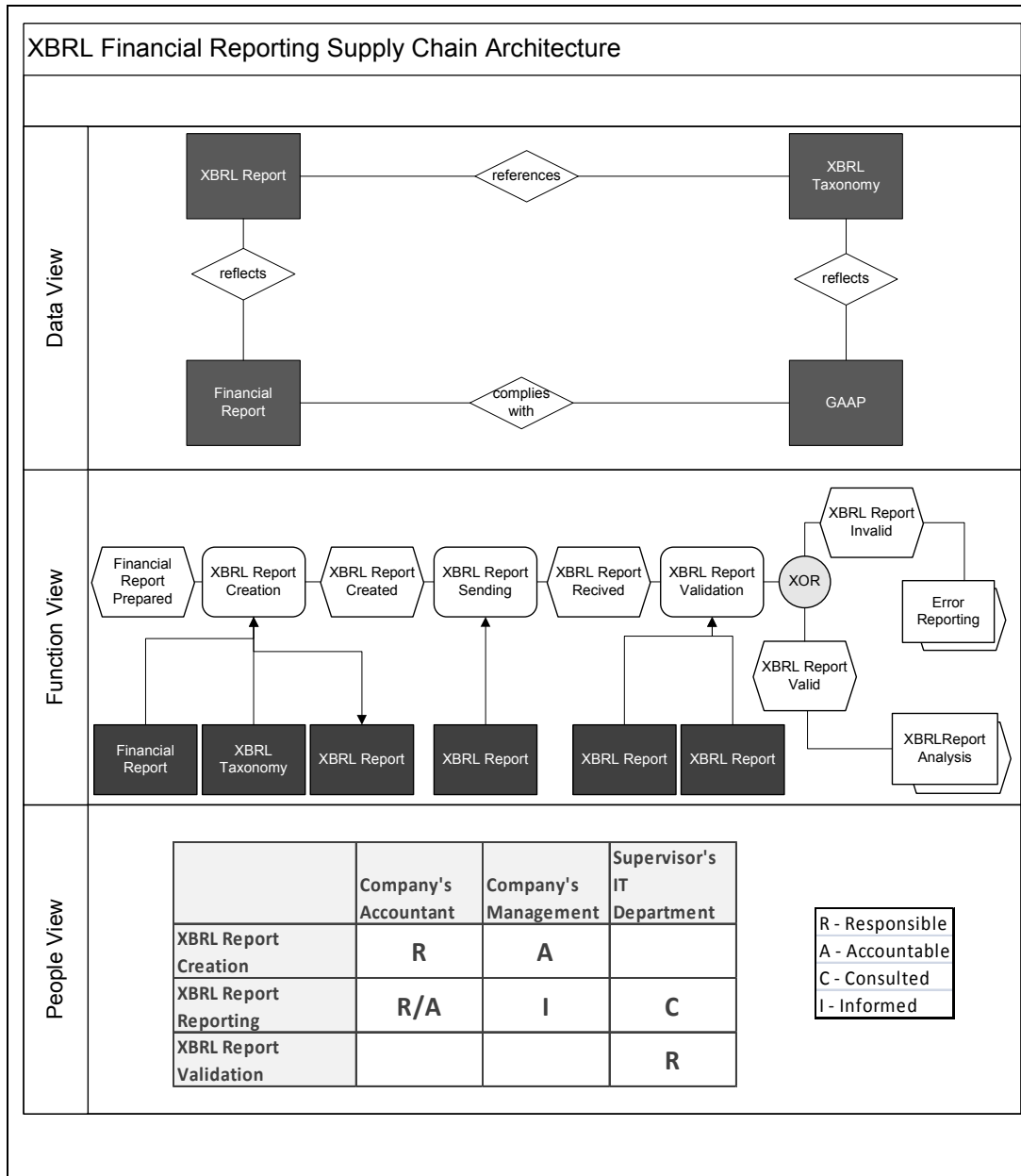


Figure 2. Different Views on the XBRL Financial Reporting Supply Chain Architecture

The second provided view of the example of the XBRL financial reporting supply chain architecture concerns the functions¹⁰. This view provides information about the processes conducted together with the input and output data necessary to conduct a certain process. The used modelling technique is the event-driven process chain (EPC).

¹⁰ The distinction between function view and processes is explained in the fifth chapter.

For the creation of the XBRL report both financial report and the XBRL taxonomy are necessary as an input. An output of the process is the XBRL report. Further the XBRL report is used in the reporting process and finally is validated¹¹ at the reporting system of the supervisor. The result of the validation leads either to the set of processes related to error report generation or to the set of processes related to the analysis of data provided in the XBRL report.

In the solution presented only three participants are considered. First two are organisational units from the reporting company and the third one is the IT department of the supervising entity. The used modelling technique is the RACI (Responsible, Accountable, Consulted and Informed) approach [PrWo2004; ITGI2005, 18]. The use of the RACI matrix provides information about the relation of the organisational units and the conducted processes. For example the reporting process needs to be conducted by the accounting department of the company, with information to the management that the financial data was sent. Also in order to complete the process the accountants as well as the IT department of the supervisor need to be consulted in order to finish the activity.

Even brief analysis of a simplified reporting scenario presented as a solution clarifies the need for a number of different views on the financial reporting supply chain architecture. It leads to a conclusion that in order to analyse the impact of XBRL on such a reporting scenario detailed and structured information is needed. Such information can be obtained from formal models of the different views on a reporting scenario. First having such models the analysis of XBRL components can be placed in the modelled architecture.

This section provided a brief overview of the solution to give a better understanding of the research presented in the further chapters as well as indicate results to be achieved. The next section analysis provides the theoretical framework for this research.

¹¹ Validation of XBRL reports means an automated process of checking if the XBRL report complies with the XBRL taxonomy.

2.4 Underlying Theory

This section delivers the underlying theoretical framework for the research conducted in this study. The analysis of the available research theories does not provide a theory on how to model financial reporting supply chain scenarios and how to organise them in a form of architecture. Further, from the existing studies it is not clear how to measure and analyse impact of XBRL on the financial reporting supply chain. Thus this section presents the theoretical framework for this research using established approaches and theories known from research literature.

The presented theoretical framework uses four levels of abstraction. The first level concerns the general philosophical position assumed for the conducted research which is constructivism. The second level applies the design science theory which builds up the fundament of this research. The third level provides the theoretical background for the modelling part which is known from the MIS as the reference modelling approach of Schütte and Becker [BeSc2004, 65-170]. Finally the fourth level specifies the modelling approach and provides the structure for the modelling in a form of Zachman enterprise architecture framework. Figure 3 provides a graphical overview of the theoretical framework used in this study.

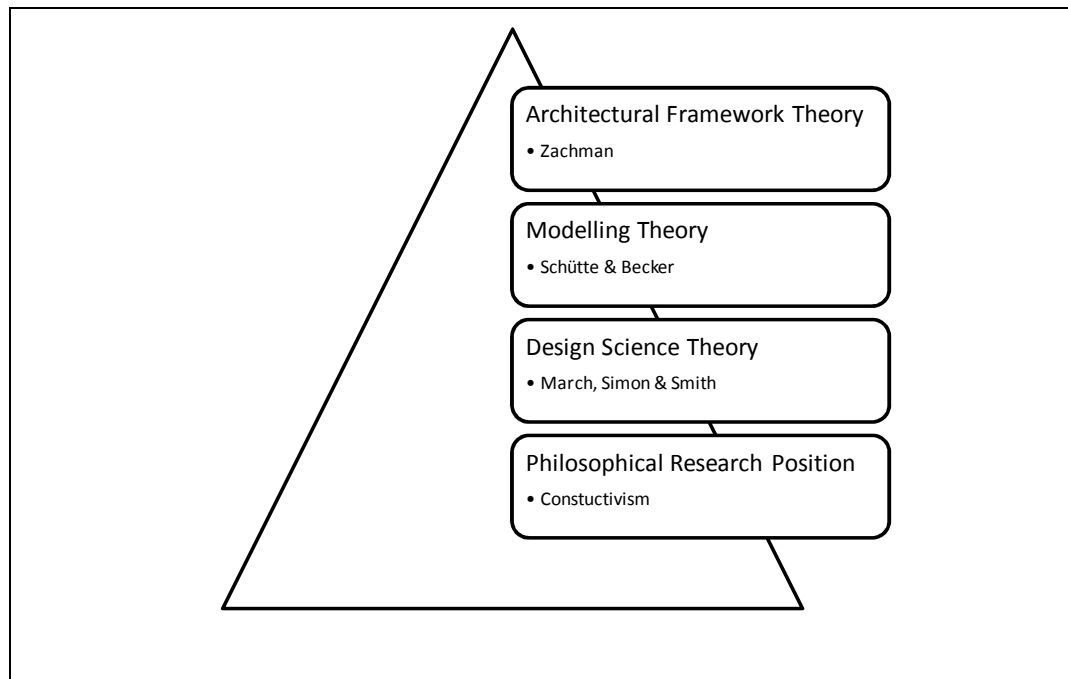


Figure 3. Theoretical Framework

2.4.1 Philosophical Research Position

In order to explain the philosophy of science context of this research the constructivist paradigm is explained in this section. Constructivism builds general philosophical background for the development of the financial reporting supply chain architecture addressed in this thesis. [GuLi1994, 111; Schw1994, 120]

Further the constructivist paradigm states that generally individuals do not discover reality and truth but they construct and develop. Researchers design concepts, models and theories in order to understand the reality [Schw1994, 126]. One and the same reality can in this way be expressed with the use of different constructs. Further the constructs are exposed to continuous changes being confronted with the reality. From the methodological perspective the constructivists are application-oriented researchers. The application-oriented research derives the research questions from unsolved practical issues. The goal of constructivism is to deliver constructs which help understand the complexity of the reality. Therefore important for the constructivism is to deliver and verify models for the reality in the background. Quality factor of the constructed models is their practical applicability together with the usefulness of the

models in the practical usage. In the context of this study constructivist paradigm is the underlying philosophy of science position taken.

2.4.2 Design Science Theory

The second level of the theoretical framework applies to the design science theories being background for the research conducted and extending the constructivist approach¹². According to Simon as well as March and Smith design is the use of scientific principles, technical information and imagination in the definition of a system to perform pre-specified functions with maximum efficiency. The design of information systems is regarded as a goal-oriented activity [MaSm1995; Simo1996]. March and Smith address the design science in their research framework addressing thus research activities and research outputs [DaGM2002]. The design artefact includes construct vocabulary, symbols and models for abstraction and representations, methods and prototypes that illustrate proof-of-concept for evaluation [HMPR2004; MaSm1995]. Design theory is the prescriptive type of theory that gives principles for the construction of a tool or artefact to meet a set of meta-requirements [HMPR2004; Iiva2003; Simo1996]. This study uses the constructivist paradigm as a background for the design science theory and applies both to the Becker and Schütte modelling approach.

2.4.3 Modelling Theory

In order to enhance the discussed theories with modelling considerations appropriate theories need to be applied. This is represented by the third and fourth level of the developed theoretical framework. Becker and Schütte provide a theory on the reference modelling. They define modelling as a tool of MIS and provide a set of classifications for modelling activities. Becker and Schütte theory also delivers definitions of types of information models and information system architectures. Becker and Schütte extend it

¹² According to Atwood et al. the design theorist Schön, Simon, March and Williamson seem to have in common that these authors approach design and designers from a theoretical level and do not deal extensively with concrete applications of those theories [AGMM2003, 11]. But Cross states that making an explicit analysis and comparison of the paradigms underlying the approach of Simon, on the one hand, and Schön on the other, Simon's positivism leads to a view of design as rational problem solving, and Schön's constructivism leads to a view of design as reflective practice [Cros2006, 102]. From the viewpoint of Cross this study reflects the Schön's view on the design science theory.

with a set of modelling paradigms. Becker and Schütte discuss especially the data, function, organisation and processes modelling. [BeSc2004, 65-170]. This theory can be directly applied to the research presented in this thesis due to the fact that the theory is not domain specific. Moreover Becker and Schütte theories concern not only the creation of the models but also their evaluation. Evaluation is an important factor of the modelling process guaranteeing the high quality of the model.¹³ This study uses the Generally Accepted Modelling Principles (GAMP) developed by Schütte and Becker which are:

- principle of accuracy,
- principle of relevance,
- principle of efficiency,
- principle of systematic design,
- principle of clearness,
- principle of comparability. [BeAl2003]

Becker et al. indicates that the aim information models cannot only be the creation of conceptual design for information system design. Instead Becker et al. support organisational design in a way that increases the importance of comprehensibility. This process is counteracted by the current predominant description of methods especially by the way it represents the respective rules of notation. There is a need for appropriate recommendations on how to improve the model quality – the usefulness of information models for the design of information systems and organisation design. [BeRS1995]

Schütte discusses new¹⁴ GAMP in the context of reference modelling [Schu1998, 111]. Goal of the GAMP is to define aims and conventions for modelling¹⁵. According to these aims it is possible to assess quality of constructed models

¹³ Additionally to Becker and Schütte, Balzert developed a theory discussing the use of different formal modelling approaches based on different views on the organisation. Balzert theoretical foundation is guidance later in this study when selecting the best modelling approach for the certain view on the financial reporting supply chain. [Balz2001, 106]

¹⁴ Old draft version of GAMP is discussed by Becker et al. [BeRS1995].

¹⁵ Becker and Schütte refer often to modelling of information in the context of modelling of information systems [BeSc2004, 65].

and using the modelling conventions it is possible to enhance models quality [Sche2000, 67].

Due to the constructivist background of Becker and Schütte modelling approach [BeNK2004, 12] it is not possible to evaluate created models by comparing them with modelled reality. The evaluation can be conducted only in the context of goals set. Schütte is driven in that case by the customer oriented model understanding. The lower the difference between the requirements of the model addressees and the effective adequacy of the model for the problem solution the higher is the quality of the model [Schu1998, 113]. Schütte together with Becker present further a number of general criteria from which they constructs the generally accepted modelling principles. The main criteria are:

- construction of model adequate to problem;
- modelling capability of the chosen modelling language;
- costs and revenues;
- analysed system;
- legibility of constructed models;
- selection and integration of models. [Schu1998, 113-115]

As GAMP Becker and Schütte classify six single principles listed before:

1. The principle of accuracy means that from methodical point of view a model should represent a design rationale in the context of modelling language. Models must be consistent according to modelling technique from the syntactic point of view. Additionally in the broader sense of modelling of information systems models must be semantically correct. It means that it must be possible to draw reasonable conclusions on the basis of the models. The drawing of conclusions refers only to the existence of language community in the context of used terminology as well as modelling language. Correctness of the transfer between the case expressed by the use of the domain terminology and the case expressed using the modelling language can be verified in the context of language community. [BeSc2004, 125].

Becker and Schütte state that models represent information according to the extended understanding of used terminology if they are syntactically correct and it can be stated that their semantic accuracy is correct. Their validity does not have to be assessable before. [BeSc2004, 125]

2. The principle of relevance addresses the usability of the reference models in practice. Only these circumstances should be modelled which are relevant for the underlying modelling aims. In order to assess this criterion the aims of modelling must be explicitly stated. Only explicitly stated modelling aims allow selecting proper abstraction level for a model as well as choice of proper modelling techniques. The principle of relevance helps also to enhance modelling techniques. The aim oriented adjustment and development of modelling techniques are the basic tasks in each modelling project. For example it is possible to leave some notation elements together with a part of terminology out of a model when they are not contributing to the aims achieving on the analysed level of abstraction. Additionally it is possible to develop more powerful modelling languages for specific modelling aims. [BeSc2004, 126]

Becker and Algermissen addresses external and internal minimality in the context of principle of relevance presented in the figure 4. External minimality is achieved when a model represents all relevant components of the modelled systems of objects. Internal minimality¹⁶ is achieved when all components of a model are relevant.

¹⁶ Also Weber addressing ontological issues in AIS indicates that minimality is a condition of good decomposition of object systems [Webe2002].

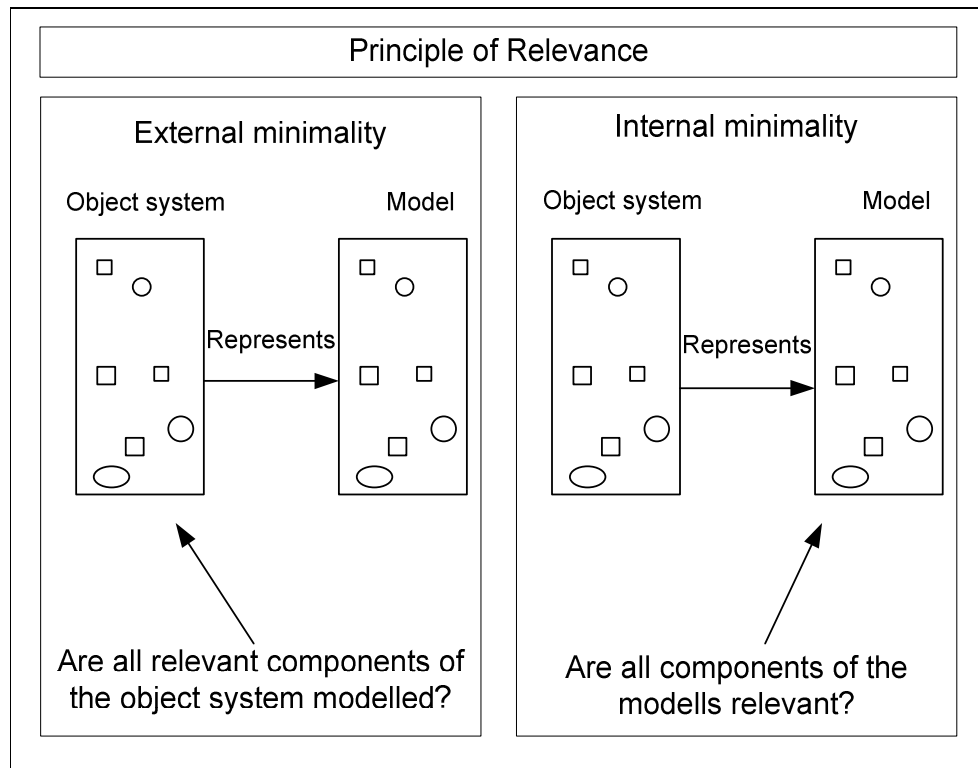


Figure 4. External and Internal Minimality in the Principle of Relevance [modified after BeAl2003, 3]

Further figure 5 explains how the requirements for syntactical and semantic correctness are related to the criteria of relevance. While relevance communicates the relationship between meta model and system of objects, the correctness addresses syntax between meta-models and constructed models as well as semantic between constructed model and system of objects in the real world.

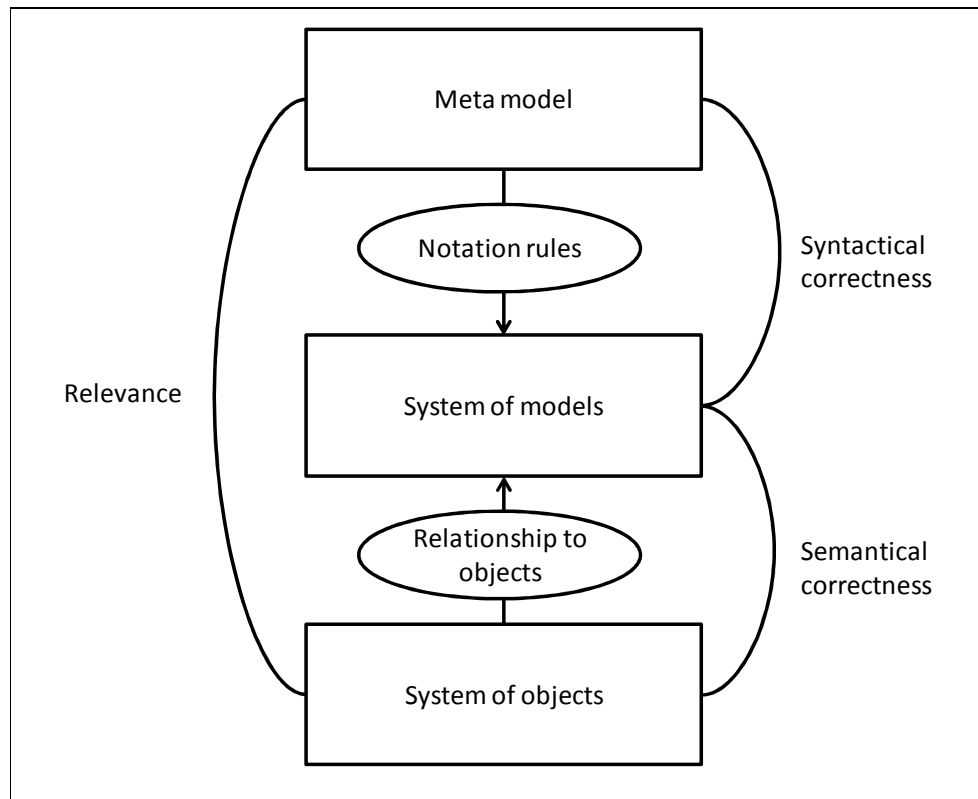


Figure 5. The relationship between the principle of accuracy and principle of relevance [BeRS1995, 438]

3. Principle of efficiency formulates economic restrictions for constructed models. Each activity of an economic entity should be conducted in the efficiency context. This general rule applies also for information modelling. [BeSc2004, 126]. Schelp indicates that the development of information models not only generates costs but also delivers possibilities to sink costs or increase revenues. Aim of the principle of efficiency is to take both aspects into consideration during modelling process. Also flexibility and changeability of models should be considered from this economic perspective [Sche2000, 68].
4. Principle of systematic design postulates presentation of modelled domain using a number of different views. It leads to increase of homogeneity of modelled domain as well as to reduction of complexity. When modelling information systems it can be distinguished among data, function, organisation, steering as well as structure and operation views. [BeSc2004, 128]. In order to fulfil the requirements of this principle two aspects need to be considered:

- the existence of a general modelling meta-architecture encompassing the analysed views and delivering systematic framework for modelling activities;
 - the consistency and systematic in modelling elements of different views, which enables later the compositions of different views. [BeRS1995, 439].
5. Principle of clearness represents the goal to assure the comprehensibility of models especially for different group of users. Model users who are domain experts are often not as familiar with modelling techniques as the model users who are IT experts. Therefore there is different understanding of the principle of clearness for different users groups. The principle of clearness addresses additionally the unambiguousness of system of models [BeSc2004, 129]. According to Schelp three criteria should be analysed in this context.
- Unambiguousness of model hierarchy means it should follow systematic decomposition of complex systems of objects and building of models on different abstraction levels.
 - Unambiguousness of model layout has the goal of assessing the graphical alignment of modelled objects.
 - Possibility of filtering means that it should be possible to prepare user oriented models. [Sche2000, 69]

Additionally Becker and Algermissen address general readability of constructed models [BeAl2003, 4]. Figure 6 provides an example of principle of clearness in a model with enhanced readability.

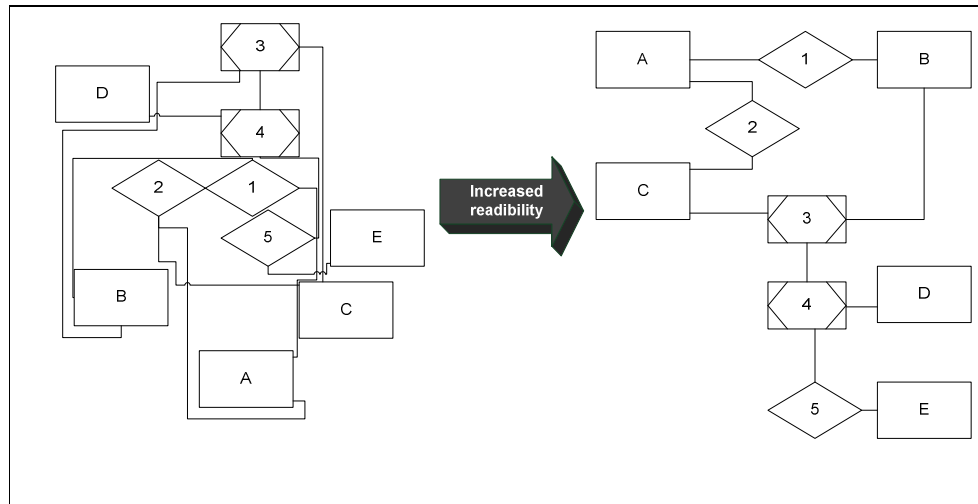


Figure 6. Readability in Constructed Models [BeAl2003, 4]

6. Principle of comparability refers to the possibility of conducting models comparison. Schütte addresses in his research primarily the comparisons between actual and desired models in context of reference models [BeSc2004, 130]. He indicates usefulness of existence of a meta-meta-model for both compared meta-models.

For the operationalisation of the GAMP Schütte suggests the choice of one modelling alternative. It requires evaluation of models with the use of the full set of six principles. Principles of accuracy, relevance and clearness are only partly measurable. Therefore Schütte suggests using the overall conclusion drawn from all the principles with the goal of maximising subjective modelling quality. [Sche2000, 69]

Usage of the GAMP should be regarded in the context of similarities in the structures of the models and their potential for modelling processes and further reference model use. Table 2 presents use of structural analogies for each of the GAMP.

Table 2. Use of Similarities in Structure in GAMP Context [modified after BeAl2003, 6]

Principle	Effects Due to Use of Similarities in the Structure of the Models
Principle of Accuracy	Lower risk of semantic and syntactic incorrect modelling
Principle of Relevance	Bigger target group of model users for whom model fulfils the minimal criteria
Principle of Efficiency	Lower modelling costs and lower costs of model adjustments
Principle of Systematic Design	Structural analogies in different views require overall consistency
Principle of Clearness	Increased readability and increased later recognition
Principle of Comparability	Improved semantic and syntactic comparability

GAMP approach presents mature, well-designed and valid concept for measuring the quality of constructed reference models. Especially in the context of information modelling the six principles refer to both company specific models and reference models encompassing parallel multi views on analysed domain as well as overall perspective on the modelled system of objects [BeAl2003, 7-8].




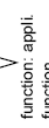
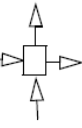
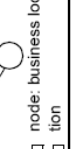
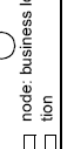

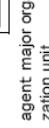


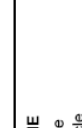




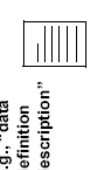

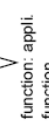
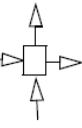
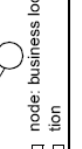
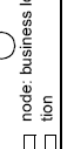

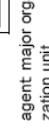


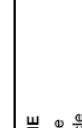




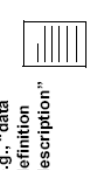

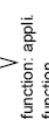
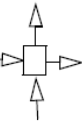
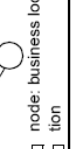
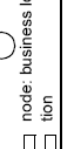

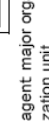


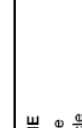




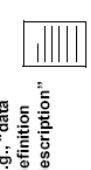

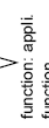
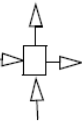
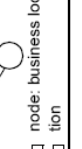
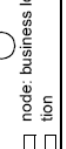

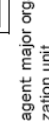


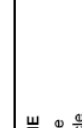




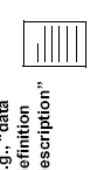

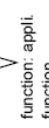
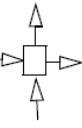
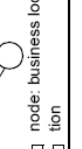
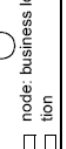

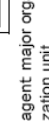


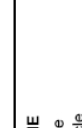



2.4.4 Architectural Framework Theory

On the highest level of the research framework, Zachman provides a generic and comprehensive architectural framework which combines different views on an information system. Such framework consists of the levels of detail and provides a structured approach to the modelling of financial reporting supply chain. This study applies this architecture framework to model the financial reporting supply chain and XBRL financial reporting supply chain architectures. The role of the Zachman framework is to present a logical structure of an information environment [Zach1987; InZG1997; IyGo2004]. The Zachman framework facilitates understanding of the information environment and communication between disparate parties that own or are influenced by

particular information applications or solutions¹⁷. At first glance the Zachman framework is very similar to enterprise modelling approaches such as ERM. However the Zachman framework does not replace formal information modelling. Instead it supports the general conclusions about the application of information technology within an organisation's enterprise information architecture. The Zachman framework enables analysis of the single aspect of the modelling of the architecture together with the consideration of their overall field of application including developing clear understanding of the context in which the information architecture is applied. The framework pays particular attention to, for example, levels of abstraction from scope at the highest level of abstraction to the functioning system at the lowest level. The players that interact within the enterprise information architecture are also a key characteristic of the framework. The Zachman framework allows consideration of particular system components without losing the overall application context. At the same time the meta-models generated from within the Zachman framework support enterprise information architecture development and maintenance, information systems design and implementation. Table 3 represents the Zachman enterprise architecture framework.

¹⁷ The descriptive presentation concerns the design artefacts such as Entity-Relationship Diagrams (ERD).

Table 3. Conceptual Representation of the Zachman Enterprise Architecture Framework [modified after STKB2006, 27]

	DATA	FUNCTION	NETWORK	PEOPLE	TIME	MOTIVATION
SCOPE Planner	<input type="checkbox"/> Entity <input type="checkbox"/> Relationship List of things important to the business  <input type="checkbox"/> entity: class of business thing e.g., "ERM-Diagram"  <input type="checkbox"/> entity: business entity	<input type="checkbox"/> Function <input type="checkbox"/> Argument List of processes the business performs  <input type="checkbox"/> function: class of business process e.g., "process flow"  <input type="checkbox"/> function: business process e.g., "data flow diag." 	<input type="checkbox"/> Node <input type="checkbox"/> Link List of locations  <input type="checkbox"/> node: major business location e.g., "logistics network"  <input type="checkbox"/> node: business location	<input type="checkbox"/> Agent <input type="checkbox"/> Work List of organizations/people  <input type="checkbox"/> agent: major organization unit e.g., "organizat. chart"  <input type="checkbox"/> agent: organization unit	<input type="checkbox"/> Time <input type="checkbox"/> Cycle List of events  <input type="checkbox"/> time: major business event e.g., "master schedule"  <input type="checkbox"/> time: business event <input type="checkbox"/> cycle: bus. cycle e.g., "processing struc." 	<input type="checkbox"/> Ends <input type="checkbox"/> Means List of business goals  <input type="checkbox"/> ends/means: major business e.g., "business plan"  <input type="checkbox"/> ends: business objective <input type="checkbox"/> ends: criterion <input type="checkbox"/> means: option e.g., "knowledge design" 
ENTERPRISE MODEL Owner	<input type="checkbox"/> Entity <input type="checkbox"/> Relationship List of things important to the business  <input type="checkbox"/> entity: class of business thing e.g., "ERM-Diagram"  <input type="checkbox"/> entity: business entity	<input type="checkbox"/> Function <input type="checkbox"/> Argument List of processes the business performs  <input type="checkbox"/> function: class of business process e.g., "process flow"  <input type="checkbox"/> function: business process e.g., "data flow diag." 	<input type="checkbox"/> Node <input type="checkbox"/> Link List of locations  <input type="checkbox"/> node: major business location e.g., "logistics network"  <input type="checkbox"/> node: business location	<input type="checkbox"/> Agent <input type="checkbox"/> Work List of organizations/people  <input type="checkbox"/> agent: major organization unit e.g., "organizat. chart"  <input type="checkbox"/> agent: organization unit	<input type="checkbox"/> Time <input type="checkbox"/> Cycle List of events  <input type="checkbox"/> time: major business event e.g., "master schedule"  <input type="checkbox"/> time: business event <input type="checkbox"/> cycle: bus. cycle e.g., "processing struc." 	<input type="checkbox"/> Ends <input type="checkbox"/> Means List of business goals  <input type="checkbox"/> ends/means: major business e.g., "business plan"  <input type="checkbox"/> ends: business objective <input type="checkbox"/> ends: criterion <input type="checkbox"/> means: option e.g., "knowledge design" 
SYSTEM MODEL Designer	<input type="checkbox"/> Entity <input type="checkbox"/> Relationship List of things important to the business  <input type="checkbox"/> entity: class of business thing e.g., "ERM-Diagram"  <input type="checkbox"/> entity: business entity	<input type="checkbox"/> Function <input type="checkbox"/> Argument List of processes the business performs  <input type="checkbox"/> function: class of business process e.g., "process flow"  <input type="checkbox"/> function: business process e.g., "data flow diag." 	<input type="checkbox"/> Node <input type="checkbox"/> Link List of locations  <input type="checkbox"/> node: major business location e.g., "logistics network"  <input type="checkbox"/> node: business location	<input type="checkbox"/> Agent <input type="checkbox"/> Work List of organizations/people  <input type="checkbox"/> agent: major organization unit e.g., "organizat. chart"  <input type="checkbox"/> agent: organization unit	<input type="checkbox"/> Time <input type="checkbox"/> Cycle List of events  <input type="checkbox"/> time: major business event e.g., "master schedule"  <input type="checkbox"/> time: business event <input type="checkbox"/> cycle: bus. cycle e.g., "processing struc." 	<input type="checkbox"/> Ends <input type="checkbox"/> Means List of business goals  <input type="checkbox"/> ends/means: major business e.g., "business plan"  <input type="checkbox"/> ends: business objective <input type="checkbox"/> ends: criterion <input type="checkbox"/> means: option e.g., "knowledge design" 
TECHNOLOGY MODEL Builder	<input type="checkbox"/> Entity <input type="checkbox"/> Relationship List of things important to the business  <input type="checkbox"/> entity: class of business thing e.g., "ERM-Diagram"  <input type="checkbox"/> entity: business entity	<input type="checkbox"/> Function <input type="checkbox"/> Argument List of processes the business performs  <input type="checkbox"/> function: class of business process e.g., "process flow"  <input type="checkbox"/> function: business process e.g., "data flow diag." 	<input type="checkbox"/> Node <input type="checkbox"/> Link List of locations  <input type="checkbox"/> node: major business location e.g., "logistics network"  <input type="checkbox"/> node: business location	<input type="checkbox"/> Agent <input type="checkbox"/> Work List of organizations/people  <input type="checkbox"/> agent: major organization unit e.g., "organizat. chart"  <input type="checkbox"/> agent: organization unit	<input type="checkbox"/> Time <input type="checkbox"/> Cycle List of events  <input type="checkbox"/> time: major business event e.g., "master schedule"  <input type="checkbox"/> time: business event <input type="checkbox"/> cycle: bus. cycle e.g., "processing struc." 	<input type="checkbox"/> Ends <input type="checkbox"/> Means List of business goals  <input type="checkbox"/> ends/means: major business e.g., "business plan"  <input type="checkbox"/> ends: business objective <input type="checkbox"/> ends: criterion <input type="checkbox"/> means: option e.g., "knowledge design" 
COMPONENTS Subcontractor	<input type="checkbox"/> Entity <input type="checkbox"/> Relationship List of things important to the business  <input type="checkbox"/> entity: class of business thing e.g., "ERM-Diagram"  <input type="checkbox"/> entity: business entity	<input type="checkbox"/> Function <input type="checkbox"/> Argument List of processes the business performs  <input type="checkbox"/> function: class of business process e.g., "process flow"  <input type="checkbox"/> function: business process e.g., "data flow diag." 	<input type="checkbox"/> Node <input type="checkbox"/> Link List of locations  <input type="checkbox"/> node: major business location e.g., "logistics network"  <input type="checkbox"/> node: business location	<input type="checkbox"/> Agent <input type="checkbox"/> Work List of organizations/people  <input type="checkbox"/> agent: major organization unit e.g., "organizat. chart"  <input type="checkbox"/> agent: organization unit	<input type="checkbox"/> Time <input type="checkbox"/> Cycle List of events  <input type="checkbox"/> time: major business event e.g., "master schedule"  <input type="checkbox"/> time: business event <input type="checkbox"/> cycle: bus. cycle e.g., "processing struc." 	<input type="checkbox"/> Ends <input type="checkbox"/> Means List of business goals  <input type="checkbox"/> ends/means: major business e.g., "business plan"  <input type="checkbox"/> ends: business objective <input type="checkbox"/> ends: criterion <input type="checkbox"/> means: option e.g., "knowledge design" 

The data, function and network views were the initial representation of the framework [Zach1987]. Later Zachman extended the framework to include the views people, time and motivation [SoZa1992]. The listed components are analysed on different levels of abstraction which are reflecting the stages of system development. The highest level provides an overview of the problem domain. The lowest level is a specific view of the application. Zachman combines the views with specific questions that can be answered and modelled within each cell of the framework. The data view answers the question *what* (boundaries) and can be represented as thing-relationship-thing. The function view refers to the question *how* and can be modelled as input-process-output. The next view represents the network and is responsible for the question *where*. The modelling approach is node-line-node. The fourth view (people) answers the question *who*. The assigned modelling can be expressed as people-workflow-people. The view time refers to the question *when*. The representation is event-cycle-event. The final view motivation addresses the question *why* and can be modelled as ends-mean-ends [InZG1997].

Answering these questions at the different levels of abstraction enables filling in the appropriate cells of the framework. Assigning the framework to the financial reporting supply chain context allows us to analyse each aspect of the architecture by filling in the views with appropriate level of details. Integrating the views provides a complete view of the financial reporting supply chain architecture. For this research all of the views are used. Further, the detail level is restricted to the contextual (planner) and conceptual (owner) rows. The first of these reflects the objectives and scopes while the second demonstrates the modelling of the financial reporting supply chain and XBRL financial reporting supply chain. This is due to the fact that the research does not deal with the implementation of the reporting supply chains and the encoding of the presented models or the design of user interfaces.

This section presented the underlying theoretical framework for this study. It applies constructivist paradigm, theories of design science, enterprise modelling theories and Zachman enterprise architecture framework to the modelling of XBRL financial reporting supply chain architecture. Next section explains the methodology and the course of conducted research.

2.5 Research Limitations

The scope of the thesis is to research the financial reporting supply chain as well as XBRL financial reporting supply chain architecture¹⁸. This section refers to the themes related to the research area but excluded from this study.

The thesis addresses aspects of accounting, report preparation and reporting subjects with a special focus on the financial data and financial reports flow, participants of the processes, network aspects as well as data and data structures used. The accounting described in the second chapter is analysed only in context of the creation of financial reports and not from the viewpoint of accounting for various transactions which is often the central point of AIS research. Also accounting processes not directly connected to the financial report creation are not modelled later as a part of financial reporting supply chain architecture.

The thesis analyses the financial audit domain only in the context of the information needs and not the detailed audit processes¹⁹. The financial audit is treated as a certification stage in the financial reporting and the detailed functions of auditor in the process of report preparation are faded out²⁰. The tax audit domain is considered only in the scope of information gathering and not in its tax control function.

Although the reporting process of a subsidiary to its parent company is analysed the consolidation processes as such are out of scope of the thesis. The thesis analyses the consolidation only in the context of reporting to the parent institution but not receiving of the financial data and conducting the consolidation. Further the management reporting within a company is not discussed in detail here as generally the internal reporting aspects are considered mainly from the perspective the creation, assurance and delivery of the financial reports to the external users.

¹⁸ Although relevant from the receiving institutions point of view this research does not address explicitly the processes related to the preparation of taxonomies for reporting purposes. These issues are discussed by one of the earlier studies concerning XBRL taxonomy engineering [PiFe2007] as well as classified as not directly related to financial data flows in the financial reporting supply chain. Some researchers regard taxonomy development activities as part of the financial reporting supply chain [ChSi2005].

¹⁹ Some researchers indicate XBRL potential for the continuous audit and continuous assurance [HuWW2004] which is also out of scope of this study.

²⁰ However auditors are analysed as receivers of financial reports.

This study does not discuss in detail the aspects of monthly or quarterly reporting. It is assumed that yearly reports are the most comprehensive ones and thus the implications can be adapted for the other frequencies of reporting²¹. Also reports such as company press releases, including preliminary results, prospects, non financial information published by the company in the annual report, analysts' reports and credit ratings, media reports, annual strategy presentations to analysts by the company or additional financial information on the company's website are out of scope of this study.

This thesis focuses on the financial reporting for commercial and industrial institutions. Most of the analysed reporting scenarios are based on the reporting of public and incorporated companies²² [HuWW2004]. Financial reporting of these companies is most comprehensive in scope and thus most suitable for the research conducted. Most of the research results can be later scoped down for other types of companies as well as non-public entities. Also most of the applications are important for the small and medium-sized enterprises (SMEs).

²¹ Also the discussion on continuous reporting or real time reporting is out of scope of this research and is not discussed in greater detail.

²² However this study provides also analysis of big incorporated non public companies.

3 Financial Reporting Domain Analysis

This study relies on the domains associated with financial accounting and financial reporting²³ in order to support the research propositions. The analysis of the domain provides necessary information for the models of financial reporting supply chain architecture. Also the AIS literature is considered and provides valuable input for the analysed financial reporting. Further this study derives additional necessary information from a set of interviews conducted within various reporting scenarios.

This chapter analyses the reporting aspects from the financial reporting domain point of view. It is subdivided in accounting, report preparation and reporting sections. The division of financial reporting into accounting and report preparation is stated by Weber and Weizenberger [WeWe2006, 31]. The addition of reporting section is in line with discussions held by many researchers [WaEw2003, 3-15; BiKu1996, 49-51] but financial accounting and financial reporting literature often does not consider financial reporting aspects on the detail level necessary for further modelling of the financial reporting supply chain architecture. Figure 7 explains the course of research and the structure of the three components applied in this chapter together with their definitions and scope.

²³ This study refers to financial reporting domain analysis as to both financial accounting and financial reporting but with a clear context of the reporting flow. Wagenhofer and Ewert state that both areas can be referred to as external accounting [WaEw2003, 3-4].

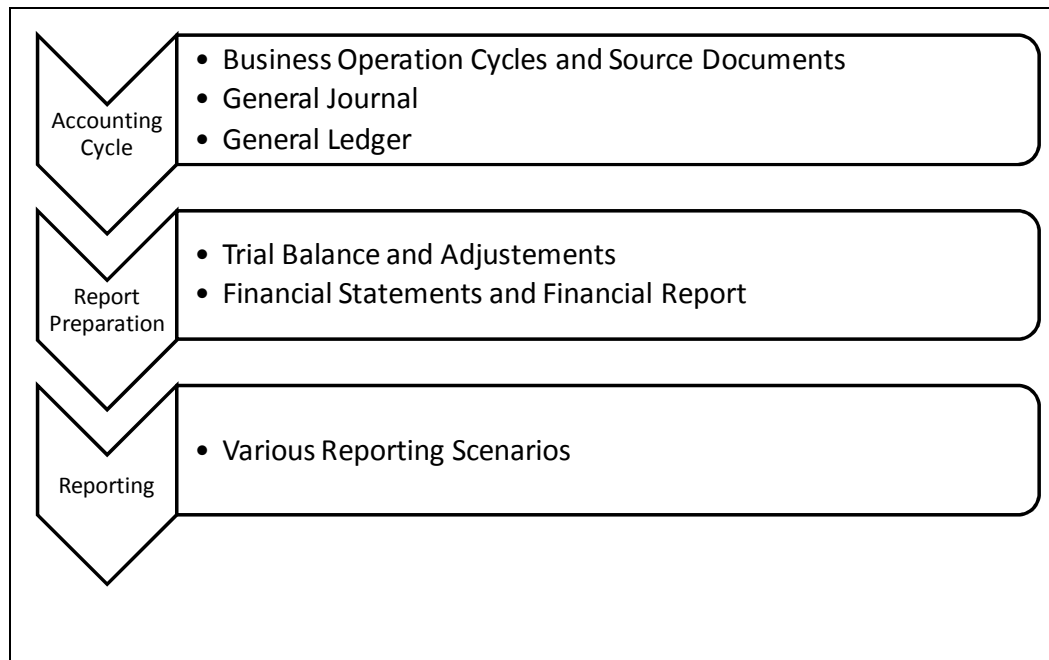


Figure 7. Course of Financial Reporting Domain Analysis

The definition of financial accounting stated by the American Accounting Association (AAA) applies to the research presented in this chapter. The AAA provides definition of accounting as “... the process of identifying, measuring and communicating information to permit judgements and decisions by user of the information” [AAA1966]. Only the second part of the definition focusing on communication of business information applies directly to the financial reporting processes. But it is not possible to understand the financial reporting supply chain without the first part of the definition which focuses on the importance of collection, measurement, recording and summarising of business transactions for the later communication activities. It is the reason for considering the accounting part as an integral part of this study.

The accounting cycle section is based mostly on the aspects discussed widely in the accounting information systems literature as well as financial accounting literature and concerns the repeatable operations resulting in the entries in the accounting systems. The section describing report preparation deals with the transition from the cyclical accounting operations to the creation of financial report. Finally the reporting section is devoted to the aspects of inter-organisational production, delivery and assurance of financial reports to stakeholders. Because of the lack of structured information

concerning analysis of various financial reporting scenarios in the literature this study applies the interviews as a method of delivering additional information. The information provided by interviewees is later reviewed with the use of legal sources indicated during the interviews.

The sections presented in figure 7 constitute the analysis framework for this chapter. Financial accounting and financial reporting literature usually address only parts of the sections described [Wage2007]. For example Sutton addresses this section without the necessary level of detail in order to derive the financial reporting supply chain architecture [SutT2006, 115]. Thus, this part of the thesis provides a systematic analysis of financial accounting and financial reporting in order to create a solid background for modelling the financial reporting supply chain architecture.

Also the approach presented by Eisele indicates the requirements of the division applied to this study [Eise2002, 531]. The accounting cycle section together with report preparation sections reflect what Eisele refers to as record-keeping cycle²⁴ presented in figure 8 with focus on the financial data flow and its relevant data components.

²⁴ Definition used in this study is the following: the record-keeping cycle includes the accounting cycle which further includes business operation cycles.

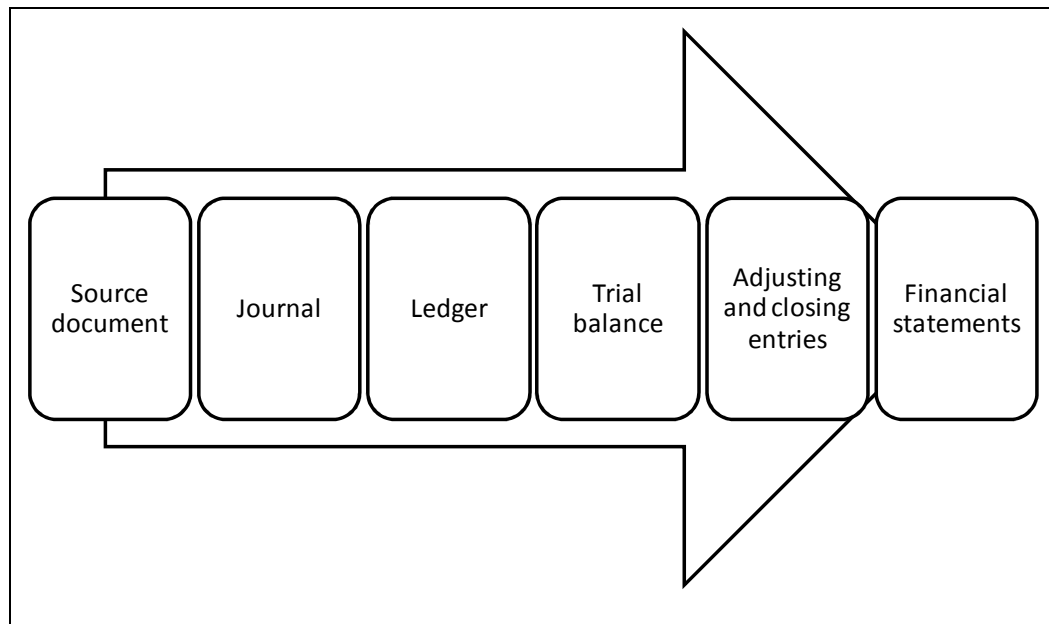


Figure 8. Record-keeping Cycle [modified after Eise2002, 531]

This chapter proceeds as follows. The next section briefly presents the accounting part of the financial reporting domain and is followed by the report preparation and reporting sections. The reporting section presents the conclusions and summary tables especially for the results of the analysed reporting scenarios. This chapter is summarised with the conclusions section.

3.1 Accounting Cycle

The accounting cycle analysed in this section starts with the business operations generating raw report data being the beginning of the reporting flow. Business operations are the source of information for accounting and further report creation. The business operation cycles discussed in the literature are mainly the revenue cycle, the expenditure cycle, the production cycle and the human resources management and payroll cycle. Another important aspect for the reporting flow is the output data produced in each of the cycles. The data collected in journals and later transferred to the general ledger (GL) is usually coded by the use of a chart of accounts [Eise2002, 565-581]. This section discusses accounting cycle in detail according to the composites described above and presented in figure 9.

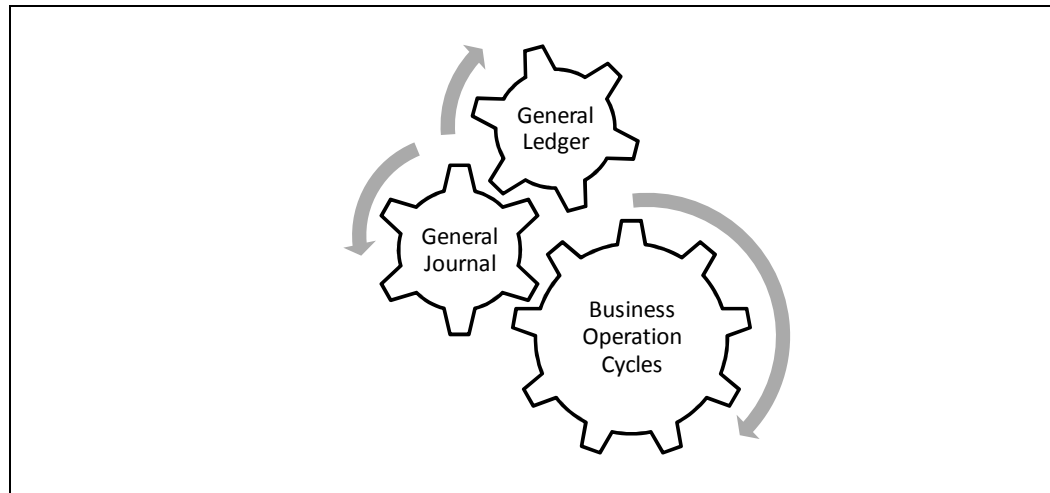


Figure 9. Composites of Accounting Cycle²⁵

The accounting cycle is defined as a series of activities which begin with a transaction and end with the entries in the general ledger. These processes are repeated during each reporting period. From the viewpoint of financial reporting, accounting cycles start with the identification of accounting transactions or recognizable events [Eise2002, 503], usually followed by generation of a source document concerning the transaction or conducted within Enterprise Resource Planning (ERP) systems. Next the transaction needs to be analysed and classified in order to record it in the general journal. Finally number of journal entries are posted to the general ledger [EMMO1996, 147-150].

3.1.1 Business Operations Cycles and Role of Source Documents

As stated in the previous section, the accounting information flows start with the business operations generating raw report data. Thus, business operations are the basic source of information for further reporting. The business operation cycles discussed in the literature are the revenue cycle dealing with sales and cash collections, the expenditure cycle dealing with purchasing and cash disbursements, the production cycle and the human resources management (payroll) cycle, capital acquisition and repayment,

²⁵ Another decomposition of financial accounting functions is provided by Becker and Schütte. They classify as accounting cycle functions accounting of personal accounts, accounting for bank account and closing entries and as report preparation functions preparation of balance sheet and income statement, creation of balance sheet and income statement and reporting [BeSc2004, 528]. This study classifies Becke and Schütte approach as not comprehensive from the viewpoint of financial reporting.

and inventory and warehousing cycle [Eise2002]. Due to the fact that business operations cycles represent only the input for further reporting they will be not discussed in a greater detail in this thesis.

The important aspect for the reporting flow is the output data produced in each cycle. Different business operations cycles consist of a number of transactions in which source documents describing these transactions are produced. Blain et al. state that for modern accounting systems²⁶ “...each transaction creates a record ... and may be a part of a batch input or ... the result of a dialogue at a terminal.” [BIDS1998, 18] If such a transaction is accepted by the system it can be used to update the journal file and can be posted to GL accounts.

Source documents provide the original record of each transaction [MaQR2001, 341]. According to Blain et al. classification of special document types and posting keys used for particular type of transactions in modern accounting systems is the following²⁷:

- customer or vendor invoices,
 - cash receipts and disbursements,
 - inventory transactions,
 - allocations and distributions for cost accounting,
 - transactions involving two or more profit centres,
 - transactions involving two or more codes,
 - statistical postings (noted items, guarantees, etc.),
 - special business transactions (down payments, bill of exchange, etc.).
- [BIDS1998, 19]

²⁶ Blain et al. refer to the SAP R/3 General Ledger Accounting [BIDS1998, 3].

²⁷ Also Cohen provides a list of possible source documents already with the consideration of their representation by the means of XBRL technology. The list encompasses check, debit-memo, credit-memo, finance-charge, invoice, order-customer, order-vendor, payment-other, reminder, tegata (a promissory note or banker’s draft), voucher, shipment, receipt, manual-adjustment and other. [CoGa2007]

The source documents contain the monetary terms which have to be entered in the appropriate journal. In particular each source document should consist of a minimal amount of data including the date, amount and the transaction description. The number of accounting transactions is processed internally by the accounting systems and the necessary information is transmitted automatically to the journal and GL accounts.

Information from accounting transactions is the basic input for the journalising process described in the following section. After a transaction is journalised the filing of the source document needs to be conducted in order to ensure information retrieval at a later point of time²⁸.

In the AIS literature there are several considerations about enabling electronic processing of source documents [Desh2006, 88-127]. Liebermann and Wiedmayer use the term financial supply chain management in the context of business operations cycles [LiWi2006, 65-71] also referring to electronic processing of source documents. As far as transactions are concerned, there is a number of electronic standards²⁹ supporting the transfer of electronic data³⁰.

3.1.2 Journals and General Journal

Data from business operations cycles discussed in the last section is transferred into the journal. Many authors present a historical view on the journals differentiating among sales journal, purchase journal, cash receipt, disbursement journal or the general journal [MoSt1963, 104]. Contemporary accounting systems treat journals as an intermediate step during the source documents processing or batch processing and so use the daily journal file [BIDS1998, 19]. Modern accounting information systems and ERP systems are keeping information in one general journal without differentiating be-

²⁸ Filing of the source documents is related to later financial audit and tax audit procedures [Selc1996, 228-229] which are out of scope of this study and are not a part of the financial reporting supply chain architecture modelled later.

²⁹ Examples here are Electronic Data Interchange For Administration, Commerce and Transport (EDIFACT) [SeSM2006] or Electronic Business XML (ebXML) [Mong2006].

³⁰ Buxman et al. discuss the use of web services for converting XML accounting documents. According to their results it is possible to enable automatic transformations among different transaction-oriented XML standards but also EDIFACT. [BWBR⁺2003, XAct2003].

tween different kinds of journals or even not having a general journal as part of accounting software at all [Desh2006, 31].

In order to make an entry in a journal, each transaction and especially each source document needs to be analysed and classified. The transaction needs to be quantified in monetary terms and the corresponding accounts need to be assigned together with information if they should be debited or credited. In the next step the transaction can be entered in the journal [Selc1996, 234].

The treatment of the journal has not changed significantly over the last hundreds of years. Already Pacioli described in 15th century the structure of the journal [Matt1964, 94]. Furthermore according to Moore and Stettler [MoSt1963, 104-105] journals are characterised by the following data items inputted. Firstly are the general ledger accounts where a transaction should be entered with account number, amount, posting check, and debit or credit indication. Secondly the dates of the journal entry, names of the responsible persons and further explanations are required³¹. Also source document number is sometimes referenced from the journal voucher in order to keep accounting information linked for further audit trial purposes [Selc1996, 228-229]. The entries made in the journals, which are recorded in the chronological order, are also referred to as journal vouchers.

Once entered in the journal, the transactions may be posted to the appropriate accounts of the general ledger. The posting to the general ledger is different to the journal entry³². It is a mechanical process due to the fact that the account number and information, if the account should be debited or credited is already included in the journal voucher [Eise2002, 528].

The posting to the ledger can be treated as an uncomplicated rearrangement of data without the need for further human interaction. This process is conducted by accounting information systems either after each journal entry or as a batch process after a number of journal entries or in a given time schedule [Eise2002, 528].

³¹ The data items listed build minimal requirements of the data entered into journal. Accounting systems today contain larger amount of data related to every single transaction. [BIDS1998]

³² It should be however noted that some accounting systems perform a number of journal entries also in an automatic way as batch processes directly from the transactions data.

3.1.3 General Ledger and Chart of Accounts Role

In this section the role of ledgers and chart of accounts is discussed. Eisele defines a ledger as the collection of a company's accounts [Eise2002, 505]. Different to the general journal which is ordered in form of chronological record the ledgers are ordered according to the accounts. Moore and Stettler define the ledger as follows “... a book in which a summary of account is kept; the final book of record in business transaction, in which all debits and credits from the journal ... are placed under appropriate heads” [MoSt1963, 114]. In most cases the term ledger is referred to as the general ledger³³ although in practice a number of enlargements and refinements of ledgers can be found. Apart from the GL companies can have accounts receivable ledgers, accounts payable ledgers or subsidiary ledgers representing the corollary development of the controlling account principle. This analysis explores the GL in the context of creation of the financial reports [MoSt1963, 113]. In addition to this in accounting systems, a single journal and ledger system is more typical [LiWi2006, 63-64] and transactions in the general ledger are posted at the atomic, rather than aggregated, level.

The data collected in the GL is usually coded with the use of a chart of accounts³⁴ [Eise2002, 565-568]. The chart of accounts specifies each type of asset, liability and owners' equity assigning a code number for each account. Identifying the transaction and making a journal entry the code number is used to indicate the accounts affected. In continental Europe, many countries have standardised or semi-standardised charts of accounts [Matt1964, 91]. The goal in these countries is to have standardised accounting basis used for the financial statements along with standardised presentation of financial statements³⁵. Moreover the governments can collect statistics with a high level of internal consistency of the underlying data.

³³ General ledger is often referred to as nominal ledger. [RoWo1997, 178]

³⁴ Bornhofen differentiates between chart of accounts and accounts structure [Born2005, 68]. The first refers to industry-specific superset of all possible accounts. The latter means individual or company-specific ordering of all company relevant accounts. This study refers to the chart of accounts in the general understanding, meaning the structure of the accounts for the general ledger.

³⁵ For example France and Belgium have mandatory use of the standardised chart of accounts, Germany and Poland have a non-mandatory standardised chart of accounts widely used by most of the entities [Born2005, 487-530; RaKl2002, 427; Palk2007] while in the UK and US standardised chart of accounts is not common [Matt1964, 91-92].

The structure of the general ledger is based on the double-entry accounting rule and also reflects the underlying chart of accounts. The general ledger enables monitoring the impact of the transaction affecting various accounts at a point of time. According to Eisele the general ledger should include date of the transaction, description and balance entries for each account [Eise2002, 504-505]. Usually a general ledger consists of account divided into at least five categories according to the chart of accounts. These are assets, liabilities, revenue and expenses and equity. The main categories of the general ledger may be subdivided into subsidiary ledgers to include details such as cash, accounts payable, accounts receivable, etc.

The direct mapping between journal entries and ledger entries can be facilitated by reference numbers being included in ledgers allowing tracing information back to the journal and further back to the source transaction. The general ledger is the last phase discussed in the accounting cycle section and is followed by the financial report preparation section.

3.2 Financial Report Preparation

The section describing financial report preparation reflects activities being conducted at the end of accounting period. The trial balance created from the general ledger upon the chart of accounts [Eise2002, 531-535] is the linkage between the accounting cycle and report preparation sections. Therefore this section starts with the consideration of the role of the trial balance as well as adjustments to the trial balance. Furthermore the financial statement and financial reports are discussed.

3.2.1 Trial Balance and Adjustments

The previous section focused on repeatable accounting activities. But in order to create a financial report each entity needs to perform further actions. As Eisele states the trial balance is the linkage between accounting cycle processes and financial report preparation processes. The trial balance is the listing of all debit and credit balances in ledger accounts at the end of financial period to check that balance totals equals [Eise2002, 436-437]. Main task of the trial balance is to provide a test for the accuracy of record keeping. If one transaction will not balance then the trial balance will not balance ei-

ther³⁶. Adjusting journal entries are used to record accrued, deferred, and estimated amounts. Accruals refer to revenues and expenses matched³⁷ to dates before a transaction is recorded while deferrals refer to revenues and expenses matched to dates after a transaction is recorded. The adjustments are conducted at the end of the accounting period in order to allocate revenues and expenses to the period they are relating to. The entries are posted to the ledger accounts and an adjusted trial balance is produced. This is an iterative process when, in case of errors in the trial balance, further adjusting entries are posted to the ledger accounts and another adjusted trial balance is produced [Eise2002, 436]. After producing the trial balance the closing journal entries need to be prepared to close temporary accounts such as revenues, expenses, gains and losses. Usually these accounts are closed to a temporary income summary account which is used later for transferring the balance amount to the balance sheet position retained earnings (accumulated losses)³⁸. These journal entries are posted to ledger accounts and the post-closing trial balance is produced in order to ensure that there are no errors in account balances [Selc1996, 234].

The final adjusted trial balance is the basis for the preparation of the financial statements [Eise2002, 439]. During the transfer of the numbers from the trial balance to the financial statement the analyses is conducted which accounts are aggregated to which financial statement disclosure. It is important to note that not all financial statements are created directly upon the trial balance information³⁹. Transferring data from adjusted trial balance to financial statements is conducted with mentioned aggregations and splits of different accounts together with the use of additional information.

Eisele addresses six areas which have to be considered while creating financial statements. First are amounts and valuation differences. Mainly corrections resulting from depreciation and amortisation impact the financial statements. Second area con-

³⁶ However it does not guarantee that transactions are recorded properly. There are some cases when trial balance will not indicate an error. It is when the transaction was not recorded in the journal, recorded in the wrong accounts, if the debit and credit side were transposed for a transaction or when a journal voucher was not posted to the ledger.

³⁷ The adjusting entries are necessary because of the matching principle of the accrual accounting.

³⁸ Also accounts characterising dividends or withdrawals are closed to the capital accounts later transferred to the balance sheet items.

³⁹ Cash flow is created upon cash account from the GL together with information included in the balance sheet and income statement as well as explanatory disclosures (such as leasing information).

cerns time related differences in accounting resulting in accruals and deferrals. Third addresses accounting of reserves which cannot be simply transferred from trial balance. Fourth area is deferred taxation if tax results differ from accounting results. Finally Eisele refers to corrections of profit and loss accounts in order to separate commercial and owner results. [Eise2002, 345-346]

The above sections demonstrate the human impact on the process of creating financial statements upon trial balance information and the comprehensiveness of this process. Often financial statements require disclosures which do not come direct from the trial balance. When a company moves from the trial balance to the financial statements, there are many reallocations and rearrangements of data. Data also has to be extracted by a number of queries in order to meet the particular reporting requirements of the financial statements. Thus there is semantic mismatch between AIS and financial statements especially impacting later creation of the notes to financial statements. There is also reduced support of AIS to the creation of financial statements. Thus spreadsheets with a number of macros and manual arrangements still play a very important role while adjusting and forming financial statements.

3.2.2 Financial Statements and Financial Report

The final and key aspect of the financial report preparation section is the discussion of differences between the financial statements and the financial report often referred to as annual accounts and annual report. The financial statements along with the explanatory notes on the financial statements and the auditors' report are the first part of the financial report⁴⁰. The second part is often varying in form of discussion and analysis of accounts⁴¹ [Heno2004, 29-35].

⁴⁰ The 4th Directive of the EU defines the contents of the financial report (referred to as annual report) as follows "... annual report must include at least a fair review of development and performance of the company's business and of its position, together with a description of the principal risks and uncertainties that it faces ... [which] ... shall be a balanced and comprehensive analysis of development and performance of the company's business and of its position, together with a description of the principal risks and uncertainties that it faces ..." [EuCo1978, 32].

⁴¹ Perhaps most importantly for the purpose of designing a technology-enhanced financial reporting supply chain, a number of financial statement disclosures, particularly note disclosures, require additional analyses as they draw upon information that is not disclosed in the trial balance.

Accounting standards define scope of financial statements⁴² differently. For example according to the IFRS financial statements comprise balance sheet, income statement, cash flow statement, statement of changes in equity and the notes⁴³ to financial statements [IASB2006a, 692]⁴⁴, while *Handesgesetzbuch*⁴⁵ (HGB) does not address cash flow statement as part of financial statements. In the following the composites of financial statements are discussed.

The income statement provides information on revenues, expenses, the calculated net profits or losses. It is prepared by transferring the revenues, expenses and capital gain or losses ledger account balances. The role of the income statement is to measure entity's performance during the reporting period [IASB2006a, Framework §§ 69-73]. Entity may present the analysis of expenses based either on their nature or their function within entity [IASB2006a, IAS 1 §88]. Under the natural basis expenses are reported according to their type or nature while under functional basis expenses are grouped by department or functional activity.

The balance sheet provides the view on the financial position⁴⁶ of the reporting entity presenting the assets, liabilities, and shareholder equity. The common balance sheet format in the EU and the US is the account format. There is other format allowed for the balance sheet [IASB2006a, IAS 1 §§ 71-72] such as the statement format.

The purpose of the cash flow statement is to show the reasons for changes in the cash and bank balance over the accounting year. In detail it presents sources and uses of cash in the operating, financing, and investing activities of the entity

⁴² This study refers to the financial statements in the scope defined in the IFRS for two reasons. The first reason is the growing importance for the IFRS financial reporting in Germany not only for consolidated financial statements but also for individual financial statements [BOGP2006, 15]. The second reason is that the scope of the financial statements as defined by IFRS incorporates the scope of the financial statements as defined by German GAAP.

⁴³ This study uses the term explanatory disclosures which is equivalent to the term notes to the financial statements.

⁴⁴ HGB in §§ 242 and 264 presents a different view on the composites of the financial statements and does not recognise cash flow and statement of changes in equity as components of financial statements [HGB2006].

⁴⁵ HGB regulates German accounting principles. HGB is the abbreviation for German commercial code often referred to as German accounting principles.

⁴⁶ The US GAAP refers to the balance sheet as to the statement of financial position. Similar the new draft of the IAS 1 concerning presentation of financial statements proposes using the term statement of financial position instead of the term balance sheet [IASB2006b, 5].

[IASB2006a, IAS 7 §10]. The cash flow statement as cash based report cannot be derived directly from the ledger account balances of accounting information systems. It is commonly calculated by converting the accrual information to the cash basis using the direct or indirect method. In the direct method cash flow information is determined by subtracting the cash disbursements from cash receipts. In practice companies show operating cash flow not as a difference between operating receipts and payments but as a sum of reported profits and accruals. Accruals are explained as operating revenues and expenses without cash flow impact. This approach is known as the indirect method of creating cash flow statements.

Fourth statement according to IFRS is the statement of changes in equity. Statement of changes in equity can be constructed either showing all changes in equity or changes in equity other than those arising from transactions with equity holders acting in their capacity as equity holders [IASB2007, 786].

The explanatory disclosures comprise a summary of significant accounting policies and other explanatory disclosures [IASB2006a, 692].

The auditors' report⁴⁷ is the separated from financial statements⁴⁸. The 4th Directive of the EU requires that all but very small EU companies must have their financial statements audited by an individual or organisation authorised under national law. Usually auditors' report consists of two parts. In the first part it indicates the scope of the audit. The second part contains the auditor's judgement on the items audited. The 4th Directive of the EU requires a company's auditors to state whether the financial statements for the period give a true and fair view of the company's profits for the period and its state of affairs at the end of the period.

The management report along with the financial statements constitutes the financial report. The management report includes the review of the main factors and in-

⁴⁷ This study refers to auditors' report as to formal opinion issued by an independent external auditor as defined by §322 of HGB [HGB2006].

⁴⁸ It is not clear from the financial accounting literature or from the GAAPs if the auditors' report is classified as a part of financial statements or is out of financial statements being part of financial report. This research assumes that auditors' report is the component of the audited financial statements. On the contrary §267 of the HGB points out that management report is in the scope of the audit procedures thus implicitly indicating that auditors' report could be a part of the financial report or even out of financial report [HGB2006].

fluences determining financial performance, including changes in the environment in which the entity operates. It also incorporates the entity response to the changes in the environment and their effect. Further, the management report includes a review of entity's policy for investment to maintain and enhance financial performance, including its dividend policy [IASB2007, 786]. According to IFRS many entities present, apart from the financial statements and management report, reports and statements such as environmental reports and value added statements, particularly in industries in which environmental factors are significant and when employees are regarded as an important user group [IASB2007, 787].

Figure 10 provides an overview of the components of the financial report as used in this study.

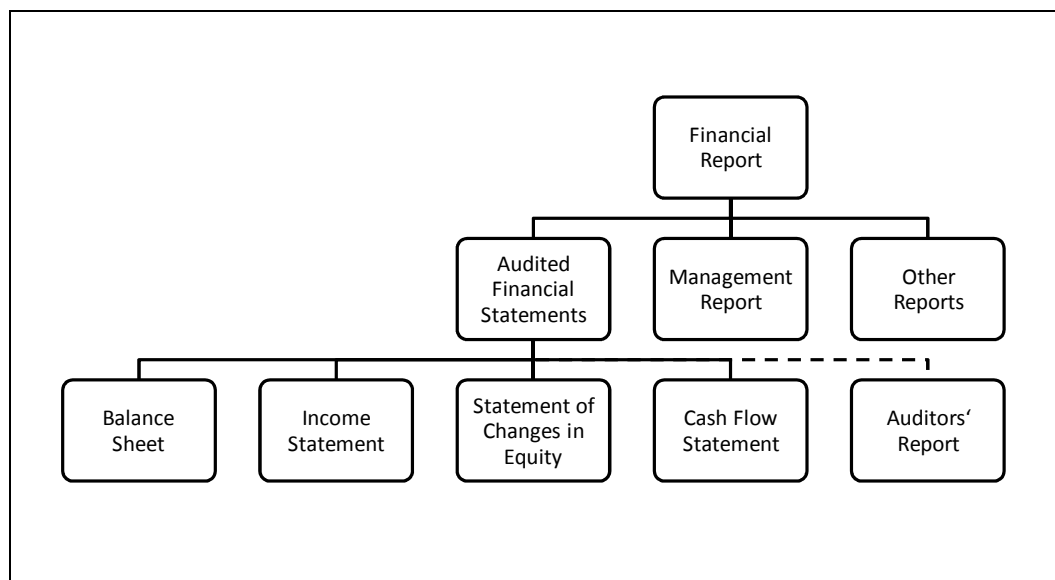


Figure 10. Components of the Financial Report

An important consideration valid for this thesis is the distinction between financial statements based on commercial⁴⁹ and on tax codifications. Figure 11 presents the distinction between financial statements based on the separate financial statements, tax

⁴⁹ The commercial codes in the context of this research are German accounting principles, IFRS or US GAAP.

financial statements and consolidated financial statements. Both tax and consolidated financial statements are created upon the separate financial statements⁵⁰.

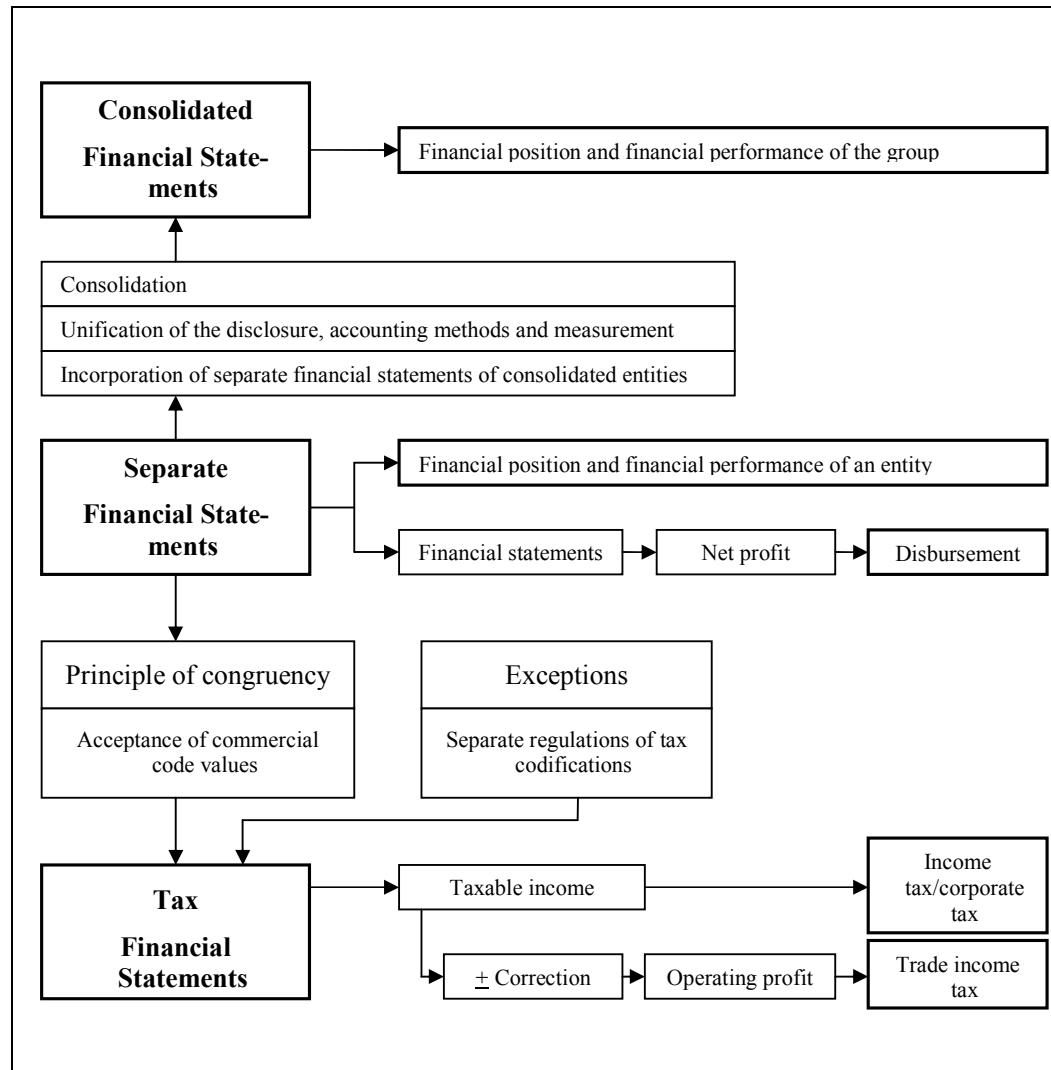


Figure 11. The Relationships between Financial Statement Based on the Commercial and Tax Codifications [modified after BiKu1996, 69]

A remarkable consideration presented in figure 11 is that there are different functions of the consolidated, separate and tax financial statements. Bieg and Kußmaul indicate the role of the consolidated financial statements mainly for the investor communication

⁵⁰ Consolidated financial statements are created upon a number of individual financial statements of subsidiaries in the consolidation process [BOGP2006, 44].

purposes, the separate financial statements additionally for the disbursement function. Very different is the goal of the tax financial statements which main function is the determination of the income, corporate and trade income taxes [BiKU1996]. Additionally the principle of congruency can lead to the situation of the construction of united financial statements. United financial statements⁵¹ fulfil the requirements of both commercial and tax code.

Weber and Weißenberger state that the systematic differentiation between consolidated and separate financial statements known from German GAAP is not emphasised in the IFRS⁵². The IFRS take much more pragmatic approach assuming that the company creating the financial statements according to IFRS and being a parent entity must prepare the financial statements as consolidated financial statements [WeWe2006, 49]. This study uses the IFRS view on the financial statements not differentiating between separate and consolidated financial statements.

3.3 Reporting

This section discusses the reporting activities. Financial accounting, AIS and XBRL literature often presents a simplified model of financial reporting [Hoff2006, 148; RaKO2006; HAon2005, 73; DeGr2001, 65; NuSt2002, 450]. Such simplified perspective does not consider aspects relevant for further modelling of the whole financial reporting supply chain. The simplified approach requires further investigation because various report formats, various GAAPs used, various information scope in various reporting areas contradict using the models presented in the literature. This research provides a structured approach to the analysis of the reporting in the context of financial accounting domain. Thus the research question for this section is *how financial reporting is conducted between reporting company and receivers of financial information*.

Following sections are organised as follows. First section refers to a number of existing reporting scenarios which can be identified in financial accounting and report-

⁵¹ This study does not analyse the role of the united financial statements due to the fact that they are discussed mainly in the German accounting literature and not addressed in the context of the IFRS.

⁵² The reason for different approaches is missing regulation of disbursements in the IFRS but existing in the German GAAP as well as focus on the investors as main addressees of the IFRS financial statements. [WeWe2006, 49]

ing domains. The assessment of possible scenarios is conducted with the use of literature review applying financial accounting views on participants of the domains. Next section provides a selection of scenarios relevant from the view point of this research. Subsequent sections demonstrate the data collected in the survey enriched with the analysis of the legal background sources. In order to provide a detailed view how the financial information flows are organised between various participants a series of interviews⁵³ are conducted. Finally the results of this survey and analysis are presented in a form which is aligned with the Zachman categories discussed in chapter two.

3.3.1 Literature Review

In order to provide reliable information for further modelling this study uses financial accounting and AIS literature. Further this study identifies possible receivers of the financial reports and thus plausible reporting scenarios.

The IFRS framework provides a brief overview of the users of the reports. Together with the thorough analysis of the German and European law concerning reporting, they provide a background for analysing the reporting section. According to the IFRS framework “... the users of financial statements include present and potential investors, employees, lenders, suppliers and other trade creditors, customers, governments and their agencies and the public [which] use financial statements in order to satisfy their different needs for information” [IASB2006a, 35].

Additional analysis of the roles in financial reporting is provided by Baldwin et al. [BaBT2006, 106]. They provide an interesting grouping into four categories presented in table 4.

⁵³ The various views on the users of financial reports together with their requirements were the background for the XBRL for External Reporting (XER) research project. Significant part of the XER project was the survey conducted with a number of participants of financial reporting scenarios. The survey was conducted from September 2006 till January 2007 at the Chair of Information Systems at the Technische Universität Bergakademie Freiberg in Germany.

Table 4. Roles in the Financial Reporting [modified after BaBT2006, 106]

Roles	Description of Roles
Systematisers	Accounting standard setters Legislators and regulators
Providers	Organisations and individuals
Intermediaries	Auditors and others who review and express opinions regarding financial information Financial publishers
Users	Analysts Investors Creditors Regulators Managers Researchers

Baldwin et al. focus on the roles of financial reporting participants divided into four groups. Systematisers provide the basis for the financial reporting, providers are responsible for the reporting itself and intermediaries gather financial reports in order to share them with other users. Different classification of the roles in financial reporting is stated by Wagenhofer and Ewert and presented in table 5. They distinguish between internal and external receivers of financial reports but differently to Baldwin et al. not consider the intermediaries role.

Table 5. The Receivers of Financial Reports [modified after WaEw2003, 5]⁵⁴

Internal receivers	Top management
	Division managers
	Owners involved in running the company (owner-managers)
External receivers	Owners holding publicly traded shares of the company (investors)
	Potential owners, company's acquirer
	Banks and other capital providers
	Counterparties (suppliers, customers)
	Employees
	Competitors
	Public authorities
	General public

The analysis of the roles and selection of plausible reporting scenarios concentrates on the users of financial reports as indicated by Baldwin et al. in table 4 and external receivers as stated by Wagenhofer and Ewert in table 5.

3.3.2 Selection of Reporting Scenarios

This section provides an overview of the scenarios selected for further analysis and considered for the survey. This study regards internal receivers discussed by Wagenhofer and Ewert as well as the groups of systematisers, providers and intermediaries⁵⁵ as important part of the financial reporting supply chain but not directly related to the

⁵⁴ This classification of Wagenhofer is similar to the classification of Heno [Heno2004, 5]. Heno indicates also the different functions of the financial reporting according to IFRS with mainly informative role. This implies different receivers of the financial reports according to IFRS than according to German GAAP [Heno2004, 18].

⁵⁵ For example none of the interviewees confirmed the importance of the role of intermediaries in the financial reporting. They are more relevant in the further processing of financial information for the need of financial analysis which is not directly related to the financial reporting of companies.

reporting scenarios⁵⁶. The reporting scenarios considered in this study are listed and explained in table 6.

⁵⁶ Different to auditors, the management and controllers of the company are not treated as receivers of financial reports in this study. Although they need to interfere with the financial reports before they can be conveyed to the external users they often conduct their activities using accounting or management information systems and so the traditional reporting process does not take place.

Table 6. Selected Reporting Scenarios

Reporting scenario	Description	Receivers analysed
Auditor reporting	Conveying of the financial reports to the auditor for the needs of audit procedures	Big four auditors ⁵⁷
Group reporting	Reporting of a subsidiary to its parent entity	Parent entities
Capital markets reporting	Reporting of public companies regulated by stock exchange regulations to the investors, analyst ⁵⁸ and stock exchange but not related to supervisory reporting	Frankfurt Stock Exchange
Statutory reporting	Reporting regulated by local GAAPs and related to the publication of financial report in generally accessible media	German Business Register
Supervisory reporting	Reporting regulated by the stock exchange supervision of the publicly traded companies	Federal Financial Supervisory Authority
Tax reporting	Reporting related to the submission of the financial reports to the tax offices for the purpose of calculating tax values	Freiberg and Dresden tax offices
Credit risk reporting	Reporting to the credit risk management divisions of commercial banks for the needs of credit risk assessment and ratings	Deutsche Bank AG and Freiberger Bank eG

In order to structure the reporting scenarios this study applies the views of the Zachman enterprise architecture framework introduced in the second chapter. Use of Zachman categories data, function, network, people, time and motivation allows close cor-

⁵⁷ Big four auditors are referred to as the biggest four companies providing financial audit services which are Deloitte Touche Tohmatsu, Ernst & Young, KPMG, PricewaterhouseCoopers.

⁵⁸ Although Baldwin et al. indicates analyst as a separate group of receivers this study uses the grouping of analysts as the receivers in the investors and capital market reporting scenario.

relation of the analysis conducted in this chapter with later modelling conducted in chapter five. Based on these categories a catalogue of questions was prepared. The six views together with specialising those views questions aimed at giving a synthetic and comprehensive view on the selected reporting scenarios.

The answers to the questions based on the above criteria were delivered by interviewees and contributed to the content of the following sections. The following sections provide a set of brief summaries of each analysed reporting scenario.

3.3.3 Survey Methodology

The survey examined the reporting of entities to various groups of receivers, referred to as reporting scenarios in this study. Background for the survey was the lack of required detail of the literature covering the financial reporting supply chain in a comprehensive way across various reporting scenarios. The goal of the survey was to prepare background information and an overview of the financial reporting in Germany. Therefore the analysis addressed also the legal basis for different reporting scenarios selected⁵⁹. The survey was conducted by the means of interviews⁶⁰ with the participants of the financial reporting scenarios enhanced with the analysis of legal documents and supported by literature research. The researched reporting scenarios were selected due to their importance and comprehensibility in the context of the financial reporting in Germany and analysed thoroughly. The reporting scope was limited to the financial reports of public companies and thus the internal reporting aspects were excluded from the analysis similar as the consolidation issues. Financial reporting domain analysis could be regarded as a very broad research area if all reporting entities should be considered. For the needs of the survey mainly the reporting of incorporated companies was interviewed and analysed. The incorporate companies are part of most reporting scenarios and their financial reports are most comprehensive. Also the implications from the financial reporting supply chain architecture of incorporated companies can be often applied to SMEs. The aspect of financial and tax audit were dis-

⁵⁹ Appendix 1 provides a detailed list of interviewees taking part in the survey.

⁶⁰ Appendix 2 provides a list of questions used for the interviews.

cussed with interviewees mainly from the perspective of the receivers of the financial information and not in the context of auditing processes.

3.3.4 Auditors Reporting Scenario

Although the financial and tax audit procedures are out of scope of this research⁶¹, two aspects related to audit need to be discussed due to their impact on the financial reporting supply chain architecture. First is the reporting of the companies to the auditors⁶² and second is the change in the data components transferred along the reporting process from unaudited financial statements and management report to audited financial reports.

Companies are obliged to convey their financial statements to auditors as a part of the financial audit process [WaEw2003, 381]. Therefore reporting to these entities in the context of their audit activities is investigated in this section. The financial reports are transferred to auditors usually using the postal way and even often by email. There are also cases reported when the data transfer is conducted by the means of a data storage⁶³. The financial statements⁶⁴ therefore are in printed form or as Excel, Word, PDF or other electronic documents. Depending on the company size financial statements and management report are delivered either at the end of the quarter or at the end of the financial year. While medium companies usually report annually, from capital market-oriented companies additionally quarter reports are required. The §§ 264 and 320 of the HGB [HGB2006] require companies to convey their financial statements and management report directly after preparation. The received statements

⁶¹ This section does not address the distinction between internal and external audit often discussed in the audit literature [MaQR2001, 12; Hofm1993, 28]. Also context of the audit of accounting information systems is out of scope of this research similar as the problematic of the continuous audit often discussed in the context of XBRL [Trit2002].

⁶² Audit procedures require the audited company to provide the financial information in the appropriate format. Thus in this study auditors are regarded also as receivers of the financial information in the financial reporting supply chain.

⁶³ Compact disc (CD) or Universal Serial Bus (USB) are used as data storage.

⁶⁴ According to HGB §320 financial statements are transmitted often together with management report [HGB2006].

need to be audited and later archived⁶⁵. Due to reporting according to IFRS for parent entities regulated by §315a of the HGB [HGB2006] the audit procedure encompasses HGB, IFRS but also United States Generally Accepted Accounting Principles (US GAAP)⁶⁶ oriented financial statements.

Since auditors are obliged to examine the company's financial situation thoroughly, they require financial data. In addition to yearly and quarterly disclosures, single disclosures are gathered such as other business reports, economical evaluations and further reports relevant for audit [MaQR2001, 4-8]. As legal basis, which grants the auditors access to financial data of the entities is §316 of the HGB [HGB2006]. HGB obligates entities, which are not SMEs in the understanding of §267 HGB [HGB2006], to conduct end year examination of their accounts and reports.

The §§ 316 and 322 of the HGB [HGB2006] require from the auditors the auditors' report on the financial statements and management report⁶⁷. Additionally according to §317 HGB the record keeping procedure needs to be examined at the end of the reporting period. Both should ensure proper assurance on the financial reports of the companies.

This section analysed conveying financial statements and management report to the auditors. Next section focuses on the financial reporting within a group.

3.3.5 Group Reporting Scenario

The second reporting scenario to be analysed is reporting to a parent entity in the consolidation context. Although not clearly defined as external reporting the aim is to transfer financial reports from the subsidiary to the parent entity of the group. Although International Accounting Standard (IAS) 27 states the consolidation procedure [IASB2006a, 1224-1226], it is not clear how financial reports should be transmitted.

⁶⁵ Some of the receivers examined in the further sections require the audited financial reports directly from the auditor which in such a case act as intermediary dispatching the data to further institutions. This scenario is not analysed further in this study.

⁶⁶ US GAAP financial statements are not regulated by HGB but due to a number of companies listed in the US reporting according to US GAAP is an often case.

⁶⁷ It is important to differentiate between auditors' report regulated by the §322 of the HGB which is later part of the audited financial report and audit documentation according to §320 of the HGB which is later conveyed to public authorities [HGB2006]. This study focuses on the auditors' report only.

Also the financial statement consolidation literature does not address explicitly the reporting activities of the subsidiaries to the parent entity focusing in the conceptual aspects of the consolidation processes [WeWe2006]. HGB in §294 is more specific and requires conveying separate financial statements according to §325 of the HGB, management reports, consolidated financial statements, consolidated management reports and if available auditors' report [HGB2006]. In order to enhance the analysis of the group reporting scenario the results from the survey are applied.

The legal basis for reporting to the parent entity in Germany is §290 HGB. Also IASB published two standards, IFRS 3 [IASB2006a, 273] and IAS 27 [IASB2006a, 1215], which provide guidance on the accounting for business combinations and preparation of consolidated financial statements. However no detailed information is provided on what should be reported in the consolidation process. The results of the survey demonstrate that sending financial statements can be conducted in two ways. The first concerns sending the financial information according to the structure provided by parent entity in the spreadsheet format and the second is working directly on the consolidation system of the parent entity and thus having the structure for the report provided. Data structures are based on the accounting standards and enhanced with additional information. The accounting literature often addresses the character of this additional information but does not discuss the format or the structure in which such information is transmitted. For example Weber and Weißenberger state that during consolidation apart from separate financial statements of the subsidiaries, information related to equity consolidation, liabilities consolidation, interim results consolidation as well as revenue and expense consolidation must be considered [WeWe2006, 304]. But they do not provide further information how this additional information is transmitted to the parent company. The survey results indicated that a part of the reporting structure provided by the parent company includes an elimination matrix where the additional information is entered. The accounting standards regulating group reporting depend on the accounting standard used by the parent entity as well as on the size criteria of the subsidiary. In general reporting according to German accounting principles, IFRS and US GAAP is allowed.

Referring to the process of reporting to the parent entity the financial reports are usually directly transmitted from subsidiaries. Ramin et al. indicate three possible sce-

narios, in the context of information transmission, used in reporting practice thus extending the results of the survey. The first scenario is reporting by the use of spreadsheets send by email or fax, which are finally entered to the consolidation system of the parent company. The second scenario indicated by Ramin et al. is the use of a container in an electronic format with the structure predefined by the reporting company. Such containers can be imported into the consolidation applications of the parent entity later. The third possibility is an online connection between the reporting systems of the subsidiary and those of a parent entity, referred to as online reporting. This requires common, open or proprietary standards for the encoding of financial reports. [RaKO2006]

As indicated by Ramin et al. and confirmed by the results of the survey the scope of the reporting channels and reporting means is very broad and heavily based on the size and IT maturity of the parent entity as well as the subsidiaries. [RaKo2006]

The reporting frequency varies depending on the requirements for further consolidated report. In the survey the interviewees referred to end-of-year financial reports which are transmitted directly after financial report is prepared by the subsidiary according to §294 of the HGB [HGB2006].

The participants of the group reporting scenario are subsidiaries as senders and the parent entities as receivers. The parent entities are responsible for conducting the consolidation and providing the consolidated financial report of the group. The consolidation requires in some cases support of the auditors of either parent entity or subsidiary⁶⁸.

In this section the focus is on the yearly financial reports transmission. Often the financial information transmitted is used not only for consolidation procedures but also for further purposes. An example here is cost accounting where the transmitted financial data enhances measurement of the profitability of the subsidiaries.

⁶⁸ The EU states that "...in the case of consolidated accounts, it is important that there be a clear definition of responsibilities as between the statutory auditors who audit components of the group... for this purpose the group auditor should bear full responsibility for the audit report." [EuCo2006]

This section addressed the aspects of the reporting in the context of consolidation of financial statements. The next section discusses external reporting scenario referring to the capital markets reporting.

3.3.6 Capital Markets Reporting Scenario

The scenario analysed in this section is often referred to when discussing financial reporting supply chain. Publicly listed entities are obliged to make their financial reports available to investors⁶⁹. Companies whose securities are publicly traded need to convey their interim and yearly financial reports⁷⁰. The goal of capital market reporting is to protect the public during the stock broking by enhancing market transparency⁷¹. The entities are also obliged to publish the yearly reports as well as ad-hoc statements in various media.

The data components and data structures of the capital markets reporting are addressed by a number of legal regulations in Germany. According to the §72 of the *Börsenzulassungs-Verordnung*⁷² (BoersZulV) the financial reports are:

- financial report according to §§ 242 and 325 of the HGB [HGB2006],
- consolidated financial report according the §13 of the *Publizitätsgesetz*⁷³ (PublG) [Publ1969],
- reports according to other referenced regulations,
- reports according to foreign regulations if they comply with four above definitions. [Boer1987]

According to these regulations accounting standards which can be the basis for financial reports are IFRS and for companies listed in the US the US GAAP.

⁶⁹ This study treats analyst as receivers acting on behalf of investors and so not addressed separately. This study acknowledges however different views on this issue represented by Frank and Ramin et al. addressing financial analyst as a separate group [Fran2007; RaFK2007].

⁷⁰ However further documents can be demanded by the supervisory authorities and stock exchanges according to §§ 42 and 54 Börsengesetz (BörsG) [Boer2002].

⁷¹ Reporting to the supervising authorities is addressed in detail in the next section.

⁷² BoersZulV regulates the access of the companies to the stock exchange.

⁷³ PublG regulates accounting of the selected companies and parent companies.

The processes important from the viewpoint of the analysed scenario are described in the stock exchange regulations. The emitter of certified shares are obligated to publish their financial report according to §40 *Börsengesetz*⁷⁴ (BörG) [Boer2002].

The §5 of the PubLG [Publ1969] regulates the publishing period which is three months after year end which concerns all (also non listed companies) according to §1 of the PubLG [Publ1969].

According to Marston and Polei the use of Internet for publication of financial reports and ad-hoc statements in Germany is gaining importance and is often used as a reporting medium [MaPo2004]. The use of HTML and PDFs dominate as the formats of publishing the financial reports. Financial reports are also often conveyed to investors in form of paper brochures.

Further report obligations result from the stock exchange recommendations. The interviewees indicated that all reports are transferred over by the Exchange Reporting System (ERS) as PDFs and afterwards as XML documents. The ERS serves listed companies to fulfil their reporting obligations, especially the transmission of the annual and interim financial disclosures to the stock exchange. Financial information is published on the website of the stock exchange and international investors and analysts can access the reports shortly after the publication. The ERS system offers an open interface so the entity can transfer the financial reports with either directly connection or by a service provider.

Apart from the discussed capital markets reporting discussed in this section a separate scenario for the supervisory reporting is analysed in the following section.

3.3.7 Supervisory Reporting Scenario

This section focuses on the conveying the financial reports to the capital market supervision. In Germany the Federal Financial Supervisory Authority (FFSA)⁷⁵ has united the supervision of banks and financial service providers, insurance institutions and securities trading. In the scope of this study only the activities relating to securities trad-

⁷⁴ BörG regulates all stock exchange related activities in Germany.

⁷⁵ The FFSA stands for *Bundesanstalt für Finanzdienstleistungsaufsicht* (BaFin).

ing and their supervision are considered. It is important to note that FFSA activities are strongly related to the stock exchange reporting discussed in the previous section.

Public companies regulated by the FFSA⁷⁶ must publish yearly documents according to §14 of the WpPG [WpPG2005]. Additionally the *Börsenordnung*⁷⁷ of the Frankfurt Stock Exchange specifies in §62 the financial reports as annual reports, as well as separate and consolidated reports and in §63 interim reports as quarterly reports [Boer2007]. In addition the *Bilanzkontrollgesetz*⁷⁸ (BilKoG) from December 2004 [BilK2004] regulating the accounting and financial reporting of listed companies requires from the 1st of January 2005 additional external enforcements in a form of financial report control. The enforcement procedure is conducted in two steps checking the legal quality of the latest separate financial report, consolidated financial report and management report. In this procedure the checkpoint is the Financial Reporting Enforcement Panel (FREP)⁷⁹ providing random checks for breaches of accounting rules and FFSA regulations.

The legal regulations related to the transmission of reports to the FREP is §37 *Wertpapierhandelsgesetz*⁸⁰ (WpHG) [WpHG1998] together with §342 HGB [HGB2006]. The reporting processes are based on the §10 *Wertpapierprospektgesetz*⁸¹ (WpPG) [WpPG2005]. According to these regulations each issuer trading securities on a regulated market is obliged to publish a document with all relevant information. The WpPG classifies as relevant information required by following regulations:

- the §§ 15, 15a, 25 and 26 of the WpHG [WpHG1998];
- the §39 of the BörG [Boer2002] in relation to the second chapter of the *Börsenulassungsverordnung*⁸² (BörsZulVO) [Boer1987];

⁷⁶ Companies listed in the US are supervised by the US SEC.

⁷⁷ *Börsenordnung* regulates standards for the stock exchange regulations.

⁷⁸ BilKoG regulates the control of the financial reports.

⁷⁹ FREP stands for Deutsche Prüfstelle für Rechnungslegung (DPR).

⁸⁰ WpHG regulates the securities trading in Germany [WpHG1998].

⁸¹ WpPG states the law for the preparation, approval and publication of stock exchange prospectus [WpPG2005].

⁸² BörsZulVO regulates admission of the securities to the stock exchange trading [Boer1987].

- the §§ 42 and 54 of the BörG in relation to *Börsenordnung* [Boer2002];
- the foreign regulations discussed in §10 WpPG [WpPG2005].

The above regulations allow public companies to report according to IFRS with the exception for US listed companies reporting according to US GAAP.

According to §10 WpPG the FFSA requires publication of the financial report in publicly accessible media⁸³ [WpPG2005]. According to EU regulation 809/2004 article 27 public companies are obliged to submit the printout of the yearly document to the FFSA 20 working days after disclosure [EuCo2004]. The printout of the internet website is sufficient to fulfil the requirements of the FFSA [WpPG2005].

The participants of the supervisory reporting scenario in Germany are the FFSA and supervised companies. The mission of the FFSA is “...to guarantee the proper functioning, stability and integrity of the German financial system ... [so that] ... bank customers, insurance policy holders and investors ought to be able to trust the financial system...” [Bafi2007]. The resulting goals of the FFSA are in the areas of acting against insider trading, supervising the ad-hoc reporting, directors’ dealings, market manipulations, significant shares of rights to vote, prospects, performance and duties of supervised organisations, acquisitions, enforcement, financial analysis and solvency supervision.

Apart from the capital markets oriented and supervisory reporting, listed companies must fulfil their statutory reporting requirements addressed in the following section.

3.3.8 Statutory Reporting Scenario

The reporting scenario analysed in this section is statutory reporting, which is obligatory in many European countries. The institution responsible for statutory reporting in Germany is Business Register⁸⁴. The representatives of the incorporated companies are

⁸³ WpPG refers to the internet website of the company as to publicly accessible media [WpPG2005].

⁸⁴ Diesem indicates that Business Register stands for *Unternehmensregister* and Federal Gazette for *Bundesanzeiger* [Dies2007].

obliged to submit their annual reports to the German Business Register with the scope of the reports depending on the legal form and the size of reporting entity.

The underlying legal basis for the statutory reporting are §§ 264, 325 of HGB [HGB2006]. The reporting company has the option to choose the HGB, IFRS or US GAAP reports according to §325 HGB [HGB2006]. The direct legal regulation for the statutory reporting is the *Gesetz über elektronische Unternehmens-, Handels-, sowie Genossenschaftsregister*⁸⁵ (EHUG) [Noac2007]. This regulation changes the roles of the former *Bundesanzeiger* and *Handelregister*. They are no longer responsible for the publication of financial reports. The regulation changes also the way of how the disclosure, reception, storage and further publication of the financial reports are conducted. It also introduces the possibility to submit the financial report in XBRL format [Noac2007, 122]⁸⁶.

The reporting for the incorporated companies⁸⁷ requires delivery of the following reports according to §21 of EHUG [EHUG2006]:

- the financial report with the auditor's report,
- management report,
- report of the supervisory board,
- the information about the net profit/ loss deployment⁸⁸,
- the conformance declaration according to §161 Aktiengesetz (AktG) [AktG1965].

Concerning the reporting processes the statutory reporting encompasses receiving, storage and publication of financial reports [Noac2007, 24]. For the transmission of the reports the companies can deploy one of the four formats⁸⁹:

⁸⁵ EHUG regulates the statutory reporting in Germany.

⁸⁶ The Federal Gazette conducted already in 2005 a pilot project together with Microsoft and ITA Systemhaus testing the transmission and publication of XBRL reports. [Micr2005]

⁸⁷ Small and medium-sized enterprises can use the alleviations of §326 HGB for small and §327 HGB [HGB2006] for medium companies. The required documents are only the balance sheet and explanatory disclosures.

⁸⁸ According to §325 HGB [HGB2006] information about the net profit/ loss deployment is often part of the explanatory disclosures to the financial statements.

- paper⁹⁰,
- Excel,
- Word or Rich Text Format (RTF),
- XML or XBRL. [Bund2007, 2]

The EHUG reduced the number of participants of the statutory reporting scenario. The former receivers of financial statement which were the Bundesanzeiger and the Handelsregisters are replaced with one receiving entity which is the German Business Register [Noac2007, 98-99].

Regarding the time view on the statutory reporting HGB addresses the reporting timeframe. According to §325 of HGB the financial reports must be submitted within twelve months from disclosure for non-listed and four months from disclosure for listed companies.

The central goal and motivation of the statutory reporting to the German Business Register is stated by Noack⁹¹. The new EHUG regulation should enable online access to the company's data in the central national portal [Noac2007, 101].

This section discussed statutory reporting scenario regulated by HGB. In the next section tax reporting in the context of financial reports conveying is addressed.

3.3.9 Tax Reporting Scenario

The next addressed reporting scenario deals with the reporting of the companies to the tax offices. The tax administration in Germany undergoes a number of changes with the goal of introducing fully paperless processes. Important part of these processes concerns the tax assessment. Tax assessment should be considered in the context of the organisation aspects and relationships between tax payers and tax administration

⁸⁹ The prices that the reporting companies have to pay for the publications are related to the transmission format. XBRL reports are less cost intensive than other allowed formats. [Noac2007, 126-128]

⁹⁰ Paper submission is possible only till 2009 [Noac2007, 32].

⁹¹ Also Flickinger indicates easier access to financial information as one of EHUG goals. Additionally Flickinger states that EHUG should reduce the bureaucracy in statutory reporting as well as accelerate reporting and publication of financial information [Flic2007, 103].

[GMDF1996, 78]. The tax administration processes are stated by a number of regulations some of which have also implications for the financial reporting of companies and are substantial part of this section.

The reporting in the context of tax assessment is conducted with the use of a number of forms. The tax payer must attach additional documentation according to the tax regulations. This paragraph is substantiated in the context of income taxes in §60 of the *Einkommensteuer-Durchführungsverordnung*⁹² (EStDV) [EStD1995]. In the case of determination of taxable income the tax payers must attach a copy of the balance sheet, which is based on the entity's accounting. This obligation extends to the income statement, corrections concerning the transfer between commercial code and tax code, the explanatory disclosures, management report and auditors' report according to the §60 of the EStDV [EStD1995]. The submitted financial statements must comply with the tax code so the submission of tax financial statements is possible. Weber und Weißenberger refer to tax reporting as to a special case of external financial reporting [WeWe2006, 34].

Regarding the processes in the tax reporting scenario it should be differentiated between the reporting of tax forms and reporting of financial statements described in the previous section. The reporting of the tax forms is conducted by the ELSTER system [BaLS2007] which does not have the capabilities to convey the financial statements. Thus the financial statement is conveyed in the paper form and delivered by post [BaLS2007]. The tax offices are responsible for analysing and storing the submitted financial statements.

From the time viewpoint the §149 of the *Abgabenordnung*⁹³ (AO) [AO1976] regulates the time framework for the submission of the financial reports. The reporting entities have five months from the year end⁹⁴ to submit their tax declarations along with the financial reports.

⁹² EStD regulates the assessment of income taxes in Germany.

⁹³ AO is the basic regulation of the taxation in Germany.

⁹⁴ The tax declarations together with financial reports must be submitted till 31 of May of the following year.

Participants of the tax reporting scenario are the incorporated companies as senders as well as tax offices as receivers of financial reports⁹⁵. The goals and motivations for the tax reporting scenario are stated in the Tax Compliance Strategy. According to the Ministry of Finance of Germany:

- the effective risk management should reveal malpractice and mistakes of tax payers and provide the basis for rigorous sanctions;
- the broad service offer should enhance to cooperation with tax payers. [Diec2004, 7]

This section addressed conveying financial reports to tax offices as an addition to the tax declaration of a company. The next section analyses last selected reporting scenario which is reporting of companies to commercial banks.

3.3.10 Credit Risk Reporting Scenario

The last reporting scenario analysed in this section is reporting to the Credit Risk Management (CRM) divisions of the financial institutions. The main goal of the analysis is to state which financial information is required by banks from borrowing companies.

The legal basis for the CRM reporting is §18 of the *Kreditwesengesetz*⁹⁶ (KWG). KWG requires that banks gather annual reports⁹⁷ from a certain amount of credit given [KWG1961]. But the banks require financial reports also from companies not fulfilling the requirements of §18 KWG. Further legal regulation related to the CRM reporting is *Mindestanforderungen an das Risikomanagement*⁹⁸ (MaRisk). As it

⁹⁵ The role of tax advisors which plays an important role for SMEs in Germany due to DATEV activities is not considered in this study. The assumption is that listed companies being analysed here have tax competences within the company and so tax advisors are not separate participants of the financial reporting supply chain.

⁹⁶ KWG regulates the activities of the credit services sector [KWG1961]

⁹⁷ Additionally the banks require business assessments from the companies. The frequency of business assessments transmission is related to the liability of the borrower. It depends on the volume of the credit, the credit risk and can lead to half-yearly, quarterly or monthly transmission of the business assessments. The business assessments are based on the data from financial accounting. They provide information about revenues and costs of the current accounting period as well as about the financial position of the company.

⁹⁸ MaRisk regulates the risk management for the financial institutions in Germany.

is not a law but a recommendation it requires the banks to incorporate the Basel II requirements in their CRM processes [MaRi2005]. The submitted financial reports are either based on German accounting principles or IFRS.

The reporting process is heavily paper based and the transmission of reports is conducted by post. Although it is discussed to require the financial reports and financial information directly from intermediaries' systems, the solution is still not mature enough to go into production stage. Also the costs on the customer side need to be considered which creates further issues with reporting mediums other than paper. The reports transmitted in the postal way are further manually processed and entered into the information systems of the bank.

Annual reports are transmitted at the end of the fiscal period. The motivation of the financial institutions is to secure the borrowings.

This section addressed briefly the composition of the financial reporting for the credit risk reporting scenario. The following section summarises all discussed scenarios and prepares the base for the further modelling.

3.3.11 Summary of the Reporting Scenarios

The above sections provided an overview of selected financial reporting scenarios. Results of the survey were merged with the analysis of legal sources indicated in the interviews thus providing a structured view on each reporting scenario. In this section two summary tables are used to gather all results and provide an overview of the whole financial reporting domain. The tables apply Zachman views (data, function, network, people, time and motivation) on the financial reporting domain discussed in chapter two. The goal of this section is also to ensure a comprehensive and consistent basis for the modelling of the financial reporting supply chain architecture components in chapter five.

This study analyses the data perspective of the financial reporting scenarios. Table 7 presents the overview of the last Zachman view focusing on data components. The data view analysis is divided into three parts. First the underlying accounting regulations are listed. The three scenarios (auditors', group and statutory reporting) allow the use of all three accounting standards (HGB, IFRS and US GAAP). Reporting to the

stock exchange and the supervision requires only financial reports based on IFRS or US GAAP. The tax reporting scenario allows solely tax financial reports based on German accounting principles while reporting as a borrower to a financial institution allows use of either HGB or IFRS. The second and the third levels of the data view analysis uses the input – process – output approach to summarise the discussed reporting scenarios. Second level for the data view analysis is the input information for the reporting process. Three reporting scenarios (investors, supervision and statutory) require financial report to be submitted. Also for the group reporting the scope can be financial report (if available) but financial statements only are also possible. Financial statements together with management report are submitted to the auditor for audit procedures and for archiving and banks require only financial statements. The last analysed level of data view concerns the output information. Only two of the reporting scenarios produce output related directly to the financial reporting. The first one is group reporting where consolidated financial statements are produced. The second one is the auditors' reporting scenario which produces auditors' report being later part of the financial report.

Table 7. Summary of the Results of the Analysis Concerning Reporting Scenarios for Data Components⁹⁹

Reporting scenario	Auditors reporting	Group reporting	Capital markets reporting	Supervisory reporting	Statutory reporting	Tax reporting	Credit Risk Reporting
Underlying legal regulations	HGB, IFRS, US GAAP	HGB, IFRS, US GAAP	IFRS, US GAAP	IFRS, US GAAP	HGB, IFRS, US GAAP	HGB	HGB, IFRS
Financial information	Financial statements, management report, financial report, auditors' report	Financial statements, management report, financial report	Financial report	Financial report	Financial report	Tax financial statements	Financial statements

⁹⁹ Only financial reporting oriented data components are analysed in the context of output criteria in this section.

Table 8 presents the overview of the five categories function, people, network, time and motivation for each of the discussed reporting scenarios. The categories presented in table 8 enable development of a comprehensive set of views on the financial reporting supply chain.

First, the function level demonstrates diversity of processes conducted with the use of financial reports. Apart from involvement directly in the reporting process the processes conducted by receivers can be scoped down to five items:

- audit,
- analysis,
- archiving,
- consolidation,
- publication.

It is important to note that analysis in the context of group reporting refers to cost accounting and in the context of tax reporting to tax calculation processes.

The second analysed category is the people perspective on the reporting scenarios. Apart from the discussion on intermediaries' role conducted earlier in this chapter the analysis provides a clear view on the participants. Each scenario indicated companies¹⁰⁰ as senders of financial reports and in each scenario there was one receiver¹⁰¹ of financial reports indicated.

The third analysed category concerns the network view on the financial reporting domain. It must be stated that paper financial reporting is used across five out of seven reporting scenarios analysed. Further, electronic formats, open standards and proprietary formats are in use. Finally, group reporting and stock exchange reporting offer usage of integrated systems for reporting needs.

¹⁰⁰ This study refers to listed companies but the senders in the reporting scenarios were defined in a various ways as listed companies, incorporated companies fulfilling certain requirements etc.

¹⁰¹ In the holding and auditors reporting scenario the number of receivers is in general bigger than one but one company reports to one receiver only.

The fourth analysed category refers to the time aspects. Five financial reporting triggers were identified:

- report preparation,
- report audit,
- report publication,
- financial year end,
- request.

Companies are obliged to convey their financial reports with the relation to these triggers or in a certain time interval from the triggering event.

The next analysed view is the motivation view on the financial reporting scenarios. From the perspective of the goal of different reporting scenarios high diversity can be identified. For each reporting scenario there is different set of goals and thus different motivation.

Table 8. Summary of the Results of the Analysis Concerning Various Reporting Scenarios for Function, People, Network, Time and Motivation Components

Reporting scenario	Auditors reporting	Group reporting	Capital markets reporting	Supervisory reporting	Statutory reporting	Tax reporting	Credit Risk Reporting
Function	Audit, archiving	Consolidation, analysis	Publication, analysis	Analysis	Publication	Analysis, archiving	Analysis
People	Audited company, auditor	Subsidiaries, parent entity	Public companies, stock exchanges, investors	Public companies, supervisor	Companies, companies register	Companies, tax offices	Borrowing companies, commercial banks
Network	Paper, Excel, Word, PDF	Excel, proprietary formats, integrated systems	HTML, PDF, integrated systems, XML, paper	Paper	Paper, RTF, Word, Excel, XBRL	Paper	Paper
Time	Directly after preparing	Directly after preparing or after audit	Three months after year end	Within 20 days after publishing	Within four months after publishing	Within five months after year end	On request and at the year end
Motivation	Assurance of financial information	Providing a fair view of the group	Providing investors with a fair view on the public companies	Protection of the capital markets participants	Providing general public with financial information	Revealing malpractice and mistakes of tax payers	Securing the borrowings

This section presents research results of the conducted surveys and analysis presented in a structured manner. Identification of plausible reporting scenarios and their comprehensive analysis are the basis for the further modelling of the financial reporting supply chain architecture and especially supportive with the identification of the architecture components. Application of the Zachman views already to the survey and analysed scenarios and later to the summary tables contributes to the consistency of this study. Traditional data flow oriented understanding of financial reporting is enriched with a number of additional components thus providing a comprehensive view on financial reporting.

3.4 Conclusions

The analysis conducted in this chapter delivers detailed overview of the financial reporting domain. The literature review for the accounting cycle and report preparation delivers comprehensive overview of the components related to the financial reporting. These two sections presented in this chapter provide with a detailed level the understanding of the domains necessary to conduct further modelling. Such level of detail cannot be achieved for the reporting section. Thus this study contributes to existing literature on financial reporting providing details and comprehensive view on plausible reporting scenarios. The reporting section analysis gives a clear outline of the data, functions, people, network, time and motivations for financial reporting in these different reporting scenarios. Finally also using Zachman categories the reporting section summarises the results of the survey and the analysis in a set of tables. Such presentation of the results is a basis for modelling activities conducted in chapter five.

The analysis provided in this chapter supports research proposition 1.1 stating that the *financial reporting supply chain architecture consist at the minimum of data, data structures, processes, participants and network components*. The results presented in this chapter clearly address the components and address their role in the supply chain. The next chapter focuses on the analysis of the technical domain concerning XBRL technologies.

4 Technical Domain Analysis

The technical domain analysis¹⁰² of XBRL is the substantial subject of the fourth chapter. This study focuses on the analysis of the impact of XBRL on the financial reporting domain. Especially the aspects of the changes in the financial reporting supply chain architecture due to XBRL introduction are analysed. Thus the XBRL components relevant for this study need to be identified and discussed. The XBRL literature do not provide a comprehensive view on XBRL standard [DeFP2007; Hoff2006, Berg2003, HoSt2001]. Therefore this chapter provides an analysis of the XBRL specifications and enhances it with information available in the literature.

This chapter proceeds as follows. The discussion starts with the introduction to XBRL specification which is the basis documentation for the language¹⁰³. The first section of this chapter addresses XBRL for financial reporting (XBRL FR) which is regarded to be the core XBRL technology [Hoff2006, 16; BoWo2005, 13; GIPa2006, 68]. The definitions and critical analysis of terms such as XBRL taxonomies, taxonomy extensions and instance documents together with the analysis of the issues concerning the current XBRL specification [EHSK2003] build the next section of this chapter. XBRL apart from the mentioned FR adaptation has a separate adaptation for the General Ledger¹⁰⁴ (XBRL GL). XBRL GL plays an important role in the internal reporting domain while standardising the journal entries, general ledger and trial balances [RaKO2006; hAon2005, 74; KrSc2003, 80] as well as in hybrid reporting discussed later in this chapter. Further and recent XBRL technologies such as XBRL dimensional taxonomies (XDT) allowing representation of multidimensional data sets [HRWa2006], XBRL functions and formulas allowing advanced calculations and validations [Hams2005, Enge2005], XBRL versioning and XBRL rendering as well as the

¹⁰² The technical domain can be understood in the broader context and encompass information systems components. This study focuses solely on the XBRL components as technical components of the financial reporting supply chain architecture.

¹⁰³ XBRL is often referred to as de facto standard for digital business reporting so the terms language and standard are used interchangeably [Berg2003, 15-16]. Comprehensive analysis on the XBRL standardisation level follows at the end of this chapter.

¹⁰⁴ Both XBRL FR and XBRL GL are based on the main XBRL specification 2.1.

relation of XBRL GL and XBRL FR known as hybrid reporting are analysed in the later sections.

4.1 XBRL Base Specification

Main building blocks of XBRL technology are XBRL specifications, XBRL taxonomies and XBRL instance documents. XBRL specification regulates the syntax for reporting based on the language. It is reporting specific extension to several XML specifications. XBRL taxonomies compromise business concepts for further reporting in form of catalogues or thematic vocabularies. The reported business facts are encoded in instance documents as reports. The relationship and roles of XML specifications, XBRL specifications, XBRL taxonomies and XBRL instance documents are presented in figure 12.

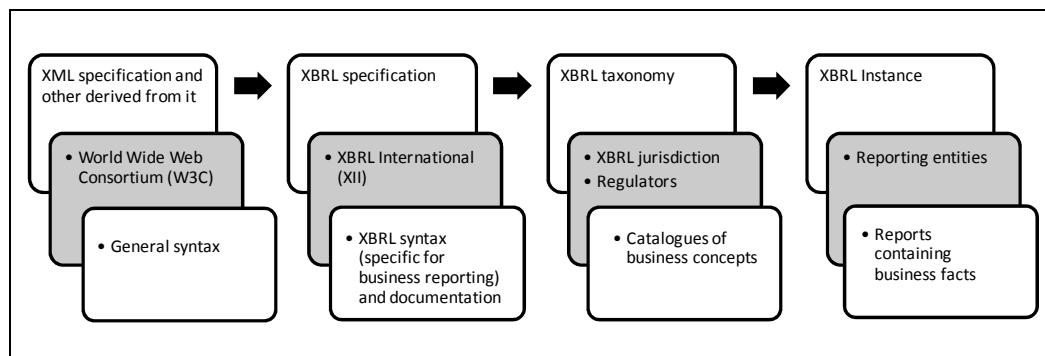


Figure 12. Relationships between XML Specifications, XBRL Specifications, XBRL Taxonomies and XBRL Instances

The XBRL specifications¹⁰⁵ are built and maintained by the XBRL International¹⁰⁶ (XII) [EHSK2003, 1]. The start of the work on XBRL is dated back to 1998 when Hoffmann started prototyping with XML for financial statements [XBRL2006b]. The first XBRL specification was published in July 2000 [HaKa2000, 1]¹⁰⁷. The next specification 2.0 published in December 2001 was implementing the new World Wide Web Consortium (W3C) XML schema recommendation [HaKa2001, 1]. The XBRL 2.0 specification introduced also XML Linking Languages (XLink) technology [XBRL2006b]. Published on 15th of November 2002 the 2.0a Specification incorporated errata to the 2.0 version [XBRL2006c]. First with the specification 2.1 dated on December 2003 XBRL has reached maturity¹⁰⁸ and guaranteed stability over the next few years [Hoff2006, 46]. The XBRL specification is defined as follows: “XBRL is the specification for the eXtensible Business Reporting Language [which] allows soft-

¹⁰⁵ Apart from the XBRL specification 2.1 there are more governing documents defining the rules for XBRL FR vocabulary and taxonomies architecture. The most important document for creation of XBRL taxonomies is called Financial Reporting Taxonomy Architecture (FRTA). FRTA states a set of 104 rules concerning best practices of taxonomy creation [HGHH2005, 4-5]. Financial Reporting Instance Standards (FRIS) exists for the creation of instance documents and facilitates the analysis and comparison of XBRL financial reporting data by computer applications and human readers [GoHa2004, 1]. Finally underlying principles for modelling of financial reporting taxonomy were created by Hoffmann [Hoff2006, 265-355]. The so called patterns are a collection of 20 modelling rules which help to create standardised taxonomies which are FRTA valid. FRTA and FRIS similarly to XBRL specification are accompanied by conformance suits in order to achieve greater software compatibility [Wall2004; Wall2005a].

¹⁰⁶ XII defines itself as “... a not-for-profit consortium of over 450 companies and agencies worldwide working together to build the XBRL language and promote and support its adoption” [XBRL2006a].

¹⁰⁷ The first XBRL specification was later called XBRL specification 1.0 [XBRL2006c].

¹⁰⁸ The XII assigned the recommendation status to the XBRL specification 2.1 on 31st of December 2003 [EHSK2003, 1; XBRL2006c].

ware vendors, programmers, [and] intermediaries in the preparation and distribution process and end users who adopt it as a specification to enhance the creation, exchange, and comparison of business reporting¹⁰⁹ information” [EHSK2003, 1-2].

In relation to the financial reporting supply chain architecture the first part of the definition plays an important role. XBRL is designed to support the preparation and distribution processes of business reports as well as creation, exchange, and comparison of them. This significant statement is placed in all XBRL specifications. It proves that the orientation of the XII goes towards enabling XBRL for use in the financial reporting supply chain. Willis and Hannon state that to achieve it XBRL provides a common standardised format that enables applications to seamlessly share and process data [WiHa2004, 57]. In order to achieve a high level of standardisation among XBRL software products, the XBRL specification is accompanied by the conformance suite. A conformance suite is a set of tests for software vendors, passing of which assures compatibility with the specification. The purpose of the conformance suite is to facilitate interoperable XBRL processor implementations. XBRL documents produced by an XBRL application should be consumable directly by a different XBRL application without risking the loss of information [HaAW2005, 4].

As mentioned before XBRL specification is the base for two adaptations of XBRL. The first, which is called XBRL FR¹¹⁰, deals with creation, exchange, and comparison of financial reports. The second called XBRL GL deals with journal entries, accounting master files, and historical status reports [GaHa2005, 58; RaKO2006, 3]. The analysis starts with XBRL FR explaining the basis terms used in XBRL.

¹⁰⁹ According to Engel et al. business reporting includes, but is not limited to, financial statements, financial information, non-financial information, general ledger transactions and regulatory filings, such as annual and quarterly reports. XBRL specification defines XML elements and attributes that can be used to express information used in the creation, exchange, and comparison tasks of business reporting. XBRL consists of a core language of XML elements and attributes used in XBRL instances as well as a language used to define new elements and taxonomies of elements referred to in XBRL instances, and to express constraints among the contents of elements in those XBRL instances [EHSK2003, 1-2].

¹¹⁰ The term XBRL FR is sometimes referred to as XBRL visual reporting (XBRL VR) [Gree2004].

4.1.1 XBRL Financial Reporting

XBRL was first named eXtensible Financial Reporting Markup Language (XFRML) but soon the XBRL community stated that the language has broader use and adjusted its name to incorporate various business reporting aspects [GaHa2005, 57; Hoff2006, 45; XBRL2006b]. Combining the XBRL definition from the XBRL specification and the definition of financial reporting from Wagenhofer and Ewert [WaEw2003, 4] the XBRL FR could be outlined as follows: “XBRL for financial reporting comprises all XBRL enabled information systems oriented towards external users such as investors, creditors, customers, suppliers, competitors and public”.

Table 9 explains the basic terms in XBRL FR area which are taxonomies and instance documents. XBRL taxonomies reflect the underlying financial reporting principles in form of different GAAPs¹¹¹ encoded using standardised XBRL vocabulary. The instance documents reflect financial statements of an entity but in the digital format.

¹¹¹ Although division between principle and rule based accounting standards exists between different GAAPs, the statements reflects the IFRS view as principle based accounting standard [LeMe2006, 210].

Table 9. Relation of XBRL Financial Reporting to the Traditional Financial Reporting

	Underlying Accounting Principles	Financial Report
Traditional Reporting	GAAP	Paper, PDF or HTML financial report
XBRL FR	GAAP based XBRL taxonomy	Instance document

Figure 13 provides more detailed view of the XBRL FR framework. The basis terms like taxonomy, taxonomy extension, instance document or Discoverable Taxonomy Set (DTS) are visualised together with relations among them.

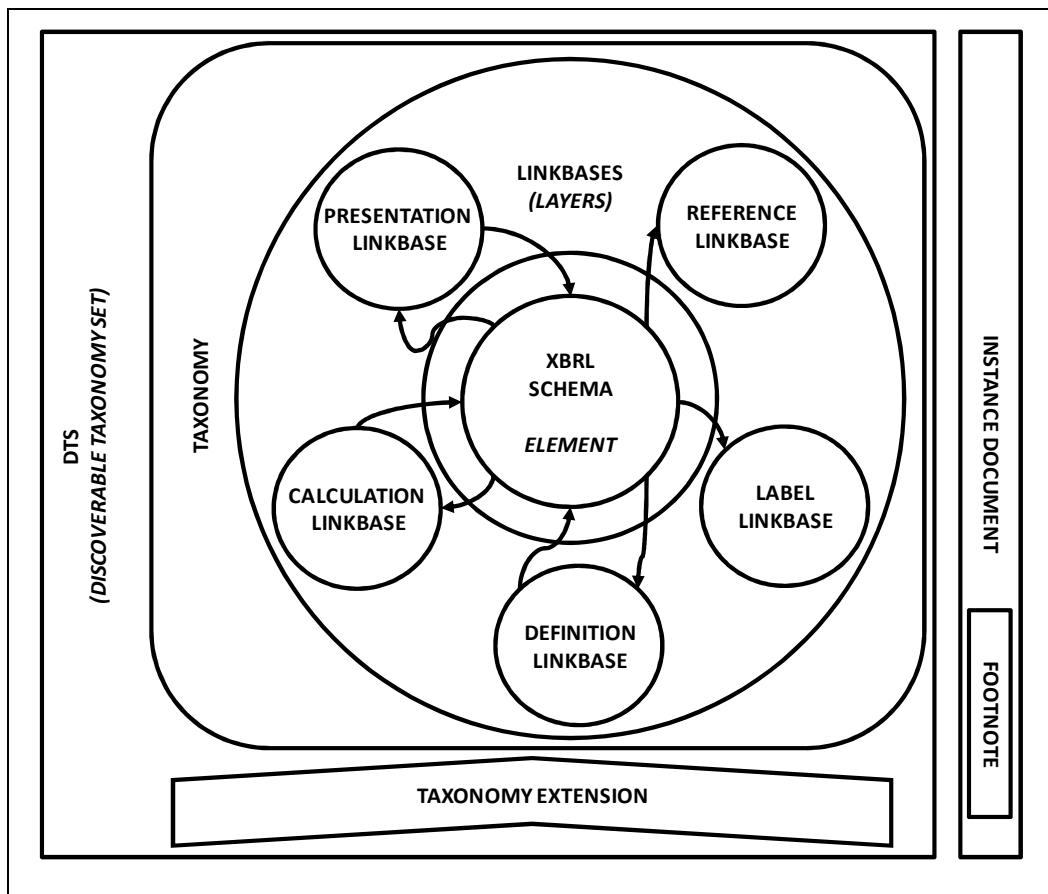


Figure 13. XBRL Financial Reporting Framework [IAS2006a]

A taxonomy in general means a catalogue or a set of rules for classification. In XBRL, taxonomy is a dictionary, containing computer-readable definitions of business report-

ing terms as well relationships between them and links connecting them to human-readable resources. A typical taxonomy consists of a schema (or schemas) and linkbases. A set of taxonomies that can be discovered¹¹² from one entry point schema is called DTS [EHSK2003, 16-17; Hoff2006, 77; IASC2006a].

Taxonomy extensions¹¹³ add concepts and modify the relationships among the concepts in the base taxonomies that they extend [HGHH2005, 61]. They are created to support specialised reporting requirements in specific accounting jurisdictions, in specific industries, or for specific companies. Taxonomy extensions consist of a set of taxonomy schemas and/or linkbases that augment a DTS that includes the base taxonomies [IASC2006a].

An instance document is a business report in the XBRL format. It contains tagged business facts, together with the context in which they appear and unit description [EHSK2003, 13; IASC2006a] and is referring the tags to the elements specified in the taxonomy.

This section discussed briefly the composites of XBRL technology. In the following sections the composites referred to as XBRL financial reporting framework are discussed in details.

4.1.1.1. Role of Taxonomies

The word taxonomy is derived from the Greek verb tassain which means to classify and the noun nomos that could be translated into English as law or science [Dude1990]. Combined and interpreted it means classification of a kind of knowledge. Initially, it referred to the science of classifying living things, but later it received wider meaning and is currently applied to either classification of things in general or rules governing this classification [Scho2006]. Frequently taxonomies are given hierarchical structures or are built in the form of networks so, as well as the elements, they also represent relationships [McCo2004, 51-52].

¹¹² Discovery is a technical term and means traversing over related XBRL schemas and linkbases [EHSK2003, 16-17].

¹¹³ The term taxonomy extension is used interchangeably with the term extension taxonomy [Hoff2006, 110; TeHM2003, 1-2].

Virtually everything could be a subject of classification under some taxonomy. The most common example of taxonomy is classification of living creatures. The root element, which is the most general one, is organism since all living things are of this group. Its first child is domain which in turn is a parent of kingdom whose subgroup is division that is divided into classes and so on. One important characteristic of taxonomies is that children (lower level elements) may have many parents (upper level elements) and so called unique location issue appears¹¹⁴. McComb recognises chart of account as a very common taxonomy known from the accounting domain. A chart of accounts classifies business and accounting entries into categories of assets, liabilities, revenues and expenses so the business activity can be better controlled by stakeholders [McCo2004, 53].

Analysing XBRL taxonomy in the context of general taxonomy definition¹¹⁵ explained before, the taxonomy schema is the part that contains definitions of elements (such as assets, equity or liabilities) whereas taxonomy linkbases provide relationships between them. In the example of living things the explanation of what is an organism, kingdom, division and class would be placed in the schema while the hierarchical relationships between them would appear in the linkbases. Taking accounting vocabulary into consideration the linkbases would provide the relationships between assets, equity and liabilities in form of balance sheet presentation and calculation structure.

¹¹⁴ In some classifications, spiders could be categorised as insects, in others as eight-legged creatures and in another as non-flying organisms [McCo2004, 55].

¹¹⁵ Close correlation can be found between ontology and XBRL taxonomy. Nevertheless the XBRL framework is based on taxonomies as metadata and instance documents as data of the reports. This distinction cannot be found in the ontologies domain.

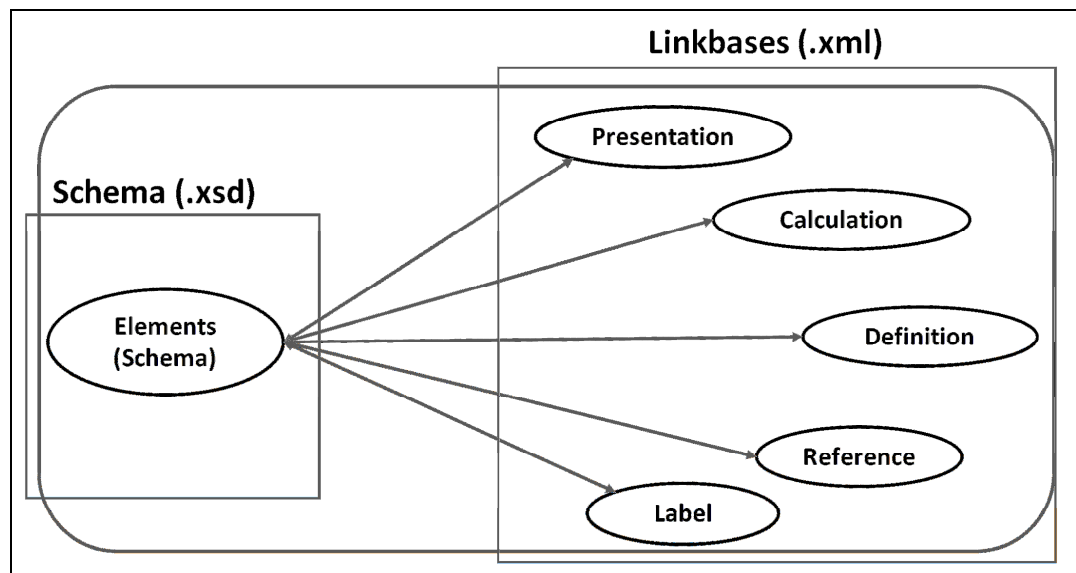


Figure 14. XBRL Taxonomy Architecture in Form of a DTS

Figure 14 provides an overview of an XBRL taxonomy DTS. A DTS contains one or more taxonomies i.e. a number of schemas together with linkbases related to them. This term was developed as taxonomies became more complicated and more closely related to each other¹¹⁶. The schema in form of an .xsd file is connected to one or more linkbases in form of .xml files. Standard XBRL linkbases defined by XBRL specification are presentation, calculation, definition, label and reference linkbase [EHSK2003, 90].

4.1.1.1.1. Taxonomy Schema

An XBRL schema stores information about taxonomy elements such as their names, ids and various other characteristics¹¹⁷. It can be perceived as a container where a list of unrelated elements and references to linkbase files are described. From the technical point of view the XBRL Schema is an XML Schema tailored to particular business and financial reporting needs. The use of schema allows the definition of the instance

¹¹⁶ A complete DTS of the IFRS-GP 2005 taxonomy consists of 47 files (including three schemas). Modular taxonomies are often approached using another entry schema. This so-called shell schema imports core DTS schema that defines all elements and refers to selected linkbases. The new shell schema importing core DTS creates a new DTS.

¹¹⁷ The term taxonomy element is used for financial or business reporting concept defined in a taxonomy schema.

documents elements with their characteristics and later their validation [Vlis2003, 2-3; SkWi2004, 23].

In the following section XBRL schema is discussed in detail¹¹⁸. Because the same element could be defined in many schemas each of which would assign it a different meaning¹¹⁹, to distinguish between the elements different namespaces are used [Vlis2003, 167-168]. Namespaces are similar to Internet addresses (for example <http://xbrl.iasb.org/int/fr/ifrs-gp/>) but they are not¹²⁰. The reason for using names that look like World Wide Web (WWW) locators, Uniform Resource Identifiers (URIs¹²¹), is that they are unique and therefore are appropriate to identify the elements that are unique to a schema. Instead of using the whole, long address a prefix can be assigned. Defining for example `ifrs-gp="http://xbrl.iasb.org/int/fr/ifrs-gp/"` allows later instead of quoting the whole URI before an element name, simply using `ifrs-gp` (for example `<ifrs-gp:Assets/>`). The main purpose of XBRL schemas is to provide an application with information on how it should represent and process accounting and reporting concepts. To achieve this, definitions of elements that appear in schemas are constructed according to a specific set of rules. The example below describes simplified (prefixes are omitted) definition of the element `Assets`.

¹¹⁸ The root element of all schemas is `<schema>`. It opens (`<schema>`) and closes (`</schema>`) every schema document. It contains attributes describing XML Schema.

¹¹⁹ For example under various GAAPs the accounting concept *assets* may be defined differently.

¹²⁰ So for example namespace <http://xbrl.iasb.org/int/fr/ifrs-gp/> does not lead to any internet website.

¹²¹ URI is a compact string of characters for identifying an abstract or physical resource [Bern1998].


```

<element
  name="Assets"
  id="Assets"
  periodType="instant"
  balance="debit"
  abstract="false"122
  substitutionGroup="item"
  type="monetaryItemType" />

```

Code 1. Element Declaration in the Taxonomy

The basic attributes provided in code example 1 and valid from the business perspective are *name*, *type*, *balance* and *periodType*. The first component assigns an element a unique name. A name must meet several criteria and cannot contain spaces and other characters that are treated differently in various operating systems¹²³. XML distinguishes between upper and lower case so *assets* and *Assets* are different elements. The *periodType* attribute relates to the accounting distinction between flows and stocks. Since it is natural to provide a value of assets on a particular date and time¹²⁴, the value of the attribute is set to *instant*. Flows such as payments, revenue or profit have duration assigned as *periodType* attribute value.

Another accounting characteristic that application needs to recognise is the balance nature of an element. According to the basic T-rule of double entry accounting, assets and expenses have standard balances in debit while equity, liabilities and revenues have balances in *credit*. So to increase an asset or expense, the account is debited and to decrease them the account is credited. To reflect the rule in XBRL, each element carrying a monetary value should contain in its definition a specification of whether it has a debit or credit balance. This requirement was introduced because of the need of having comparable data and because it is necessary in order to perform accounting calculations. It also enables the instance document creators to assign proper

¹²² Abstract attribute determines if an element can appear in an instance document. Elements with the value "true" for the abstract attribute are used for hierarchical ordering of the taxonomy structure for the presentation purposes.

¹²³ The list below provide an overview of special characters: () * + [] ? \ / ^ { } | @ # % ^ = ~ ` " ' ; : , < > & \$ £ € [HGHH2005, 16].

¹²⁴ The stocks are usually reported at the end of the reporting period.

positive or negative value to the reported fact¹²⁵. For example the element *cost of sales* as an expense could be assigned negative value and added to revenue (credit) in order to calculate gross profit or it could be a positive figure which by subtraction from revenue would give the same result. Table 10 explains the use of the balance attribute values and their relation to reported facts as well as calculation relationships¹²⁶.

Table 10. Sign of Reported Fact in an Instance Documents in Correspondence to the Balance Attribute of an Element

Element	No balance attribute assigned				Balance attribute assigned	
Revenues	+	1,000	+	1,000	+	1,000 (Cr)
Cost of Sales	-	1,200	+	-1,200	-	1,200 (Dt)
Gross Profit (Loss)	=	-200	=	-200	=	-200 (Cr)

Although using a balance attribute is useful and straight forward in case of balance sheets or income statements, it creates difficulties in calculating some cash flows statement elements. The issue with cash flow elements is that they do not necessarily follow credit/debit rules¹²⁷.

Another important characteristic of an element that has to be defined is the type. In financial reports companies include information that are in the form of figures with monetary units (e.g. £100), numbers (e.g. number of employees), percents (interest rates), strings (regular text) and others. To help applications recognise each of these,

¹²⁵ For example assigning *credit* to the attribute for an element *Profit/Loss* means a positive number reported is a profit while a negative number reported is a loss.

¹²⁶ The use of a balance attribute is also related to the sign of a reported fact in a broader sense. The negative debit is treated as a credit in a debit element and a negative credit as a debit in a credit element which ensures more flexibility while defining the taxonomy elements.

¹²⁷ Treating a positive cash flow (inflow of cash) as an increase in cash and cash equivalents, that is a component of assets, the natural balance attribute would be debit. But calculating cash flows in indirect method, net profit or loss is a credit as part of equity and as a result of subtraction of debit expenses from credit revenues. In operating cash flows the adjustment concerns position for non-cash items and items from income statement related to investing or financing activities. A problem occurs while subtracting change in receivables or change in inventories (increase of both is debit) and adding change in payables (increase of which is credit). So the operating cash flow, as stated above, could have debit balance attribute as an increase of cash and on the same time credit as the excess of revenues over expenses.

XBRL specification uses, with minor adjustments, XML schema built-in types¹²⁸. By doing so, applications can check the validity of data entered according to the type as well as perform calculations. The most common types that appear in financial statements are *monetaryItemType*, *stringItemType* and *decimalItemType*.

There are circumstances when taxonomy developers want to be sure that values entered in instance documents are selected from a list of enumerated possibilities provided by them. The enumerated list is a concept well known from programming languages as well as from HTML specification being a helpful feature while restricting and validating user entries¹²⁹. XML and related technologies provide several solutions for enumeration to be modelled. XBRL, by extending XML with XML schema and XLink imposes constraints and at the same time reduces the number to fewer possibilities.

Enumerated list is a list where all (or at least some) values are known. It could refer either to elements or their attributes as well as their values. In particular, an element from an enumerated list may be associated with other elements that have to be provided if this particular element appears in the instance document.

Code example 2 provides definition of an enumerated list of values for measurement base. The alternatives are historical cost, current cost, realisable settlement value, present value and fair value.

¹²⁸ The list of all accessible XML schema data types and their hierarchy is presented by Vlist [Vlis2003, 24].

¹²⁹ Enumerations of data type values are known from the HTML [RaHJ1999] as well as programming languages such as C# [Möss2006, 19].

```
<complexType name="measurementBaseItemType">
  <simpleContent>
    <restriction base="xrli:tokenItemType">
      <enumeration value="Historical Cost"/>
      <enumeration value="Current Cost"/>
      <enumeration value="Realisable Settlement Value"/>
      <enumeration value="Present Value"/>
      <enumeration value="Fair Value"/>
    </restriction>
  </simpleContent>
</complexType>
```

Code 2. Enumerated List Declaration

Code example 3 demonstrates the use of enumerated list defined in code example 2 for an element Measurement Basis for Goodwill. The predefined enumerated list is recognised as a type for the defined element.

```
<element
  name="MeasurementBaseForGoodwill"
  id="MeasurementBaseForGoodwill"
  type="measurementBaseItemType"
  substitutionGroup="item"
  nillable="true"
  periodType="duration"/>
```

Code 3. Use of Enumerated List in the Type Attribute

The business concepts explained above are defined in taxonomy as elements. One important characteristic is the *substitutionGroup* attribute. In code example 1 as well in code example 3 *substitutionGroup* is set to item. Items are not associated in schema with any other items and are not grouped in any way [EHSK2003, 11]. Facts in instance documents referring to items are unique in one context and within same unit. However there are some concepts in business reporting domain that are expressed in XBRL using elements whose definitions and constructions differ significantly from presented above. They have *substitutionGroup* attribute value assigned to tuple. Tuples are designed to express connected concepts in order to create compound or complex

element structures in the schema [Hoff2006, 71]. Tuples contain items or other tuples¹³⁰. Code example 4 provided below demonstrates element definition with the *substitutionGroup* set to tuple for deposits. The tuple *deposit* contains three items for description of the deposit, its amount as well as effective interest rate. Tuples do not have the same constraint as items concerning uniqueness of the facts in instance documents. Facts relating to tuples can appear more than once in the same context and having the same unit in an instance document¹³¹.

The definition of the content of a tuple includes additional information concerning the order of elements and their minimum number of occurrences (*minOccurs*) and maximum number of occurrences (*maxOccurs*)¹³². In code example 4 the minimum number of occurrences equals one which means that for each set of values expressed as a tuple in an instance document at least *DepositDescription* must be reported.

¹³⁰ Tuples contained within other tuples are referred to as nested tuples.

¹³¹ Tuples have no *periodType* attribute. It means that for a tuple in an instance document no context will be assigned. Contexts are assigned only for single facts referring to items within the tuple.

¹³² Attributes *minOccurs* and *maxOccurs* determinate how many times an item element can appear within one tuple element in an instance document. Default values (1;1) can be omitted.

```
<element id="Deposit" name="Deposit" substitutionGroup="tuple"
nillable="true">
  <complexType>
    <complexContent>
      <restriction base="anyType">
        <sequence>
          <element ref="DepositDescription" minOccurs="1"/>
          <element ref="DepositAmount"/>
          <element ref="EffectiveInterestRate"/>
        </sequence>
        <attribute name="id" type="ID" use="optional" />
      </restriction>
    </complexContent>
  </complexType>
</element>
```

Code 4. Tuple Declaration

Once elements and their characteristics are defined in a schema, taxonomy developers face the task of providing applications with knowledge on relations between elements and their links with human readable resources. These constitute components of five linkbases which are described in the later section.

4.1.1.1.2. Taxonomy Linkbases

Figures 13 and 14 provided an overview of five linkbases¹³³ which fall in one of the three categories:

- relation linkbases (calculation, definition and presentation) that manage the relations between taxonomy elements;
- label linkbases that associate taxonomy elements with text labels defined in various languages;
- reference linkbases that connect concepts with authoritative literature [EHSK2003, 90].

¹³³ Taxonomy linkbases are often referred to as taxonomy layers [HoPi2005].

Linkbases use two XML technologies. The first is known as XLink which provides a framework for creating both basic unidirectional links and more complex linking structures in XML documents [DeMO2001]. The second is XML Pointer Language (XPointer) that helps to express fragment identifiers for any URI reference (for example elements definitions in XBRL schemas) [DeMD2001]. In order to create a relationship between two elements from the schema, a linkbase needs to point to these elements or resources and define the type of relationship between them. A simplified example of a hierarchical relation from a presentation linkbase is provided below.

```
<loc type="locator"
href="schema.xsd#Assets"
label="Assets_Locator"/>

<loc xlink:type="locator"
href="schema.xsd#CurrentAssets"
label="CurrentAssets_Locator"/>

<presentationArc
type="arc"
arcrole="http://www.xbrl.org/2003/arcrole/parent-child"
from="Assets_Locator"
to="CurrentAssets_Locator"
order="2"/>
```

Code 5. Locators and Arcs

A locator labelled *Assets_Locator* points to the element that is defined in the schema file *schema.xsd* with id attribute value *Assets*. Similarly the second locator points to the element *CurrentAssets*. The presentationArc describes the relation between located elements by describing the type of relationship using arcrole attribute. An arcrole defines the type of relation which in this particular case is parent-child¹³⁴. The arc attributes to and from point to locators. In the example the relation defines that *CurrentAssets* is a child of *Assets*.

¹³⁴ *Parent-child* arcrole together with the *order* attribute defines a hierarchical relationship between elements.

The relation linkbases as presented in code example 5 work on the locator – arc locator principle. Figure 15 demonstrates the operating mode of these linkbases in a graphical form.

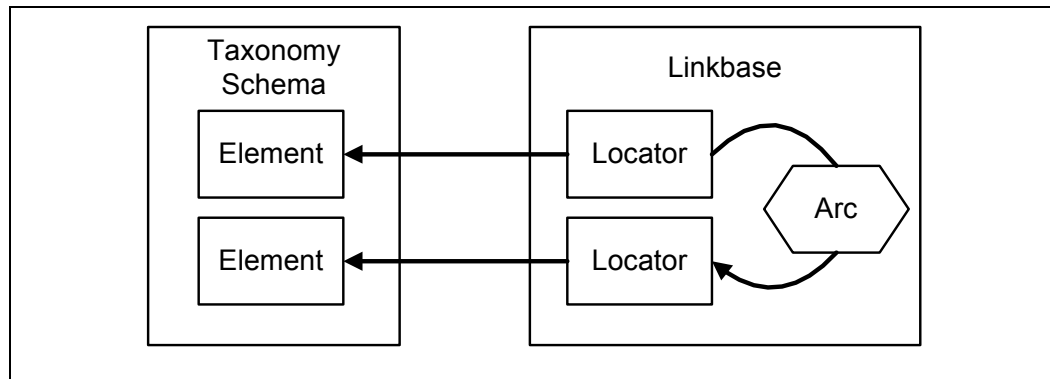


Figure 15. Operating Mode of Relational Linkbases

Linkbases provide descriptions of connections between elements by localising them and defining the type of relationships (utilising arcrole attribute). Each of the five linkbases presentation, calculation, definition, reference and label contain definitions of different types of relations [EHSK2003, 89-91]. Table 11 provides an overview of arcroles available in each of the five linkbases.

Table 11. Overview of the Linkbases in Regards to the Corresponding Arcroles

Linkbase	Arcrole
Presentation	parent-child
Calculation	summation-item
Definition ¹³⁵	general-special essence-alias similar-tuple requires-element
Label	concept-label
Reference	concept-reference

Most data structures existing in financial reports can be represented by hierarchical trees or tables. The presentation linkbase stores information about relationships between elements in order to properly organise the taxonomy content. This allows for the elements to be arranged in a structure that is appropriate to represent the hierarchical relationships in particular domain. The groupings can be performed in many ways. For example, a typical balance sheet contains assets, equity and liabilities. The element assets has two children elements, current assets and non-current assets. Current assets are split in inventories, receivables etc. The presentation linkbase, using parent-child relations supported by the order attribute organises elements in this way and helps users find concepts they are interested in. Figure 16 presents the hierarchical structure of the presentation linkbase.

¹³⁵ Together with introduction of the XBRL dimensional taxonomies specification new arcroles are defined for the definition linkbase.

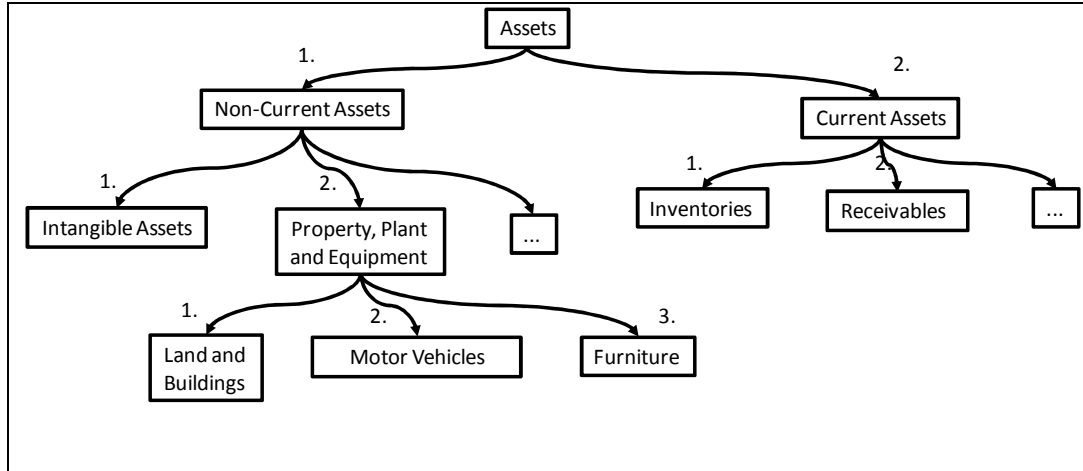


Figure 16. Hierarchical View of the Presentation Linkbase

The main drawback of a hierarchical structure in a presentation linkbase is that it only allows the presentation of flat lists of elements, while financial statements also contain more sophisticated reports such as changes in equity or movements in property, plant and equipment presented in form of tables. Hoffmann [Hoff2006, 265-355] provides a set of patterns enabling and standardising modelling of report data structures in XBRL taxonomies. Nevertheless due to difficulties with later rendering of such taxonomies the solution still raises a lot of questions¹³⁶.

The underlying idea of the calculation linkbase is to improve the quality of an XBRL instance document. It contains definitions of basic validation rules, which apply to all instance documents referring to a particular taxonomy. Calculation linkbase sorts all monetary elements in a hierarchical way, so that the lower level elements sum up to or are subtracted from one another. The upper level concept is the result of these operations.

¹³⁶ The XII is currently working on rendering solution that provides help for the automatic creation of tabular reports [XBRL2006e] and is addressed in the later section.

Table 12. Calculation Structure

Calculation	
Gross Profit	
Revenue Total	+1
Cost of Sales	-1

The sign of the relationship depends on the weight attribute that is assigned to the arc connecting two elements. Table 12 and code example 6 show two calculation arcs providing details concerning relations between gross profit, revenue and cost of sales. Gross profit is a difference between the other two elements. Therefore, the weight attribute assigned to the value is 1 on the arc connecting gross profit and revenue and -1 between gross profit and cost of sales¹³⁷. The calculation linkbase utilises the arcrole summation-item to express the type of relationship between elements.

```
<calculationArc xlink:type="arc"
xlink:arcrole="http://www.xbrl.org/2003/arcrole/summation-item"
xlink:from="GrossProfit" xlink:to="RevenueTotal"
order="1" weight="1" use="optional"/>

<calculationArc xlink:type="arc"
xlink:arcrole="http://www.xbrl.org/2003/arcrole/summation-item"
xlink:from="GrossProfit" xlink:to="CostOfSales"
order="2" weight="-1" use="optional"/>
```

Code 6. Calculation Linkbase Arcs

The reason of the difference between calculation and presentation linkbases is that the total element that stands for the summation of all elements often appears at the bottom in the financial statements whereas in the calculation linkbase it must be placed as the

¹³⁷ The value of the *weight* attribute is usually assigned to either -1 or 1.

parent concept. Table 13 demonstrates the difference between the presentation and calculation structure of the balance sheet section assets.

Table 13. Differences between Presentation and Calculation Structures

Presentation		Calculation		
Assets		Assets, Total		
	Assets, Non-Current		Assets, Non-Current	+1
	Assets, Current		Assets, Current	+1
	Assets, Total			

There are two major rules concerning calculation relations in XBRL. The first rule is that it is not possible to conduct calculations on elements with different values of the *periodType* attribute assigned in the schema. This is often called the cross-context calculation rule and relates to defining some elements as duration and others as instant. For example, concepts that appear on Balance Sheet are instant which means that their value is presented as a stock as of a specified day, while elements in the income statement are duration because they represent flows that took place over a period of time. The problem emerges for example in the statement of changes in equity or movements in property, plant and equipment where instant elements are mixed with duration elements and it is impossible to perform some calculation checks¹³⁸. The second rule is the double entry accounting rule requires defining the credit/debit nature of monetary elements. As a basic accounting rule it does not allow the addition of elements with opposite balance attributes¹³⁹ [Born2005]. Calculation linkbase enables additions or subtractions of multiplied element values (facts) according to the formula $X = (^{\pm}/.) A \times Y$, where X, and Y are reported and A the value of the weight attribute. The allowed operation complying with accounting rules are:

- credit element + credit element,

¹³⁸ The solution to this issue is provided by the formula linkbase. Formula linkbase provides taxonomy developers with various functions more advanced than just simple addition or subtraction available in the calculation linkbase [Hams2005, 1]. Formula linkbase is addressed in the further section in detailed way.

¹³⁹ Elements with the opposite *balance* attribute must be subtracted.

- credit element – debit element,
- debit element + debit element,
- debit element – credit element.

The definition linkbase provides taxonomy developers with the opportunity to define various other kinds of relationships between elements. There are four standard types of relationships supported by the definition linkbase.

The first one is general-special type. It distinguishes between concepts that have more generic or more specific meaning. For example zip code is the US representation of postal code which is used worldwide. Therefore, to indicate that connection, taxonomy developers define postal code as a general term to which there is more specialised concept zip code [EHSK2003, 113].

The second available type of relationship is essence-alias. By utilising it, taxonomy developers are able to indicate that two concepts have similar meaning. For example, some airlines may want to use the term planes to describe their main component of their property, plant and equipment while other would prefer aircraft. To state that meaning of these two is the same and that they can be used interchangeably, taxonomy developers may connect them using essence-alias arcrole¹⁴⁰ [EHSK2003, 114; HGHH2005, 56-57].

The third standard type of relationship is called requires-element. Taxonomy developers use it to force instance creators to enter the value of one element, if they provide the value of another. For instance, a regulator may want to require disclosures in the notes on a particular component of assets if it appears on the balance sheet. In order to achieve that, the definition linkbase defines requires-element relationship between two elements (for example between elements property, plant and equipment, Net and property, plant and equipment disclosures) [EHSK2003, 115; HGHH2005, 58-59].

The fourth relation is similar-tuple. It resembles essence-alias relation but is applied to tuples. It connects two tuples that are equivalent in terms of definition (docu-

¹⁴⁰ The use of essence-alias type of relationship is not recommended due to creating redundancy of elements in a taxonomy.

mentation from label linkbase or reference in reference linkbase) but are diverse from XML perspective (e.g. do not have identical content models). One of the reasons that this type of relation was introduced is impossibility of schema redefinition in XBRL. It implies that no changes are allowed in the basis schema for the content of the tuples when creating taxonomy extensions [EHSK2003, 115; HGHH2005, 57-58].

The difference between relation linkbases and reference or label linkbase is the use of resource. Code example 7 presents a locator on an element *CurrentAssets*. There is also a label resource for the element with an English label *Current Assets*. The label arc connects the locator with the resource and not as in the case of relational linkbases with another locator.

```
<loc xlink:type="locator"
xlink:href="schema.xsd#CurrentAssets"
xlink:label="CurrentAssets_Locator"/>

<label xlink:type="resource"
xlink:role="http://www.xbrl.org/2003/role/label"
xlink:label="CurrentAssets_lbl"
xml:lang="en">Current Assets</label>

<labelArc xlink:type="arc"
xlink:arcrole="http://www.xbrl.org/2003/arcrole/concept-label"
xlink:from="CurrentAssets_Locator"
xlink:to="CurrentAssets_lbl"/>
```

Code 7. Resources, Locators and Arcs

The difference in the operating mode for the label and reference linkbase is presented in figure 17. The operating mode is different than for relation linkbases and works on the principle locator-arc-resource.

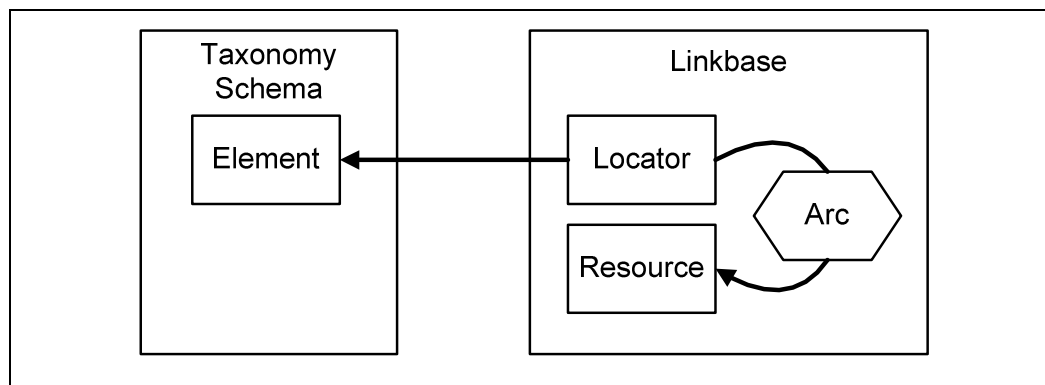


Figure 17. Operating Mode of Resource Type Linkbases

Financial concepts appearing on business reports more often stem from regulatory documents issued by various authorities. The IFRS taxonomy describes financial reports prepared based on the IFRS Bound Volume¹⁴¹. Elements defined in the taxonomy refer to the specific terms and concepts explained in the IFRS. For this reason, taxonomy is often provided with a reference linkbase that presents relationships between elements and external regulations or standards. Reference linkbase helps users understand the intended meaning of each element defined in the schema. The reference linkbase does not contain the full text of the regulations or standards. Instead, it points to source documents by identifying their name and indicating the relevant paragraphs and clauses¹⁴². This connection is created using concept-reference arcrole.

There are several types of references that could be provided for each element. Table 14 demonstrates the most important types of references defined using role attribute in the reference resource. XBRL allows for an element to be linked to various types of references containing examples, commentaries, etc.

¹⁴¹ The IFRS Bound Volume is the common term used for the book publication of all standards applicable for a reporting period [IASB2006a, 1].

¹⁴² The other solution is to enclose documentation in the label linkbase under a special defined label resource role [HGHH2005, 18].

Table 14. Reference Role Attribute Values and their Meaning [modified after EHSK2003, 100]

Reference Role	Meaning
reference	Standard reference for a concept
definitionRef	Reference to documentation that details a precise definition of the concept
disclosureRef	Reference to documentation that details an explanation of the disclosure requirements relating to the concept
presentationRef	Reference to documentation which details an explanation of the presentation, placement or labelling of this concept in the context of other concepts in one or more specific types of business reports
measurementRef	Reference concerning the method(s) required to be used when measuring values associated with this concept in business reports
commentaryRef	Any other general commentary on the concept that assists in determining appropriate usage
exampleRef	Reference to documentation that illustrates by example the application of the concept that assists in determining appropriate usage

Code example 8 defines references for *CashFlowFromUsedInOperations*. First, it provides a reference to a text which explains how and where the element should be presented in terms of its placement and labelling. IAS 7, paragraph 14 describes the presentation of the concept Cash Flows from Operating Activities [IASB2006a]. Secondly, measurement reference provides explanations about what determines the value of the element and how it should be calculated. The description can be also found in IAS 7 but in paragraph 18 and subparagraph a [IASB2006a].


```

<reference xlink:type="resource"
  xlink:role="http://www.xbrl.org/2003/role/presentationRef"
  xlink:label="CashFlowsFromUsedInOperationsTotal_ref">
  <ref:Name>IAS</ref:Name>
  <ref:Number>7</ref:Number>
  <ref:Paragraph>14</ref:Paragraph>
</reference>

<reference xlink:type="resource"
  xlink:role="http://www.xbrl.org/2003/role/measurementRef"
  xlink:label="CashFlowsFromUsedInOperationsTotal_ref">
  <ref:Name>IAS</ref:Name>
  <ref:Number>7</ref:Number>
  <ref:Paragraph>18</ref:Paragraph>
  <ref:Subparagraph>a</ref:Subparagraph>
</reference>

```

Code 8. Reference Resources

Elements defined in a schema are built to convey accounting meaning to applications. In order to make it easier for applications to process their names, they have to obey a number of rules¹⁴³. Additionally, big taxonomies such as International Financial Reporting Standards for General Purpose (IFRS-GP) obey specific rules of naming and labelling to ensure consistency within the schema. For example, there could be a list of words that are excluded from the names (e.g. and, of) or words that appear only in a particular order (i.e. net or total at the end of the element name).

In the label linkbase, elements are connected to human readable labels using concept-label arcrole. Elements have labels assigned in different languages. Code example 9 describes definitions of labels of the IFRS-GP taxonomy element *AssetsTotal* in English, German and Polish.

¹⁴³ For example, the use of spaces is not allowed so *Cash and Cash Equivalents* would be named *CashAndCashEquivalents* in the IFRS-GP taxonomy. Other taxonomies such as German Accounting Principles taxonomy provide own sets of rules for the naming patterns for element.

```
<label xlink:type="resource"
xlink:role=http://www.xbrl.org/2003/role/label
xlink:label="ifrs-gp_AssetsTotal_lbl"
xml:lang="en">Assets, Total</label>

<label xlink:type="resource"
xlink:role="http://www.xbrl.org/2003/role/label"
xlink:label="ifrs-gp_AssetsTotal_lbl"
xml:lang="de">Vermögenswerte, Gesamt</label>

<label xlink:type="resource"
xlink:role="http://www.xbrl.org/2003/role/label"
xlink:label="ifrs-gp_AssetsTotal_lbl"
xml:lang="pl">Aktywa, Razem</label>
```

Code 9. Label Resources in Different Languages

To distinguish between languages, XBRL uses the XML attribute `lang`. Taxonomy creators may also define different types of labels for single element. One of the ideas of XBRL is that the information about the period and unit for which the element is reported is not contained within an element definition but is described by a context in instance documents. In financial reporting, many terms express the date for which they are being reported, for instance property, plant and equipment at the beginning of the year or property, plant and equipment at the end of the year. XBRL allows creation of different labels depending on the context in which an element will be used. Apart from the `arcrole` attribute on `arc` the label linkbase utilises a `role` attribute on resources. Table 15 provides an overview of the most important values for the `role` attribute on the label resource.

Table 15. Meaning of the Label Role Attribute Values [modified after EHSK2003, 93-94]

Label Role	Meaning
label	Standard label for a concept.
terseLabel	Short label for a concept, often omitting text that should be inferable when the concept is reported in the context of other related concepts
verboseLabel	Extended label for a concept, making sure not to omit text that is required to enable the label to be understood on a standalone basis
totalLabel	The label for a concept for use in presenting values associated with the concept when it is being reported as the total of a set of other values
periodStartLabel periodEndLabel	The label for a concept with <i>periodType="instant"</i> for use in presenting values associated with the concept when it is being reported as a start (end) of period value
documentation	Documentation of a concept, providing an explanation of its meaning and its appropriate usage and any other documentation deemed necessary

Code example 10 presents three different labels assigned to one element by applying different values of role attributes on label resources. The element *PropertyPlantAndEquipment* is associated with three different label resources using three different roles. The element can be later reported in two different contexts for the beginning or ending balance.

```

<label xlink:type="resource"
xlink:role="http://www.xbrl.org/2003/role/label"
xlink:label="ifrs-gp_PPE_lbl"
xml:lang="en">Property, Plant and Equipment, Net</label>

<label xlink:type="resource"
xlink:role="http://www.xbrl.org/2003/role/periodStartLabel"
xlink:label="ifrs-gp_PPEEB_lbl"
xml:lang="en">Property, Plant and Equipment, Net, Beginning
Balance</label>

<label xlink:type="resource"
xlink:role="http://www.xbrl.org/2003/role/periodEndLabel"
xlink:label="ifrs-gp_PPEEB_lbl"
xml:lang="en">Property, Plant and Equipment, Net, Ending
Balance</label>

```

Code 10. Label Resources with Different Roles

Approach of labelling one element with the use of the different roles allows higher flexibility when constructing the presentation linkbase¹⁴⁴ as well as greater reporting consistency. All three labels from code example 10 refer to the same element *PropertyPlantAndEquipement* which can be reported in the instance document in three different contexts¹⁴⁵.

4.1.1.2. Extensibility of XBRL

Public taxonomies define elements and relationships between them according to particular legislation or standards. It allows applications to create financial statements that are valid and compliant with the requirements of regulators. But in the diverse world of finance, companies are required to include in their business reports additional concepts

¹⁴⁴ The attribute *preferredRole* on the presentation arc enables setting the appropriate label for the presentation tree. It is possible for example to display only terse (short) labels for the whole taxonomy in the presentation view.

¹⁴⁵ XBRL does not handle well the mapping between reported facts in different contexts with the proper presentation according to presentation linkbase *preferredRole* attributes. So for example it is impossible to create the movements-oriented view of the cash flow with the beginning balance element at the top and ending balance element at the bottom in an automatic way.

usually related to the area of their activity or the reporting purpose [TeHM2003]. It is the reason why XBRL specification enables extending¹⁴⁶ an existing base taxonomy.

Extending a taxonomy may involve performing the following operations:

- adding an element that was not described in the base taxonomy but is required for the jurisdiction, industry or company;
- modifying the relationship between elements in terms of their order, addition or deletion [HGHH2005, 67].

There are several rules that have to be obeyed for extending base taxonomies. The most important one states that the extension should not physically modify the content of any of the files of the base taxonomy which is being imported. Building an extension that involves the modification of linkbases requires that the taxonomy extension developers are familiar with the attributes *use* and *priority* as well as the concept of equivalency. With these attributes it is possible to prohibit a relationship or override it. The use attribute may take the values *optional* and *prohibited* of which the latter implies that the relationship will not be processed by an XBRL application¹⁴⁷. The priority attribute assigns relations with ranks that inform the application about the processing order.

The XBRL specification allows overriding or prohibiting a relationship between elements or between elements and resources and adding new elements. What is not possible is deleting elements included in the core schema. It results with inheriting all core schema elements in the taxonomy extension.

Code example 11 demonstrates a prohibition of the relationship from code example 5 utilising use attribute on the *presentationArc* and setting its value to *prohibited*.

¹⁴⁶ The extensibility in XBRL goes beyond XML extensibility because of the use of a number of extension techniques. There is no explicit distinction what an extension means from the business perspective. From the technical point of view every DTS importing another DTS is a taxonomy extension.

¹⁴⁷ The optional value is the default value for the arc and means the relation is processed by an application.

```

<presentationArc xlink:type="arc"
arcrole="http://www.xbrl.org/2003/arcrole/parent-child"
from="Assets_Locator"
to="CurrentAssets_Locator"
order="2"
use="prohibited"/>
```

Code 11. Prohibition of an Arc

Taxonomy extensions are built for different purposes mainly by regulators, local authorities or simply by reporting companies. Figure 18 demonstrates XBRL taxonomy space. The base taxonomy is extended with industry taxonomies or with jurisdiction¹⁴⁸ specific elements and relationships and finally with company specific extensions.

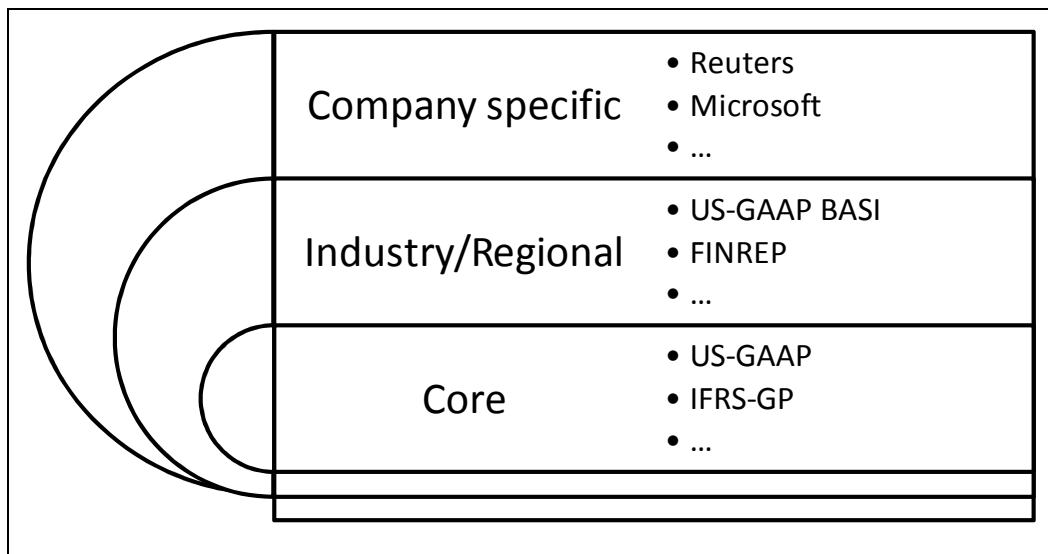


Figure 18. XBRL Taxonomy Space [HoPi2005, 32]

There is no agreement in XBRL literature on how taxonomy extensions should be created and which relationships should exist between various extensions. Silva and Ramos propose the approach called *Fully Integrated Extension Building* demonstrated in figure 19. Instead of using as core DTS a taxonomy created by only one jurisdiction,

¹⁴⁸ XBRL jurisdiction is a national authority responsible for developing and supporting XBRL in a specific country or region. Jurisdictions focus on the progress of XBRL in their areas as well as contributing to international development [XBRL2006d].

the core is a reunion of all the elements created by all approved taxonomies¹⁴⁹, one big pool of publishable accounting concepts and their IDs. To facilitate the interpretation of each element in the pool, one would refer the taxonomy that first defined it. New jurisdictions would be able to reach into the pool for the elements that they require and combine them using their national specific linkbases. The XII would have to ensure that different taxonomies do not create new elements for similar concepts when one is already available [SiRa2004, 22]. The disadvantage of this approach is the significant effort on the convergence and equivalency expertise which XII would have to provide to ensure the lack of elements redundancy.

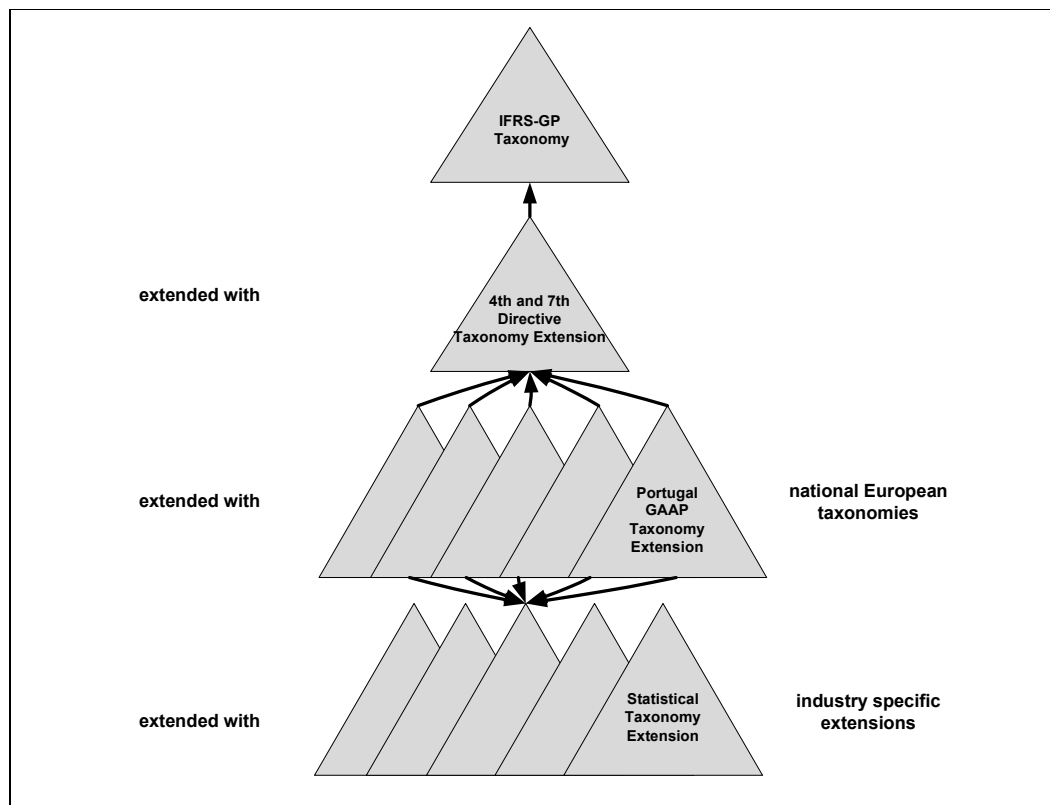


Figure 19. Fully Integrated Extension Building [SiRa2004, 22]

Teixeira et al. extends the approach of Silva and Ramos trying to identify the taxonomy extension building process, as well as different approaches to the taxonomy extension development. The two approaches identified are *Taxonomy to Taxonomy Map-*

¹⁴⁹ Approved taxonomies are taxonomies which passed a Taxonomy Recognition Process (TRP) of XII [CaMa2004, 2].

ping and *Integrated Extension Building*. The first approach assumes that a separate jurisdictional taxonomy is developed independently of the base taxonomy and later mapped to the core. The second approach uses the extensibility features of XBRL so that the jurisdictional taxonomy imports the core DTS schema and extends it [TeHM2003, 12-13]. Apart from identifying the approaches to the extension development, Teixeira et al. discuss the basics of the equivalency theory for XBRL. Equivalency is described being a function of elements that are required to be disclosed and measured [TeHM2003, 7-8]. Nevertheless only the basics of the equivalency theory in XBRL are stated in the document as a first draft. Facing the growing importance of the convergence between different GAAPs more advanced equivalency theory is needed.

Although taxonomy extension theory is being discussed, a holistic approach to XBRL extensions is still missing. The presented theories are assuming the leading role of a specific taxonomy and seem to neglect the role of multi-GAAP reporting. Table 16 provides an overview of the local GAAP XBRL taxonomies and their relationship to base taxonomies. The reality of taxonomies creation shows that the local GAAP taxonomies are rarely developed as extensions to the base taxonomies. One of the reasons is sophisticated convergence process that needs to be conducted before extending any base taxonomy. In the convergence project the equivalencies between core and extension taxonomy¹⁵⁰ elements, relationships and resources need to be defined.

¹⁵⁰ Usually the convergence process concerns not only the GAAP taxonomies but also GAAPs themselves.

Table 16. Relationship between local GAAP and Base XBRL Taxonomies

Local GAAP Taxonomy	Relationship to Base Taxonomies
German GAAP taxonomy	none
Polish GAAP taxonomy	none
Dutch GAAP taxonomy	IFRS-GP taxonomy extension
Spanish GAAP taxonomy	IFRS-GP taxonomy extension
US GAAP taxonomy	none ¹⁵¹
Canadian GAAP taxonomy	none
Swedish GAAP taxonomy	none
Belgian GAAP taxonomy	none
United Kingdom GAAP taxonomy	none
Irish GAAP taxonomy	none
Australian GAAP taxonomy	IFRS-GP taxonomy extension
New Zealand GAAP taxonomy	none
China GAAP taxonomy	none
Korea GAAP taxonomy	none

In order to provide the theory for extensibility this study identifies a number of levels of extensions. Figure 20 presents the overview of the extension levels. On the first level are all extension methods which are allowed according to XML specification (or related documentation). They may not be defined by XBRL specification (or related documentation). The second level concerns any modification of XBRL base taxonomy or set of taxonomies using techniques and following the rules allowed by XBRL specification (and related documentation). The third consortium level are official procedures for members to enhance, develop and redesign existing and future specifications and particular technologies. These techniques, in general, are not part of the official XBRL

¹⁵¹ The convergence project between IFRS-GP and US GAAP taxonomies is being conducted by IASCF.

Specification and may not apply to XBRL taxonomies extension development in the technical or business sense. The fourth proprietary level is any other solution which can be classified as XML, XBRL or consortium extensibility and which concerns XBRL standard extension mechanisms and/or XBRL taxonomies extensions technical and business development.

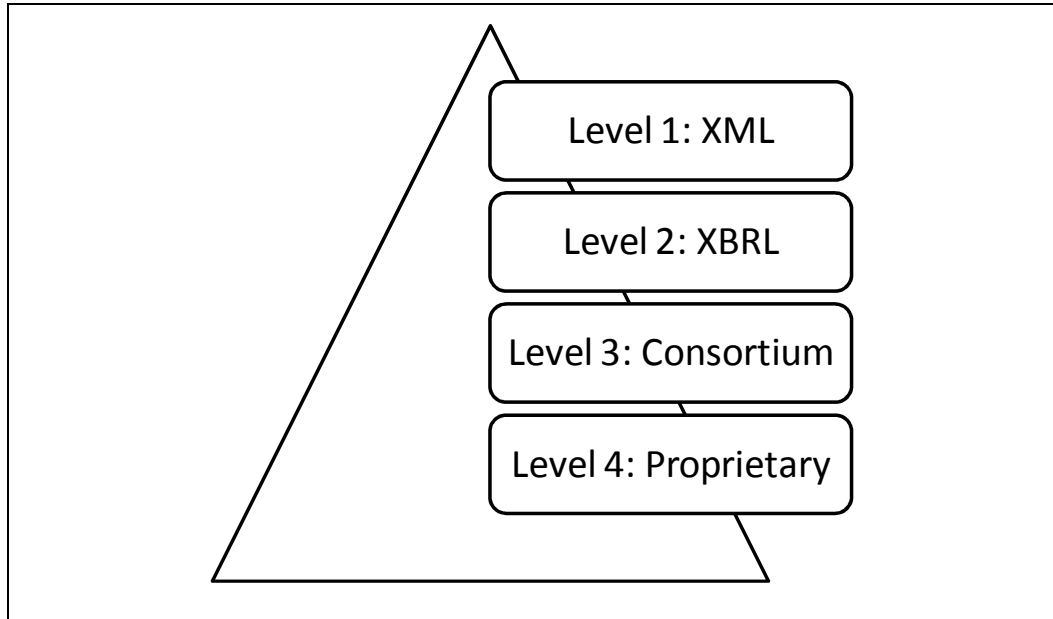


Figure 20. Overview of the Levels of XBRL Extensibility

Analysing different XBRL techniques which can be used while extending a taxonomy it is possible to order them according to discussed extensibility levels. Figure 21 presents the classification of the extensions techniques according to the presented levels of extensibility.

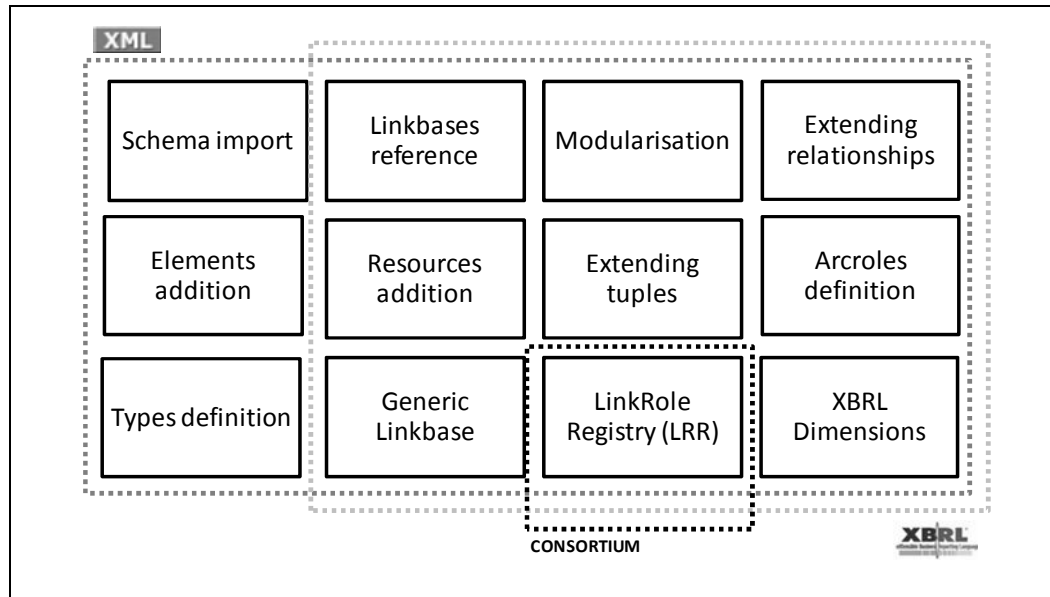


Figure 21. Classification of Extensions Techniques for XBRL Taxonomies

The first XML level encompasses importing a taxonomy, adding a new element or defining new types which can be used later for element definitions. The XBRL level deals with referencing the linkbases, modularising the taxonomies, extending the relationships, adding new label or reference resources, defining new arcroles or using the generic linkbase¹⁵² or dimensional XBRL constructs. Finally on the consortium level the Link Role Registry (LRR) can be classified which enables registering well established roles and arcroles for the use as standard XBRL constructs. It is important to note that all consortium classified extension techniques are incorporated into XBRL level and all XBRL level techniques fulfil requirements of XML level. The discussed techniques classified on the proprietary level of extensions are not addressed in figure 21. An example of such a technique could be a proprietary handling of business rules known as formula linkbase created by several software vendors but not published officially.

¹⁵² The danger of creating several new linkbases motivated XII to consider creating a generic linkbase. The generic linkbase is designed to be a long-term mechanism for specifying the base for XBRL linkbases [Hoff2006, 502]. In order to systematise the works on new linkbases as well as enhance the XBRL semantic XBRL International introduced the new generic linkbase facilitate the creation of new kinds of metadata by providing additional concrete linking components, as well as guidance for the definition of custom linking components [GoHS2007, 1].

The extensibility of XBRL taxonomies is neither widely discussed in the academic literature nor intensively presented in the publications of XBRL International consortium members. The XBRL specification and the FRTA document merely provide some very basic rules on how taxonomy extensions should be constructed without analysing the impact and the importance which taxonomy extensions have.

4.1.1.3. Modularity of XBRL

Taxonomy modularisation is closely related to the taxonomy extensions. In general, modularisation in XBRL is referred to in two cases. In the first one, modularisation relates to separation of a taxonomy into two parts, one of which defines concepts and the other provides information on relations between them. In the second case, modularisation may also involve creating a hierarchy in which one schema defines so-called core elements and other extends the core to provide full set of concepts for particular purpose. In the later approach, both the core and the extension schemas can also be separated as in the first approach.

The example of the first approach of modularization is the IFRS-GP taxonomy presented in figure 22. In general, it consists of two parts. The first part (basic layer) contains a schema defining all concepts and referring to label and reference linkbases. The other part (linkbase modularity layer) is a schema created by user or produced on demand as shell schema that imports the core schema defining concepts and refers to selected presentation and calculation linkbases¹⁵³.

¹⁵³ The presentation and calculation linkbases as well as other than English label linkbases are separate files in the IFRS-GP taxonomy and are first linked if needed when using the shell schema.

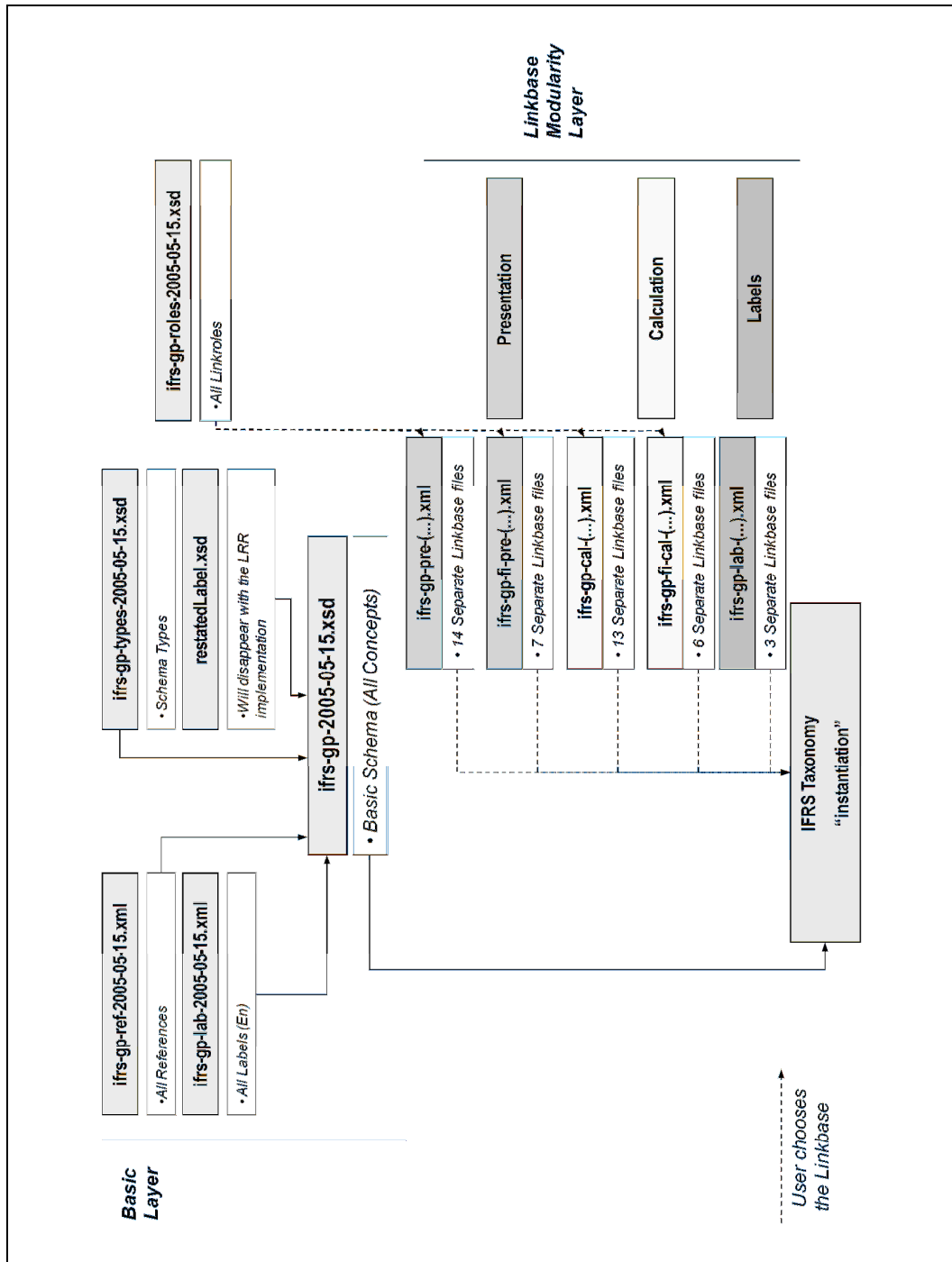


Figure 22. IFRS-GP 2005 Taxonomy Framework [IASC2005]

XBRL GL taxonomy is an example of the other modularisation approach with hierarchical relations between schemas¹⁵⁴. For example, base schema is extended by schema

¹⁵⁴ Detailed description of the XBRL GL taxonomy framework is discussed in later sections.

for business facts less common in general ledger and third schema defines accounting and business concepts more prevalent in non-continental accounting. The reasons, why XBRL GL taxonomy is modularised much deeper than IFRS-GP include not only the functional requirement but also the size of the taxonomy (in terms of number of elements) and its complexity.

4.1.1.4. XBRL FR Taxonomies

Different taxonomies are required for different financial reporting purposes. National jurisdictions may need their own financial reporting taxonomies to reflect their local accounting regulations. Many different organisations, including regulators, specific industries or even companies, may require taxonomies to cover their own business reporting needs. The presented research considers taxonomies with potential use in the European area with the special focus on the financial reporting in Germany. The discussed taxonomies are IFRS-GP, US GAAP¹⁵⁵ and German Accounting Principles (German AP).

Due to the discussed character of financial reporting and accounting standards it is necessary to create different XBRL taxonomy representing single GAAP. A number of financial reporting XBRL taxonomies are published on the XBRL website [XBRL2007a].

The XBRL FR taxonomy which enables reporting according to HGB is available on the website of XBRL Germany in the version 2.0¹⁵⁶ [XBDE2007]. The taxonomy consists of two modules representing German GAAP and German Common Data¹⁵⁷ (GCD). Figure 23 presents two modules of the German AP taxonomy. Together with their composites they present the possibility to provide a comprehensive

¹⁵⁵ According to the assumptions of the thesis and focus on the profit-generating entities in the commerce and industry and not financial or insurance area mainly the US GAAP Commerce and Industry (CI) taxonomy is taken into consideration.

¹⁵⁶ The German AP taxonomy 2.0 is based on the XBRL 2.1 specification [XBDE2007].

¹⁵⁷ GCD refers to Global Common Data [XBRL2005b] or German Common Data [XBDE2007] and means the general elements describing the sender of the document as well as document itself which can be unified on the international level. It is important to note that the German Common Data taxonomy does not refer to nor uses the international Global Common Data taxonomy which questions the unifying approach.

financial reports complying with German accounting principles and enhanced with additional data about document, report and reporting entity.

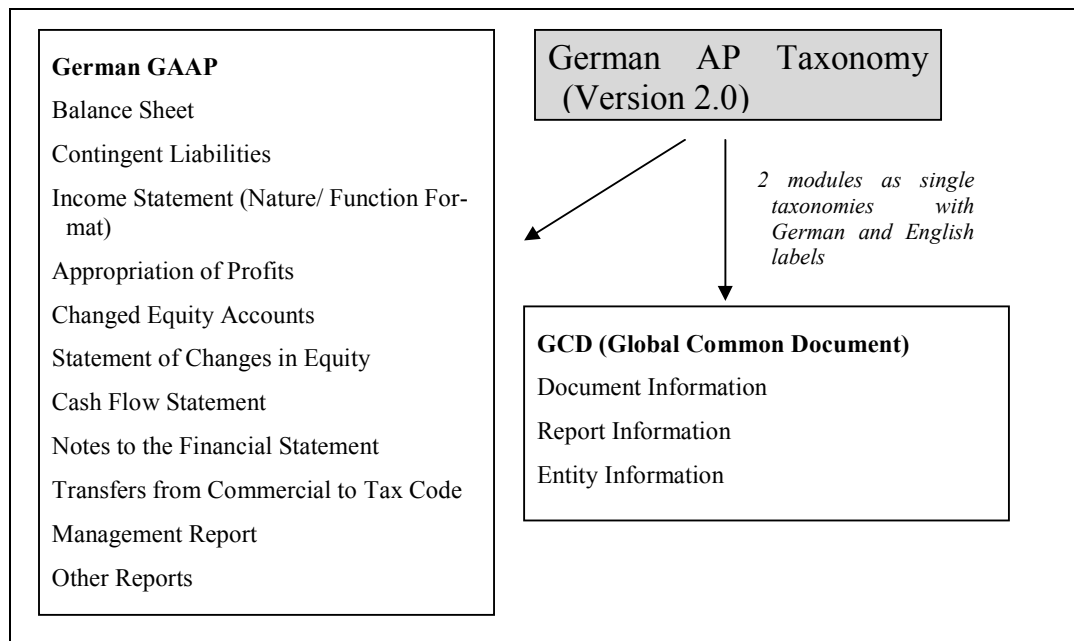


Figure 23. Structure of the German AP XBRL Taxonomy [modified after RaKO2006]

The two other taxonomies relevant for reporting scenarios in Germany are IFRS-GP and US GAAP taxonomies. Table 17 provides an overview of the most important characteristics of the three taxonomies discussed.

Table 17. Comparison of the XBRL FR Taxonomies Relevant for the Reporting Purposes in Germany¹⁵⁸

Characteristic	IFRS-GP	US GAAP	German AP
Legal base	International Accounting Standards, International Financial Reporting Standards	United States Generally Accepted Accounting Principles	Handelsgesetzbuch (HGB) und Deutsche Rechnungslegungsstandards (DRS)
Taxonomy developer	(IASCF)	XBRL United States (XBRL US)	XBRL Germany
Taxonomy version	Final 2006 Version [IASC2006c]	Final 2005 Version [XBUS2005]	Final 2007 Version [XBDE2007]
Number of elements	3975 items and 124 tuples	1483 items and 20 tuples ¹⁵⁹	2637 items and 40 tuples
Modularisation	On the linkbase level	On the schema level	No
XBRL status	Acknowledged	Approved	None
Extensions	Yes	No	No
Label linkbases	English, German, Portuguese, Spanish, French, Dutch [IASC2007]	English	German, English

The comparative analysis of the three taxonomies demonstrates the largest scope of reporting elements included in the IFRS-GP taxonomy. Also for the IFRS-GP the biggest number of foreign label linkbases is provided. Further IFRS-GP is a basis for a number of extensions which is completely different to the German AP and US GAAP taxonomies. Analysis of the conceptual scope is presented in table 18.

¹⁵⁸ Analysed are the latest versions of the taxonomies according to the XBRL Specification 2.1.

¹⁵⁹ The number of elements for the US GAAP taxonomy does not include the Financial Services Terms Elements (FSTE). Analogue elements are part of the IFRS-GP taxonomy referring to the statements for financial institutions and are calculated in the presented comparison.

Table 18. Comparison of the Scope of the XBRL FR Taxonomies Relevant for the Reporting Purposes in Germany

Financial Report Component	IFRS-GP	US GAAP	German AP
Balance sheet	Yes	Yes ¹⁶⁰	Yes
Income statement	Yes (by function and by nature formats)	Yes	Yes (by function and by nature formats)
Cash flow	Yes (direct and indirect formats)	Yes (direct and indirect formats)	Yes (direct and indirect formats)
Statement of changes in equity	Yes	Yes	Yes
Explanatory disclosures	Yes	Yes ¹⁶¹	Yes
Management report	No	Yes ¹⁶²	Yes
Auditors' report	No	Yes ¹⁶³	No
Transfer to tax code	No	No	Yes
Other	No	SEC Certification Management Discussions and Analysis (MD&A)	Appropriation of Profits Contingent liabilities Report of the Supervisory Board Invitation to/Agenda for General Meeting Resolutions

¹⁶⁰ The US GAAP taxonomy includes balance sheet as statement of financial position.

¹⁶¹ The US GAAP taxonomy refers to the explanatory disclosures as to the notes to the financial statements.

¹⁶² The management report in the US GAAP taxonomy is not a part of the US GAAP CI taxonomy but a separate taxonomy module.

¹⁶³ The auditors' report in the US GAAP taxonomy is not a part of the US GAAP CI taxonomy but a separate taxonomy module and is referred to as accountants' report.

The three compared XBRL taxonomies differ in scope. The largest scope here have US GAAP and German AP taxonomies incorporating additional reports relevant for the financial reporting. IFRS-GP is strongly correlated with the bound volume and thus represents only the financial statements discussed by the IFRS.

4.1.1.5. Instance Documents

An XBRL instance document is a business report in an electronic format created according to the rules of XBRL. It contains facts that are defined by the elements in the schema it refers to, together with their values, units and an explanation of the context in which they are placed. Code examples 12, 13, 14 and 15 provide an overview of an element defined in the taxonomy schema and an instance document which assigns it a value and provides additional information about the currency in which it is disclosed and defines a period and the entity that it refers to. The information that can be consumed by an application from the four code examples is Sample Company's Profit Loss Before Tax for the year 2004 amounting to 661,000 EUR.

```
<element
id="ifrs-gp_ProfitLossBeforeTax"
name="ProfitLossBeforeTax"
type="xbrli:monetaryItemType"
substitutionGroup="xbrli:item"
xbrli:periodType="duration"
xbrli:balance="credit"
nillable="true" />
```

Code 12. Element Declaration in the Taxonomy

```
<ifrs-gp:ProfitLossBeforeTax
contextRef="Current_ForPeriod"
unitRef="U-Euros"
decimals="0">661000</ifrs-gp:ProfitLossBeforeTax>
```

Code 13. Fact Declaration in the Instance Document

```
<unit id="U-Euros">
  <measure>iso4217:EUR</measure>
</unit>
```

Code 14. Unit Declaration in the Instance Document

```
<context id="Current_ForPeriod">
  <entity>
    <identifier scheme="http://www.sampleCompany.com">
      Sample Company Inc.</identifier>
    </entity>
    <period>164
      <startDate>2004-01-01</startDate>
      <endDate>2004-12-31</endDate>
    </period>
  </context>
```

Code 15. Context Declaration in the Instance Document

Apart from the entity and period information the context part of an instance document provides information about entity segment for which the fact is reported as well as scenario under which a fact is reported. Code example 16 demonstrates definition of the context for *Sample Company* segment *Aircrafts* and scenario *Audited*.

¹⁶⁴ This example refers to a fact reported in the context for an element with a duration attribute value so the starting and ending date must be specified. For facts reported in the context for an element with instant attribute value only one date must be specified.

```
<context id="Current_ForPeriod">
  <entity>
    <identifier scheme="http://www.sampleCompany.com">
      Sample Company Inc.</identifier>
    <segment>
      <my:SampleSegments>Aircrafts</my:SampleSegments>
    </segment>
  </entity>
  <scenario>
    <my:SampleScenarios>Audited</my:SampleScenarios>
  </scenario>
  <period>
    <startDate>2004-01-01</startDate>
    <endDate>2004-12-31</endDate>
  </period>
</context>
```

Code 16. Segment and Scenario Declaration in the Instance Document Context

Footnotes appear on instance documents and provide additional information for some of the elements¹⁶⁵. If for example, in a business report, several concepts refer to the statement *For more information see Disclosures on Assets*, it is possible to create linkages between them and a footnote element containing this block of text. Code example 17 provides a description of the fact Assets reported in the current period, amounting to Euro 20,000 and defines a locator that points to this fact. The element footnote contains the text of a footnote and the *footnoteArc*¹⁶⁶ connects the element with this reference.

¹⁶⁵ There is a difference between footnotes in the instance document and the notes to the financial statement. The footnotes provide short, additional, textual information to the reported fact value. Notes to the financial statement are a substantial part of GAAP and are modelled within a taxonomy.

¹⁶⁶ The *footnoteArc* is similar to arcs defined in the taxonomy linkbases. The difference is that it can be used in instance documents only. The *footnoteArc* is utilising the *fact-footnote* arcrole [EHSK2003, 72-74].

```
<Assets id="Assets"
decimals="0"
contextRef="Current_AsOf"
unitRef="EUR">20000</Assets>

<loc
type="locator"
href="#Assets"
label="Assets"/>

<footnoteArc
type="arc"
arcrole="http://www.xbrl.org/2003/arcrole/fact-footnote"
from="Assets"
to="AssetsFootnote"
order="1.0"/>

<footnote
type="resource"
label="AssetsFootnote"
role="http://www.xbrl.org/2003/role/footnote"
xml:lang="en">For more information see Disclosures on
Assets</link:footnote>
```

Code 17. Using Footnotes in Instance Documents

4.1.2 XBRL General Ledger

This section discusses the XBRL GL¹⁶⁷ taxonomy. The GL taxonomy provides an interface to transactional standards and a common model for moving data through an ERP system, and links to end reporting schemas and XBRL taxonomies [GIPa2006, 68]. This section starts with the analysis of the XBRL GL taxonomy and follows with the aspects of the instance document modelling. Finally the enhancement to the XBRL GL taxonomy, the Summary Reporting Contextual Data (SRCD) module, is discussed at the end of this section.

¹⁶⁷ XBRL GL refers to either XBRL General Ledger [Paul2007; KrSc2003, 78] or XBRL Global Ledger [RaKO2006; XBRL2005a].

The XBRL GL taxonomy is intended to provide a standardised format for representing the data fields found in accounting and operation systems and transactional reports that will allow organisations to tag journal entries, accounting master files, historical status reports in XBRL and the underlying detail for financial reporting taxonomies [XBRL2005a]. XBRL GL often addressed as an additional adaptation of XBRL is not a separate specification but is based on the XBRL specification 2.1. However XBRL GL is not related to the FRTA and FRIS documents and their conformance suites. The XII published as drafts the XBRL GL Instance Standards (GLIS) to facilitate the analysis and comparison of XBRL GL data by computer applications and human readers [Wall2005b, 3] as well as GL Taxonomy Framework Technical Architecture (GLFTA) establishing rules and conventions that assist in comprehension, usage and performance among different journal focussed taxonomies [Wall2005c, i]. From the technical point of view it is a stand-alone taxonomy, suitable for the needs of representing basic accounting databases and transactions. The most important features of the XBRL GL taxonomy according to XBRL International are:

- possibility to perform multi-GAAP drill-ups to XBRL reporting taxonomies;
- providing a standard format to move non posted and posted GL information to consolidating systems, budgeting and forecasting tools and reporting tools;
- providing a standard format to move information from client systems to auditor system;
- providing a tool for representing detail drill-down for performance measurement reporting items;
- creating possibilities for any type of mandatory audit trail [XBRL2006g].

For this study the most important point is the first one addressing the linkage between the XBRL FR and XBRL GL in form of drill-ups. This is discussed in the further section proceeded by the general analysis of the XBRL GL taxonomy and GL instance documents.

4.1.2.1. General Ledger Taxonomy

The modular structure of the XBRL GL taxonomy is described in figure 24. The modular set consists of the COR (Core), the BUS (Advanced Business Concepts), MUC (Multi Currency), USK (concepts for the US, UK, etc.) and TAF (Tax Audit File) modules [XBRL2005a].

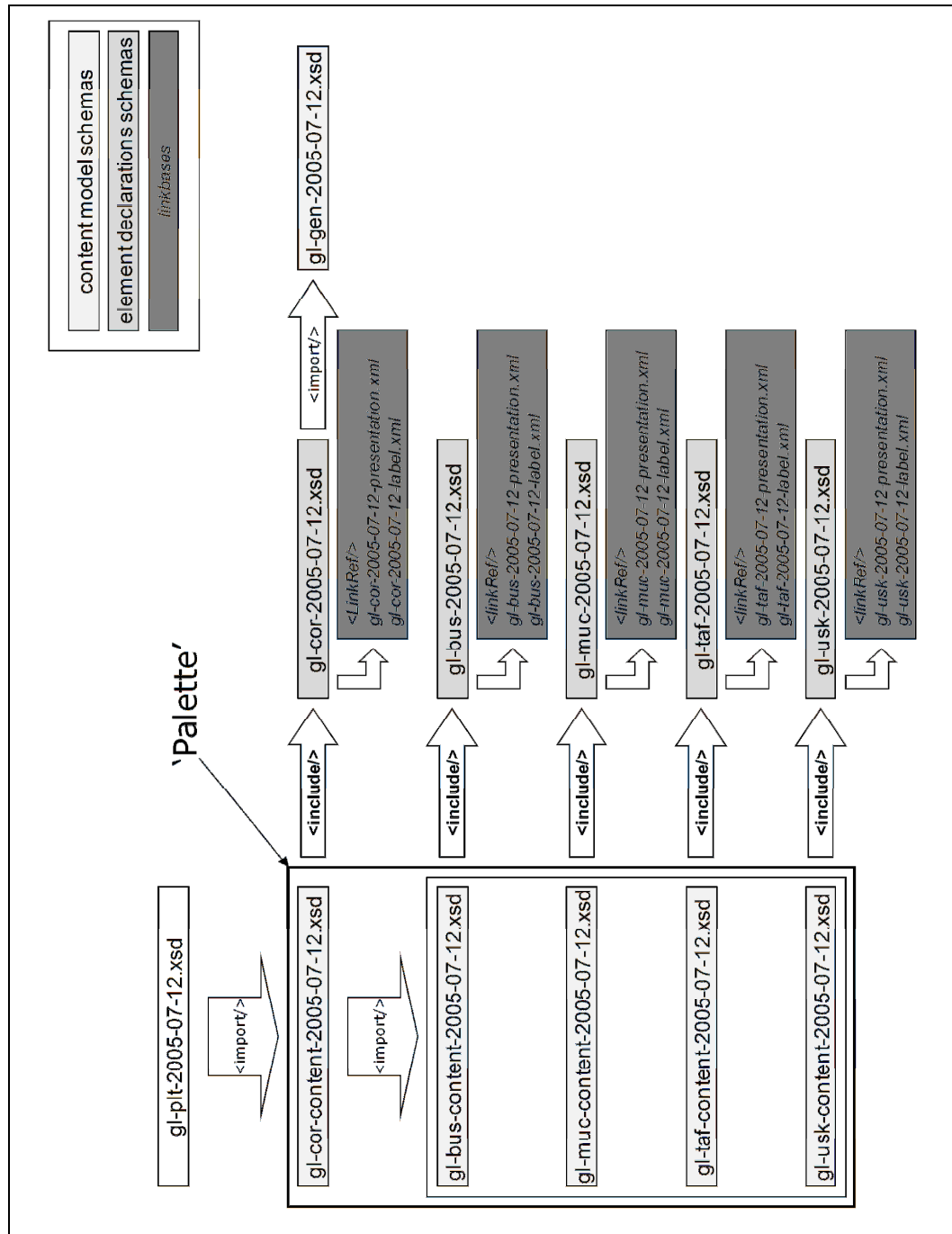


Figure 24. XBRL GL Taxonomy Framework [modified after Wall2005c, 8]

The COR module is the foundational schema with document information, entity information, and the entry header/entry detail data structure, along with elemental concepts for representing accounting data [XBRL2005a].

The BUS module extends the COR with business facts less common in the general ledger itself and represents inventory and business metrics, organizational detail and the entity information section, and other common items to supplement the resources, agents and events that represent the customer, vendor and employee related transactional details. The BUS module contains approximately 80 unique, individually identified pieces of information related to the data found in an accounting system [XBRL2005a].

The third USK module extends the XBRL GL COR with accounting and business concepts more prevalent in non-continental accounting. It provides data fields found in accounting and operation systems that will allow organizations to tag journal entries, accounting master files, and historical status reports with additional information necessary for accounting needs common to Saxon accounting model¹⁶⁸. The USK module elements represent job costing information and repetitive and repeating journal entries to supplement the resources, agents and events that represent the customer, vendor and employee related transactional detail that feed from operational systems and are summarised and aggregated into financial reporting taxonomies. It contains approximately 15 unique, individually identified pieces of information related to the data found in an accounting system. In the general ledger module of many accounting systems, there are means for creating a library of journal entries for reuse, and especially templates of journal entries that can be tracked, recalled, and reused. In discussions with European accounting experts, this type of system, especially one that would lead to the automated creation of journal entries, would raise problems with governmental audit, so these items are not considered as COR. Advanced USK accounting module standardises data fields for creating libraries of standard, recurring and repeating entries for archival, backup and migration purposes [XBRL2005a].

The MUC module extends the COR with additional fields necessary for full multicurrency tracking on transactions and well as provides the XBRL GL with the ability to collect multi-currency entry to supplement data fields underlying detailed entries required for accounting, business operations and other data found in accounting

¹⁶⁸ Data fields representing specifically the needs of other accounting models are not referred to as XBRL GL modules.

systems. Specifically, the MUC module represents local and home currencies and exchange rates. It contains 7 unique, individually identified pieces of information related to the data found in an accounting system [XBRL2005a].

The next described module is TAF¹⁶⁹. TAF is a new module, not an update of a previous version from the XBRL GL taxonomies based on older XBRL specifications. It adds data fields needed for tax audit. [XBRL2005a]

The last presented module is GEN. It contains type definitions (content models) that are used in different modules and which cannot be altered by anyone extending the taxonomy [XBRL2005a].

The structure of the taxonomies is such that a complete taxonomy is compiled by assembling a set of schemas via a palette schema¹⁷⁰. Since the content models of many elements vary depending on the combination of modules that are being used in any application, the taxonomy schemas are separated into multiple physical files that are connected by means of *include* and *import* XBRL mechanisms. Each module own schema is divided into two main parts – the element declarations and the content model declarations which combined form a complete schema [XBRL2005a].

4.1.2.2. Modelling of Instance Documents

XBRL GL taxonomy is heavily tuple oriented. Thus most of the semantic is expressed with the use of instance documents and not contained in the taxonomy as in case of XBRL FR. Basic structure of instance documents for XBRL GL following entry type documents can be described using instance documents:

- account - information to fill in a chart of accounts file;
- balance - the results of accumulation of a complete and validated list of entries for an account (or a list of account) in a specific;

¹⁶⁹ The addition of TAF fields enables XBRL GL to be used by the international tax agencies and was developed with the input of groups such as the OECD SAF-T group and the OASIS tax XML group. [XBRL2005a]

¹⁷⁰ *Palette schema* is always in the file named *gl-plt-2005-11-07.xsd*.

- entries - a list of individual accounting entries, which might be posted/validated or non-posted/validated;
- journal - a self-balancing (debit equals credit) list of entries for a specific period including beginning balance for that period;
- ledger - a complete list of entries for a specific account (or list of accounts) for a specific period (debits do not have to equal credits);
- assets - a listing of open receivables, payables, inventory, fixed assets or other information that can be extracted from but are not necessarily included as part of a journal entry;
- trial balance - the self-balancing (debit equals credit) result of accumulation of a complete and validated list of entries for the entity in a complete list of accounts in a specific period [XBRL2005a].

XBRL GL uses a journal entry metaphor as a framework to characterise accounting master files, asset listings and journal entries themselves. It is through a combination of the appropriate fields, and especially those with enumerated values directly associated with a certain representation, that master files, transactional files, status listings and other files can be properly accomplished [XBRL2005a]. Analysing the journal entry structure is important to understand how to model XBRL GL instances. XBRL GL instance documents have one or multiple *accountingEntries* structures within an instance document. This allows one physical XBRL GL instance document to convey different types of information/entries. This is especially helpful in reducing redundant entries in a transactional/journal entry file by having a separate listing of account with the related information once per account, rather than repeating all of the related information (such as description or mapped taxonomies) for every line item. The most important element at this level is the *entriesType*, which has enumerated values to communicate that the information with *accountingEntries* relates to a list of accounts, an asset listing, and a set of journal entries, a complete ledger, and other options. There is one or more *entryHeader* structure within an *accountingEntries* structure. This is primarily important for representing multiple entries or groupings of entries. There is one or more *entryDetail* structure within an *entryHeader* structure. Multiple *entryDetail*

lines are used for many different reasons, and especially using the repetitive structures that are contained with *entryDetail*, including:

- account, and within account, *accountSub*, so the subaccounts;
- *xbrlInfo*;
- *identifierReference* [XBRL2005a].

By the judicious and consistent repetition of these structures within the *entryDetail* structure, most of the important representations of accounting can be accomplished. For example, XBRL GL can be used to associate a standardised chart of accounts with a company specific chart of accounts. This is done by using *entryDetail* structures that contain multiple account structures, each with an associated *accountPurposeCode* such as standardised and company specific. Using *xbrlInfo*, different elements from XBRL taxonomies (or other schemas) can also be associated. This can be used to represent a link between a standard and internal taxonomy. Combining account and *xbrlInfo*, a complete set of mappings as well as the ability to drill down from a report and drill around to other reporting taxonomies can be accomplished [XBRL2005a]. The detailed analysis of the linkage between XBRL GL and XBRL FR is provided in the next section XBRL hybrid reporting.

4.1.2.3. XBRL Hybrid Reporting with XBRL GL SRCD Module

According to Ramin et al. XBRL GL addresses different perspective than XBRL FR. XBRL GL was developed as an interface for exchange of not aggregated financial data. It enables encoding of such data being accounting system neutral. In order to do so XBRL GL specifies a framework for encoding the accounting field. Additional fields enable linkage to the summary reporting [RaKO2006, 14]. Figure 25 presents the relationships between XBRL GL and XBRL FR.

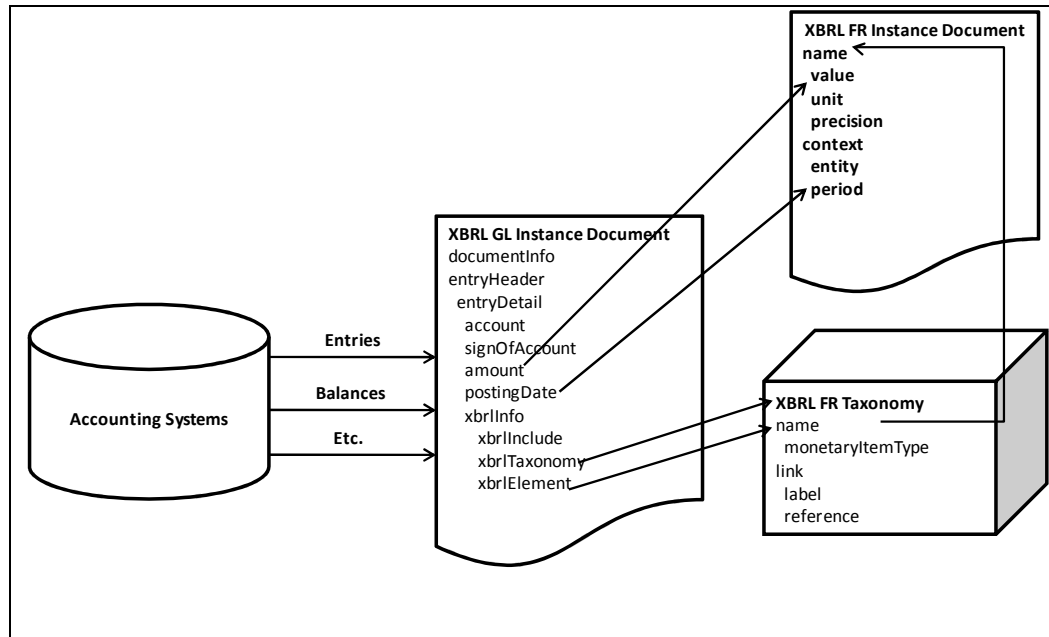


Figure 25. The Relationships between the XBRL GL and XBRL FR [modified after RaKO2006, 15]

The first sections of this chapter discussed the distinction between XBRL FR and XBRL GL. The section on XBRL GL introduced briefly the *xbrlInfo* element of the XBRL GL taxonomy responsible for the linkage with XBRL FR taxonomies. This section discusses public working draft of XBRL International dealing with the other ways to drive the creation of end reports. It also discusses the linkages to specific reports, representing sophisticated ways to drive XBRL FR creation and simpler way of annotating the exact content in an original XBRL FR instance document that XBRL GL represented facts relate to [GaCo2007]. This is realised with the introduction of the new SRCD module¹⁷¹, which helps XBRL GL elements drive linkages to the contextual data (contexts, units and other attributes) found in summary reporting (especially XBRL FR reporting) [GaCo2007]. This section discusses also the relationships between XBRL GL and XBRL FR from the business perspective.

¹⁷¹ The SRCD module works with the existing XBRL GL framework and is currently available in a palette that includes all of the current modules.

Code example 18 presents a part of a *trial balance* where the amount *232042.26 USD* from the account *1001 SunTrustOperating* is linked to the *closing balance* of the *US GAAP* XBRL taxonomy element *Unrestricted Cash*.

```

<entryDetail>
  <lineNumber contextRef="now">2</lineNumber>
  <account>
    <accountMainID contextRef="now">1001</accountMainID>
    <accountMainDescription contextRef="now">SunTrust
Operating</accountMainDescription>
    <accountPurposeCode
contextRef="now">usgaap</accountPurposeCode>
    <accountType contextRef="now">account</accountType>
  </account>
  <debitCreditCode contextRef="now">D</debitCreditCode>
  <amount contextRef="now" decimals="2"
unitRef="USD">232042.26</amount>
  <postingDate contextRef="now">2005-06-30</postingDate>
  <xbrlInfo>
    <xbrlInclude
contextRef="now">ending_balance</xbrlInclude>
    <summaryReportingElement contextRef="now">usfr-
pte_UnrestrictedCash</summaryReportingElement>
  </xbrlInfo>
</entryDetail>

```

Code 18. Journal Entry in the XBRL GL Instance Document [XBGL2006]

Figure 25 provided the overview of the relationships between single components of the XBRL GL instance document and XBRL FR taxonomy and instance document. For example, the amount from XBRL GL instance document is linked to the value of the fact from the XBRL FR instance document. XBRL FR does not include agreed-upon tools for drilling down from summary information to more detailed information. According to Garbellotto and Cohen in the linkage from XBRL FR to XBRL GL (or vice versa), the weight falls upon XBRL GL to provide any explicit links from detail to summary information. The COR module described in the section on XBRL GL includes the *xbrlInfo* structure, which identifies the link to the concept within an FR taxonomy. Using logic and content from an XBRL GL instance, retrieval of information

necessary to create (or link to) FR instance is possible [GaCo2007]. The linkage between GL and FR is especially important for this study. The high level of sophistication of the transfer from trial balance to the financial statements addressed in chapter three opens perspectives for the use of standardised and linked financial information there. This linkage provides a very valid point for this research leading to the semantic connection between report preparation and reporting activities.

Garbellotto and Cohen state that the primary reason for the development of the SRCD module was to unambiguously associate details in XBRL GL with summarised information found in XBRL FR instance [GaCo2007]. Before SRCD, XBRL GL had the representational capability to store all of the necessary information at a detailed level, but possibility to conduct simple transformations, rather than transformations requiring additional programming logic, was necessary. In addition to being able to encode explicit representation of the summary reporting contextual information, users interested in having XBRL GL meet with XBRL FR stated their need to communicate conditional selection and filtering rules to move from GL detail to FR summary information¹⁷². [GaCo2007]

This section closes the discussion on the XBRL specification 2.1 based technologies. Next sections analyse technologies based on different specifications.

4.2 XBRL Dimensions Specification

This section discusses XBRL view on multidimensional data and data structures. The latest published XBRL recommended specification describes how to model sophisticated report structures in a multidimensional way. XBRL is intended to express data in form of business reports. Nevertheless the need for modelling and expressing more sophisticated data structures and especially dimensional modelled data pushed the XII to create of the XBRL Dimensions 1.0 specification (XDT¹⁷³). The XDT was published on 24 of April 2006 and is a modular extension to the XBRL 2.1 specification. It provides a generalised mechanism to define dimensional metadata and to reference it in

¹⁷² SRCD is able to represent the exact dates found in an FR instance. It also provides a rule on which of a number of GL dates might provide conditions that trigger certain details to be summarised.

¹⁷³ XDT stands for XBRL Dimensional Taxonomies although is used in the context of both taxonomies and instance documents.

XBRL instances [HRWa2006, 1]. XDT introduces non-normative taxonomies distinction into primary taxonomies, domain member taxonomies and template taxonomies. The differentiation in the XDT provides an architectural framework to projects that incorporate multidimensional information into existing taxonomies [HRWa2006, 2]. Figure 26 provides an overview of the relationships between the different taxonomies.

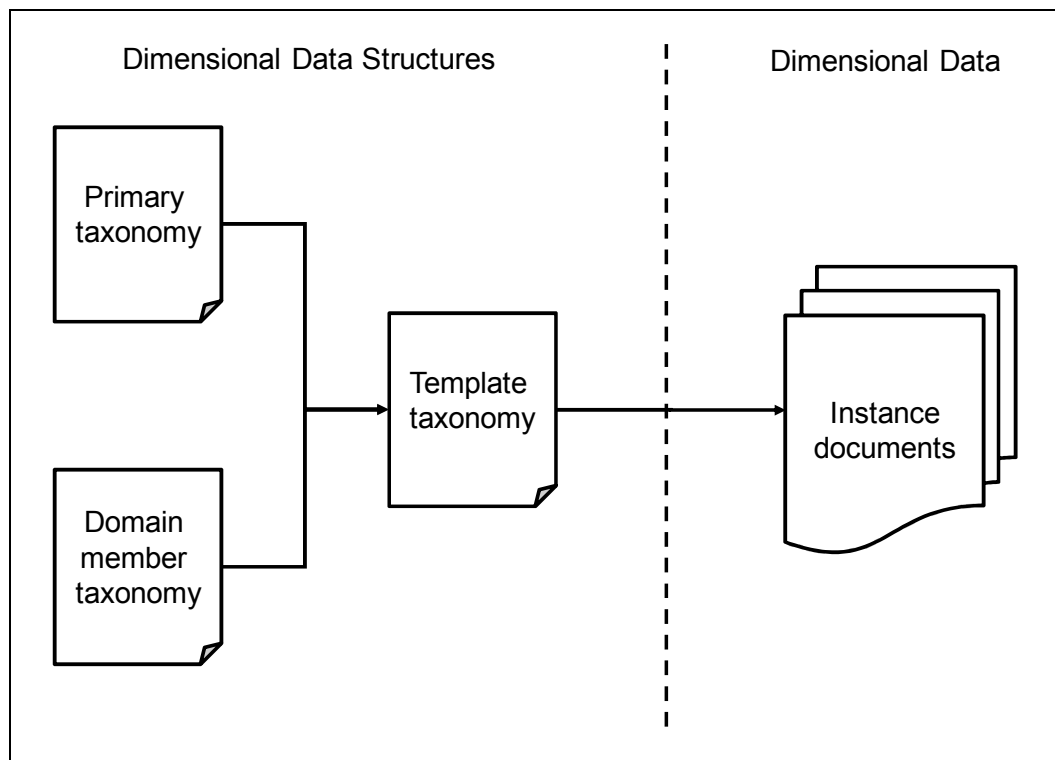


Figure 26. Taxonomies in the XDT [modified after IASC2006b]

- Primary taxonomy - a primary taxonomy is the DTS of an XBRL taxonomy that has no dimensional elements and no arcs defined in XDT;
- domain member taxonomy - typed dimensional taxonomies define syntactic constraints on the contents of segments and scenarios. Explicit dimensional taxonomies are those in which the XBRL items form a discrete, countable finite partitioning of a set of members, which hereinafter is called a domain. Examples include a taxonomy of the domain of geographic territories, or a taxonomy on a domain of product lines;

- template taxonomy - a template taxonomy imports all domain member taxonomies and primary taxonomies and adds the dimensional structures [HRWa2006, 2].

The basis for the dimensional data modelling in XBRL taxonomies are four new arcroles for the definition linkbase:

- all or notAll (primary item– hypercube),
- hypercube – dimension,
- dimension – domain,
- domain – member [Feld2007, 197].

Figure 27 presents the use of the four arcroles. The arcroles define which dimensions characterise a hypercube (*hypercube – dimension*), which dimensions include which domains (*dimension – domain*) and of which members consist a domain (*domain – member*). The diagram consists of elements with various *substitutionGroup*¹⁷⁴ values. Depending whether an element is a hypercube, a dimension or a domain, the value of *substitutionGroup* should be assigned to *hypercubeItem*, *dimensionItem* or *item*. Primary items describe business reporting concepts. The items are modelled in relation to other elements. The arcroles *all* and *notAll* express the relation between the primary item and the hypercube. *All* is used when all dimensions of the hypercube can be applied for the item. *NotAll* is used when all dimensions of the hypercube should be excluded from the item [HRWa2006, 10]. The arcrole *domain – member* can be used also in primary taxonomies so that the whole tree hierarchies can be connected with the hypercube.

¹⁷⁴ This study introduced two values for *substitutionGroup* attribute namely *item* and *tuple* in the previous sections. XDT adds other alternative values *hypercubeItem* and *dimensionItem* [HRWa2006].

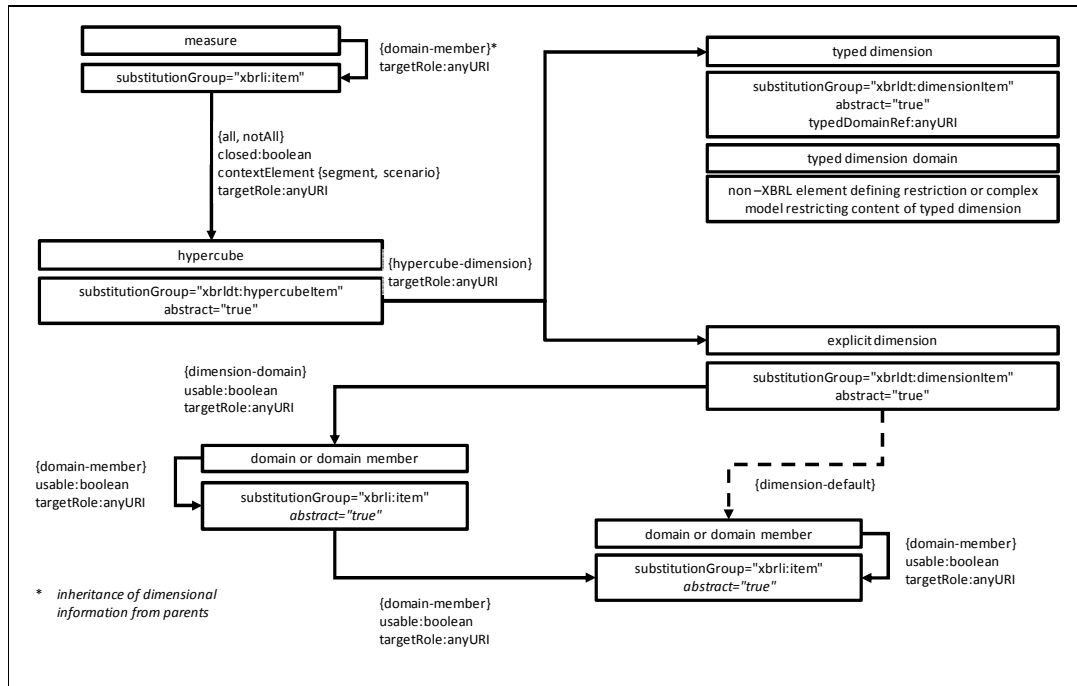


Figure 27. Relationships in XDT [modified after HRWa2006, 7]

The dimensional features are addressed in instance documents using segment or scenario element in the context and so adding the dimensionality to the reported facts. In case of explicit dimensions the instance documents refer to the members or their combinations defined in the domain member taxonomies. In case of typed dimensions the domain members are defined within an instance document itself and thus addressed.

The XDT enables modelling and expressing multidimensional data in standardised XBRL format. It also raises a lot of questions concerning the relations between traditional multidimensional data analysis and XDT.

4.3 Other XBRL Developments

XII published the plan for XBRL technologies that sets out the steps for the development and release of the technical documents and enhancements to the existing specifications, documentations and conformance suites [XBRL2006e]. This plan apart from defining dates of publishing the specifications sets out the most important technologies from the XII point of view. In the first line the formulas and functions should be finalised. The technology solving the issues of existing calculation linkbase is going to be

implemented in a form of a linkbase. It should also enable more advanced validations in XBRL [Hams2005]. The growing role of the proper versioning approach requires the XII to analyse and address the issues of the taxonomy life cycle. The impact of taxonomy versioning on software products, previous versions of taxonomy extensions and created instances is reported to be significant. Nevertheless there is no explicit implementation method for the versioning technology in XBRL [Hoff2006, 500-501]. The issues with the presentation linkbase not allowing for the proper modelling of the tables as well as visualisation of instance documents and taxonomies pushed the XII to consider providing a rendering technology. Although often reported as not a core XBRL technology¹⁷⁵ the solution is to create additional linkbase. Each of the three technologies mentioned above is discussed in detail in the following sections.

4.3.1 Aspects and Potential Use of XBRL Formulas and Functions

The section on the XBRL taxonomy linkbases discussed the calculation linkbase and indicated the restrictions of conducting calculations in XBRL. The potential solution to the calculation linkbase restrictions as well as to the areas not covered by any other linkbase is the formula linkbase. Shuetrim states that a formula is a way of describing formulaic relationships between XBRL concepts. If evaluated successfully against an XBRL instance, formula produces new XBRL facts. For example, a simple formula may express the formulaic relationship of current ratio = current assets / current liabilities. A formula describes the use of the XBRL concepts for the current ratio, current assets and current liabilities and that current assets should be divided by current liabilities to result in a value for the current ratio. [Shue2007]

According to Shuetrim XBRL formulae should be expressed using the generic linkbase. The processing model is to apply the formula against an XBRL instance document. Formulas may be used to validate information in the instance document or to produce new facts to augment the information in the instance document. [Shue2007]

¹⁷⁵ XBRL is designed as a mean of data exchange and the task of rendering and visualisation should be taken over by stylesheets.

Formulas are in the public draft stadium at the moment of this analysis and thus are discussed mainly from the theoretical perspective and not explicit technological impact on the financial reporting supply chain architecture.

4.3.2 Managing Taxonomy Life Cycle with XBRL Versioning

New taxonomy releases, called versions, are a direct result of the XBRL taxonomy life circle. Differences between versions are often indicated in separate documentation called change logs [IASC2006d]. However, no fully developed solution which provides a comprehensively human readable change log and machine-readable versioning information has been discussed so far neither by the academic community nor the XBRL International consortium members.

Hernández-Ros states a number of reasons for amending taxonomies. Most important ones are:

- changes in laws supporting the concepts modelled in the taxonomy;
- changes in other source literature or references;
- correction of errors in the labels or references;
- addition of new languages and or references;
- reorganization of the presentation or calculation trees;
- addition of new languages;
- addition of new linkbases like the formula linkbase. [Hern2006, ii]

According to Goto and Hamscher the versioning "... is to allow comparison, analysis and aggregation of data represented in XBRL instance documents to be performed even when the source instances refer to different versions of the same base or extension taxonomies" [GoHa2002, 1-2]¹⁷⁶. Taxonomy versioning maintains information

¹⁷⁶ The prototype approach to the XBRL taxonomy versioning with the use of generic linkbase is discussed also by IASCF [IASC2006d].

about how successive versions of a taxonomy differ from each other¹⁷⁷. Further taxonomy versioning supports more basic functions such as notification of developers and users of changes so that they can physically change instance documents, update stylesheets and other declarative information, as well as XBRL-aware databases and accounting software. [GoHa2002, 1-2]

This study recognises importance of taxonomy versioning especially for the reporting and receiving entities in the financial reporting supply chain.

4.3.3 Discussing Presentation Issues with XBRL Rendering

This section provides a brief overview of the activities in the XBRL consortium related to the rendering of XBRL encoded information. XBRL instance documents enable receiving financial information in an open, structured, machine-readable form. The data points in an XBRL instance document are associated at least with a time period, a business entity (such as a corporation), and a reporting concept. The reporting concepts are defined in XBRL taxonomies with relationships to other concepts, human-readable labels, and links to authoritative literature. Calvert states that XBRL rendering specification aims to improve the creation of new kinds of metadata by providing additional concrete linking components, as well as guidance for the definition of custom linking components. [Calv2007]

According to Hoffman existing XBRL linkbases demonstrate their weaknesses if used for associating information and express relationships between XML elements that are not XBRL concepts. A very common case is the use of the presentation linkbase in order to display the reported facts in a hierarchical order. This approach is highly undesirable since the presentation linkbase was designed in order to provide a hierarchy for the taxonomy development and taxonomy use and not to provide structure and formatting information for the later instance document rendering [Hoff2006].

¹⁷⁷ Especially information about how instance documents or extension taxonomies that are based on earlier versions could be converted or interpreted is important in the taxonomy life cycle [GoHa2002, 1-2].

Solution to the rendering issues has been discussed for a long time within XBRL community. The XBRL International discusses a number of options to enable formatting of the instance documents in a standard way. The discussed options are:

- formatting linkbase [KaMu2006],
- microXBRL [Core2007],
- FDIC approach [Hoff2006],
- other approaches [Calv2007].

The current activities lead to the conclusion that many market participants require a standard solution for the rendering of instance documents but the requirements of various participants differ. This situation makes it difficult to create one single set of requirements which will later lead to the specification of the rendering linkbase. At the point of conducting the analysis none of the solutions is preferred and thus the XBRL rendering is not considered in the XBRL financial reporting supply chain architecture in the next chapter.

4.4 Conclusions

Chapter four provided a detailed analysis of the XBRL standard which is the technical foundation for the further research. First the components of XBRL 2.1 specification were analysed. The concepts such as XBRL taxonomies, instances and taxonomy extensions were addressed together with a distinction between XBRL FR and XBRL GL perspectives. Further the extension to the XBRL 2.1 specification which is XBRL Dimensions 1.0 specification was addressed. The third section discussed new developments in the area of XBRL. Especially the use of technologies such as formulas and functions, versioning and rendering was addressed in the context of XBRL technology. Chapter four addressed research proposition 2 stating that *XBRL introduction alters financial reporting supply chain*. Although only technical discussion of XBRL was conducted, potential areas of the use of the language such as GL and FR support this research proposition.

5 XBRL Financial Reporting Supply Chain Architecture

As discussed in the second chapter, the domains of financial accounting, financial reporting as well as accounting information systems literature rarely deals with the aspects of modelling the financial reporting supply chain nor presents its architecture. In the first section of chapter three of this thesis analysis of financial reporting domain was conducted. The conclusions from the analysis, surveys and interviews presented in chapter three are the domain input for the modelling of architecture in this chapter. Chapter four addressed the technical foundation which is the XBRL technology. The results from the fourth chapter are applied to enhance the modelled financial reporting supply chain architecture with XBRL technologies thus addressing XBRL financial reporting supply chain architecture. The modelling is conducted according to the presented theory of Zachman involving all six views on the financial reporting supply chain architecture on the contextual and conceptual level. For the modelling of conceptual views formal modelling notations were selected and applied in following sections.

5.1 Basic Definitions and Concepts

Before the financial reporting supply chain and XBRL financial reporting supply chain architectures can be modelled, basic definitions and concepts need to be addressed. As this study refers to both the modelling and the architecture these terms need to be explored. Thus the term model needs to be clarified followed by the explanation of the term architecture. Also this section delivers the definitions of the meta-models as well as reference model, both are also relevant for this study.

The number of different definitions of the term models are known in the economics literature scoping from models as interpretations of the amounts of axioms where all axioms are true [Zsch1995, 237] up to equalisation of the models with fictions [SchS1987, 24-25]. In the area of MIS many authors follow the model theory of Stachowiak where models are defined as the illustration of something (original), for somebody (user of the model), for the specified time interval and for a specific goal [Stac1973]. Table 19 provides an overview of the different definitions of the term model.

Table 19. Overview of Selected Definitions of the Term Model

Source	Definition
Object Management Group (OMG)	“...a description or specification of that system and its environment for some certain purpose... [which]... is often presented as a combination of drawings and text ... in a modelling language or in a natural language.” [MiMU2003, 2]
Schütte	A model is a result of the construction of the modeller, which represents the original object for the model user by means of relevant modelling language and in a certain point of time. [Schu1998, 59]

According to Wöhe models are categorised, depending on the goal of modelling, into:

- Description models with the goal to precisely and coherently describe the actual situation.
- Explanation models with the goal to deliver interpretation patterns for the analysis purposes.¹⁷⁸
- Configuration models with the goal to represent all the parameters necessary to fulfil a requirement or a certain task. [Wöhe2002, 39-40]

For the purpose of this modelling the general definition from Schütte applies to the modelled views on the financial reporting supply chain. From the modelling goal perspective the selected models are in the group of explanation and description models.

The literature discussed uses widely the term architecture of information systems however in an inconsistent way. According to Lockemann and Dittrich it is related to specific, technical components (i.e. architecture of data base management systems) [LoDi1987, 87]. Mehlaui states that architecture is a specific view of the company [Mehl2000] and Zachman and Tijok refer to the architecture of information systems [Zach1999, 454; Tijo1996, 8]. Also the number of existing definitions demonstrated in table 20 indicates the inconsistencies in the use of the term architecture.

¹⁷⁸ The prerequisite for the explanation models is the existence of the description models.

Table 20. Overview of Selected Definitions of Information Systems Architecture

Source	Definition
Shaw and Garlan ¹⁷⁹	“Specification of the parts and connectors of the system and the rules for the interactions of the parts using the connectors.” [ShGa1996]
Zachman	Logical construct for controlling the interfaces and integration of system components. [Zach1999]
Krcmar	Description of structures. [Krcm1990, 396]
IEEE 1471-2000	“The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution.” [IEEE2000, 3]

This study is based on the Zachman definition of information system architecture. This study also classifies the models as a subset of the architecture according to the Zachman [Zach1999] and Sinz understanding [Sinz1997, 876-878]. Both suggest using generic architectural frameworks in order to structure the models representing the architecture.

The definition of the meta-model defines it as follows: “meta-models are language oriented description models of the modelling language” [Stra1996, 23]. If the modelling language is a part of another model it is the meta-meta-model. Figure 28 provides explanation on the differences between model, meta-model and meta-meta-model.

¹⁷⁹ The definition of Shaw and Garlan is applied by OMG in the Model Driven Architecture (MDA) Guide. [MiMU2003, 2]

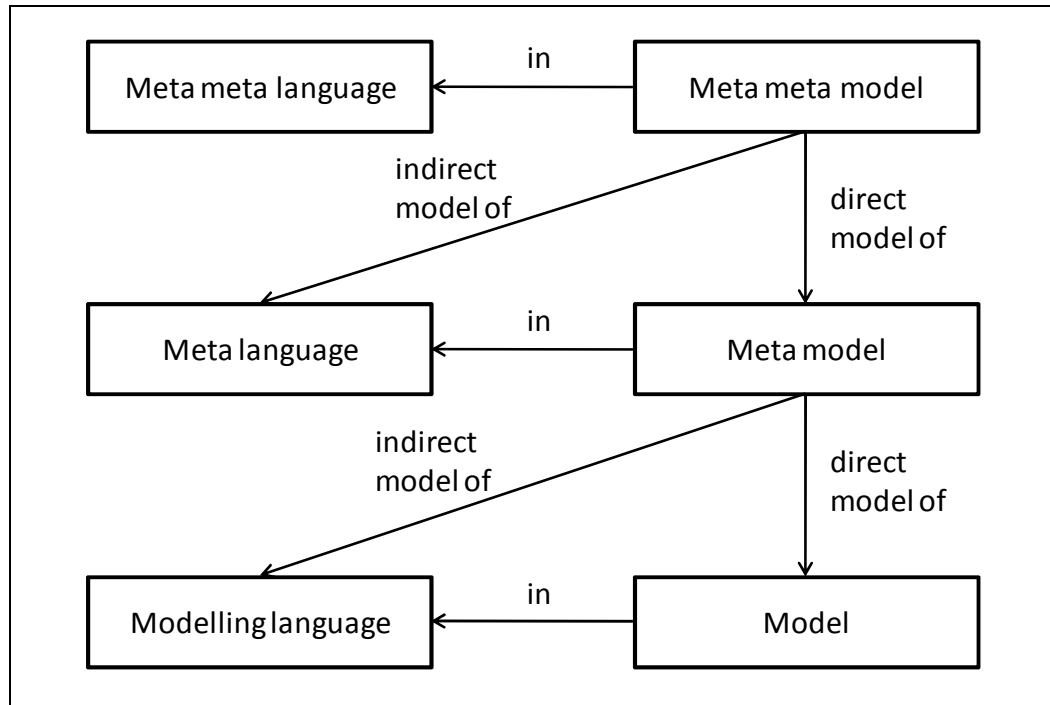


Figure 28. The Relationships Between Model, Meta-Model and Meta-Meta-Model [modified after Strah1996, 24]

Finally this section provides the definition of a reference model. Schütte states that the reference model is, similarly to the model definition, a result of the construction of the modeller, which represents the original object for the model user as recommendation by means of relevant modelling language and in a certain point of time [Schu1998, 69]. The major difference indicated by Schütte is the recommendation for the use of the model. The reference models are often constructed for groups of entities. They can be rarely used for a specific entity in general. Usually only parts of the reference models can be transferred into company specific models [Schu1998, 66]. But many researchers [Schu1998, 70, Zell2002, 137-139] differentiate between company specific and generic reference models. This study focuses on the generic oriented understanding of a reference model which as stated by Leist-Galanos abstracts from specific use cases [Leis2005, 29]. Also some literature indicates the difference between actual and target reference models [Rose1996, 31]. In the context of this study both terms will be used applying to the actual reference model of the financial reporting supply chain architecture and target reference model for the XBRL financial reporting supply chain architecture.

5.2 Models of the Financial Reporting Supply Chain Architecture

As explained in the research framework, modelling of the financial reporting supply chain architecture is conducted on two stages over six views of Zachman architecture framework¹⁸⁰. The highest level of abstraction is the contextual level. The important items should be listed here for the needs of modelling them on more detailed levels later. Felden states that textual information or lists of items are the most appropriate way of expressing the contextual models [Feld2006b, 227]. Further the conceptual view provides set of models on the modelled system of objects which explains it in more comprehensive way. The contextual and conceptual levels are analysed in this chapter for the views presented in figure 29. They start with the data view, go over function, people and network views and are completed with the time and motivation views. The result of the modelling is the financial reporting supply architecture¹⁸¹.

¹⁸⁰ Further modelling on more system specific stages is possible but in the context of this research provides very company or scenario specific views and thus the modelling is conducted on the two highest abstraction levels. Such abstract and generic modelling can be later easily applied for specific reporting scenarios.

¹⁸¹ Noran presents an interesting interpretation of possible genericity dimensions in the Zachman framework. According to his view the conceptual modelling level (owner's view) can lead to a number of instantiations in for of system views on more detailed level [Nora2003, 109-110]. This approach complies with this thesis and restricts the modelling to most generic levels in order to provide further modelling possibility for different systems models.

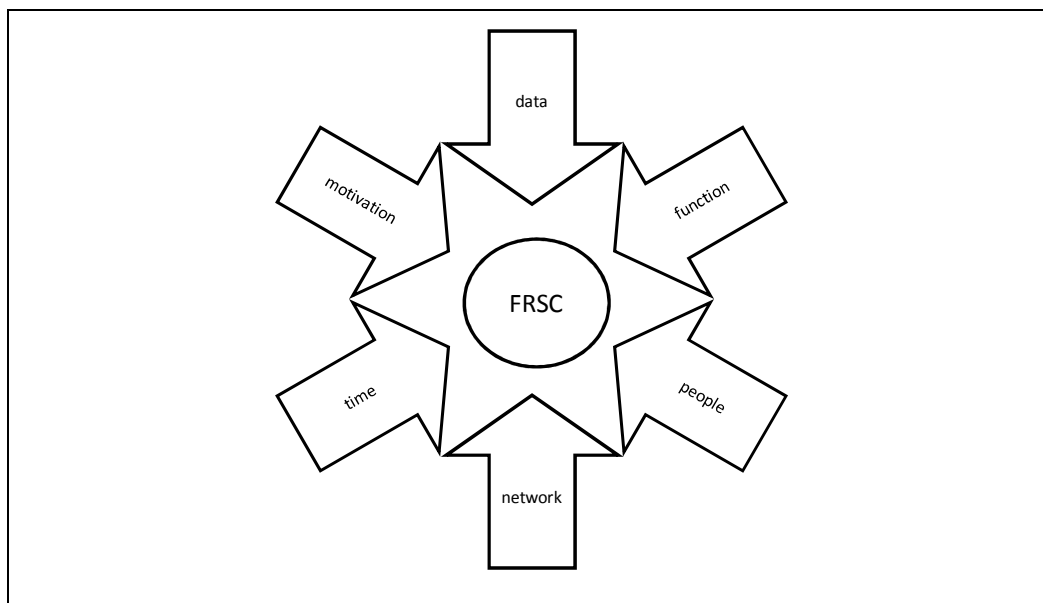


Figure 29. Different Views on the Financial Reporting Supply Chain Architecture

The above categorisation already provides the possibility of a structured view on the financial reporting supply chain architecture¹⁸².

5.2.1 Data View in Financial Reporting Supply Chain Architecture

The analysis starts with the contextual level of the Zachman framework. The first analysed category addresses the data components which can be identified in the financial reporting supply chain. Schütte and Becker indicate the high importance of the data view modelling [ScBa2004]. This study extends the understanding of the data view provided by Zachman and shared by Schütte and Becker. It introduces the distinction between the data itself and the data description. Such a distinction is known from the ontologies domain and is discussed by Fensel. He indicates that both XML schema¹⁸³ and ontology languages have the main goal in common which is providing vocabulary and structure for description of information sources that are aimed at exchange [Fens2004, 33]. The ontological distinction between data and data description is ap-

¹⁸² Becker and Schütte [BeSc2004, 38-39] indicate other approaches to structuring information systems architectures such as Semantic Object Model (SOM) from Ferstl and Sinz [FeSi1998] or Architecture of Integrated Information Systems (ARIS) from Scheer [Sche1999]. For example ARIS discusses data, function, organisation and steering views [BeSc2004, 72]. This study regards Zachman as most comprehensive of discussed architectures.

¹⁸³ Same can be applied in the context of XBRL schema.

plied for modelling both financial reporting supply chain and XBRL financial reporting supply chain. This distinction is formulated in the financial reporting domain analysis chapter in the distinction between reported data and underlying regulations and also in the technical domain analysis chapter in the distinction between XBRL taxonomies and XBRL instance documents.

The analysis conducted in chapter three provides a number of data items which need to be modelled as a part of the financial reporting supply chain architecture. Table 21 presents an overview together with descriptions of data components in the financial reporting supply chain. The discussed components are derived directly from the analysis conducted in chapter three. Their composition in the table reflects the flow of financial information along the reporting supply chain. It starts with the source documents and finishes with the preparation of the audited financial report.

Table 21. Data Components in Financial Reporting Supply Chain

Data Component	Description
Source document	Original record of each transaction
General journal	A book of original entry in a double-entry system
General ledger	Collection of the company's accounts
Trial balance	Listing of all debit and credit balances in ledger accounts
Adjusted trial balance	Listing of all debit and credit balances in ledger accounts after adjustments at the end of the reporting period
Financial statements	Statements comprising of balance sheet, income statement, cash flow statement, statement of changes in the equity and the explanatory disclosures together with auditors' report on financial statements
Tax code financial statements	Financial statements adjusted to the tax regulations
Additional information ¹⁸⁴	Information necessary to create financial statements not included in the trial balance generated from general ledger systems
Audited financial statements	Financial statements after audit together with auditors' report
Financial report ¹⁸⁵	Audited financial statements together with the management report and other reports

First data component listed in the table 21 is raw financial data included in the source documents. The source documents role is to document a transaction performed between the transaction parties or directly processed in accounting information systems. Further, due to the processing in accounting cycle as well as the steps towards preparation of the financial report, the general journal, the general ledger as well as trial balances data components are listed. The financial statements as well as financial report

¹⁸⁴ Deshmukh differentiates between financial information stored in indexed files or databases and financial and non-financial information stored in data warehouses, knowledge warehouses and business information warehouses [Desh2006, 262]. This study refers to additional information as to information not contained in general ledger systems.

¹⁸⁵ It is possible to separate the financial report category into audited and non audited but the results of the analysis in chapter three indicate very limited use of the non audited financial reports. Thus this study focuses on the audited financial reports only.

are parts of the financial reporting supply chain which are used for communication between company and external stakeholders. Also financial statements based on tax code are used for external communication. Finally additional data not contained in accounting systems is necessary to create financial statements and the financial report. The data oriented view on the financial reporting supply chain is also addressed by DiPiazza and Eccles. The data components discussed in table 21 are strongly related to their value chain of the financial information [DiEc2002].

Table 22 presents the data structures defining the structure of the data components discussed in table 21.

Table 22. Data Structures in Financial Reporting Supply Chain

Data Structure	Descriptions
Chart of accounts	Specifies each type of asset, liability and owners' equity assigning a code number for each account
Accounting standards	Conduct followed by accountants as prescribed by an authoritative body or law
Additional regulations	Number of other regulations influencing the composition of the structure of data in the financial reporting supply chain such as for example banking regulations specifying business assessment structure, tax code specifying additional items required in the tax reporting scenario and others

The data structures described in table 22 include the chart of accounts specifying the list of possible (or in some European countries recommended) accounts and their structure. The second considered data structures are accounting standards. The accounting and financial reporting standards rarely provide a closed set of structured data components to be reported. More often they include a set of principles or rules explaining what should be reported, but not naming the specific structure of such report. Finally a number of other regulations influence the data descriptions in different way described in the context of various reporting scenarios in chapter three¹⁸⁶.

¹⁸⁶ Additional regulations impact not only data components but can also have influence on other views of Zachman framework. This study models other regulation impact on the data structures only due to the modelling goals oriented towards financial reporting information flow.

The contextual level provides only a list of data components and list of data structures which can be identified in the financial reporting supply chain. In order to conduct a more detailed analysis the second level of Zachman architecture framework is modelled. The conceptual level for the data view is represented using an ERM presented in figure 30. ERM developed by Chen¹⁸⁷ is indicated as an appropriate modelling notation for the data view [Feld2006b, 227; BeSc2004, 87; Balz2001, 106].

¹⁸⁷ For more information on the specification of ERM see Chen [Chen1976].



Figure 30. Data Model for Financial Reporting Supply Chain

The ERM combines the data elements from the contextual view based on analysis conducted in the second chapter. Figure 30 presents entities as data components as well as

data structures and relationships between them. A number of source documents manually introduced in the accounting information system (dialog processing) or being result of a batch processing are the basis for the single general journal and single general ledger¹⁸⁸. The underlying structure for the general ledger is defined in the chart of accounts specific for a company which is often extended from the national guidelines or regulations for a chart of accounts [Desh2006, 260-261]. The general ledger is the basis for the trial balance which adjusted in a number of additional transactions leads to an adjusted trial balance. The aggregations and splits of the adjusted trial balance lead to the creation of the first part of financial statements [BeSc2004, 529]. The part of the financial statements which can be created automatically from the adjusted trial balance is limited and therefore additional information is required to complete financial statements and create a financial report. Both financial statements and financial report are based on one accounting standard¹⁸⁹. The audit process finishes with auditors' report which constitutes, together with management report and other reports, the audited financial report.

Additionally for the financial report, audited financial report and financial statements figure 31 shows the generalisations and specialisation of the relationships using ERM notation.

¹⁸⁸ This thesis does not analyse cases when two parallel general ledgers for different GAAPs are run by the company.

¹⁸⁹ This thesis does not discuss the reporting according to different accounting standards which is common for a number of companies in Germany. The convergence (translation between different accounting standards) can be achieved either with the use of two (or more) parallel running booking systems and creation of financial statements out of different systems or creation of the financial report according to one accounting standard and further reconciliations to the other accounting standard. Swanson et al. addresses the issues of convergence between US GAAP and IFRS and further the potential of XBRL to solve the convergence issues [SwDR2007, 129-145].

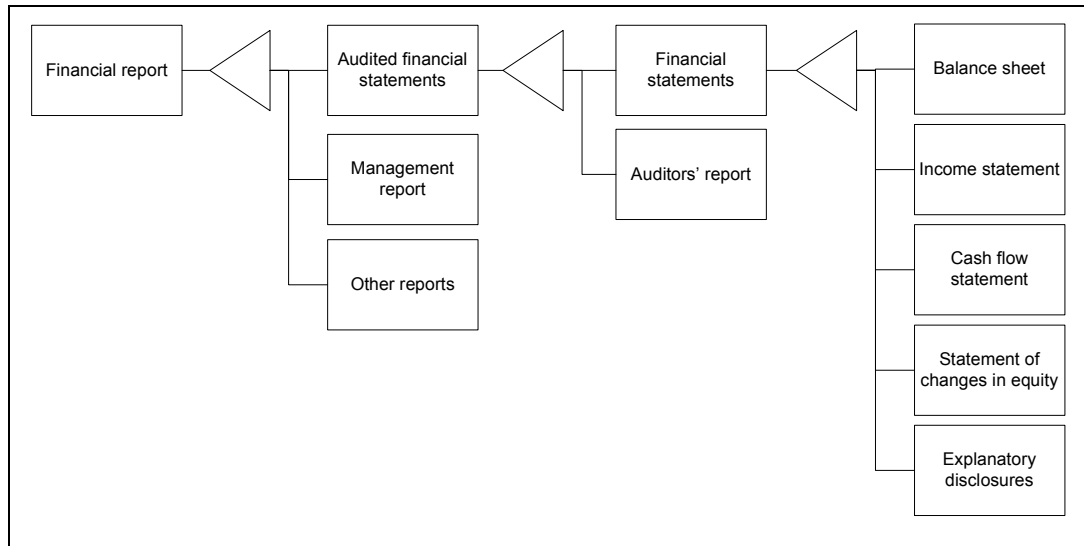


Figure 31. Relationships between Financial Report, Audited Financial Statements and Financial Statements

The above modelling extends the view from the financial reporting domain analysis chapter by adding audited financial statements as a level between financial report and financial statements. This study states that the financial statements together with auditors' report constitute audited financial statements. Further adding management report and other reports the financial report is constructed.

This section models data items on the contextual and conceptual view for the financial reporting supply chain architecture. Next section focuses on the processes which take place in the supply chain.

5.2.2 Function View in Financial Reporting Supply Chain Architecture

The second analysed view is the function view. The MIS literature provides distinction between modelling of functions and processes [BeSc2004, 103-116]. But Zachman architecture framework explicitly addresses modelling of processes in the function view which is applied in this study [STKB2006, 27]. Also Mertens indicates the close relation of processes and functions¹⁹⁰ [Mert2007, 24]. This study follows the understand-

¹⁹⁰ Mertens states that a process which has clearly defined start and end can be composed of a number of single functions. But conducting a complex function can require a number of single processes. [Mert2007, 24]

ing of Zachman and extends it to the understanding of Becker and Schütte where unambiguous definition of process places it as a consecution of functions [BeSc2004, 107].

Firstly contextual level includes the list of function items important from the financial reporting supply chain point of view. Table 23 provides an overview of the processes together with their descriptions.

Table 23. Processes in Financial Reporting Supply Chain

Function Item	Description
Recording transaction	Analysing and providing a track of record for each transaction (conducted automatically in the system or manually entered)
Journalising	Transferring data from source document to the general journal
GL posting	Transferring the data from general journal to the general ledger
Trial balance preparation	Closing the accounts and providing a list of all debit and credit accounts
Adjusting trial balance ¹⁹¹	Introducing adjustments to the trial balance at the end of the period, making adjusting entries, preparing closing entries and finally preparing closing trial balance [Desh2006, 262]
Financial statements preparation	Transferring data from adjusted trial balance to financial statements using aggregations and splits of different accounts and using additional information
Auditing	Providing the assurance on the financial statements and producing an auditors' report
Financial report preparation	Preparing a comprehensive set of audited financial statements, together with management report and other reports
Report consolidation	Transferring financial statements of subsidiaries into the financial statements of the group
Report delivery	Physical transfer of financial reports between company and its stakeholders
Report publication	Publishing financial reports
Report archiving	Storing financial reports for further needs
Report analysis	Analysis of financial information from financial reports

The listed processes are closely related to the events starting and completing each process. Also the data components can be related directly to certain processes enabling later integration of data and function views..

¹⁹¹ Adjusting a trial balance is often related to the process of closing the books [Desh2006, 262].

In order to represent and model the function view EPC are used [KeNS1992]. Becker and Schütte address EPC as a comprehensive method of process modelling [BeSc2004, 109-112]. Figures 32, 33 and 34 are graphical representations¹⁹² of accounting cycle processes, report preparation processes and reporting processes within the financial reporting supply chain. Accounting cycle processes presented in figure 32 describe the input and output documents and their processing used during repetitive accounting activities.

¹⁹² This study follows EPC notation as indicated by Becker and Schütte [BeSc2004, 153].

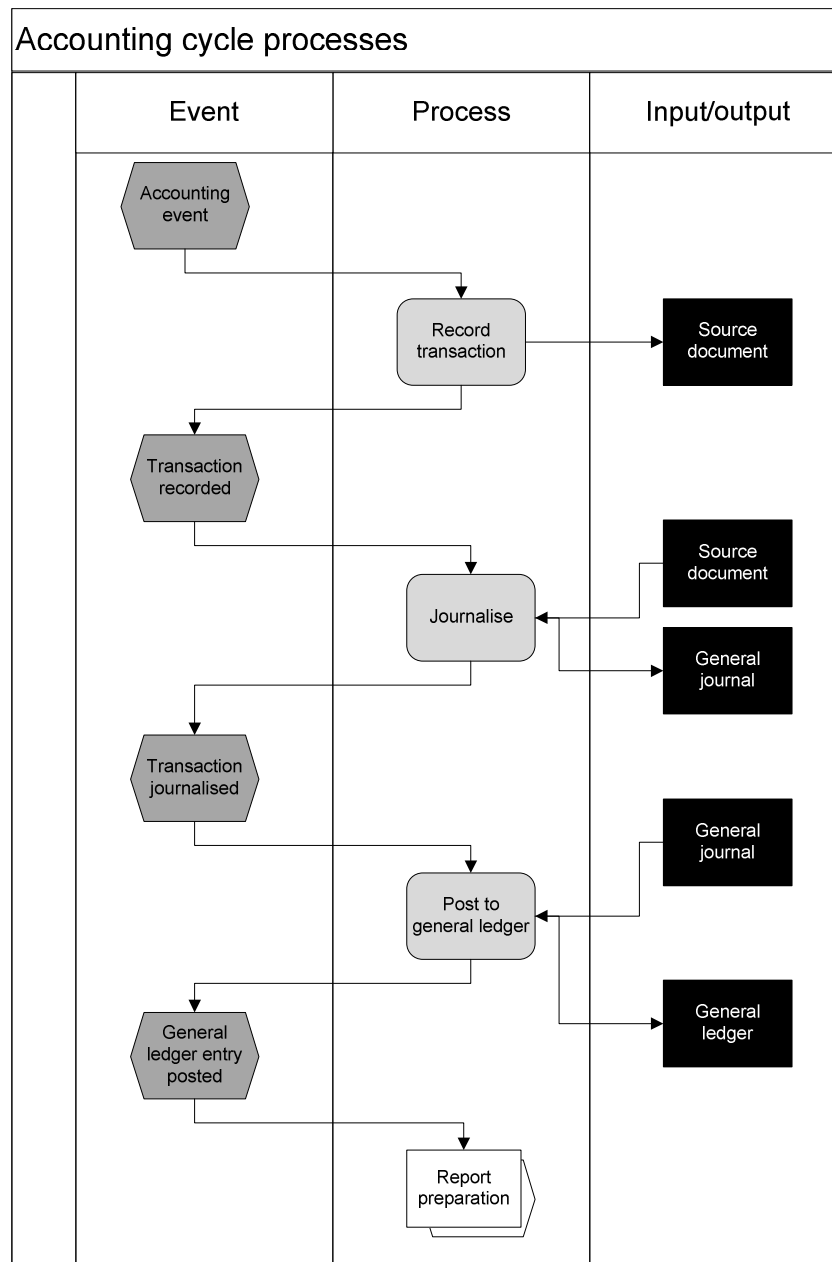


Figure 32. Process Model of Accounting Cycle in Financial Reporting Supply Chain

The accounting cycle is repeatable which means that it is repeated for each occurring accounting event from the beginning of the process chain. The output of the transaction recording¹⁹³ is a source document which can be either in paper or electronic format [BeSc2004, 529]. Mertens indicates that around 30% of source documents must be

¹⁹³ Transaction recording encompasses also the process of conducting the transaction.

entered manually into journal and GL systems while the rest is submitted from other application in machine readable form [Mert2007, 234]. The source document is input¹⁹⁴ for the journalising process and the financial data is stored in the general journal and later posted to the general ledger. The accounting cycle processes end when financial statements are requested.

Figure 33 presents the report preparation processes. Somewhat differently from accounting cycle processes the report preparation processes are conducted usually at the end of the financial period or at the time when the report is requested. Information included in the general ledger is passed through a number of processes in order to prepare financial statements which are subject to audit. The adjustments to trial balance are usually conducted apart from the cases of preliminary statements when this process can be omitted. This is signalled by the *xor* component in the process model. Financial statement preparation output is a set of financial statements as well as, if necessary, a set of tax financial statements. Financial statements are subject to the audit and audited financial statements are output of this process. Finally a financial report can be prepared including all additional information necessary for further reporting.

¹⁹⁴ According to DATEV 100 journal entries generate about 270 GL entries [Mert2007, 234].

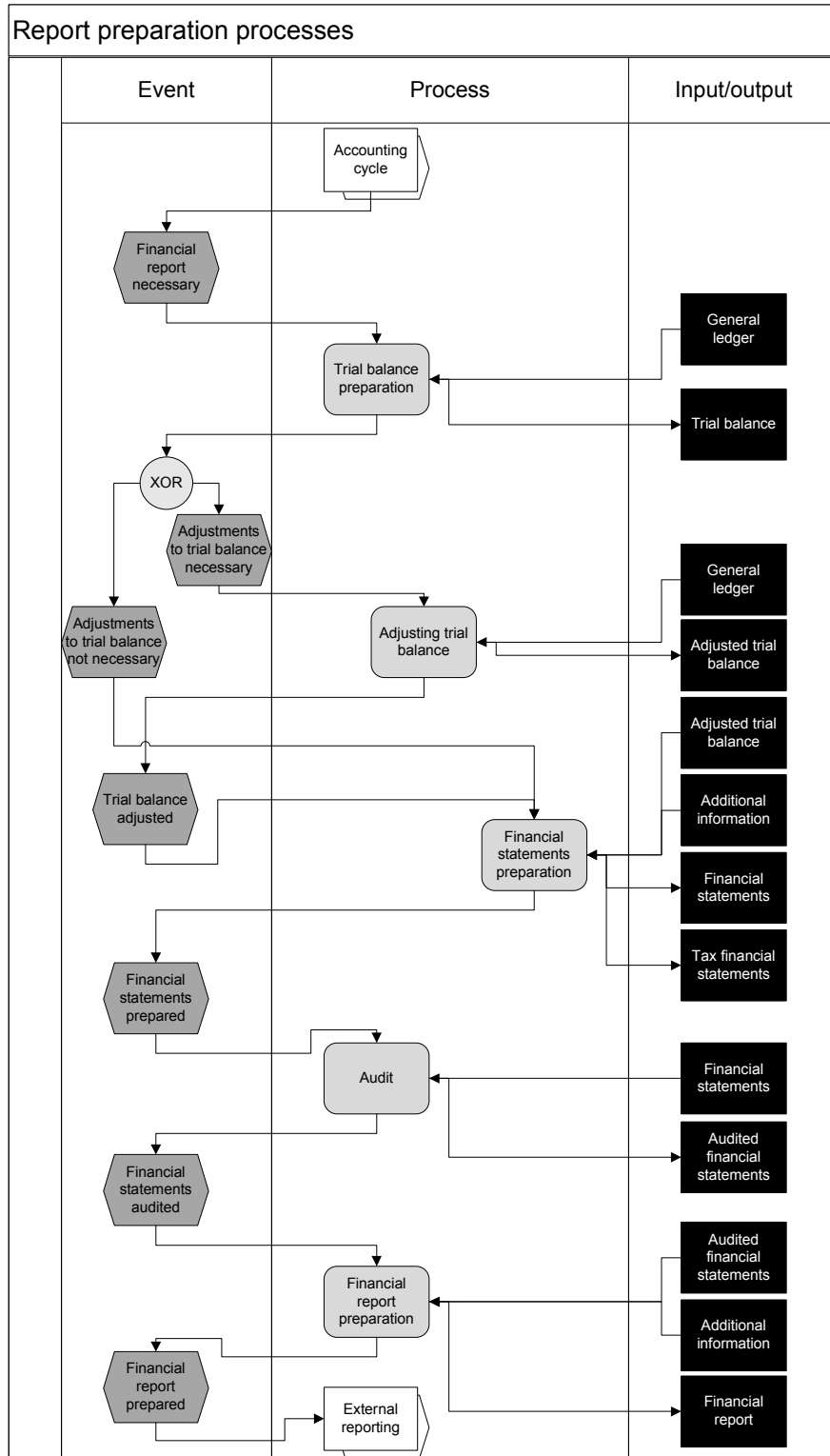


Figure 33. Process Model of Report Preparation in Financial Reporting Supply Chain

After the financial report is prepared the reporting processes starts. Figure 34 models the financial reporting processes.

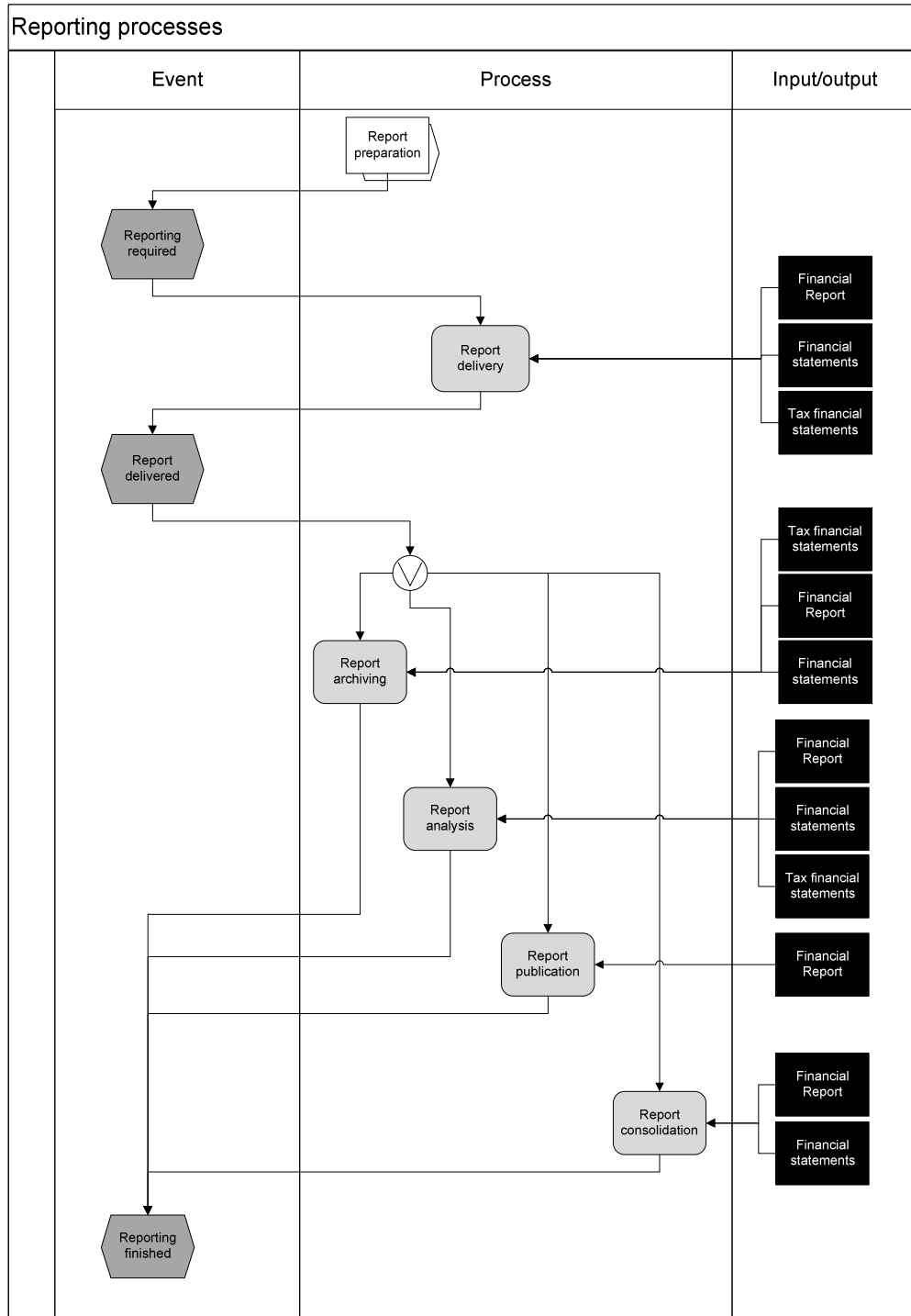


Figure 34. Process Model of Reporting in Financial Reporting Supply Chain

The requirement for the reporting starts with the report delivery process. This study addressed the report delivery also in the context of publication of financial reports by

the company¹⁹⁵. The inputs for the delivery process are financial statements, financial report or tax financial statements. The delivery process is followed by one up to four processes. All three kinds of delivered reports can be archived or analysed depending on the reporting scenario. Usually only financial reports are published, while both financial report and financial statements are input for the consolidation process. The reporting is finished with the completion of one or more of the four processes.

This section presented contextual and conceptual models for the function view of the financial reporting supply chain architecture. The next analysed view is people perspective addressed by Zachman enterprise architecture framework.

5.2.3 People View in Financial Reporting Supply Chain Architecture

The third analysed category is the people view of the financial reporting supply chain. This analysis focuses on the participants of the supply chain and their role in supply chain. Table 24 lists the participants with a brief description of their roles thus modeling the contextual level of the Zachman architecture. List of participants comply with the stakeholders discussed in chapter three.

¹⁹⁵ Report publication is addressed as delivery to investors.

Table 24. People Components in Financial Reporting Supply Chain

Senders/ Re- ceivers	People Components	Description
Senders	Accountants	Responsible for preparing the financial statements, financial reports and tax financial statements
	Management	Responsible for signing off the financial reports
Receivers	Auditors	Responsible for providing assurance on financial statements
	Parent company	Responsible for consolidation of financial statements
	Tax offices	Receivers controlling the reporting entities in the context of tax assessment
	Commercial banks	Receivers controlling the reporting entities in the context of the credit risk management
	Companies registers	Receivers responsible for publication of financial reports
	Supervising institutions	Receivers responsible for controlling the reporting entities and securing the capital markets
	Investors, analyst and stock exchanges	Stakeholders and shareholders interested in information about the reporting entities
	Others	Employees, customers and other potential receivers interested in information about the reporting entity

Table 24 classifies listed participants in senders and receivers. Auditors although often involved in the preparation of financial information are regarded as receivers in financial reporting supply chain. Table 24 provides also a brief description of roles of each participant. In order to ensure more detailed people view modelling on conceptual level is provided. It is conducted with the use of the Responsible, Accountable, Consulted, and Informed (RACI) diagram where responsibilities of participants of the financial reporting supply chain can be modelled:

- Responsible - This role conducts the actual work/owns the problem.¹⁹⁶
- Accountable - This role approves the completed work and is held fully accountable for it.
- Consulted - This role has the information and/or capability to complete the work.¹⁹⁷
- Informed - This role is to be informed of progress and results.¹⁹⁸ [ITGI2005, 18]

Additionally the supportive role is used in this study thus implying the Responsible, Accountable, Supportive, Consulted, and Informed (RASCI) diagram which is the extension¹⁹⁹ to the discussed RACI diagram:

- Supportive - This role provides additional resources to conduct the work or plays a supportive role in implementation.

RASCI roles are assigned to processes discussed in function view thus enabling later integration of both discussed views.

¹⁹⁶ There should be only one R modelled. If multiple R's are listed, then the work needs to be further subdivided to a lower level.

¹⁹⁷ For the role responsible there exists two-way communication (typically between R and C).

¹⁹⁸ The role informed concerns one-way communication (typically from R to A).

¹⁹⁹ RASCI Charts were developed by the Department of Defence in the US and originally called Linear Responsibility Charts (LRC). They were used to clarify roles and responsibilities of people and functions assigned to large projects. The name RASCI evolved as the charts were adopted by defence contractors. [Hale2003, 55]

Table 25. RASCI Diagram of People View in Financial Reporting Supply Chain

	Accountants	Management	Auditors	Parent company	Tax offices	Commercial banks	Companies registers	Supervising institutions	Capital markets	Others
Recording transaction	R ²⁰⁰	A								
Journalising	R/A									
GL posting	R/A									
Trial balance preparation	R/A									
Adjusting trial balance	R/A									
Financial statements preparation	R	A	C		C	C		C		
Auditing	S	S	R/A							
Financial report preparation	R	A	C		C	C		C		
Report delivery	R	A	I	I	I	I	I	I	I	I
Consolidation	S	A	S	R						
Report publication	R	A	I				R/I		R/I	I
Report archiving			R		R			R		
Report analysis					R	R			R	

²⁰⁰ In the ERP systems often usual workers (without accounting knowledge) are responsible for data entries which later are transferred to the journals and ledgers.

Table 25 presents participants and their roles in processes performed within the financial reporting supply chain. The RASCI diagram enables modelling five roles of different participants for listed processes. As presented in the table the majority of responsibilities from the processes concerning the accounting cycle and report preparation activities relates to the company's accountants, company's management and to auditors. Often for the financial statements and financial report preparation receiving institutions can be contacted and consulted in order to provide them with the correct reports. The report delivery needs to be conducted also by the accountants but the accountability is bear by the company's management. The consolidation processes are conducted by reporting company accountants often with auditors' support and also with support of the subsidiary's accountants. Usually all receivers are informed about the report delivery. Publication process is conducted either by the company itself, through the companies register or stock exchange. Auditors, tax offices and supervisors are obliged to archive the reports. Finally tax offices, commercial banks as well as investors and analysts are responsible for conducting analysis of financial reports.

This section focused on the people perspective and their role in the financial reporting supply chain. The RASCI diagram allowed modelling this perspective. The next section focuses on the network and communication components of the financial reporting supply chain architecture.

5.2.4 Network View in Financial Reporting Supply Chain Architecture

The fourth modelled view of the financial reporting supply chain architecture is the network view. In the context of this research network view describes communication components of the transmission of financial information. The network components consist of communication channels, communication means and communication formats presented in figure 35. The communication channel can use a number of communication means while for communication means there can exist no, one or more communication formats.

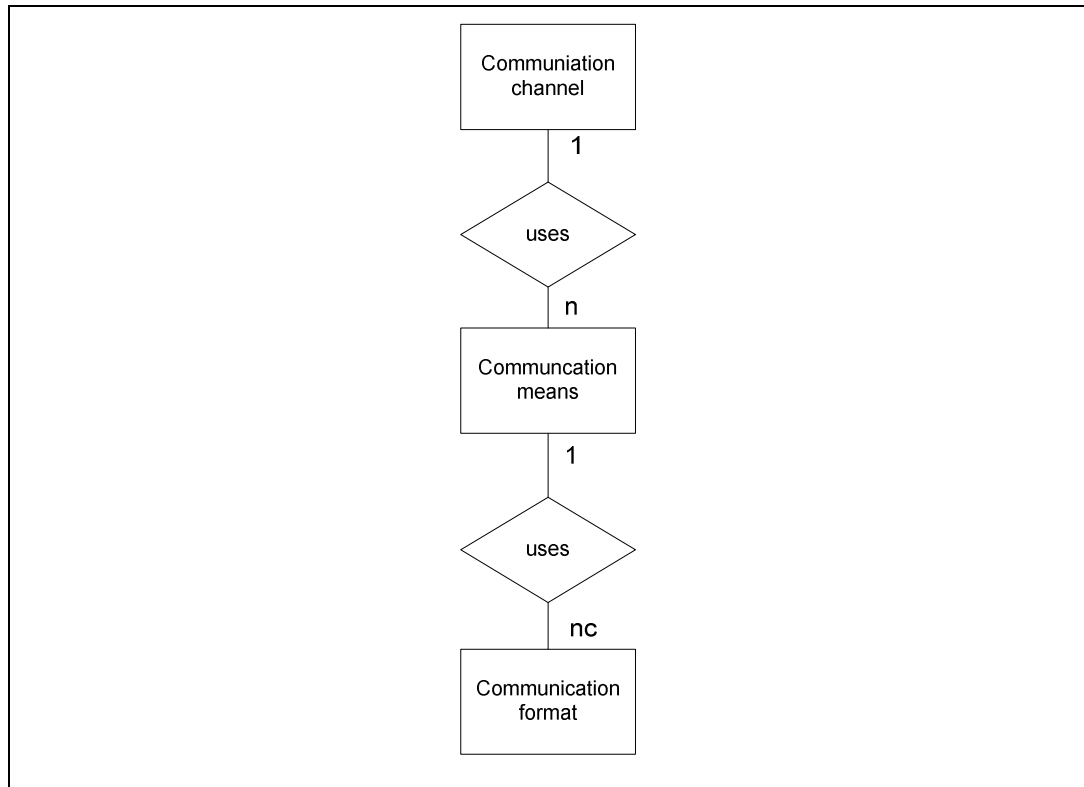


Figure 35. Network Components in the Financial Reporting Supply Chain

In this section all three components are analysed on the contextual level and later modelled on the conceptual level. Table 26 lists all possible communication channels which are results of the analysis conducted in chapter three. Communication channel refers to the way used to convey financial information from sender to receiver.

Table 26. Communication Channels as Network Components of Financial Reporting Supply Chain

Communication channel	Description
Personal	Handing the financial reports in a personal way (possibly on paper, USB, CD ²⁰¹ , etc.)
Post	Sending financial reports via postal way
Fax	Conveying financial reports via fax
Integrated systems	Enabling automated connection between the senders and receivers systems
Internet (HTTP, FTP, Web Services ²⁰²)	Sending the information over internet in electronic form without constant connection

The traditional channels of conveying financial information which are personal, post or fax are still used in many reporting scenarios. But their inefficiencies cause that digital reporting channels are becoming significant. Integrated systems and use of internet are changing the channels of financial communication.

The financial information conveyed by one of channels presented in table 26 can be physically conveyed by one of means of communication described in table 27.

Table 27. Communication Means as Network Components of Financial Reporting Supply Chain

Communication medium	Description
Paper	Using paper to capture the financial information
File	Using file(s) to encode the financial information

²⁰¹ The use of personal communication channel with CD or USB requires the communication means file. But due to rare use of such scenario this is not further modelled.

²⁰² Web services can be also used in communication channel integrated systems.

Principally two means of communication were identified. Financial information may be conveyed by the means of paper or in form of an electronic file.

The possibility to transfer the data in an electronic way introduces next level of the complexity of the network view components which is communication format. Communication format refers to the data format of the transmitted electronic file. The overview of the data format used in financial reporting supply chain is presented in table 28.

Table 28. Data Formats as Network Components of Financial Reporting Supply Chain

Data format	Description	Automatic Processing
Text file	Word/RTF documents use for encoding financial reports	Publishing only
Hypertext Markup Language (HTML)	Use of websites to present financial reports [MPGr2002, 44]	Publishing only
Spreadsheet	Use of Excel calculation spreadsheets to present financial information	Partly possible (semantic not supported)
Portable Document Format (PDF)	Use of internationally accepted file format for documents exchange [MPGr2002, 44]	Publishing only
XML	Use of XML ²⁰³ as format for encoding financial reports (other than XBRL)	Possible with semantic support
XBRL ²⁰⁴	Use of XBRL instance documents and XBRL taxonomies to convey financial reports	Possible with increased semantic support
Proprietary data formats	Use of other data formats which are proprietary (software vendors or receivers owned formats)	Depending on the data format

²⁰³ Use of XML in this context is referred to XML together with XML schema or with DTD.

²⁰⁴ Analysing impact of XBRL is the substantial part of the next sections of this chapter. Table 27 discusses XBRL only as one of the possible data formats of the delivery of financial information in the financial reporting supply chain.

Table 28 provides the overview of the formats possible for conveying of financial information in case a file is used as means of communication. The overview apart from the description delivers answers to the further automatic possibilities of the conveyed financial reports. Only XML and XBRL (and partly Excel²⁰⁵) support further automatic processing of submitted reports. Further only XML and XBRL are able to provide semantic data structured for data submitted.

The contextual level of the network view presented in tables 25, 26 and 27 provides an overview of network components divided in three groups. First ERM specialisation and generalisation relationships are modelled between the components of the communication channels, communication formats and communication means. They enhance the later modelling of dependencies among various network components and are addressed in figure 36.

²⁰⁵ It is possible to automatically process data from spreadsheet cells but the definition of data structure is not available using this format.

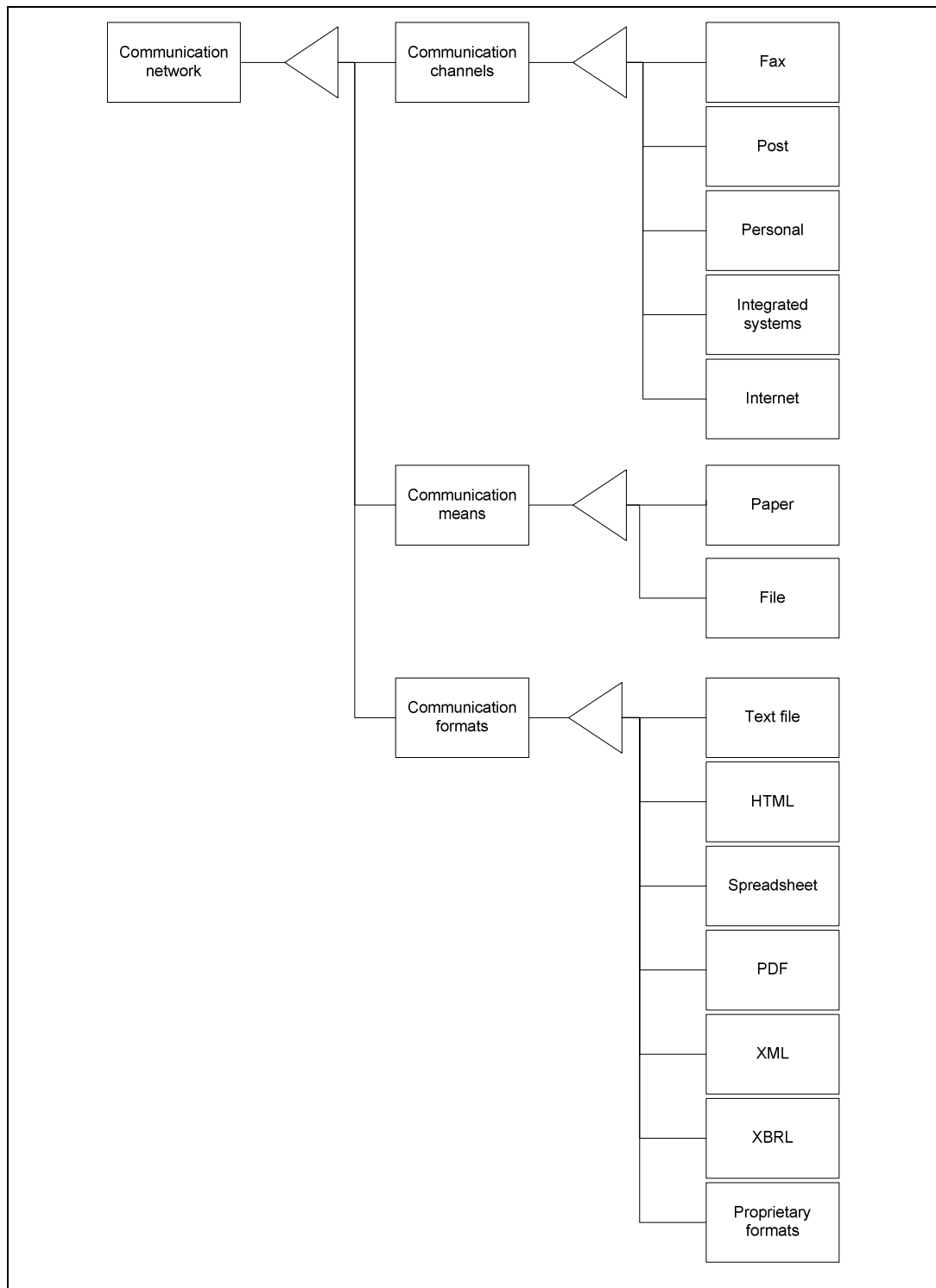


Figure 36. Network Model of Financial Reporting Supply Chain

Specialisations of communication network are communication channels, communication means and communication formats. Communication channels can be specialised

into fax, post, personal, integrated systems or internet way of conveying financial information. For communication means the specialisation encompasses paper or file in which financial information is stored. Finally for the communication format text files, HTML, spreadsheets, PDF, XML, XBRL or proprietary formats are available.

Figure 37 presents the dependencies between communication channels, communication means and communication formats using simplified²⁰⁶ ERM diagram.

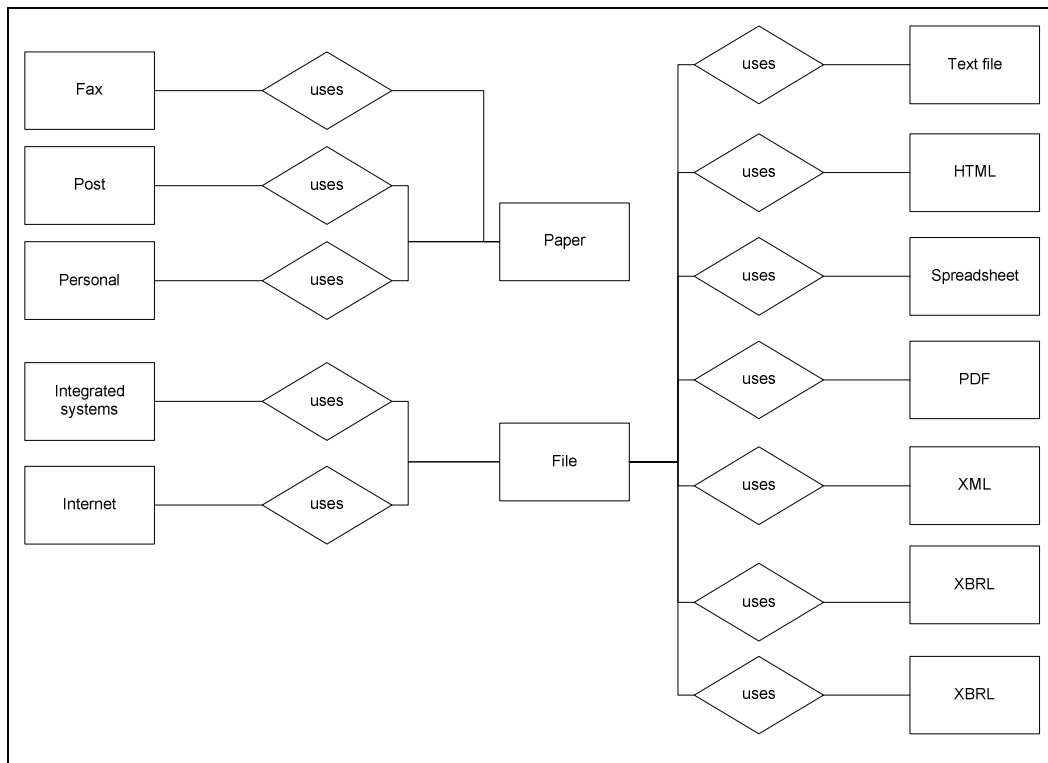


Figure 37. The Dependencies between Communication Channels, Communication Means and Communication Formats

The relationships between communication channels, means of communication and communication format presented in figure 37 provide an overview of the situation in communication network the financial reporting supply chain. According to results from financial reporting domain analysis the traditional communication channels such

²⁰⁶ Cardinalities of relationships were omitted since they do not increase the value of the model. The focus of the model is on the data components and their relationships. also attributes of entities and relationships are not modelled in order to increase readability of the model.

as personal, postal or fax use paper as communication means. Modern communication channels such as integrated systems or use of the internet for communication between reporting and receiving institution are solely based on the electronic files. Reports on data storage and in a form of a file transmitted over the internet or through an integrated system are stored in a number of data formats. The range is from text documents, PDF or HTML files through spreadsheets up to XML and XBRL together with proprietary formats used in some reporting scenarios.

This section modelled the network view for the financial reporting supply chain architecture. The next section deals with time aspects in the financial reporting.

5.2.5 Time View in Financial Reporting Supply Chain Architecture

The next modelled view of financial reporting supply chain is the time view. On the contextual level it refers to list of events important for modelled architecture. Chapter three while analysing financial reporting domain already referred to significant events triggering certain processes. Also function view modelled in section 5.1.3 provided a number of important events. The events related to the time view are summarised in table 29.

Table 29. Triggers as Time Components of Financial Reporting Supply Chain

Time related event	Description
Financial statements prepared	Trigger for the reporting to auditors and to group
Financial statements audited	Trigger for preparation of financial report and reporting to group
Financial report prepared	Trigger for reporting to capital markets
Financial year ends	Trigger for reporting to capital markets, credit risk reporting and tax reporting
Financial reports published	Trigger for statutory reporting
Request of financial statements	Trigger for credit risk reporting

The events described in table 23 enable general understanding of the time view. The issue arises while modelling the next level of the Zachman architecture which is the

conceptual view. The conceptual time view is modelled with a Gantt diagram²⁰⁷. Due to the fact that generalising time view is difficult, figure 38 presents the modelling for the scenarios in Germany discussed in chapter three. Due to the fact that accounting cycles and report preparation are related to company specific time schedules only reporting is visualised in the time conceptual model. The balks presented in the figure are modelled either without time constraint (white bar) when there is no defined time for completing an activity or with time constraint (grey bar) when there is legally bounding timeframe of completing an activity.

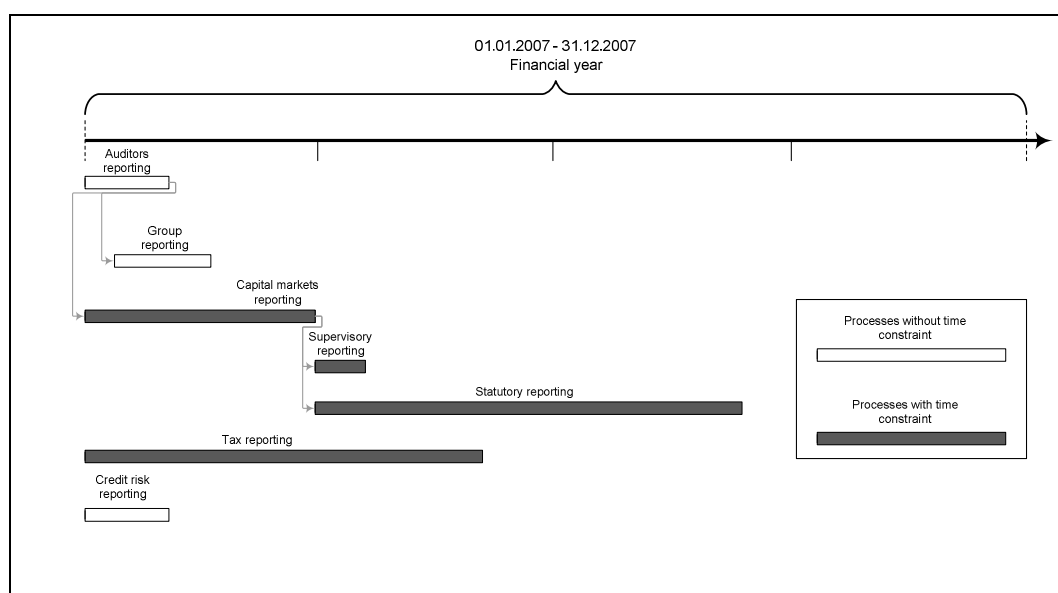


Figure 38. Time Model of Reporting Processes in Financial Reporting Supply Chain

The modelled time view assumes the financial year (01.01.2007-31.12.2007 in the example) is the year following the reporting financial period. It means that the times for reporting processes refer to the financial information reported as of 31.12.2006 or for 01.01.2006- 31.12.2006. Four reporting processes, auditors, capital markets, tax and credit risk reporting are related to the year end trigger. For auditors reporting and credit risk reporting there is no legally defined time constraint²⁰⁸, while for the capital mar-

²⁰⁷ Felden indicates the possibility of using master schedule for conceptual modelling of time [Feld2006b, 227]. This study applies Gantt charts as visualisation of master schedule.

²⁰⁸ But the time constraint can be agreed individually between the sender and the receiver.

kets there is a timeframe of three months and for tax reporting five months after year end. Auditors' reporting is followed by the group reporting²⁰⁹ which also have no legal time constraint. After the financial report is published the supervisory reporting must take place within 20 days and statutory reporting within four months. The GANTT diagram together with the list of triggers can be integrated with the function view modelled in earlier section.

This section analysed briefly time perspective on the financial reporting supply chain architecture. The last analysed view discussed in next section is motivation view.

5.2.6 Motivation View in Financial Reporting Supply Chain Architecture

The last modelled view of financial reporting supply chain is the motivation view. On the highest contextual level it refers the list to the business goals and objectives. In the context of financial reporting supply chain the diversity of the participants leads to a number of different goals. Nevertheless it is important to include all the goals from general perspective and not focus only on single participants. The list of business goals and strategies derived from reporting scenarios discussed in chapter three is presented in table 30. Modelled components are direct motivations of different scenarios as reported in the survey.

²⁰⁹ The assumption is that audited financial report is used for reporting to the group.

Table 30. Business Goals/Strategies as Motivation Components in Financial Reporting Supply Chain

Business goal	Description
Provide assurance of financial reports	Assure that disclosed information is reliable
Provide fair view of group	Providing information about the group which represents the fair view on group's financial position, performance and other relevant information
Provide a fair view of company	Providing information about the company which represents the fair view on company's financial position, performance and other relevant information
Protect capital market participants	Control of the listed companies in order to avoid practices not allowed on capital markets
Provide general public with financial information	Publishing information in a form accessible to general public
Reveal malpractice and mistakes of tax payers	Control of the tax assessment processes and analysis of financial information submitted by tax payers
Secure borrowings	Control of the borrowing entity esp. in the context of its solvency

The goals listed in table 30 are modelled using graphical approach and presented in figure 39. Especially hierarchy of the goals and their relations are identified. The hierarchy of goals is constructed based on the results of the survey from chapter three. The following section explains the interrelation of the listed goals.

The first goal, providing assurance on financial reports, supports the goals related to providing fair view on the company or on the whole group. Also due to the consolidation of financial statement providing a fair view on the company supports providing a fair view on the whole group. Further both goals support providing general public with financial information. From the single company perspective²¹⁰ providing fair view on the company protects market participants, helps reveal malpractices and

²¹⁰ Similar relates to the whole group.

mistakes in tax assessment process and finally helps secure borrowings. In general the motivation model delivers high level set of goals which can be mainly used for strategy setting for financial reporting supply chain. Operationalisation and integration of motivation view can be first conducted after transferring the goals into rules and modelling them on system model level.

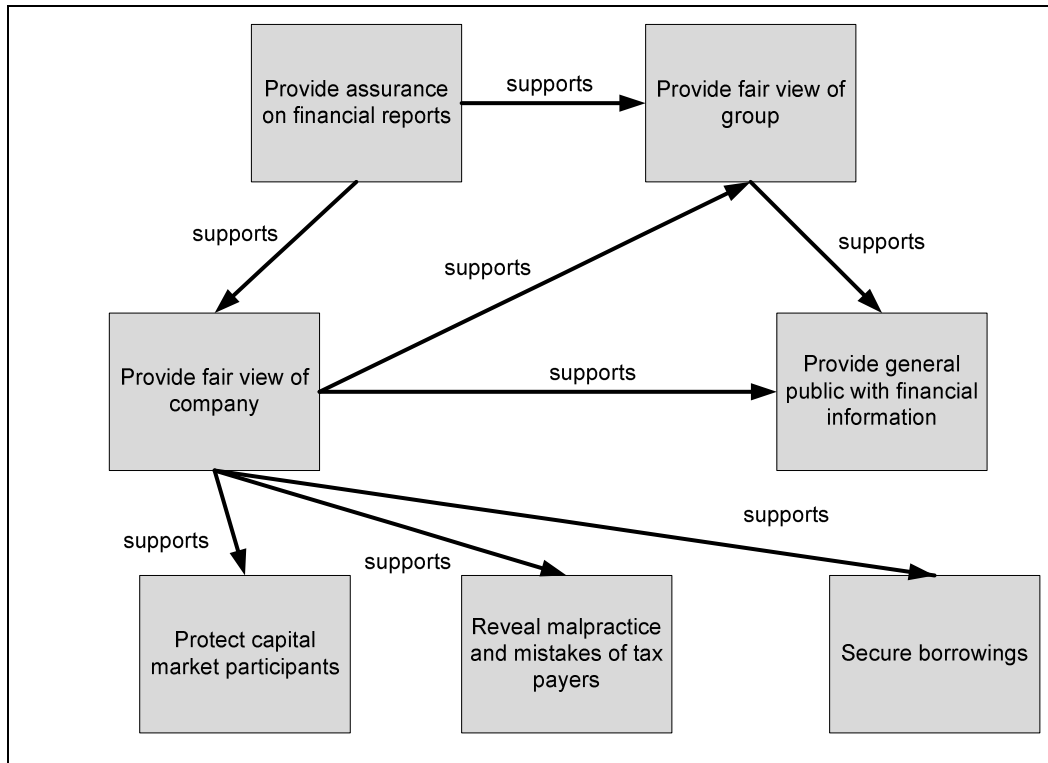


Figure 39. Motivation Model of Financial Reporting Supply Chain

5.3 Models of XBRL Financial Reporting Supply Chain Architecture

This section focuses on modelling of the XBRL financial reporting supply chain architecture. In the first part this section introduces XBRL reporting cycles as well as classification of XBRL technologies. Further the results of modelling activities are presented. The basis for the analysis is set of models of the financial reporting supply chain discussed in the previous sections. XBRL financial supply chain architecture section is ordered according to Zachman architecture framework views. It discusses XBRL impact on the contextual and conceptual level. The analysis starts with data

view, goes over function, people, network and time view and is completed with the discussion over motivation view.

5.3.1 Open and Close XBRL Reporting Cycles

The analysis of XBRL in the reporting processes leads to differentiation among two reporting cycles. The current section discusses the open and close reporting cycles and the role which taxonomies, taxonomy extensions and instance documents play in each of the cycles.

Close reporting cycle concerns a situation when the data structure of the report is closed and cannot be amended by the reporting entity. Such a case can be often observed in the tax and supervisory reporting scenarios. In the context of XBRL language it means that the receiving entity is providing a taxonomy²¹¹ and the reporting entity must not extend this taxonomy. The reporting entity is only allowed to build an instance document based directly on the taxonomy. Figure 40 provides an overview of the XBRL use in the close reporting cycle.

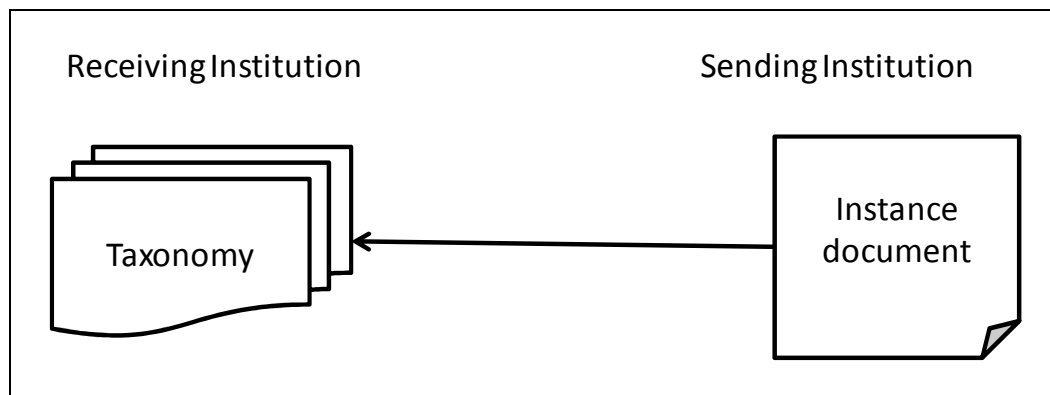


Figure 40. XBRL Use in the Close Reporting Cycle

In the open reporting cycle the situation is different. The receiving institution provides a taxonomy and the reporting institutions can extend it and report back the instance

²¹¹ From the technical perspective the receiving institution can also provide a taxonomy extension to the sending institution. It changes nothing for the sending institution in the close reporting cycle. The instance document created needs to refer to one (entry point) schema of the DTS indicated by the receiving institution.

document together with the company specific taxonomy extension. The instance document in such a case refers to the company specific taxonomy extension which imports the taxonomy provided by the receiving institution. Figure 41 provides an overview of the use of XBRL taxonomies, taxonomy extensions and instance documents in the open reporting cycle.

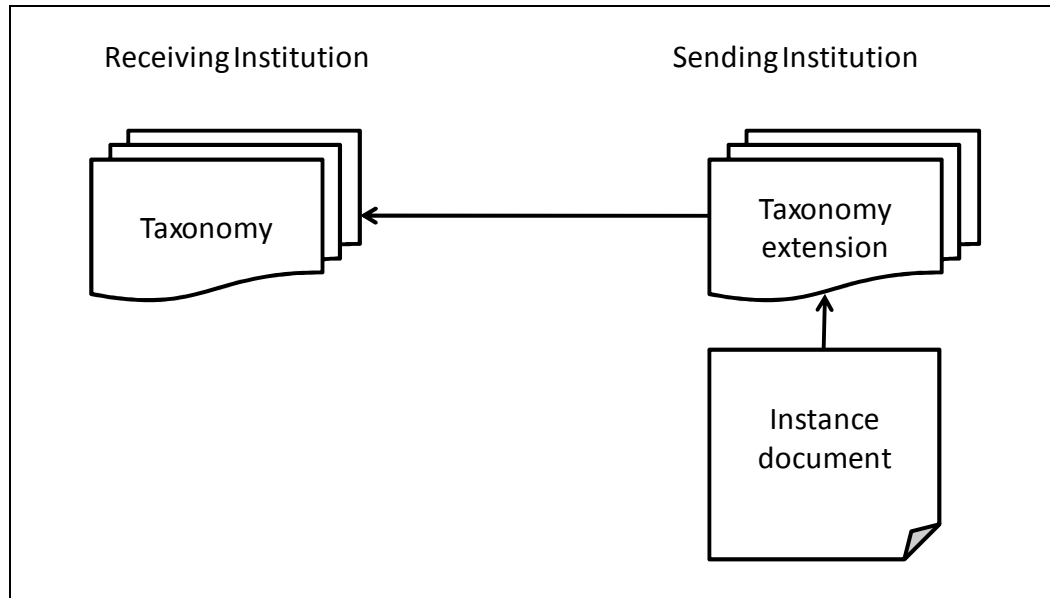


Figure 41. Use of XBRL in the Open Reporting Cycle

The differentiation between open and closed reporting cycle is very common in reporting scenarios without XBRL. But with the introduction of XBRL technology it receives a new perspective since the use of taxonomy and taxonomy extensions stronger than before impacts the information systems of both sending and receiving institutions. Also the issues related to mapping of data structures as well as the XBRL extensibility issues need to be considered especially in the open reporting cycle scenarios.

5.3.2 Classifications of XBRL Technologies

This section discusses different approaches to classify XBRL technologies discussed in this chapter. Apart from the classification provided by Turner et al. this section presents the semantic oriented approach to the classification of XBRL technologies. Figure 42 presents the XBRL technology stack.

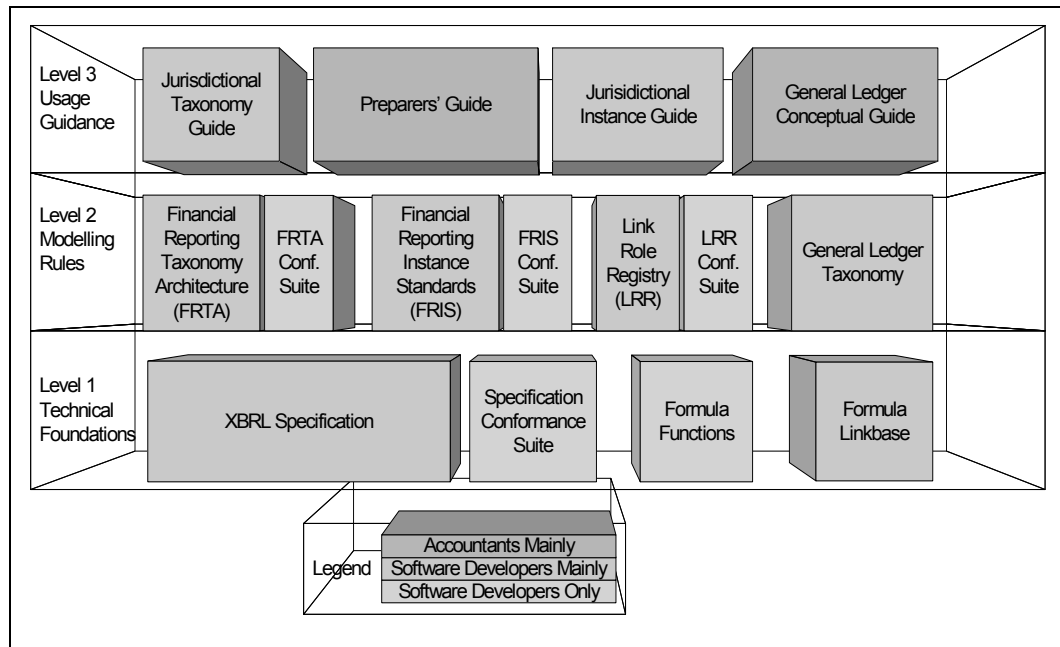


Figure 42. XBRL Technology Stack [Turn2005, 2]

According to Turner et al. there are three layers of XBRL documentation, comprising:

- a technical foundations layer;
 - a layer of modelling rules to guide advanced XBRL users as to how to use XBRL for applications such as financial or business reporting;
 - a usage guidance layer that enables end-users to create XBRL documents.
- [Turn2005, 2]

Within these layers, the documents are aimed at different audiences, either strictly software developers, mainly software developers, or primarily for accountants (or equivalent business users) [Turn2005, 1-2]. Nevertheless the framework does not explain the role and implementation method of different XBRL technologies as well as relations between them. What is more the framework addresses a number of documentations that not exist yet or there are no further information from the XII that they will be finalised soon [XBRL2006e].

This study builds own classification of the XBRL technologies on the basis of approaches to the classification of XML technologies. The approaches to classify

XML based technologies are based on the identification of the semantic data structure together with the differentiation between data and document orientation. Klettke and Meyer discuss the storage of XML documents in the relationship of their data structure character. Figure 43 presents three approaches to the storage of XML documents.

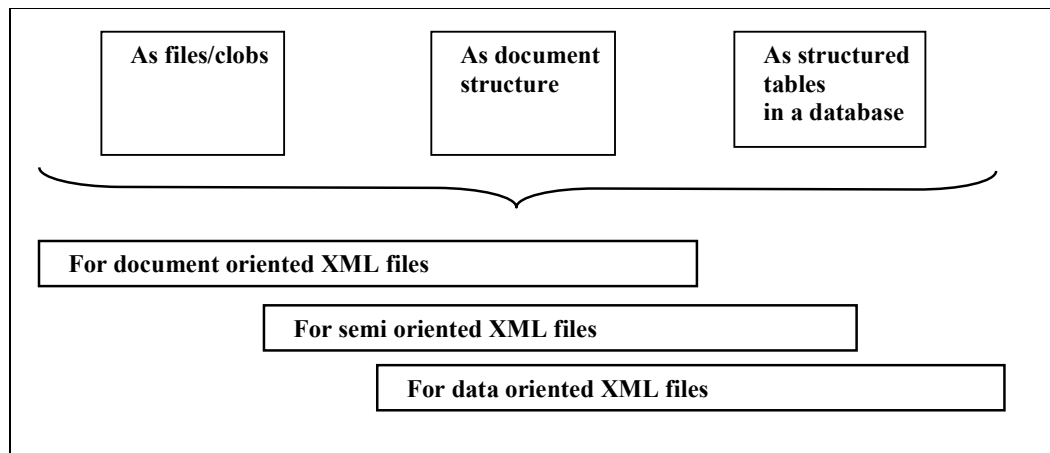


Figure 43. Approaches to Storage of XML Documents [KlMe2003]

XML files can be stored as a character large object (CLOB) in relational data bases. Also the storage of the document structure with graph structure of XML document is possible. Further Schwalm and Bange indicate the possibility to map the XML documents directly to the database tables [ScBa2004, 7]. Additionally Klettke and Meyer indicate the possibility of hybrid storage with splitting of XML documents and handling single parts with different approaches [KlMe2003, 190].

The discussed approaches to the storage of XML documents do not take into consideration multidimensional data storage. This needs to be considered in the context of discussed XBRL dimensions. It is important to classify the existing XBRL technologies according to their semantic importance. Figure 44 presents the division of XBRL technologies discussed in this chapter into three parts. The underlying consideration is to identify existing XBRL data models, especially these expressed in different XBRL taxonomies and try to classify them according to the level of semantic complexity. The data model being the XBRL GL and similar taxonomies is heavily based on tuples and nested tuples. The importance of the relationships between elements is of lower importance since the facts reported are expressed using the tuple. Such data

model is data oriented and has the lowest level of semantic complexity. The complexity rises in case of XBRL FR taxonomies. In such a case the hierarchies of elements gain higher importance since the order in which elements are placed holds indirect information of the construction of the created report. This data model is oriented towards not only transmitting data entries but also expressing whole document (report) and keeping semantic relationships among reported facts. Finally the XBRL dimensions introduce the third and highest level of semantic complexity. The important construct in case of XDT are hypercubes and it is designed to transmit data which is multidimensional.

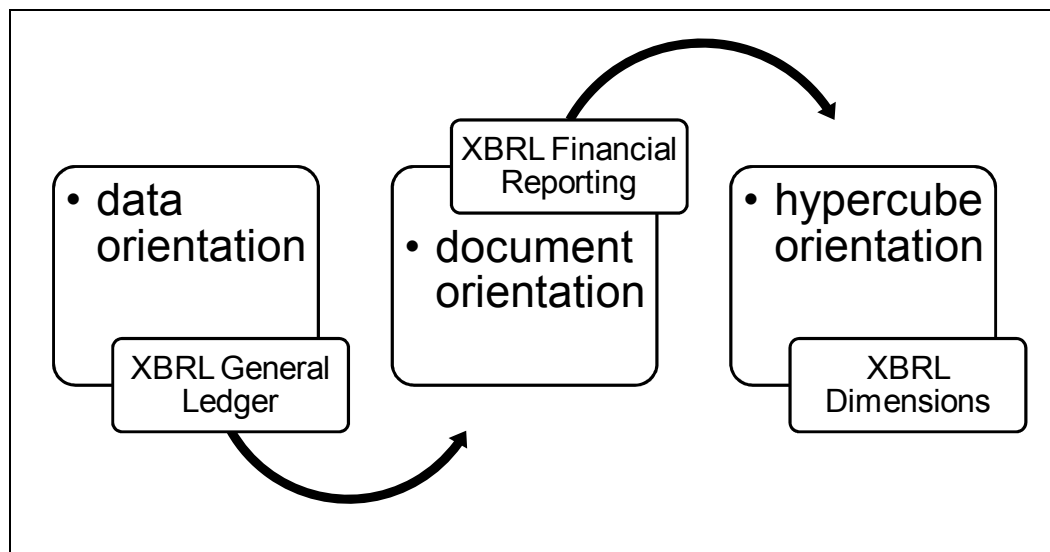


Figure 44. Classification of XBRL Data Models According to their Semantic Representation

The above classification differs from the classification suggested by Turner and presented at the beginning of this section. The semantic oriented classification does not consider the underlying documents or the level of knowledge of the users of XBRL. It focuses on the data models behind different XBRL technologies and categorises them according to their semantic expressiveness.

In further modelling activities the XBRL GL and XBRL FR components are applied. XBRL dimensions due to their main use in the banking reporting are out of scope of this study.

5.3.3 Data View in XBRL Financial Reporting Supply Chain Architecture

Impact of XBRL technologies can be first analysed using the contextual view on the data components and data structures. In this view XBRL leads to a number of changes listed in table 31.

Table 31. Data Components in XBRL Financial Reporting Supply Chain

Data Component	Counterpart XBRL Data Component
Source document	--
General journal	XBRL GL general journal instance document
General ledger	XBRL GL general ledger instance document
Trial balance	XBRL GL trial balance instance document linked to XBRL FR with the use of SRCD module
Adjusted trial balance	XBRL GL trial balance adjusted instance document linked to XBRL FR with the use of SRCD module
Financial statements	XBRL FR instance document representing financial statements based on XBRL FR taxonomy extension
Tax code financial statements	XBRL FR instance document representing tax financial statements based on XBRL FR taxonomy extension
Additional information	--
Audited financial statements	XBRL FR instance document representing audited financial statements based on XBRL FR taxonomy extension
Financial report	XBRL FR instance document representing financial report based on XBRL FR taxonomy extension

As presented in table 31 it is possible to express almost all data components from data view of financial reporting supply chain architecture. For most of data components it is possible to find XBRL counterpart data component in either XBRL GL or XBRL FR. Only source documents are not represented with XBRL data components²¹². For general journal, general ledger, trial balance and adjusted trial balance data it is possible to create instance documents based on XBRL GL taxonomy. This section does not discuss further use of these documents only indicating the possibility of their creation.

²¹² In theory it is possible to express source documents using XBRL GL taxonomy but this research classifies this approach as implausible at the time of writing of this thesis.

Exception to this rule is connection between trial balance data and XBRL FR with the use of SRCD module of XBRL GL taxonomy. According to Klement such a connection increases transparency²¹³ of the data transferred over the supply chain and also enhances the automation of the supply chain [Klem2007, 258].

Further data components refer to the financial statements, tax financial statements, audited financial statements and financial report. Ideally all of these could be based on a base taxonomy. But in the reality different underlying regulations²¹⁴ cause that companies base their instance documents on different taxonomy extensions. The composition of the instance document depends on the requirements of the receiver. Instance documents representing financial statements are smallest in scope while instance documents representing financial reports provide lot more information. XBRL supports also the disclosure of the audited information by the use of different context on the facts in an instance. Additional information does not have XBRL counterpart due to the fact that it is a feed for financial statements and financial report without the need²¹⁵ to encode it with XBRL.

Table 32 provides an overview of the XBRL impact on the data structures discussed for the financial reporting supply chain.

²¹³ Klement indicates also the issues with mapping XBRL GL to XBRL FR [Klem2007, 266]. But these issues concern in the first line context mapping which is partly solved with the SRCD module released after publication of Klement.

²¹⁴ For example IFRS is used for capital market reporting and HGB is required for tax reporting.

²¹⁵ And in most situations the possibility to express additional information in XBRL is not plausible. Exception here are projects where systems dealing with preparing explanatory disclosures are XBRL enabled and based on one of XBRL FR taxonomies.

Table 32. Data Structures in XBRL Financial Reporting Supply Chain

Data Structure	Counterpart XBRL Data Structure Component
Chart of accounts	-- ²¹⁶
Accounting standards	XBRL FR taxonomy
Additional regulations	XBRL FR taxonomy with taxonomy extensions
--	XBRL GL taxonomy

Accounting standards are expressed with the use of XBRL FR taxonomy. A standard set of elements representing accounting and financial reporting concepts create a solid base for financial reporting of companies. Base financial reporting taxonomies considered in this study are the IFRS-GP, US GAAP and German AP XBRL taxonomies. Additional regulations are often expressed by the means of taxonomy extensions. This study classifies also internal company's regulations concerning financial reporting as additional regulations thus the instance documents are based on the taxonomy extension and on base taxonomies²¹⁷. New data structure component is XBRL GL taxonomy without having a direct counterpart in financial reporting supply chain.

The data view modelled and described in figure 45 demonstrates impact of XBRL on the data model in financial reporting supply chain.

²¹⁶ In theory it is possible to represent the chart of account with the use of XBRL FR taxonomy but this approach is not used in practice.

²¹⁷ This implies use of either XBRL closed reporting scenario where receiver's taxonomy extensions are required or XBRL open reporting scenario where sender's taxonomy extensions are allowed.

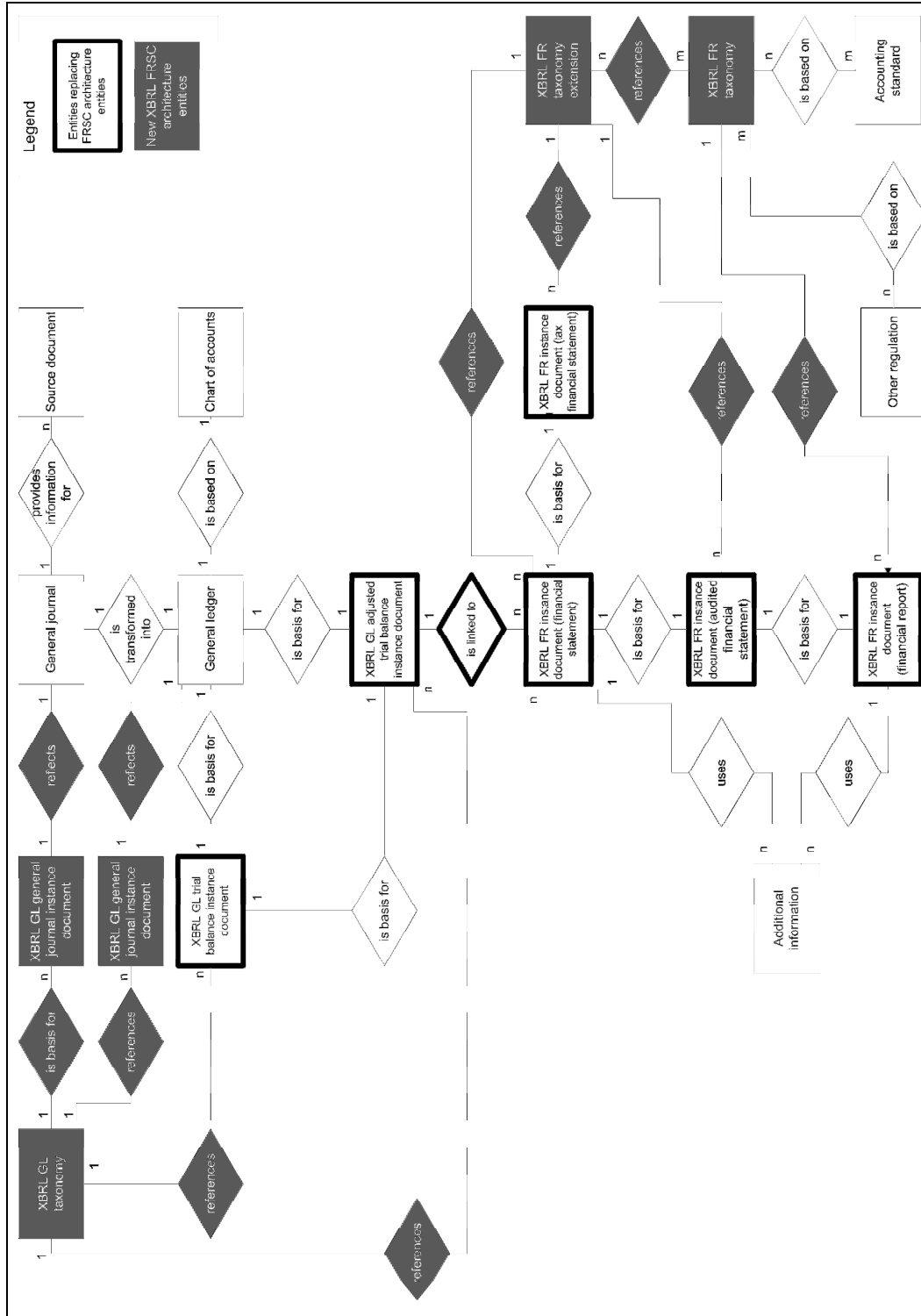


Figure 45. Data Model of XBRL Financial Reporting Supply Chain

The impact of XBRL on the conceptual model of the data view addresses components replaced (bold frame and white background) and a set of new components (grey back-

ground) in the ERM model. First the XBRL GL data components and the XBRL GL taxonomy adds a new part to the data view model. General journal and general ledger instances represent exactly the general journal or general ledger data and a number of them are based on the XBRL GL taxonomy. Due to the fact that both general journal and general ledger are parts of accounting systems it is implausible for XBRL to replace them. XBRL can be only used as a standardised output for this kind of information. Different situation is with the instances representing trial balance and adjusted trial balance. Due to the fact that trial balance is a step in report preparation and an output of the accounting system the plausibility of replacing the trial balance with the XBRL GL instance is high. Also the linkage between the adjusted trial balance instance and the financial statements instance using the SRCD module is modelled. Such an approach enables full automation of part of the report preparation process mainly due to the semantic linkage between both data components.

XBRL literature also does not address the linkage between the journal data, GL data and trial balance which also questions the approach of using these data components in the financial reporting supply chain.

The second modelled part impacted by XBRL is the XBRL FR section. Here the data components from the financial reporting supply chain are often replaced by XBRL components.

5.3.4 Function View in XBRL Financial Reporting Supply Chain Architecture

This section focuses on the changes that XBRL introduction causes to the processes in the financial reporting supply chain. XBRL apart from the impact on data components also changes the way how processes are conducted. Table 33 provides an overview of the processes listed for the financial reporting supply chain architecture and their changed descriptions referring to XBRL introduction.

Table 33. Function Components of XBRL Financial Reporting Supply Chain

Function Item	Description in XBRL Context
Recording transaction	--
Journalising	Producing XBRL instance representing general journal as additional electronic document
GL posting	Producing XBRL instance representing general ledger as additional electronic document
Trial balance preparation	Producing XBRL instance representing trial balance
Adjusting trial balance	Producing XBRL instance representing adjusted trial balance
Financial statements preparation	Transferring data from adjusted trial balance to XBRL FR instance document representing financial statements together with validation ²¹⁸ of this instance document
Auditing	Providing assurance on XBRL FR instance document representing financial statements
Financial report preparation	Preparing a comprehensive XBRL FR instance document representing audited financial statements, together with management report and other reports together with the validation of this instance document
Report delivery	Physical transfer of XBRL FR instance documents between company and its stakeholders
Report consolidation	Transferring XBRL FR instance documents representing financial statements of subsidiaries into XBRL FR instance document financial statements of the group [MPGr2002, 50]
Report publication	Rendering XBRL FR instance documents representing financial reports to the user readable format
Report archiving	Storing of the XBRL FR instance documents for further needs
Report analysis	Analysis of the data from XBRL FR instance documents [MPGr2002, 51]

²¹⁸ Validation is classified as a sub-process of the preparation of instance documents process since most current XBRL tools provide a validation while creating financial statements or financial report.

Changes resulting from XBRL introduction to financial reporting supply chain concern the character of processes. The processes of journalising and GL posting are conducted by accounting systems with the exception that XBRL GL instance document based on XBRL GL taxonomy can be produced. Due to the fact that analysed reporting scenarios did not address usability of the standardised journal vouchers or GL entries for financial reporting, this study only indicates possibility of expressing them in XBRL. Further use for example for audit processes or internal reporting is not considered. Trial balance preparation and adjustments change significantly. Both provide output in form of XBRL GL instance document and what is important the adjusted trial balance must be linked to XBRL FR. So these processes encompass mapping between the trial balance accounts and the financial statements positions with the use of SRCDD module. Thus next process which concerns the preparation of the instance document representing financial statements is conducted with the use of data included in XBRL GL instance document representing trial balance. Due to the fact that trial balance conveys only a part of necessary financial data, additional information is needed in order to provide a full set of financial statements. Instance documents representing financial statements and later financial report are based on GAAP and thus on an XBRL taxonomy.

Next process concerning assurance of instance documents is neither well documented nor discussed in XBRL literature. The study of Trites indicates future direction for assurance of XBRL information based on International Standard for Assurance Engagement (ISA) 3000 [Trit2006]. But due to the lack of pressure from regulators assurance of XBRL documents is not widely discussed yet.

On the basis of instance document representing financial statements an instance document that represents financial report can be produced. Preparation of instance documents is usually completed with the validation of the instance documents according to referenced XBRL taxonomy.

The process of delivery of instance documents focuses on the conveyance and validation on the receivers' side. Depending on reporting scenario the delivery can concern instance document only (closed reporting scenario) or an instance document together with company specific taxonomy extension (open reporting scenario). After

report is submitted four processes can take place. Report consolidation concerns creation of group financial report out of financial statements (or financial reports) of subsidiaries²¹⁹. Report publication usually relates to the rendering of instance documents to user readable formats. Archiving of the reports focuses on storage of XBRL data. This can be conducted either in files form or in various types of databases. Also the storage of XBRL data is not discussed in the literature. Final listed process important for XBRL financial reporting supply chain is report analysis. In this context the Nutz and Strauß indicate the enhancements introduced through XBRL enabled financial analysis [NuSt2002].

Due to the fact that XBRL mainly impacts the character of the functions and no new functions appeared the conceptual level modelled for financial reporting supply chain architecture remains unchanged.

Previous section discusses what changes are introduced in the input/output data components. Function view on the conceptual level is modelled in figures 46, 47 and 48.

²¹⁹ Piechocki discussed initial impact of XBRL on automation of consolidation processes [Piec2007].

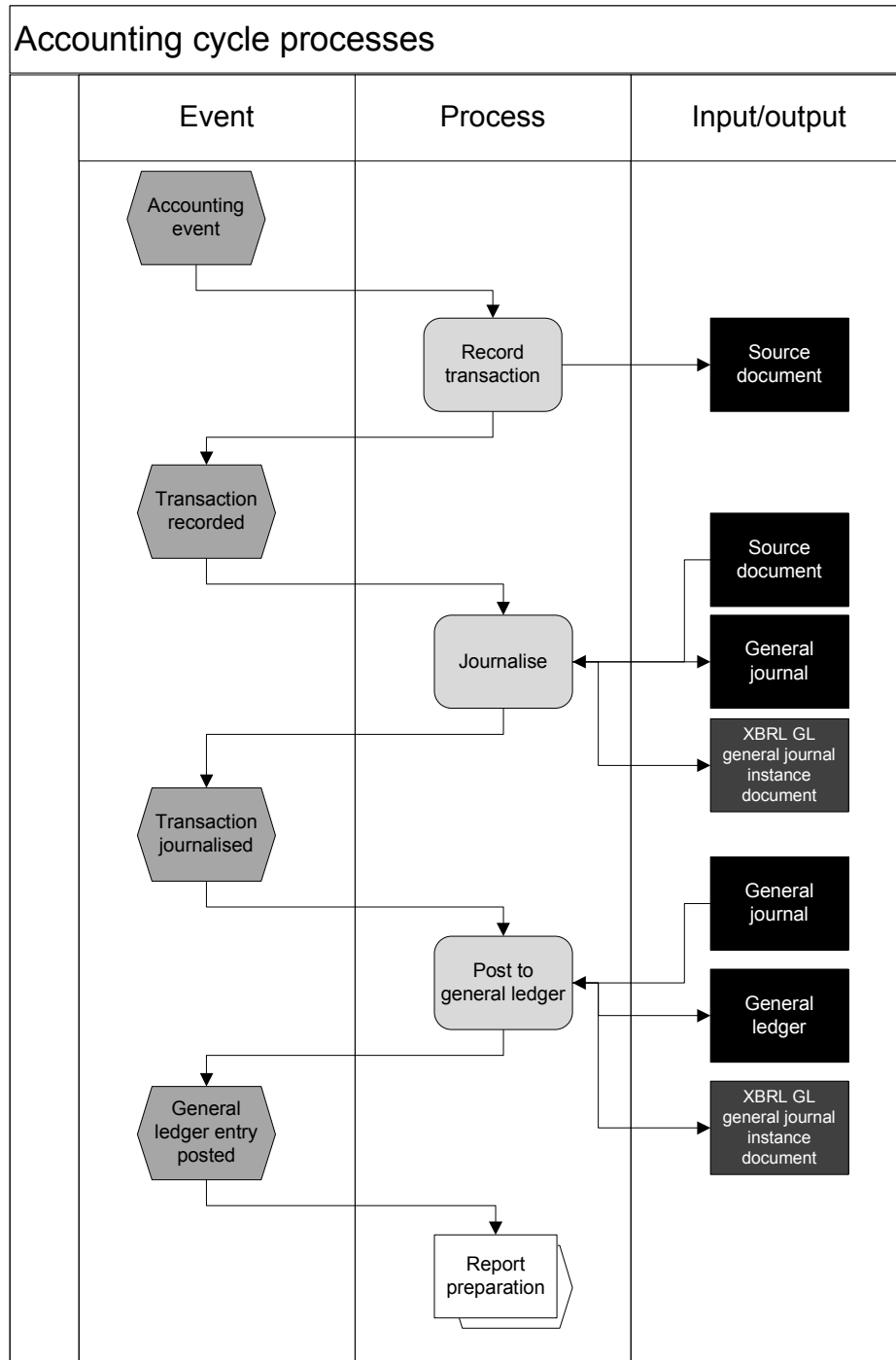


Figure 46. Process Model of Accounting Cycle in XBRL Financial Reporting Supply Chain

Changes to conceptual model of accounting cycle processes concern the discussed output of journalising and general ledger posting processes. Two kinds of instance docu-

ments, XBRL GL general journal and general ledger instance documents may be produced as additional electronic documents. It means that general journal and general ledger as part of the accounting information systems remain unaffected.

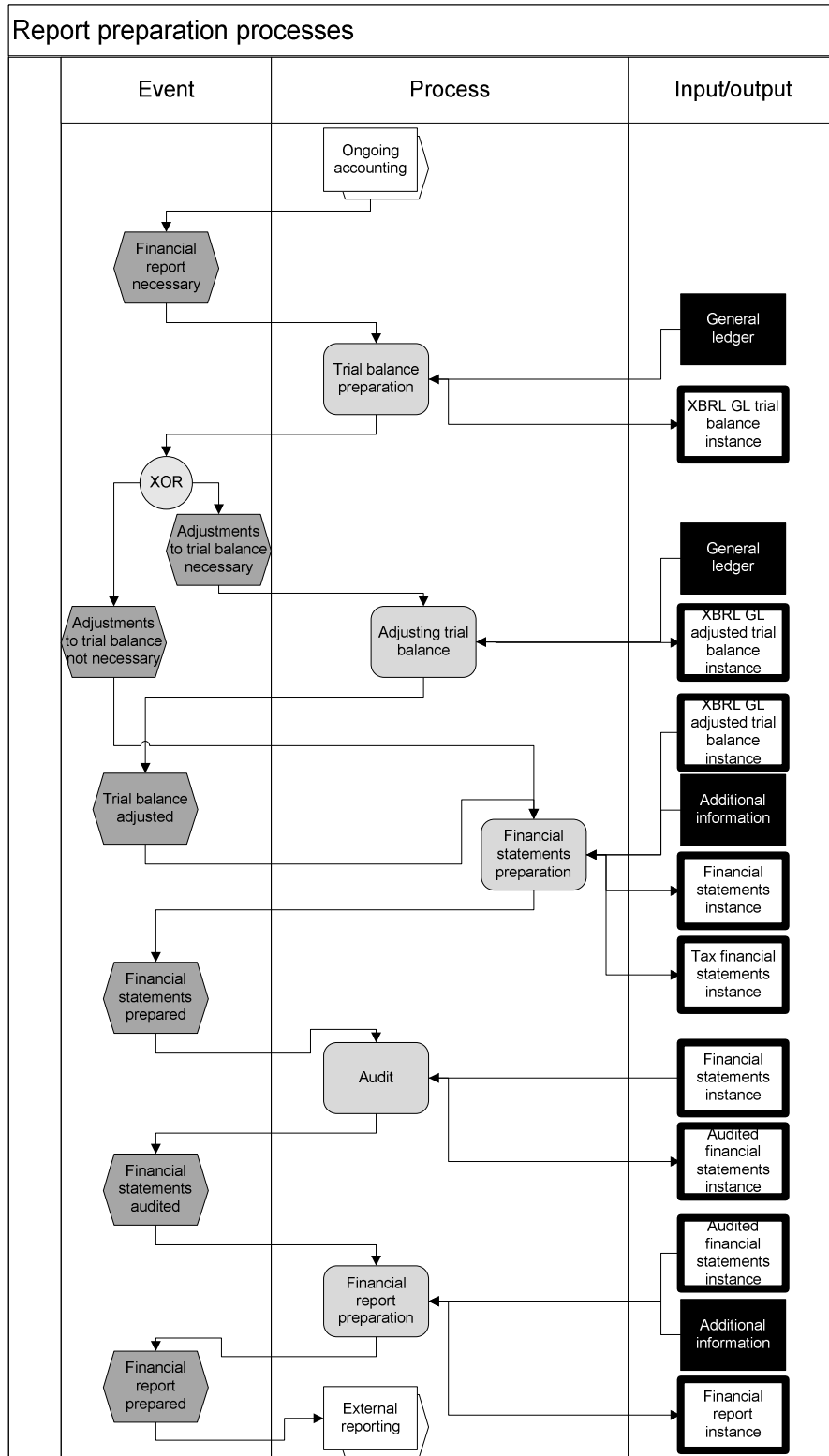


Figure 47. Processes Model of Report Preparation in XBRL Financial Reporting Supply Chain

In conceptual model of the report preparation processes the changes are also signalled by the replacements in input and output data components. The traditional trial balance documents are replaced with XBRL GL trial balance instance documents used for the preparation of the financial statements instance documents as well as tax financial statements instance documents. Both replace traditional financial statements. Also the input for reporting to auditors is solely XBRL instance document for which the auditors' report²²⁰ can be prepared. The financial report preparation process uses instance document representing the audited financial statements and additional information to produce the XBRL instance document representing the financial report.

²²⁰ It is important to note that neither IFRS nor German AP XBRL taxonomies provide a structure for auditors' report. In such a case it is important for auditors to create their own extension to both taxonomies which can be used for all clients of an auditor. Alternatively it is considerable to create jurisdictional taxonomy representing auditors' report.

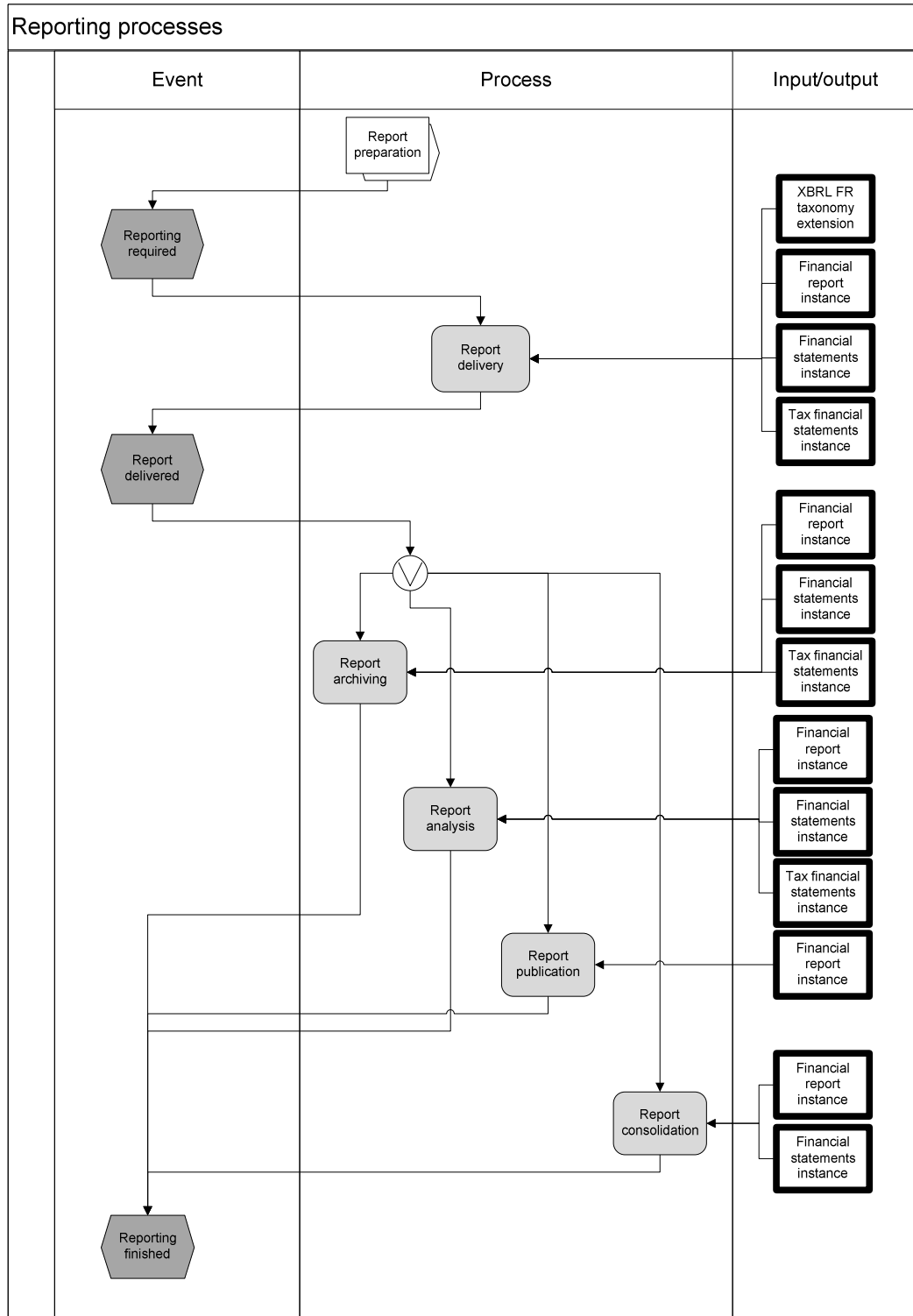


Figure 48. Processes Model of Reporting in XBRL Financial Reporting Supply Chain

The final set of processes concern reporting of financial information. If report is required instance documents build the basis for delivery process. Part of the delivery process is validation of the instance documents against the referenced taxonomy. After successful delivery instances can be stored, analysed, published or used in the consolidation process. Although each of the processes changes from the contextual level point of view, the set of processes and their relationships remain unaffected of XBRL introduction.

This section modelled XBRL impact on the contextual and conceptual level of the financial reporting supply chain architecture. The next section discusses the impact of XBRL on people view.

5.3.5 People View in XBRL Financial Reporting Supply Chain Architecture

This section addresses impact of XBRL on people components in financial reporting supply chain architecture. Earlier in this chapter the list of participants of financial reporting domain was discussed as the contextual view. Also the RASCI model for the people view, addressed before, presented participants of the financial reporting and their roles in different processes. Some studies [FFFM2005, 1; GIPa2006, 69; NuSt2002; Rami2007] address software vendors as participants of the XBRL financial reporting supply chain. This study regards this group as supporters of financial reporting processes (delivering software solutions) but not playing an active role in the supply chain. Thus the contextual level of people view from financial reporting supply chain remains unchanged. XBRL introduction does not impact senders or receivers of the supply chain²²¹.

People components are strongly related to processes conducted in the supply chain. As indicated in the function view XBRL impacts the character of the processes but not the processes itself. This lack of direct impact can be observed further in the people components. Due to the fact that both list of financial reporting supply chain participants and set of processes remain the same, also participants' roles remain un-

²²¹ XBRL introduction in the long term could possibly impact the role of intermediaries such as EDGAR in the US. But the reason for such a change is political and not related directly to XBRL technology.

changed. Thus the RASCI chart of the people view for the XBRL financial reporting supply chain also remains unaffected.

5.3.6 Network View in XBRL Financial Reporting Supply Chain Architecture

This section discusses changes in network view assuming comprehensive introduction of XBRL in whole financial reporting supply chain. Table 34 shows XBRL impact on communication channels. With XBRL introduction three out of five communication channels are not available any more. It is not possible to convey XBRL data personally, per post or using a fax machine. Main XBRL communication channels are integrated information systems having XBRL enabled interfaces and the internet.

Table 34. Communication Channels as Network Components of XBRL Financial Reporting Supply Chain

Communication channel	Description in XBRL Context
Personal	Not available ²²²
Post	Not available
Fax	Not available
Integrated systems	Available
Internet (HTTP, FTP, Web Services)	Available

XBRL encoded financial information conveyed by one of the ways presented in table 34 can be physically conveyed only by the means of communication described in table 35.

²²² Theoretically conveying XBRL files on a CD or USB is possible but is classified as implausible in the context of this research.

Table 35. Communication Means as Network Components of XBRL Financial Reporting Supply Chain

Communication medium	Description in XBRL Context
Paper	Not available
File	Available

As indicated by Hoffman introduction of XBRL terminates paper reporting [Hoff2006, 490]. The only available means of communication is file transmitted over integrated systems or internet identified as communication channels above.

XBRL introduction impacts also the communication formats. This study assumes existence of XBRL as only communication format. But this assumption does not reduce the role of user readable formats. They coexist in financial reporting supply chain as combo products with XBRL. Table 36 presents the changes on the contextual level of the network channels view.

Table 36. Data Formats as Network Components of XBRL Financial Reporting Supply Chain

Data format	Description in XBRL Context
Text file	Available only as XBRL combo product
HTML	Available only as XBRL combo product
Spreadsheet	Available only as XBRL combo product
PDF	Available only as XBRL combo product
XML	Not available ²²³
XBRL ²²⁴	Available
Proprietary data formats	Not available ²²⁵

²²³ Theoretically it is possible to use XML as XBRL derivative but this approach is classified as implausible in this thesis.

²²⁴ As analysing impact of XBRL is the substantial part of the next sections of this chapter. Table 23 discusses XBRL only as one of the possible data formats of the delivery of financial information in the financial reporting supply chain.

²²⁵ Theoretically it is possible to use proprietary formats as XBRL derivative but this approach is classified as implausible in this thesis. Also XBRL proprietary extensions are not further discussed nor modelled. For example Hoffman refers to proprietary formula linkbase [Hoff2006, 428-440].

This study assumes XBRL as main available data communication format. It leads to conclusion of superseding proprietary formats and XML or XML related formats. But formats such as text files, HTML files, spreadsheets or PDFs are still available as XBRL combo products²²⁶. Combo products can have either XBRL tags embedded into format structure²²⁷ or be a simple transformation output [Hoff2006, 98].

Tables 33, 34 and 35 present contextual model of the network view. Figure 49 provides ERM modelling for discussed tables.

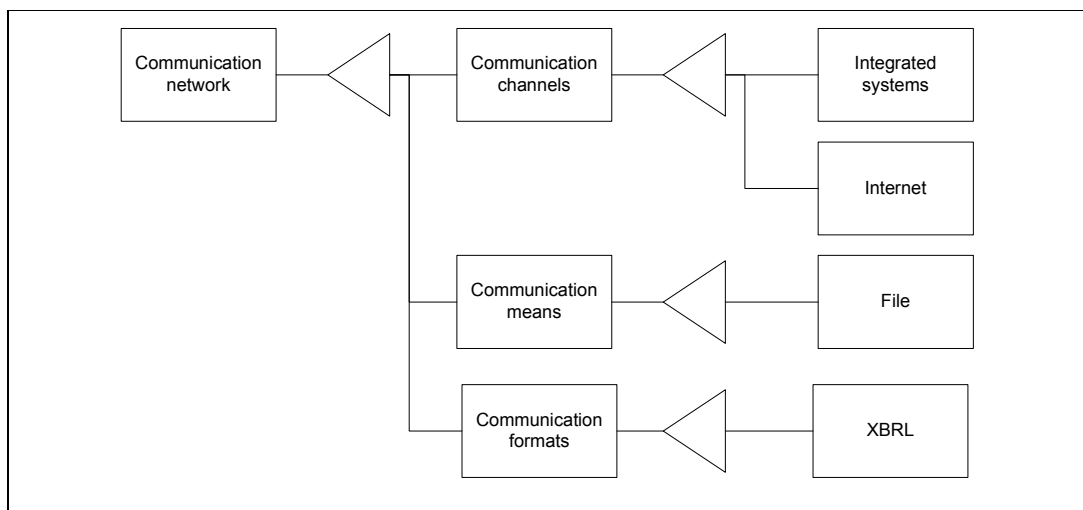


Figure 49. Network Model of XBRL Financial Reporting Supply Chain

Figure 49 presents major simplifications to the communication network in XBRL financial reporting supply chain. Modern communication channels, single communication means and single communication format are major changes in the way how financial information is being transmitted between senders and receivers. Figure 50 presents the composition of the discussed network components introducing the XBRL combo products with the use of ERM²²⁸ modelling.

²²⁶ Hoffman indicates XSLT and XSL-FO as possible transformation mechanisms to introduced combo product formats [Hoff2006, 492-493].

²²⁷ Examples of XBRL tags embedded into PDF structure can be found on the websites of Reuters [Reut2007].

²²⁸ Cardinalities of relationships were omitted since they do not increase the value of the model.

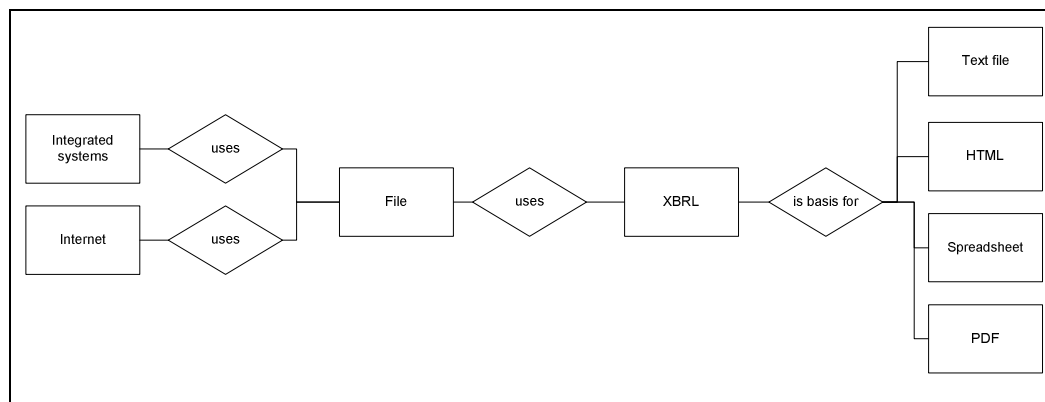


Figure 50. Dependencies between Communication Channels, Communication Means and Communication Formats

Both, integrated systems and the internet, use file as means of communication. The use of file implies that XBRL is the only data format but can be basis for rendering to text files, HTML websites, calculation spreadsheets or PDFs.

XBRL changes all three components, channels, means and communication formats, in the network view of the financial reporting supply chain architecture. The modelled network view of the XBRL financial reporting supply chain architecture is easier to integrate in the information systems. The main reason for this is the reduced number of interfaces necessary to provide a communication structure.

The next section analyses the time components of financial reporting supply chain impacted by XBRL.

5.3.7 Time View in XBRL Financial Reporting Supply Chain Architecture

Time view similarly to people view remains unchanged in XBRL context. The time triggers and time related events are derived from regulations and XBRL technology introduction itself does not affect the law²²⁹. Thus the time components and the conceptual GANTT diagram of the time view remain unaffected. Future perspective can lead to shortening of submission times due to the efficiencies which can be achieved

²²⁹ But due to the fact that many international organisations and institutions are involved in XBRL development it leads to situations where regulations can be changed in order to enable XBRL reporting. For example in Germany the adoption of EHUG did not affect financial reporting supply chain whereas in Netherlands the Dutch Taxonomy Project (NTP) introduced completely new supply chain architecture. This study focuses on the first use case which is usual XBRL introduction scenario.

by the use of XBRL. Gluchowski and Pastwa address especially shortening of the reporting times in case of group reporting scenario and thus major enhancements to consolidation processes [GIPa2006, 68-69]. But in short time XBRL seldom affects the regulation to require faster reporting or introduce new reporting triggers. Also discussion on continuous or real time reporting in the context of XBRL remains still very theoretical [Hoff2006, 506]. Pinsker addresses XBRL as continuous disclosure technology producing unprecedented gains in timeliness but also emphasises it as future direction [Pins2007, 91].

5.3.8 Motivation View in XBRL Financial Reporting Supply Chain Architecture

Final modelling section focuses on motivation view of XBRL financial reporting supply chain. First table 37 analyses impact of XBRL on the business goals identified for financial reporting supply chain architecture.

Table 37. Business Goals/Strategies as Motivation Components in XBRL Financial Reporting Supply Chain Architecture

Business Goal	Description in XBRL Context
Provide assurance of financial reports	Impact unknown
Provide fair view of group	Enhanced
Provide a fair view of company	Enhanced
Protect the capital market participants	Enhanced
Provide general public with financial information	Enhanced
Reveal malpractice and mistakes of tax payers	Enhanced
Secure borrowings	Enhanced

XBRL introduction is in line with most goals expressed by participants of different reporting scenarios. XBRL increases transparency mainly through the use of official taxonomies so the reported facts are clear and well documented for the receivers. The fair view on the company and on the group is achieved also through the validation procedures [Hoff2006, 371-381] which can be applied to the reported instance documents. Further automatic consumption of instance documents enhances the protection of mar-

ket participants, reveals malpractices and mistakes of tax payers as well as secures the borrowing. Supervisors, tax offices and borrowing banks have the ability to import XBRL reports into their analysis systems without necessity of manual data input. Also automated warning systems can be introduced where the focus is not on data integration but on data analysis. Finally the use of XBRL combined with the other user readable formats allows providing general public with the user-oriented publication of financial information clearly referenced to an XBRL taxonomy. It is important to differentiate between open and close XBRL reporting in this case. Manual input can be fully eliminated in case of closed reporting where reporting entities are not allowed to extend the taxonomies. In such a case it is enough to provide a mapping between taxonomy elements and analysis system (usually represented by database schema). In open reporting scenarios it is necessary to manually (or semi-automatically) map additional elements provided in taxonomy extension to the analysis system. The only not known impact is whether XBRL enhances the assurance of financial reports. Trites indicates that issues concerning XBRL in the context of assurance are numerous, pervasive and evolving [Trit2006, 23].

Figure 51 presents the contextual model of the motivation view for the XBRL financial reporting supply chain architecture.

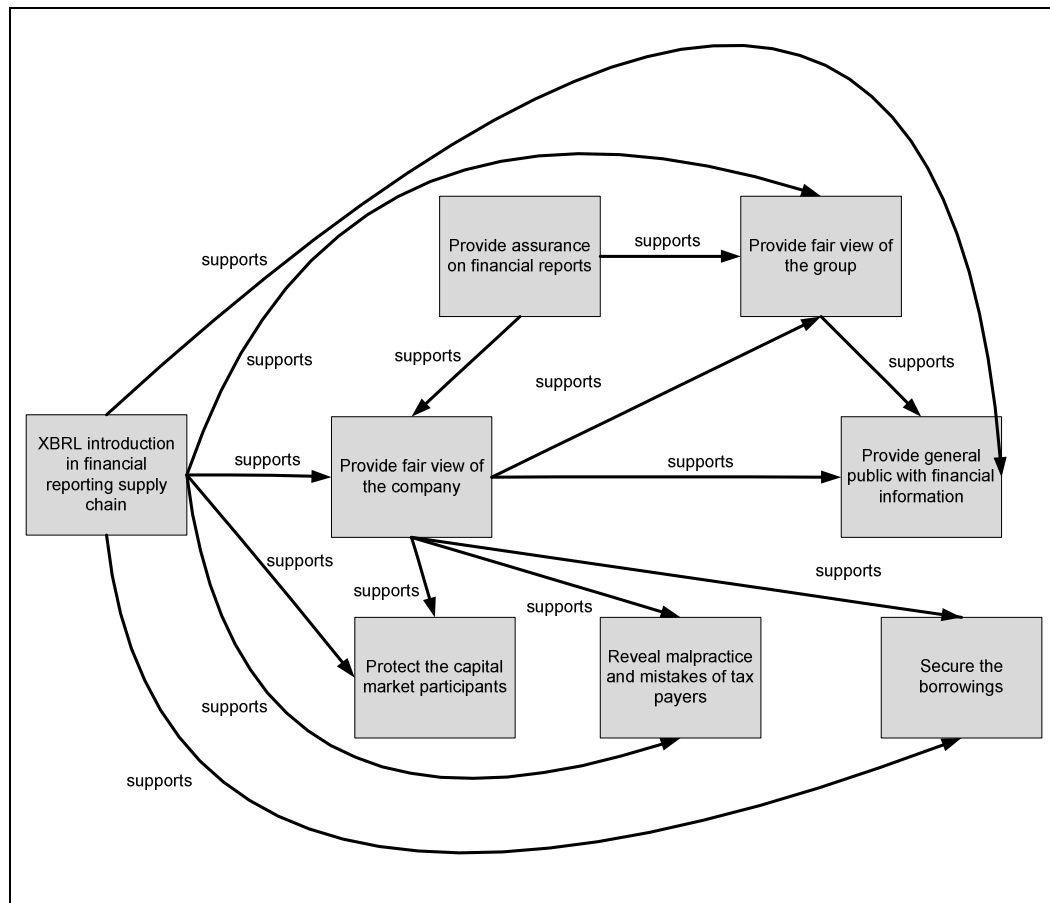


Figure 51. Motivation Model of XBRL Financial Reporting Supply Chain

As stated for the contextual level, conceptual model shows how the goal of XBRL introduction in financial reporting supply chain supports most of motivation model components.

Motivation view is the last view analysed and modelled for XBRL financial reporting supply chain. The next section draws conclusions from modelling of both architectures.

5.3.9 Conclusions

This chapter provided a set of models for financial reporting supply chain architecture and XBRL financial reporting supply chain. Analysis and modelling were conducted following the structure of the Zachman architecture framework. For both architectures contextual and conceptual model for views data, function, network, people, time and

motivation were provided. Table 38 provides an overview of the modelled Zachman categories and corresponding sections of this chapter for financial reporting supply chain architecture.

Table 38. Scope of Modelling of the Financial Reporting Supply Chain Architecture Based on Zachman Enterprise Architecture Framework

	Data (What)	Function (How)	Network (Where)	People (Who)	Time (When)	Motivation (Why)
Objectives/ Scope (Contextual)	Section 5.2.1	Section 5.2.2	Section 5.2.3	Section 5.2.4	Section 5.2.5	Section 5.2.6
Enterprise Model (Conceptual)						

Each of listed sections addresses two levels of the architecture framework. In table 39 an overview of models for XBRL financial reporting supply chain architecture is presented.

Table 39. Scope of XBRL Impact on XBRL Financial Reporting Supply Chain Architecture Based on Zachman Enterprise Architecture Framework

	Data (What)	Function (How)	Network (Where)	People (Who)	Time (When)	Motivation (Why)
Objectives/ Scope (Contextual)	Section 5.3.3	Section 5.3.4	Section 5.3.5	∅	∅	Section 5.3.8
Enterprise Model (Conceptual)				∅	∅	

Modelling of XBRL financial reporting supply chain architecture does not consider categories people and time which remain unaffected. It means that models from table

38 apply for both categories in the same way as they apply for financial reporting supply chain architecture without XBRL.

Chapter five addressed in the first sections research proposition 1 and 1.1. The financial reporting supply chain architecture was be modelled for the financial reporting domain. The supply chain architecture consists of data, function, people, network, time and motivation view. In the later sections research propositions 2 and 2.1 were addressed. XBRL impact on the financial reporting supply chain was modelled and impact on single views discussed.

In the next chapter the modelled architectures are verified according to the approach addressed by Schütte and Becker and introduced in research framework of this thesis.

6 Research Verification

This chapter focuses on verification of the results presented in both analysis chapters three and four and modelled as the financial reporting supply chain architecture as well as the XBRL financial reporting supply chain architecture in chapter five. This chapter applies approach to the modelling of information systems discussed by Becker and Schütte [BeSc2004, 65-165] and introduced in chapter two. The first section discusses the possibility of treating XBRL financial reporting supply chain architecture as a reference model. Following sections use six GAMP defined by Becker and Schütte [BeSc2004, 120-132] and evaluate the architecture according to them. The final section of this chapter provides conclusions on the verification of research results.

6.1 XBRL Financial Reporting Supply Chain Architecture as a Reference Model

In this section XBRL financial reporting supply chain architecture role as reference model is analysed. Reference models, according to the understanding of Schütte, can be used as a recommendation for the model users [Schu1998, 69]. The constructed set of models constituting supply chain architecture represents a target set of models which can be used as an orientation support for implementers²³⁰. The classification as reference model can be assumed due to the fact that potential users of the architecture can later draw on the experiences documented in this study. Such understanding complies with Frank view on the architecture of integrated information system. Frank also indicates research potential of such reference information system for later adjustments and analysis of existing information systems [Fran1994, 32-34]. Similarly Brocke and Buddenick address the reusability of reference models in construction processes of other information models [BrBu2004, 19-21].

In the context of this study the research proposition 2.2 states that *XBRL financial reporting supply chain architecture can be modelled and used as reference architecture*. Out of scope of this study is objective evaluation of the modelled architectures.

²³⁰ Becker et al. indicate the importance of the application of reference model in similar way by a number of implementers [BeRS1999].

Such assessment can be only conducted as further research and evaluated by the architecture users and not architecture modellers. This study however follows the modelling theory as stated by Becker and Schütte and addresses in chapter two. This theory discusses evaluation of models by the use of GAMP. All six GAMP are addressed in following sections together with a brief discussion on each of them. Although not conducted by the model users, and thus not clearly objective, the following discussion provide a basis for further research and indicate potential directions of later verifications.

6.1.1 Principle of Accuracy

This section analyses if modelled architectures comply with the principle of accuracy. From syntactic perspective only the conceptual models can be assessed²³¹. Table 40 provides information on the format modelling approaches used in different Zachman views.

Table 40. Formal Notations Used for Modelling of Conceptual Views

	Data (What)	Function (How)	Network (Where)	People (Who)	Time (When)	Motiva- tion (Why)
Formal nota- tion used	ERM	EPC	ERM	RASCI	GANTT	Goals map

Formal notations ERM, EPC, RASCI and GANTT used in this study prove compliance of the model with the principle of accuracy from the syntactic point of view. Goal maps provide a clear framework for motivation modelling with hierarchy of goals compliant with the modelling notation suggested by the Business Rules Group [BuRG2005]. All used modelling notations are well specified and commonly used in the MIS domain.

²³¹ According to Zachman enterprise architecture framework models on the contextual level are simple lists of objects relevant from the perspective of single modelled view [Zach1999].

From semantic point of view models presented use the terminology derived from the analysis conducted in chapters three and four. A clear relationship to the analysed objects can be stated. Thus it is possible to draw reasonable conclusions on the basis of modelled architectures. Additionally this study provides first attempt to assessing the semantic correctness of the models. Drawing conclusions from the financial reporting supply chain architecture, impact of XBRL is assessed and thus reasonable conclusions are presented.

6.1.2 Principle of Relevance

The second analysed GAMP concerns the relevance of modelled system of objects. The system of object selected in this study is financial reporting domain. Such sophisticated system of objects was restricted solely to accounting cycles, report preparation and reporting sections with a clear assumption to model only financial reporting relevant components. Also clear modelling aims of this thesis stated in chapter one indicating setting boundaries of financial reporting supply chain and assessment of XBRL impact on financial reporting domain enabled consideration of relevant components only. Choices for leaving out some components²³² are driven by the principle of relevance.

Additionally principle of relevance is analysed in the context of pragmatics for potential users of both modelled architectures. Table 41 provides an overview of potential users together with their use of modelled architecture.

²³² For example books closing process in the process view of financial reporting supply chain architecture was classified as not relevant and thus not modelled separately but addressed as a process within trial balance adjustments.

Table 41. Users and Use of Modelled Architectures

Potential users	Potential use
Senders of financial information	Reporting companies can adjust both modelled architectures to their specific reporting scenarios thus receiving a comprehensive view on own financial reporting and so improve own information systems supporting reporting activities. In case of XBRL introduction senders can better assess which components of the architecture must be adapted and in which way.
Receivers of financial information	Receiving institutions can better understand their roles in financial reporting supply chains and also adjust the architectures to their specific situations. Also receivers have the possibility to assess changed components if introducing XBRL.
Politics and administration	Institutions responsible for laws and regulations for financial reporting domain receive an instrument to better understand the impact of the regulations on certain components of both modelled architectures.
Software vendors	Software vendors receive a set of formally modelled components of the architectures of information systems which can be useful designing new products or enhancing existing software products.
Academics	Academics receive a solid basis for developing financial reporting and XBRL oriented research especially in the context of MIS and AIS.

As indicated in table above relevance of both modelled architectures can be clearly recognised. Becker et al. indicate that principle of relevance is highly subjective [BeRS1995, 438]. Especially in cases when modeller and addressees of the models are different persons the modelling aims can be set differently. Thus the assessment conducted in this section provides only initial directions for evaluation of the relevance.

6.1.3 Principle of Efficiency

Becker et al. state difficulties with operationalisation of the principle of efficiency. Lack of theories for the cost-performance analysis for reference modelling complicates

assessment of this principle [BeRS1995, 438]. Becker and Algermissen differentiate between the efficiency for model users and the efficiency for the model preparers [BeAl2003]. Efficiency for users is characterised by possibility of offering initial solutions which can be adapted to user specific situations. Both modelled architectures can be classified as such initial solutions and use of format notations to describe different views enables tailoring them to user needs. Further Becker and Algermissen discuss the efficiency from the model preparer point of view. They indicate possibilities of realising the usages of reference models in three different kinds of activities [BeAl2003]. The first use focuses on reference model as such being base for revenues. The second use indicated by Becker and Algermissen is based on using the reference models as acquisition instruments for consulting contracts for both research institutions and consulting companies [BeAl2003]. The third discussed use focuses on integration of reference models in software products thus simplifying the adjustment of software to modelled domain. It is important to note that Becker and Schütte assume commercial construction of reference models thus their approach cannot be operationalised for this study. Generally it is difficult to measure criteria of efficiency for the modelled architectures. Thus this study classifies efficiency for model users as high while efficiency for model preparer as difficult to assess at this point of time.

6.1.4 Principle of Systematic Design

This section assesses principle of systematic design in the context of modelled architectures. The first discussed aspect is existence of a general modelling meta-architecture encompassing the analysed views and delivering systematic framework for modelling activities addressed by Becker and Algermissen [BeAl2003]. This study uses general reference modelling theory of Becker and Schütte as stated in chapter two. But in order to systematise the research this study applied Zachman enterprise architecture framework. This framework constitutes required modelling meta-architecture encompassing six analysed and modelled view on two different levels of detail. The Zachman views comply with the views indicated by Becker and Schütte [BeSc2004] thus creating a systematic overview of the modelled system of objects.

Further Becker and Agermissen address the consistency and systematic of modelling elements of different views [BeRS1995, 439]. In the context of design of infor-

mation systems supporting financial reporting supply chain architecture it is necessary to present the relationships among modelled concepts. According to Frank integration of modelled views is not specifically addressed in the modelling literature [Fran1994, 156]. Frank indicates that using different views integration can be achieved by the means of using same concepts in different models. In such a way identification of corresponding components through different views is supported. This study uses consistent components naming through all modelled views. For example the integration of data and function view is achieved by using the data components as input and output components in the process models²³³.

6.1.5 Principle of Clearness

The fifth principle assessed in this study for verification of research results discusses clearness of constructed models. According to Schelp three criteria of measuring clearness should be considered. Firstly this study uses Zachman architecture framework thus follows clear decomposition rules of the reference models. All six views were modelled for each of the architectures on contextual and conceptual abstraction levels. For specific models it is possible to provide further modelling for more detailed levels. Secondly layout and readability of constructed models are guaranteed through providing conceptual models within one page. If larger models are necessary they are divided into smaller operational portions²³⁴. Research results comply with principle of clearness also through usage of readable notations and graphics²³⁵. Thirdly Schelp addresses the filtering means in order to prepare user oriented models [Sche2000, 69]. This study does not directly discuss filtering means and provides only the generic financial reporting supply chain architecture and the generic XBRL financial reporting supply chain architecture. But for both architectures it is possible (and recommended) to derive specific models. This can be conducted by adapting parts of different models presented within the use of the designed architecture.

²³³ Also Scheer discusses this approach as related to ARIS and its steering view integrating data, function and organisation views [Sche2001].

²³⁴ For example conceptual process model is divided into accounting cycle process model, report preparation process model and reporting process model with all three constituting financial reporting supply chain architecture process components.

²³⁵ All models were prepared using Microsoft Visio 2007 together with sets of shapes relevant for a selected notation.

The clearness for model users complies with requirements stated by Schelp as well as Becker and Algermissen [Sche2000, 69; BeAl2003].

6.1.6 Principle of Comparability

The last of analysed GAMP focuses on comparability of reference models. The distinction between actual and desired models, as addressed by Schütte [BeSc2004, 130] can be found in this study in the difference between financial reporting supply chain architecture and XBRL financial reporting supply chain architecture. The first is based on actual situation in modelled systems of objects, while the latter assesses a situation when XBRL is introduced for the whole financial reporting domain. In this understanding XBRL financial reporting supply chain architecture is classified as desired model.

Both constructed architectures are based on the same meta-meta-model. The role of the meta-meta-model in this research fulfils the Zachman architecture framework. Also in a number of views the desired XBRL related models extend financial reporting supply chain architecture models by XBRL components thus retain comparability between them. Becker et al. indicate importance of naming consistency across different models as well as for actual and desired models [BeRS1995, 444]. This issue, addressed already when discussing the principle of systematic design, is accommodated for all models presented in this study. The consistent use of components across the views, levels, models and architectures contributes to enhanced comparability.

6.2 Summary of Verification Results

This final section summarises discussion on the research verification conducted in this chapter. Figure 52 presents an overview of assessment of the principles for financial reporting supply chain architecture and for XBRL financial reporting supply chain architecture. The discussion from previous sections is enhanced with an evaluation. The evaluation is conducted using three stages. The highest stage (+) informs about the complete fulfilment of the analysed principle. In case the principle fulfilment level is insufficient or neutral the middle stage (o) is assigned. The third stage (-) represents the situation when a principle is not fulfilled or not concerned.

GAMPs	Financial Reporting Supply Chain Architecture			XBRL Financial Reporting Supply Chain Architecture		
	-	o	+	-	o	+
Accuracy (Section 6.1.1)			●			●
Relevance (Section 6.1.2)		●				●
Efficiency (Section 6.1.1)		●				●
Systematic design (Section 6.1.3)			●			●
Clearness (Section 6.1.4)			●			●
Comparability (Section 6.1.5)			●		●	

Figure 52. GAMP Evaluation for Modelled Architectures

The principle of accuracy is positively (+) evaluated for both analysed architectures. Models in both architectures are classified as syntactically and semantically correct as discussed in section 6.1.1.

Principle of relevance is evaluated neutral (o) for financial reporting supply chain architecture due to the fact that a number of simplifications are introduced in the models especially in the sections concerning accounting cycle. The simplifications are due to the goal of modelling which are oriented on financial reporting. The relevance of XBRL financial reporting supply chain architecture is evaluated as high (+). Also for the efficiency of both architectures similar evaluation pattern can be recognised. Neutral evaluation (o) of financial reporting supply chain architecture is mainly due to the fact that there are a number of participants on the software and consulting market providing financial reporting products. But in case of XBRL the support of the stan-

standard is not as wide so use of XBRL financial reporting supply chain architecture is classified as higher. It is important to note that objective evaluation of the relevance criteria can follow only outside of this study as further research.

Both architectures respond equally high (+) to principle of systematic design as well as to the principle of clearness. Firstly it is due to the use of Zachman architecture framework as meta-architecture for the modelled systems of objects. Secondly this principle is evaluated positively because of good readability of presented models.

Finally in case of the principle of comparability it is easier to compare financial reporting supply chain architecture with a number of accounting systems architectures (+). For XBRL financial reporting supply chain architecture it is more difficult because these systems are either not documented or do not exist yet (o). Thus there is a potential to classify this GAMP as high in the future.

To summarise the results, financial reporting supply chain architecture and XBRL financial reporting supply chain architecture may be treated as reference models. XBRL financial reporting supply chain architecture fulfils the GAMP even better which increases value of this architecture.

6.3 Conclusions

This chapter provided a verification of the results presented in earlier chapters. First the use of proposed architectures as reference models was discussed. Further an evaluation of GAMP as stated by Becker and Schütte in chapter two was conducted. Each of the GAMP was discussed separately addressing both presented architectures. Finally a summary of verification results was provided.

Chapter six addresses the research proposition 2.2 stating that XBRL financial reporting supply chain architecture can be modelled and used as reference architecture. This chapter extends this proposition evaluating also the use of the financial reporting supply chain architecture as a reference model.

7 Conclusions

This chapter presents some conclusions, discussions, as well as directions for future research. This chapter proceeds as follows. Firstly, the summary of research propositions addressed in different chapters is discussed. In the next section several topics for future research are suggested. Finally relevance of this research for both academia and practitioners is indicated.

The goal of this study was to state and set the boundaries of the financial reporting supply chain in order to critically assess the impact of XBRL on the modelled architectures, by addressing the following questions:

- What constitutes financial reporting supply chain?
- Which components of financial accounting and financial reporting domains are parts of the financial reporting supply chain?
- Is it possible to model financial reporting supply chain architecture?
- Can financial reporting supply chain architecture be useful as reference model?
- How XBRL introduction impacts financial reporting supply chain architecture and its components?
- Is it possible to build a reference model of XBRL financial reporting supply chain?

In order to answer the above questions chapter one listed five research propositions and chapter two presented a research framework for this study. The theoretical framework was built over four levels in order to use established approaches and theories known from research literature. The first level addressed constructivism as the general philosophical position of this research. The second level applied the design science theory. The third level provided the theories for the modelling part, especially the reference modelling approach of Schütte and Becker. Finally the fourth level provided a structure for the modelling in form of Zachman enterprise architecture framework.

With the first research proposition (P 1) this study addressed the possibilities of *modelling the financial reporting domain* in MIS context. Chapter three provided a

comprehensive analysis of financial reporting domain. Further chapter five applied formal modelling notations to construct financial reporting supply chain architecture thus positively verify the first research proposition.

The orientation on systematic design following the Zachman enterprise architecture framework allowed for confirmation of the second research proposition (P 1.1). *The models of financial reporting supply chain architecture were constructed for data and data structures, processes, participants and network* in chapter five. Additionally for financial reporting supply chain this study provided models for the time and motivation views. The models of six views were presented on the contextual and conceptual levels of the Zachman framework.

In chapter four the analysis of XBRL technologies was conducted. The discussion over different components of the technology allowed positive evaluation of the next research proposition (P 2). The conclusions of chapter four are aligned with this research proposition which states that *XBRL adoption alters financial reporting supply chain*. Chapter four indicated especially the importance of XBRL FR and XBRL GL in the context of financial accounting and financial reporting.

The analysis of the scope of the changes introduced by XBRL technologies was the topic of chapter five. The research proposition (P 2.1) was confirmed by analysing and modelling of the impact of XBRL components on previously modelled financial reporting supply chain architecture. The new construct, *XBRL financial reporting supply chain architecture, differs especially in the data, process and network view*.

Finally chapter six confirmed the last research proposition (P 2.2) communicating the possibility of the *use of XBRL financial reporting supply chain architecture as a reference model*. The architecture positively fulfilled five out of six GAMP. Additionally the use of financial reporting supply chain architecture as a reference model was assessed. This study classified only four out of six GAMP to be positively fulfilled for financial reporting supply chain architecture.

In the following sections some topics for further research are discussed. This study attempts to research a sophisticated domain which is financial accounting and financial reporting. Although the results build up a comprehensive framework further

research is necessary. The themes for further research are drawn together and presented in four groups.

The first group addresses the use and limitations of this study concerning the Zachman architecture framework. In order to provide generic results this study modelled financial reporting domain only on the contextual and conceptual level of the Zachman framework. An additional study would be necessary to extend the models for more specific levels such as logical (designer) and physical (builder) levels. Also modelling of some of the views is conducted on the high level of abstraction which causes issues when integrating them with the rest of the views. An additional study using different modelling techniques, especially for people and time view, could significantly add to the presented results.

The second group addresses limitations in the verification of this study. Especially the verification conducted in chapter six must be interpreted with caution. As stated by Becker verifying the relevance of the modelled system of objects is characterised by high level of subjectivity [BeRS1995, 438]. The results from this study were verified by the models constructor thus are potentially subjective. A study that draws upon the GAMP of Becker and Schütte and instantiates the architectures presented in this research would significantly add to the verification of results. Such study could use XBRL financial reporting supply chain and apply it for a certain reporting scenario including the modelling of more specific levels of the Zachman architecture framework. Such instantiations in form of proof of concept could significantly prove the application of the presented architectures in practice.

The third group of topics for further research focuses on economic aspects of financial reporting supply chain. The presented study is strongly based on the design science theories. A valuable extension could use alternative research techniques such as survey based or experimental research in order to provide answers how the modelled architectures allow for measurement of economic impact of XBRL. Sutton and Arnold discuss research of the impact of the IT on individuals, organisations and society [SuAr2002, 6]. The direction indicated by Sutton and Arnold as well as addressed by Locke and Lowe [LoLo2007] could contribute to XBRL financial reporting supply chain research. Also the discussion started by Wagenhofer [Wage2007] on the eco-

conomic aspects of financial reporting supply chain could be operationalised using results from this study.

The fourth group indicates potential for future research in the area of supply chain aspects of the financial reporting. Many of the issues discussed in this study could be considered in the context of information logistics. The information logistics, regarded as a subsection of the information management, deals with internal and external information flows among organizational units. A goal is the optimization of the availability and shortening of circulation times of information. In principle information logistics is concerned with the supply of the correct information, at the correct time, in the correct format and in the correct quality, for the correct addressee at the correct place [Krcm2005, 55]. These characteristics apply also to financial information. Information logistics is often discussed in the context of various domains. Also in the area of supply chain management information logistics plays a significant role [PfSW2004, 21; Hieb2002, 24]. Here it is crucial to ensure the seamless information flow coordinated with the flow of physical goods [Szyp1990, 80]. A valuable extension to this study could use theories related to information logistics in order to adjust the financial information transmitted to the requirements of different participants. Also the approaches related to the supply chain management could significantly add to this research.

Regarding the relevance of the researched topics it needs to be differentiated between scientific and practical view.

In the research context this study contributes to accounting research as MIS discipline as discussed by Sutton and Arnold [SuAr2002, 7]. Especially synthesis of real theories of design science and Zachman architecture framework theory gives the opportunity to provide a novel perspective on financial reporting domain. Also the application of design science approach to modelling of financial reporting supply chain architecture should be classified as original. Finally this study uses GAMP in order to evaluate constructed architectures. This study contributes to the prior research literature dealing with the financial reporting supply chain aspects by providing a set of models for the financial reporting supply chain analysis as well as systematic and reusable analysis of the XBRL impact. Research relevance of this study for the MIS con-

centrates also on the design science aspects. *Wissenschaftliche Kommission Wirtschaftsinformatik* (WKWI) in Germany defines the MIS as an engineering science with the main purpose adaptation or respectively development of information systems in order to support businesses and management. The aim is development of construction systems through the use of methods, tools, prototypes known from engineering sciences [WKWI1994]. Research relevance of this thesis aims in the first line at enhancing the MIS and AIS domains with the architecture of the financial reporting supply chain. In the broader context this thesis contributes to the area of management information systems analysed in the financial reporting context. This research adds the XBRL oriented view to AIS and MIS research. Finally in the XBRL literature it provides a solid background for analysis of various reporting scenarios based on the XBRL financial reporting supply chain architecture.

The relevance of this research for practitioners aims first of all at the possibility to provide a set of implications which support decision makers while considering XBRL introduction in various reporting scenarios. The implications are offered in form of reference financial reporting supply chain architecture consisting of a set of models using different perspectives of the modelled original. The reference architecture enhances the assessment of the impact of XBRL on its certain components. Further this study enhances the costs assessment as well as improves project management especially while implementing XBRL in financial reporting projects. The reference financial reporting supply chain architecture helps not only in XBRL reporting scenarios. It offers practitioners a well-defined background for the analysis of the reporting supply chain and its components. The significance for practitioners encompasses not only receivers and senders of the financial statements but include also the senders of as well as intermediaries and standardisers often dealing with the financial reporting supply chain.

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Appendix 1

Detailed list of interviewees for the various reporting scenarios interviewed during the survey:

Parent entities:

Institution	EJOT HOLDING GmbH & Co. KG
Address	Adolf-Böhl-Straße 7 57319 Bad Berleburg-Berghausen Germany
Interviewee position	Chief Financial Officer

Institution	SolarWord AG
Address	Berthelsdorfer Straße 111 A 09599 Freiberg/Saxony Germany
Interviewee position	Controller

Financial auditors:

Institution	PricewaterhouseCoopers AG
Address	Olof-Palme-Straße 35 60439 Frankfurt am Main Germany
Interviewee position	Senior Manger

Institution	KPMG Poland Sp. z o.o.
Address	ul. Chłodna 51 00-867 Warsaw Poland
Interviewee position	Supervisor (responsible for customers reporting to German parent companies)

Stock Exchanges:

Institution	Deutsche Börse AG
Address	60485 Frankfurt/Main Germany
Interviewee position	Stock Market Business Development Officer

Statutory Reporting Offices:

Institution	Bundesanzeiger Verlagsgesellschaft mbH
Address	Amsterdamer Straße 192 50735 Köln Germany
Interviewee position	Project manager

Tax offices:

Institution	Finanzamt Dresden
Address	Lauensteiner Str. 37 01277 Dresden Germany
Interviewee position	Tax auditor

Institution	Finanzamt Freiberg
Address	Brückenstr. 1 9599 Freiberg Germany
Interviewee position	Chief Information Officer

Commercial banks:

Institution	Freiberger Bank eG
Address	Korngasse 7-9 09599 Freiberg Germany
Interviewee position	Credit Risk Management Manager

Institution	Deutsche Bank AG
Address	Taunusanlage 12 60325 Frankfurt Germany
Interviewee position	Credit Risk Management Director

Statistic institutes:

Institution	Statistical Office of the Free State of Saxony
Address	Macherstraße 63 01917 Kamenz Germany
Interviewee position	IT Manager

Appendix 2

List of questions for the various reporting scenarios used as a guideline to the interviewees during the survey:

- Data:
 - What are the reports submitted (single financial statement, consolidated financial statement, full financial report, quarterly financial statement, additional disclosures related to the financial statement, business assessments, single financial data, etc.)?
 - Is the reporting structure closed and defined or open and can be modified by the reporting companies?
 - What is the underlying legal base for the submission of the financial reports as well as for the creation of the reports?
 - What is the underlying accounting standards and related regulations for the creation of the financial report?
 - Does the submitted financial report need to be audited or certified by a tax or financial auditor?
- Functions:
 - What are you doing with the received financial reports (analysis, archiving, publication, etc.)?
 - Which detailed processes are conducted on and after receiving of the reports?
 - Are business rules or indicators/measures used for the processes?
- Network:
 - In which way are the financial reports transmitted (postal, fax, email, data storage, reporting system, etc.)?
 - Which format is used for electronic transmissions (PDF, RTF, Excel, Word, XML, XBRL, other proprietary format)?

- Which are preferred formats of financial reports?
- People:
 - From which companies are you receiving financial reports?
 - Can these companies be grouped according to certain criteria (number of employees, revenue, assets etc.)?
 - Is there further communication (transmission of financial reports) to further institutions?
- Time:
 - What is the trigger for the reporting process?
 - How often are you requiring financial reporting from the companies (yearly, quarterly, monthly)?
 - How much time do the companies have to prepare the financial reports?
- Motivation:
 - What is the underlying goal of financial reporting?
 - How is this goal stated in legal regulations/ mission of the institution?
 - How this goal interferes with goals of other institutions?