The Future of XBRL: A Conceptual Framework

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Abstract
This paper is about high level modeling of XBRL and some of the problems and opportunities it exposes. Recently, XBRL International, Inc. (XII), proposed six strategic initiatives which will set the course of XBRL development for the next few years. The first of the new initiatives is the Abstract Modeling Task Force. Its output will be a Unified Modeling Language (UML) abstract model of the XBRL 2.1 specification plus the specification on dimensions. This initiative and the other five serve to support the continuing adoptation of the XBRL standard. This paper looks at this effort and several other abstract models of accounting from a semantic and abstract modeling viewpoint. The paper reviews developments in modeling accounting in ontologies and the promises of interactive accounting data, especially with respect to opportunities in the area of business intelligence. It proposes a high level developmental schema for XBRL in keeping with the promise of the XML language.

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The paper develops as follows. First, the use of formal modeling and ontology development is reviewed in accounting and, to a lesser extent, information systems. Next on the agenda is a review of the goals and initiatives of the XBRL International strategic document "Preserve. Promote. Participate: Moving XBRL Forward." After that, the XBRL 2.1 Specification is discussed followed by a discussion of the FASB Conceptual Framework. The paper then discusses some of the syntactic and semantic peculiarities of formal modeling. The relationships between abstract models, conceptual models and ontologies are then explored. Finally, the strategic initiatives set out by XBRL are re-evaluated in light of the previous discussions.

Literature Review

Teller (2008) writes about some of the problems of using formal representations for accounting. His purpose was to build a representation of financial and information in an efficient

way. He states that the nature of the way that accounting is built particularly its use of standards and law creates problems in designing such formal representations. More specifically he considers XBRL and its possible use as such a formal representation of accounting. Using IFRS as the standard accounting Teller reports that XBRL should bring four aspects to financial reporting. Those four are:

1. the production and publication of the information
2. information sharing and comparability
3. information checking and certification and
4. gain in the analysis process.

He concludes that XBRL is just an optimal way to store information. He criticizes XBRL for not providing explicit formalization of financial data or of accounting standards. He also states that XBRL uses an implicit formalism when specifying the XBRL taxonomies but that this implicit formalism is not published in and is not available for use for knowledge extraction and manipulation. Citing ISACA (2002) he believes accounting professionals need not only data in electronic storage format but efficient information systems requiring machine-readable data that allows reasoning. He develops an idea of the peculiar nature of financial information. Much of this peculiar nature involves the legal contexts in which financial information is usually contextualized. He sees financial information as being defined through a conceptual framework above which stands reference texts such as US GAAP and IFRS. Although there should not be any contradictions between referenced text and the conceptual framework he feels that because we are trying to represent knowledge from laws and regulations such contradictions are inevitable. He divides his model into two parts a syntactic component and a semantic component. (See Figure 1)

[Insert Figure 1 about here.]

Swanson and Freeze (2009) provide an ontological perspective of generally accepted accounting principles. They studied the perspective of the fast be and international accounting standards board's presentation standard and proposed revision to the conceptual framework. Within this context they propose and accounting ontology. They then look at the potential benefits of using such an ontology framework. They did define ontology as a method of rendering unstructured context into structured frameworks. They propose an ontological framework which is comprised of three aspects: 1) the conceptual framework, 2) the presentation standard, and 3) the GAAP codification project. They see the benefits of their project as being improved decision-making, faster assimilation of GAAP practices and a common framework for communication between the FASB and the IASB along with the SEC. They look at the conceptual framework and several of its major features. The framework captures information that provides reports for external decision-making. The information captured is about resources, claims, and transactions that change firm value. The qualitative characteristics of the information are relevance and representational faithfulness subject to constraints of materiality and cost. In terms of the presentation regulation, they interpret this to include an internal and external decision-making components. The internal component is for cash flow analysis and the external for firm valuation. Information disaggregation for decision-making is a second important feature. The last presentation feature involves liquidity along with flexibility in diverse economic circumstances. The GAAP codification project refers to the re-codification of the accounting standards away from the historical method of codification to the taxonomy codification scheme. Their major conclusions with respect to the ontology they develop are that users would view the

firm either as a value chain from an internal perspective or as a valuation model from an external perspective.

Aparaschivei (2007) discusses accounting ontology from a knowledge modeling point of view. He is concerned with knowledge in accounting and artificial intelligence. He looks at the traditional hierarchy of data, information and knowledge in the accounting domain. While data and information are defined in the usual ways, that is, information is data that is useful to decision makers, he sees knowledge as being broader, deeper and richer than either data or information. According to him this knowledge is embedded in the organizations' employees. He notes that this knowledge is seen in the difference between the company's market capitalization and the balance sheet asset value. This difference is impounded in the employees' knowledge which has two dimensions. The first dimension is tacit knowledge which is impounded in individuals and their own skill sets. The second dimension is explicit knowledge which is impounded in the documentation that the company has. He sees organizations as not securing knowledge adequately. Therefore it is important to build accounting ontologies which will help to secure this knowledge. He defines general ontology as a systematic reality explanation. However, for artificial intelligence ontology becomes a formal and explicit specification of a conceptualization. This conceptualization consists of objects, properties of these objects and the relations between them. So the ontologies describe knowledge or a vocabulary, the meanings that terms can accept and relations between terms. (See Figure 2) He sees two components of ontologies. The first is a representation of facts in terms of a vocabulary. The second is the knowledge domain of these facts represented through the vocabulary. Therefore there can be a hierarchy of ontologies from the generic to the specific. In accounting he sees two types of knowledge. The first is factual domain knowledge and the second problem solving knowledge.

The first category includes law, standards, codifications, etc. The second category is partially represented in manuals but mainly in human experience and by experts. He concludes that describing an accounting ontology provides the following advantages. The first is setting up the vocabulary which will include the terms that can be used by all. The second is that the ontology facilitates interoperability between disparate systems among organizations. The third is that structuring the knowledge domain allows the representation of knowledge acquisition. In the last is for knowledge sharing and reuse.

[Insert Figure 2 about here.]

Lupasc *et al.* (2010) look at the REA framework as an ontology of accounting information systems. According to the authors, REA primitives are resources, events, agents, stock flows, control and duality. The paper treats the REA model as an ontological representation of accounting. The duality primitive is the give-and-take relationship originally mentioned in McCarthy (1982). To this the authors add a value chain concept. That concept defines the value chain as the acquisition, conversion and revenue cycles of an enterprise. This value chain is then seen to incorporate the three critical REA primitives. These three primitives are economic events, economic agents and economic resources. The authors note the extension of REA to include location. They also note that economic claims can be included in this ontology. Finally they add the concept of an economic contract with a resulting agreement and economic commitments to the ontological model. The authors characterize these extensions as adding knowledge reuse and knowledge sharing to the ontological representation of the REA framework.

Geerts and McCarthy (1999) exemplifies the evolution of REA. The paper takes an object oriented and semantic approach to REA. The paper contrast traditional accounting systems

designs with REA system designs. According to the authors, REA designs will help to promote process orientated models, promote knowledge-based decision models, and support interoperability. The authors discuss REA accounting in its script like capabilities. As such REA designs can be used to incorporate value added exchanges to the basic REA data model. The combination of the REA data model with the value added process model helps to create and object infrastructure which can be used in enterprise design. These object oriented designs lend themselves to interfacing with knowledge-based decision tools. As such the authors believe REA helps promote a more efficient economic system. This system allows financial decision-makers to use financial information with fewer intermediaries. The characterization regards SEC EDGAR filings as being an unnecessary data stop intermediated by financial statement analyzers. The knowledge based systems could more easily represent these flows of information to the end users. This would lead to a more knowledge intensive enterprise design. As a research extension to this work, the authors note the ontological directions of REA. Here, the authors contend that REA must extend its ontological features to include enterprise knowledge management, supra-accounting theories in strategic management, and an explicit treatment of time. In addition to individual instances of cycle scripts need to be worked out.

Guan *et al.* (2006) propose adding Bunge-Wand-Weber modeling constructs to the REA ontological model in order to solve certain deficiencies. They see three main deficiencies. The first follows from REA's use of entity relationship modeling constructs. The second deficit follows from a lack of capturing the dynamics aspects of the accounting domain. And the third refers to an inability of the model to adequately represent levels of abstraction. The authors see the ontological evaluation of REA as an issue in conceptual modeling. According to the authors, conceptual modeling has two components. The first is identifying relevant phenomena in a

domain. The second is mapping those phenomena into modeling constructs. According to the authors, REA has successfully implemented the first component but not the second. They criticize the REA model is being essentially semantic and not representing behavioral aspects of the accounting domain. The authors note that moving towards an object oriented approach for REA decreases some of the issues in this area. As the authors see it, the problem of mapping REA concepts to modeling constructs occurs through the overuse of the entity construct. The authors note that entities in REA are defined inconsistently. For instance, events can change the state of an asset while a resource cannot change another entity's state. The authors' final criticism of REA is a lack of support for hierarchical decomposition. The authors then propose using the Bunge-Wand-Weber approach to correct these deficiencies.

Gailly *et al.* use the Unified Modeling Language (UML) profile to graphically represent REA ontologies. The authors look at ontology engineering methodologies to evaluate the development of the REA ontology. The authors argue that REA is a business domain ontology. The authors state that there are different schemes for classifying ontologies. Two dimensions of these classifications are the richness of the internal structure and the subject of the conceptualization. The subject of the conceptualization includes structured and semi-structured information in a formal specification with a shared conceptualization. Here formal means machine processable. In this view, there are several types of ontologies. These include representation ontologies, top-level ontologies, domain ontologies and application ontologies. The authors concluded REA is a specialization of a top-level ontology. Further they determine that REA is a business domain ontology which has a universe of discourse in business. However, REA does not support all business related subjects such as marketing strategies. According to the authors, business domain ontologies are high level ontologies. In order to be implemented, an

application ontology or ontologies must be created. They conclude that REA is not an application ontology because it is not limited to a single application. In terms of the richness of REA's internal structure, the authors note that the REA model still uses a mixture of textual description and modeling references. Therefore, they conclude that a conceptual modeling language like UML will have the richness needed to represent REA ontological components. As such, they conclude that the REA ontology would have a semantically rich internal structure. However, the details of the structure are not explicitly specified. They then work out a specific specification in OWL for REA.

Lee (2009) expands the current discourse by looking at ontological representations of social reality. Lee is looking at the accounting context of the FASB expanding its conceptual framework to include principles based accounting standards. He believes that such a move will need to explicitly formulate concepts of social reality into the conceptual framework. He joins the discussion among some academic researchers who considers two basic models of social reality. The first is the social reality construction model. The second is Mattessich's onion model of reality. Lee is concerned with both ontology and epistemology. As is usual he sees ontology as the representation of physical reality in a conceptual model. Epistemology concerns the truth values of statements within the conceptual modeling language. Since the onion model of reality will be discussed below, I focus here on Lee's discussion of the social reality construction model. Lee, relying on Searle (1995), sees social reality as methodologically akin to linguistics. Searle describes social reality from two different perspectives, the ontological and the epistemological. Searle argues that social reality ontologically is subjective. It is created by humans subjectively through observations and consensus with regard to the function and meaning of social constructs. Further, he believes that social reality is subjective or objective

depending on the truthfulness of statements made about it. This is the epistemological dimension. Lee concludes that FASB's revision of the conceptual framework is unconvincing. He believes it is a mere repackaging of the original framework. He would make a distinction between such concepts as profit or capital as social reality whereas the account classifications are primary accounting concepts. He believes that both the calculative concepts and those social reality concepts must be included in the ontology. Unless this is done further financial crises will arise.

Mattessich (2003) is engaged in a discussion with the postmodernists about the nature of reality. That discussion does not concern us here. What does concern us is Mattessich's writings on ontology. Mattessich gives a brief overview of the history of ontological discussions beginning with the ancient Greeks. What is important here is that in order to map reality onto a conceptual framework or model one must first understand what that reality consists of. Mattessich's onion model of reality is comprised of four layers. The first layer is the physical chemical layer. This layer consists of forces, quarks, electrons, atoms, molecules, amino acids, etc. In Mattessich's model each layer has emergent properties that bring it towards the next layer. Mattessich's next layer is biological reality. This is basically DNA and life. Emergent properties in the second layer give rise to the third layer which is the mental reality of humans. Here human beings represent and conceptualize the two layers below them. In doing so, they create linguistic concepts which they share socially. This emerges into a social reality, the fourth and highest layer. From the point of view of our discussion here, what we are interested in Mattessich is that the layers of reality are built into an expanding ontology. Mattessich also applies to this model to the conceptual realm of accounting. He discusses this layering in the rather simple example using an apple tree and the property claim to the crop of the apple tree. The apples are physical reality.

But if an owner has a property claim, then the income from the sale of the apples is revenue. It is the property claim which transforms the crop into income for the owner. This illustrates the hierarchical and layering nature of social reality as argued by Mattessich.

Sugumaran and Storey (2002) discuss the creation, use, and management of ontologies for conceptual modeling. They also provide a prototype for an ontology management system. The paper is concerned with the problem of good database design. Good database design is seen as a highly skilled art which could benefit from the availability of high quality ontologies. The objectives of their research include demonstrating the importance of ontologies in conceptual modeling and proposing a heuristic-based model for creating domain ontologies. They note that most ontologies are created manually and that there is no accepted methodology for constructing them. They overview two ontology frameworks: SHOE and Ontolingua. Figure 3 shows a partial travel domain ontology from their paper. Their heuristic ontology creation method contains four steps. The first step is the identification of basic terms. This includes two sub-steps: the identification of the most frequent terms and the identification of synonyms and related terms. The second step is the identification of relationships. There are three types of relationships: relationships between basic terms, relationships between ontologies, and relationships between ontologies and sub-ontologies. The third step is the identification of basic constraints. There are four basic constraints: a prerequisite constraint, a temporal constraint, mutually inclusive constraint, and mutually exclusive constraint. The fourth step is identification of higher level constraints. These constraints capture domain knowledge. There are two types of constraints in this step: domain constraints and domain dependencies. The authors further note that whereas most ontologies are built statically most domains actually evolve over time. Ontology development should include this evolution.

[Insert Figure 3 about here.]

Chou *et al.* (2008) operationalize Sugumaran and Storey's ontology creation process in the accounting domain. They use as an example of the profit and loss account. They look at ontologies as central controlled vocabularies that are integrated into relevant domains. They propose a five stage ontology development process for accounting. In stage one, accounting information is collected from enterprise data repositories. Each item would be assigned a number. Stage 2 is the analysis of the collected items. Each item would be classified based on its meaning, the relationship between items, and the operations the items could be involved in. Stage 3 creates an accounting taxonomy. In stage 4 DB schema is used to implement the items and the relationships between the items. Finally in stage 5, the accounting ontology is generated. However this final stage is not operationalized and we are left wondering how the ontology would be generated.

XBRL Goals and Initiatives

Recently, XBRL International (2010) issued a strategic document. That document consists of a number of elements. The document begins with a call to action which mentions specifically three opportunities which will be a potential benefit to XBRL stakeholders. These three opportunities are as follows. The first opportunity is aimed at software, ERP and business intelligence vendors. The opportunity is to make XBRL understandable to information technology professionals. According to the document this accessibility will help stakeholders market interoperable, interdependent intelligent business and enterprise reporting and analysis. The second opportunity is addressed to regulators, exchanges and government agencies. The opportunity here is the improved processing capabilities of XBRL-enabled tools. The third opportunity is addressed to banks and financial institutions. This opportunity is the creation of

intelligent interoperable business reporting in credit analysis, portfolio analysis, private equity and SME lending initiatives. Also included in the document are three goals for the future of XBRL. These goals are first, to make XBRL easier for IT developers. The second goal is to make XBRL information more comparable across taxonomies. And lastly is the gold to facilitate the consumption of XBRL information to a wider audience of users. The document notes that there are challenges to meeting these goals. Among those challenges are the following. First, the specification is difficult to read and to comprehend. Also, the use cases which drove the original development of X XBRL are not clearly understood. The document also notes that it is hard to compare concepts across taxonomies and periods.

In order to meet the goals and challenges the XBRL Standards Board (XSB) determined six initiatives and three principles to guide the future work of the XSB. The initiates are: the creation of an abstract model, production of training materials, definition of standard API signatures, reorganization of the existing specification, enhancing data comparability and developing application profiles. The three principles are protecting current investments while ensuring the stability of the XBRL specification, encouraging adoption of XBRL and preparing XBRL for new opportunities in the future. What follows is a brief discussion of the last five initiatives followed by a discussion of the creation of the abstract model. The abstract model is most relevant initiative to the current paper.

The second initiative by the XSB is the production of training materials. According to the board, the training materials will provide the following benefits: shortening the learning curve for new XBRL developers, shortening the time to implement next XBRL solutions, marketing the power of XBRL, and increasing consistency by creating best practices in showing how XBRL was meant to be implemented. The board calls for the creation of five types of training

materials. These include XBRL primers, white papers, case studies, tutorials and samples. The third initiative promoted by the board is the definition of standard API signatures. The API signature will attempt to standardize the characteristics of an XBRL-based API. So for instance, naming of functions, function input types, and function output types. The benefits of this initiative are as follows: first, providing software developers with an easy way to begin programming using XBRL; second, serving as a learning device for software developers; third, lending support for open source implementations of the signatures; and lastly, encouraging consistency in vendor tooling and promoting better interoperability across implementations of XBRL. The board envisions the outcome of this initiative to be signatures for mainstream programming languages, relational databases and data repositories, and web services via scalable interface sets. The signatures will need to meet the following conditions: conforming to the UML model developed in the first initiative, have a modular structure, be compatible with existing XBRL resources such as the functions registry, leveraging contributed API architectures, take into account ontological and semantic support in the XBRL community, be independent of XML, support system development lifecycle operations and support SQL generically.

The fourth initiative initiated by the board is reorganization of the existing specification. The intended benefits of this reorganization include the following: breaking up the specification into small, manageable modules; clarifying modular tendencies and how the modules relate to one another; improving cross module interoperability; aligning the modules and their test suites in ways that increase efficiency; improving module organization; differentiating between basic and advanced concepts to facilitate learning XBR; and providing better structure, easier comparison, and source control within the modules. The board notes that the modification of semantics or syntax of XBRL is out of scope for this task. In recommending an approach to this

initiative, the board once again stresses consistency to the UML conceptual model. The fifth initiative is enhancing data comparability. There are four intended benefits of this initiative: increasing usefulness of existing XBRL information by providing new and easier comparisons, breaking down boundaries between jurisdictions and taxonomies, allowing analytic models to be applied across a wider set of data, and elevating and increasing the value of XBRL globally. The board recommends the following approach: identifying comparability challenges, identifying core use cases, identifying different implementations across taxonomy boundaries, prioritizing the comparability types discovered, identifying comparability technology initiatives, consideration of registries and taxonomy profiling, and reviewing the current versioning and formula modules. The sixth initiative is the development of application profiles. The benefits of this initiative include: enabling the decomposition of the XBRL technology stack into simple components, reducing the scope of implementation for XBRL projects, allowing vendors to select the components they wish to support, facilitating easier communication of XBRL processing requirements, creating metrics which managers can use to make business decisions, allowing vendors to create profile definitions to assess their solutions, and allowing analysts to gather statistics about XBRL applications in the marketplace. Again this initiative is seen as being dependent on the first initiative the creation of the abstract model for XBRL.

The board's first initiative is the creation of an abstract model for XBRL. The board states that the abstract model is foundational for the set of initiatives and that it will complement the existing XBRL specification. As implemented, the abstract model includes the XBRL 2.1 specification and the dimensions specification. Benefits of the abstract model include two perspectives: business and technical. From the business perspective the abstract model will allow conversations about the functionality and merits of XBRL without requiring deep technical

knowledge of the specification, allow managers to better understand the application of XBRL to their projects, and allow knowledge workers to comprehend the XBRL standard more quickly. From the technical perspective the benefits include shortening the XBRL learning curve, facilitating integration of XBRL and other technologies, better understanding how complex systems with XBRL components will behave, a description of the structures and relationships at the level of syntax, and helping to ensure that existing XBRL modules interoperate. The board believes that the resulting abstract model will describe the functionality of the XBRL specification, define the primary entities of the specification, defined interactions of XBRL components with one another, describe how XBRL interacts with other specifications, and list outputs of XBRL from inputs of other specifications.

XBRL Specification

The XBRL framework is defined in the XBRL 2.1 specification. In it, the XBRL taxonomy is defined as an XML schema and all of the linkbases associated with it. A concept is an element term that is manifested in an XML schema. The taxonomy schema gives a concept a name and data type. Linkbases are used to show the relationships between concepts and to their documentation. A linkbase is a collection of extended links of which there are five different types. The types are calculation, label, reference, presentation and definition. Specific instances of data are collected in instance documents. The specific data which is contained in the instance documents are called facts. The instance documents also contain contextual information about the facts. Instance documents can be supported by more than one taxonomy. Because of this and because taxonomies themselves can be interrelated, the XBRL specification includes the concept of a Discoverable Taxonomy Set (DTS). The DTS is a collection of taxonomies and linkbases.

The specification does not include provisions for ensuring data integrity or confidentiality. However, it does include some consideration for data validity. Validity can be checked either syntactically by parsing against the specifications in the XML schema or semantically by comparison with the facts and relationships specified in a Discoverable Taxonomy Set. Links between XML fragments and XBRL are defined through XLINK. There are many links in XBRL. These include links between instance documents and their discoverable taxonomy set, instance facts and footnotes describing relationships between facts, and links between the syntactic structure and semantics as described in the linkbases. The XLINK specification itself describes the semantics and syntax used for the specification. XLINK links attributes to elements in another namespace.

Extended links in taxonomy linkbases are used to express relationships between concepts or to link concepts to authoritative documentation about the meaning of the concepts. There are three types of extended links that express relationships between concepts. These three types are definition, presentation and calculation. Definition links specifies such things as generalization, specialization, essence, similarity, requirement, etc. The presentation link describes the structure of the presentation of facts and preferred labels in presentation. The calculation link describes the numeric relationships between categories and subcategories such as summarizations. There are two types of extended links that link to authoritative documentation. These are labels and references. The label links link to labels in specific natural languages. Reference links provide information which points to documentation that is external to the discoverable taxonomy set. This would usually be authoritative literature defining concepts and elements.

FASB's Conceptual Framework

As noted in the literature review the FASB is currently working with the IASB to revisit the conceptual framework project initially developed in the 1980s. In order to contrast the modeling approach of the FASB with that that has been taken by the development of XBRL, the paper will review the construction of the conceptual framework as proposed in the Statement of Financial Accounting Concepts No. 6 (SFAC 6). That statement defines the elements of financial statements as follows**:**

> Elements of financial statements are the building blocks with which financial statements are constructed - the classes of items that financial statements comprise. The items in financial statements represent in words and numbers certain entity resources, claims to those resources, and the effects of transactions and other events and circumstances that result in changes in those resources and claims. (p. 3)

The statement defines 10 elements that are related to performance measurement and an entities status. The first element is assets. Assets are defined as "probable future economic benefits obtained or controlled by a particular entity as a result of past transactions or events." (p. 10) Liabilities are "probable future sacrifices of economic benefits arising from present obligations of a particular entity to transfer assets or provide services to other entities in the future as a result of past transactions or events." (p. 13) Equity is defined as assets less liabilities. Investments are defined as equity increases by owners who transfer ownership of assets from another entity to this entity. Distributions are transfer of assets from ownership interest in one entity to another entity. Comprehensive income is defined as equity change not resulting from investments or distributions to and from owners. Revenues are defined as inflows of assets from the production of goods services or other activities in the businesses strategic mission. Expenses are the outflow of assets weren't increase in liabilities from production of goods and services or

other activities central to the business's mission. Gains are defined as increases in equity from non-mission related activities. Losses are defined as decreases in equity from non-mission related activities.

Interestingly enough, the statement does not distinguish between the actual physical items such as assets and the representations of those items such as the records of those assets. This is an indication of a lack of distinction between the syntactic level of definition of the concepts and the semantic level of definition of the concepts. Concepts statement number six focuses on the usefulness of financial reporting information in economic decision-making. This implies a choice among alternative uses of scarce resources. Other concepts statements reflect other aspects and objectives of financial reporting. So the conceptual statement emphasizes resources and changes to resources in a business enterprise. These resources are exchanged with other business enterprises. The statement defines the primary activities of business organizations as the acquisition, production, use and distribution of resources. Profit is seen as being compensation to owners for the risks they bear in investing assets in a business enterprise. The tension between resource inputs and resource outputs is also fundamental to the conceptualization in this part of the framework. Statement number six also recognizes a distinction between stock and flow, the balance sheet elements and income statement elements. It also discusses the interrelationship between these two types of elements. The statement separates ideas of recognition, measurement and display from the definition of the elements and does so purposely. These items were to be addressed later in the development of the conceptual framework. However, the conceptual framework never developed that far.

Whither Syntax and Semantics?

A formalization, such as the XBRL specification, consists of strings of symbols which comprise the language of the formalization. In a logic formalization these strings of symbols are called sentences or formulas. At the syntactic level, these strings are manipulated by inference schemes, parsers, and validation tools in a purely formal way, without regard to the meanings which may be attached to the original or deduced sentences. The syntactic level, therefore, is merely concerned with which sentences can be produced by following the formalization. So the only way that a sentence is, in essence, 'meaningless' in syntax is if it is not derivable from the formalization via an inference rule or sequence of inferences. An interpretation is a formal map from the syntactic level to the semantic level which provides meaning or a translation of the combination of symbols of the sentences.

The syntactic rules are akin to the grammatical rules of a natural language. In natural languages, the meaning of the sentences is based on an interpretation of the form of the sentence. This form is regulated by distinguishing which sentences are grammatical. However, the distinction between syntax and semantics in natural language is often a hazy one because the grammatical rules are not specified in advance but have been reduced from the structure of the language by linguists. Therefore, it may be impossible to accurately describe the syntax of a language in a finite number of rules. For example, a basic sentence form in English is subject-verb-object. This 'rule' works well for 'sensible' sentences such as 'The computer ran the program.' Unfortunately, without further rules of grammatical construction, a naive foreign speaker might deduce the following sentence from the rule: 'The computer walked the program.' The purpose of indicating this type of problem in natural language is to point out the close relationship of both syntax and semantics to the interpretation of meaning in these languages. It

appears as though the human mind attends to both syntax and semantics simultaneously through learned patterns when constructing the meaning of natural language sentences.

Another type of interpretation has been developed in the naturalistic research methodology known as hermeneutics. Using this methodology, the researcher attempts to interpret the world as a text in order to understand the meanings which the actors in the study attach to objects, to themselves and others, and to actions. Here the objective is similar to reducing the semantic context of the world to a somewhat less complex and perhaps hidden syntactic component. The syntactic component in hermeneutics is seen to be dynamic, however, with the actors and their environment constantly interacting to reconstitute meaning and form. This technique is essentially a meta-analysis of sentences which not only looks at sentences in their own contexts but also across the contexts of different actors and environments.

In order to relate accounting to the concepts of syntax and semantics, it should be remembered that these concepts themselves are used in different ways in various types of analyses. In the case of natural language, the syntactic component of accounting is the systems of rules such as the mechanics of double entry bookkeeping, statements of auditing standards, and FASB and SEC rulings which affect transactions and manipulations of transactions, including disclosure. As is the case with all natural language, the syntactic and semantic components lie very close to one another when accounting is viewed as a natural language. For example, take a common occurrence when beginning accounting students are first introduced to accounting for merchandising firms. A typical error in this situation is for the student to debit inventory and credit accounts payable when merchandise is purchased on account instead of debiting purchases. This may happen because the student is confused about the semantic meaning of

addressing the problem of cost of goods sold calculation versus the meaning of accounting for inventories.

A further phenomena which occurs when accounting is viewed as a natural language is that the interpretation component becomes closely intertwined with both the syntactic and the semantic components. The conceptual framework and FASB statements which refine previous interpretations in order to standardize interpretation of economic events indicate the closeness of this relationship. For example, FASB statement number 13 is an attempt to standardize the interpretation of what constitutes an operating lease as opposed to a capital lease for both the lessee and the lessor. This is similar in form to the hermeneutic concept of interpretation acting as the metarule intermediating between the actors and their environment, in this case, CPAs, their clients, the FASB members and the accounting environment.

The explication of the interrelationships between form, meaning, and interpretation was the original inspiration to the formulation of formal logics and formalizations. The ancient Greeks were concerned with the problems of valid arguments proceeding from the development of schools of rhetoric. At the time, the work was concentrated on developing techniques of identifying correct inferences and exposing fallacious inferences. One of the arguments which occurred at the time was between Diodorus Cronus and his pupil Philo of Megara. The argument revolved around the correct interpretation of the inference rule modus ponens which is also known as a conditional statement. If the conditional statement is formed as $a \rightarrow b$, a is usually termed the antecedent and b the consequent. Diodorus and Philo differed as to what would be the conclusion if the antecedent was false. Diodorus took the position that a false antecedent negated the conditional so that nothing could be deduced. So the statement 'If the FASB is a governmental agency, then XBRL is an XML implementation' is false in Diodorus' system since

the FASB is not a governmental agency. Philo took the opposite view of conditionals, arguing that the only case where the conditional is false occurs when the antecedent is true and the consequent is false.

Philo's reasoning is important because his position became the standard one in formal logics. Under his interpretation, a → b, which semantically might be read as ‘a implies b' or 'if a, then b', is logically equivalent to ‘not a or b'. In this case, the 'or' is interpreted as the “inclusive or” meaning that either 'not a' is true, 'b' is true or both are true. (In the case of an “exclusive or”, the last case is disallowed.) Under this interpretation, treating the sentence 'If the FASB is a governmental agency, then XBRL is an XML implementation' is equivalent to 'Either the FASB is not a governmental agency or XBRL is an XML implementation' which is true since the FASB is not, currently, a governmental agency. Notice that the second clause, ‘XBRL is an XML implementation', can be either true or false and the entire statement remain true, as long as the FASB remains independent. As such, the Philonian interpretation of false antecedents is often referred to as the case of trivial truth of the conditional.

For whatever justifications there may be for the specific interpretations that have been given to inference schemes, and there are many equivalences between rules of inference schemes as well, the point is that the construction of formal systems requires the specification of exact syntactic rules and specific interpretive mappings to semantic meaning. In addition, even after the specification of the formal inference scheme, it may be possible to reduce the number of allowed inferences and other rules by eliminating inferences and rules which are logically equivalent to one another.

Relationships between Abstract Models, Conceptual Models, Ontologies, and XBRL

The following discussion uses concepts from the Object Management Group (OMG), especially with respect to abstract models. In OMG usage an abstract model is a model which has been abstracted away from all of its implementation issues. So in the case of XBRL, the abstract model will remove all reference to XML. So for instance, all reference to the XLINK specification would be removed from an abstract model of the XBRL 2.1 specification. This is in fact what is happening in the first initiative set by XBRL international as described earlier in the paper. Although the XLINK syntax and references to it is removed from the abstract model, the relationships themselves between concepts, etc., specified in XLINK syntax, that is, the semantic relationships, must be preserved in the abstract model. An interesting artifact of producing an abstract model from a specific implementation of the specification is that any influence of the implementation language on the original specification may show up as a semantic artifact in the abstract model. Whether this has been the case in the situation of developing an abstract model of the XBRL 2.1 specification is a matter of further study.

In computer science, conceptual models are used to model situations prior to design and implementation. They model the relationships between concepts which are usually considered to be entities. The idea is to use the conceptual model to represent the domain knowledge of experts in a particular field. However, this is done without regard to the physical linkages of the concepts to the material world. It is only modeling the relationships within the model domain. Conceptual modeling is often accomplished using the Unified Modeling Language, UML. In a UML conceptual model, the diagram consists of classes, associations between classes, and roll types. Roll types referred to the roles the associations can take in particular instantiations of the conceptual model. The cardinality of the relationships is also shown in the model.

In computer science, ontologies are an extension of conceptual models. Ontologies contained classes, associations and cardinalities but also functions, rules, axioms and events. Domain ontologies are built to describe the knowledge in a particular domain. Unlike conceptual models, they include a reference to the physical reality that they are modeling. An ontology of the group of domain ontologies which models their common concepts is called an upper ontology. A Gellish ontology is the set of upper and domain ontologies. It is understood in computer science that there is a need to model across ontologies. However there is no formal methodology with which to combine ontologies. That task is usually manually accomplished. We could infer from this that the task of combining, say, XBRL taxonomies would not have a known procedural solution.

Re-evaluating the Initiatives

What can be concluded from all of this? First, that ex-XBRL is doing a reasonable job in modeling an underlying accounting and perhaps business ontology. The modeling is called "underlying" because the XBRL 2.1 specification does not include an explicit ontology. What then of the six initiatives proposed by ex-XBRL international? Why is it still necessary to sell XBRL to developers and others? Returning to the six initiatives, we can take each in turn, leaving the first for last. The recommended outputs for initiative two, producing training materials, include a collection of technical materials. These materials rely heavily on producing samples of XBRL case studies of XBRL development efforts, white papers specifying the application of the specification, primers for how to apply the specification, and tutorials. There is nothing in this approach which would facilitate the mapping of the XBRL concepts constructs to the real world. This will likely be a weakness of this initiative.

Initiative three is defining the standard API signatures. Again, this initiative is largely a technical approach to the problems of software development. The usefulness of XBRL in defining domain concepts is not addressed. Furthermore, this initiative does not address computer science modeling concerns such as integration over knowledge domains. The fourth initiative is to reorganize the existing specification without modifying its syntax or semantics. This will largely be accomplished through modularization of the specification. However, increased modularization will not address the issue of the usefulness of the specification. Indeed in some ways, the modularization approach can only increase the complexity of the specification.

The fifth initiative is to enhance data comparability. This is a very broad-based initiative in that its recommended approach is very open ended. It recommends the identification of comparability challenges identifying use cases and real world scenarios among of other things. This initiative could lead to discussions concerning methods of combining XBRL instances in taxonomies across knowledge domains. Here, knowledge domains are considered to exist across jurisdictions and even across organizations when considering internal business data. The sixth initiative is developing application profiles. Like initiative for, this initiative largely relies on decomposition of the existing specification. As such we would not expect it to encourage adaptation of the standard since it will likely be at additional complexity. However, this may be an empirical question.

The sixth initiative is the creation of an abstract model of the XBRL 2.1 specification. It was already mentioned that there is a danger that this abstract model will contain artifacts from XML. As mentioned earlier the benefits of this initiative fall into two classes, business and technical. We will look at these two classes starting with a business perspective. The product of this initiative will be an abstract model which is a collection of classes, relationships, roles and

cardinalities. The initiative claims the following benefits: providing meaningful context, simple vocabulary, ease of understanding with respect to project implementation, value and capability of the standard. It is difficult to imagine how an abstract model which is essentially an entity relationship diagram or class diagram can provide any of these benefits. The technical benefits include shortening the learning curve, helping to integrate XBRL with other technologies, helping to understand how XBRL might behave in complex systems, describing structures and relationships at the syntactical level and unifying existing XBRL modules. To the extent that a technical person understands abstract models, then we might expect improvements in the learning curve to occur. An abstract specification should also help with integration issues especially where those technologies also have an abstract model representation. Also understanding XBRL at an abstract level should help to predict its behavior when combined with other technologies in complex systems. By definition the abstract model is defining the underlying structures and relationships, however at the semantic level not the syntactic. Finally to the extent that the abstract model does provide an overall view of the XBRL specification including its modules, that could help certain technical people to gain a comprehensive understanding of specification.

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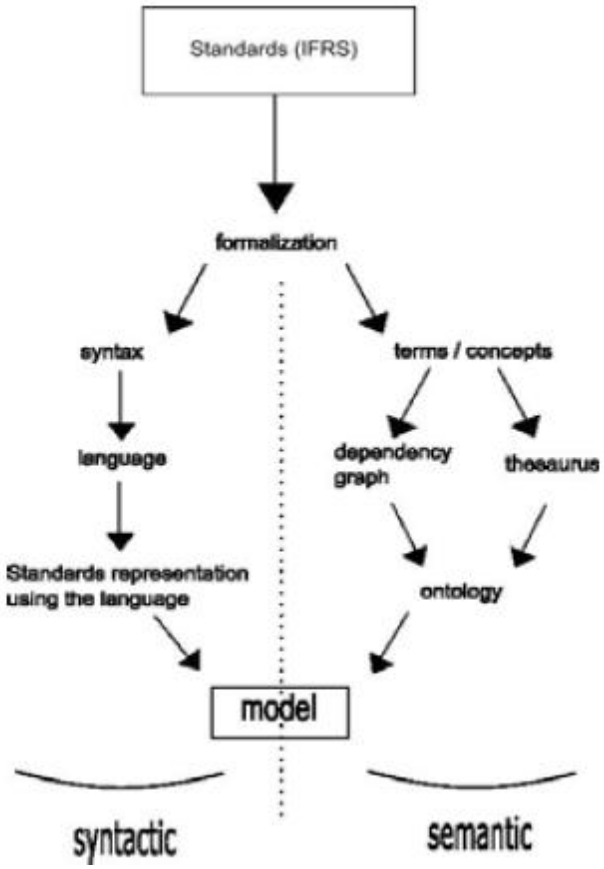
Standards (IFRS)
formalization
syntax
terms / concepts
language
dependency graph
thesaurus
Standards representation using the language
ontology
model
syntactic
semantic

Figure 1

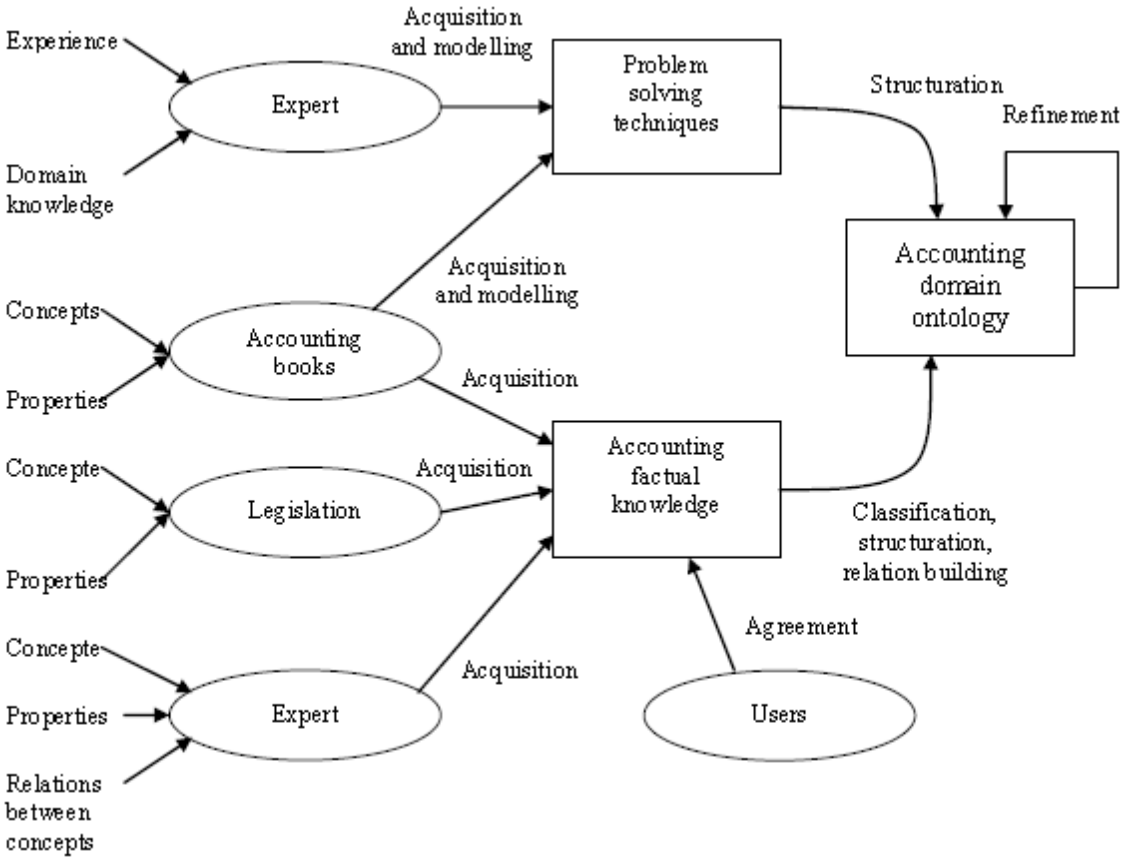
Experience
Domain knowledge
Expert
Acquisition and modelling
Problem solving techniques
Structuration
Refinement
Accounting domain ontology
Concepts
Properties
Accounting books
Acquisition and modelling
Acquisition
Concepte
Properties
Legislation
Acquisition
Accounting factual knowledge
Classification, structuration, relation building
Concepte
Properties
Relations between concepts
Expert
Acquisition
Agreement
Users

Figure 2

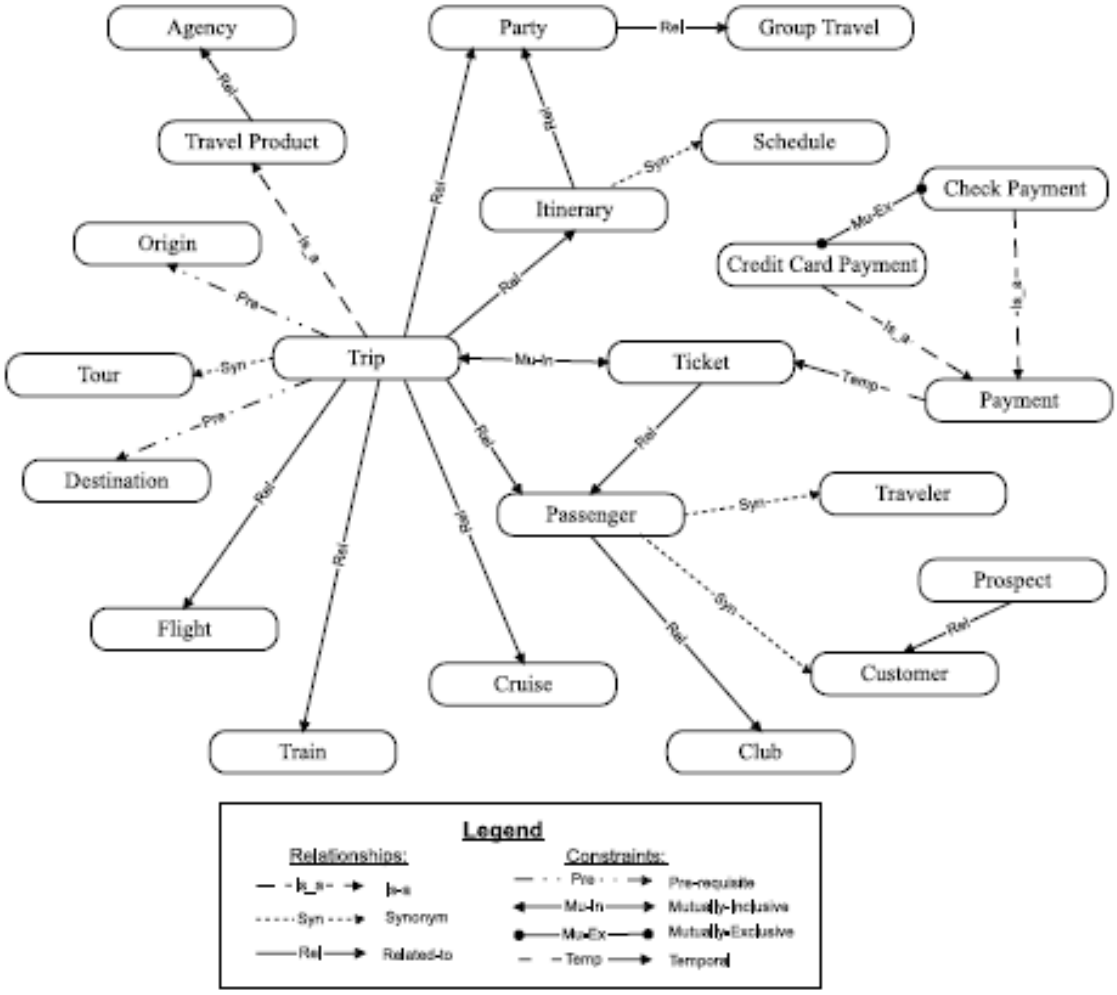

Figure 3 - Partial Travel Domain Ontology