

# What is in an Accounting Ontology? Discussion Paper

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**Abstract.** The REA accounting model of McCarthy is often taken as a reference for accounting ontologies. The focus of these ontologies is on economic exchanges. This paper argues that accounting is more: it is about accounts and reports of economic exchanges. This suggests that accounting ontologies should broaden their scope to include Accounting Information System and Financial Report artefacts. Such an accounting ontology can not only accommodate the conditional-normative rules that play an important role in Accounting, but also allows to formulate questions on the ontological status of concepts like Asset and Equity.

**Keywords:** Exchange Ontology; REA; Mattessich; Design Science Research.

## 1 Exchange ontologies

There are currently several economic exchange ontologies such as OntoREA [12], COFRIS [1], and ATE [11]. Most of them are derived from or refer to the REA accounting model originally proposed by McCarthy [8]. REA modeled “what has occurred in a business process”. The subtitle of the article speaks about a generalized framework for accounting systems in a shared data environment. It was clearly inspired by the Entity Relationship Model of Chen that proposed a generalized or unifying conceptual model for data and achieved this by moving into the semantic direction. Similarly, REA aimed to unify the accounting perspective and the management perspective on accounting information systems [8], and also made a semantic move, building on the work of Ijiri [6]. The move is from data fields (debit and credit positions) to events in the economic exchange and their effects on resources. Further developments have worked out the exchange process and its different steps [9] and added commitments as first-class citizen concepts.

However, is an accounting ontology equivalent to the economic exchange ontology? According to Wikipedia, accounting is “the measurement, processing, and communication of financial and non-financial information about economic entities. Accounting measures the results of an organization’s economic activities and conveys this information to a variety of users, including investors, creditors, management, and regulators”. Clearly, economic activities are the *object* of accounting, and for assessing the firm value, the exchange activities are key (although some might argue that production is the central economic activity). However, accounting is not the study of economic exchanges (that is Economics), but the study of *the processing of information* about these exchanges, as the Wikipedia definition says (cf. [2]). It also talks about accounting as the *language* of business. Nowadays such a language or text takes the form of a

computerized accounting system as was the subject of McCarthy's seminal paper, or a blockchain shared ledger.

In the Netherlands, business economics is the field that studies business organizations from an economic perspective and now includes not only accounting but also e.g. finance and management. The term "business administration" is used as a near synonym. Historically, accounting has been the core of business economics. Accounting dates back to the origins of writing technology in the big empires of Antiquity (Egypt, Babylonia). The development of double entry bookkeeping in the early Middle Ages, formalized later in the famous work of the Venetian mathematician Pacioli in 1494, was an important step in rationalizing business. "Ubi non est ordo, ibi est confusio (Where there is no order, there is confusion)", according to Pacioli. In particular, it allowed not just recording economic events but also to analyze causal relationships between them [6]. In this way, (double entry) accounting enabled the development of economic thinking. Pacioli's work heavily depended on paper technology. For example, he writes: "The businessman must then prepare his Inventory in the following way: First of all, he must *write* on a sheet of *paper* or in a separate *book*..." [10]. In contrast, REA builds on relational database technology.

The REA accounting model is not just about economic exchanges, but specifically refers to accounting information systems (AIS) recording these exchanges. The model defines the core structure of such systems. The processing that is done in accounting information systems, the way data are aggregated into financial reports (where FR accounting standards are all about) and how quality of these data is assured (the typical auditing question) are *not* in the REA model. That does not mean that it is not possible to build accounting information systems including aggregation etc. based on REA – this has been shown already, to some extent at least, in the work of Gal and McCarthy [3], but it is not in the REA model. Neither in the exchange ontologies. The ontology describes the basic exchange concepts. These are the same in all enterprises, whatever recording system they use. There are also requirements for and a general design of an AIS, following from the FR requirements. These apply to all AIS as well. Then, on a third level, there are variants that are implementation-specific, such as double entry bookkeeping.

The economic exchange ontology does not include the AIS and the choices that have to be made in FR. The OntoREA accounting model [12] goes beyond an exchange ontology, starting from the central accounting concepts Asset/Liability/Equity. It also has a wider scope than accounting. However, I do not see in [12] a clear distinction between the economic phenomena and the accounting of them and the recognition of the Financial Report as a research object. In the following, I argue for accounting ontology as an explicit combination of exchange ontology and artefact ontology, where artefact is taken in the Design Science Research sense.

## **2. Mattessich on accounting**

In spite of its respectful age, accounting is still wrestling with its status as scientific discipline. It has often been remarked that there is a big gap between the accountancy

practice and the mainly positivist academic research. The goal of practitioners is to assure the accuracy and relevancy of financial reports, thus serving the practical goals of management and investors. Because of this purpose-orientation, Mattessich [7] argues that accounting should be seen as an applied science. However, he also argues that it should be taken seriously as applied science (not exactly the same, but similar to Simon's plea to take engineering seriously as a science of the artificial [13] that lead to the notion of Design Science Research [5,4]). "Anyone seriously looking at the practice of accounting must admit that its objective is not to represent economic reality in a purely scientific way, but to approximate it *pragmatically* on the basis of particular norms". He compares the situation of accounting with the (applied) science of medicine. In principle, the effectiveness of medical treatments is based on physiological properties of the body such as studied in biology. However, the complexity of the body and the diversity between people make it necessary to develop (design and test) treatments that are effective even if the mechanism is not completely clear.

Central to Mattessich's proposal is the recognition of *purposes* and related values (as opposed to a positivist account that tries to keep these out of the picture), and the use of *conditional-normative rules*. An illuminating example in the paper is the following. Consider the following published hypothesis:

"The greater the value of a corporation's fixed assets, the greater the likelihood that its financial statements included an allocation of profits for renewals, repairs, maintenance or depreciation".

And compare this rather vague statement with the reformulation in a rule:

"Company X **wants** to maximize its wealth. The value of fixed assets of company X is above so and so many dollars (...) **Then it is recommended** to include in its Financial Statements an allocation of profits for renewals, maintenance or depreciation".

The former is an empirical positivist statement that can be shown statistically significant, but in fact, it hides what is really going on. The latter describes the why, *and* is directly applicable by management.

The conditional-normative rule, as in the example, refers to a purpose and is prescriptive. The prescriptive rule is not an absolute law. It may be refined on the basis of accumulated experience. Perhaps there are situations where it is better not done this way, so the rules must be interpreted as default logic.

Rules are also important in Design Science Research. An artefact contains pragmatic rules [14], for the make plan of the artefact and its use plan. The correspondence is related, I claim, to the artefact character of accounts and its derivations in the form of financial reports (I guess the same could be said about the artefact character of treatments/drugs in medicine). Financial Reports are *symbolic* artefacts: they have a material aspect (writing technology, nowadays digital) and an information capacity. They are artefacts that can be studied from a Design Science Research perspective. An accounting ontology should include the concepts that are used in the formulation of the

pragmatic rules, such as Record or Representation, Agent, Goal, Value and specific accounting constructs.

### 3. Accounting artefacts

The conclusion of the above is that accounting is about a kind of symbolic artefacts. The core Record artefact types seem to be Accounting Information System and Financial Report (both with many variants). The relationship between the two is of course that the former is used in making the latter. Like most artefacts, both are made of atomic construct. In symbolic artefacts, these take the form of language primitives, e.g. XBRL tags – these are (secondary) artefacts as well.

In the case of Financial Reports, accounting should answer questions like:

- Why are they relevant? Identification of agents involved (user, designer, maker), their goals and relevant social norms.
- What is their structure? How are they composed (recording, aggregation, controls), what are the quality criteria? This is described in make plans consisting of conditional-normative rules. Make plans can be improved over time.
- What is their use? Who uses them for what, what are the use conditions, what is the effect in the business practice (described in the form of pragmatic rules)? How do these effects differ in the case of new variants, such as promoted by the Continuous Auditing movement?
- What are they about? Symbolic artefacts differ from other artefacts in having a representational function. The structure follows a grammar, and this is semantically related to some domain. Here the economic exchange ontology comes in – including the question of the mapping between the constructs and syntactic structure and the semantics.

Of course, the questions are not new. They are at the core of the work of Standard Committees. There is overlap with the research question types formulated in [3] that does not build on the artefact concept, but on the sign triangle. From a Design Research perspective, the accounting artefacts would be relevant research objects.

Still, the question is whether they should be conceptualized in an accounting ontology. That depends on what it could achieve. I want to make one suggestion. REA ontology is often contrasted to double entry bookkeeping. Where exactly is the contrast? Double entry bookkeeping is not an exchange ontology but a way of *representing* economic exchanges and their effects, for a business purpose. The representation has its shortcomings, as has been argued by McCarthy and others, but to understand the shortcomings (or its strength, some would counter), it is necessary to compare this representation with other representations (in terms of usability etc.) and to the object of representation (in terms of completeness and precision). REA is another representation – a model for the accounting system database – and we compare its features with a traditional GL system. An economic exchange ontology is the domain semantics of both representations. Such a representation/domain relationship can be formulated if we take the representations, embodied in artefacts, to be first-class citizens in the accounting ontology.

Another question that can be formulated is whether terms like Asset and Equity exist in the economic world or exchanges, *or* are recording/reporting constructs that build on economic exchange concepts but are defined for a financial reporting purpose and do reflect stakeholder goals. This influences their ontological status.

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