Traditional Accounting with Decentalised Ledger Technology

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Abstract. Distributed ledger technology is by some believe to be the accounting system of the future, replacing the centuries old double-entry accounting paradigm, as it has desirable characteristics such as tamper-resistance. However, it might suffer from technology lock-in as double-entry bookkeeping, due to its long standing history, has offered the conceptual foundations for many laws, regulations and business practices. While some of these laws, regulations and practices might become obsolete as a result of distributed ledger technology, some might still prove to be valuable in a new technological context. While aiming at unlocking the potential of distributed ledger technology in an accounting context, we also want to preserve the wisdom of accounting craftsman. For this reason, it is the aim of this paper to offer a bi-directional mapping between traditional double-entry bookkeeping and innovative paradigms that have proven their value in decentralised systems, of which distributed ledger technology is an exponent. This paper offers such a mapping for the Resource-Event-Agent paradigm.

Keywords: Resource · Event · Agent.

1 Introduction

1.1 The Need for Collaborative Accounting

The collaborative economy [1] is rapidly gaining importance [9] , while the accounting practice is still enterprise-centric [8] This might hamper a fair distribution of value along the supply chain [4] (e.g. virtual enterprise, cradle-to-cradle). In order to enable enterprise-centric accounting to deal with the collaborative

logic, we propose an ontology-based approach that maps relevant accounting data of trading-partners, allowing third parties and individual trading-partners to assess a fair distribution of value along the supply chain. This research project aims at mapping an accounting taxonomy (e.g. XBRL GL[4]) to an international open-edi standard [5] in order to facilitate the simultaneous implementation of both paradigms in distributed ledger technology, such as blockchain.

2 Methodology

We intend to formally validate the coherence of the ontology- mapping with Formal Concept Analysis.[10] Figure 1 visualises a lattice that allows of identifying the intent and extent of a construct in a formal ontology.

In a later phase we intend to implement the mapping in a real-world system in accordance with the Action Design Research research paradigm. [11]

3 Retro-Engineering McCarthy '82 [7] & Gal '86 [2]

In this section we map REA[2], which has been demonstrated to cover both dependent views of trading-partners in a collaboration space and the perspective of any independent observer [6], with the most elementary notions of double-entry accounting, showing that double-entry bookkeeping is inherently related to the viewpoint of a single trading-partner. In a later phase, this minimal accounting taxonomy (as partly shown in figure 3 & 4) will be replaced with a fully-fledged accounting taxonomy such as XBRL GL[4]

Figure 2 shows the REA value chain as represented in REA[2] on the outside and fundamental accounting notions at the center of the figure. It shows that an `Acquisition Duality` is operationalised by an `Liability` in accounting terms. When a `purchase : economic event` occurs, the inventory of the viewpoint-defining economic agent (i.e. `self : economic agent`) increases. This increase in `raw material : inventory` can be booked as an asset increase (i.e. debit), for which the double in the journal entry is a `: liability` increase (i.e. credit). This liability can then be settled by a requiting `cash-disbursement : economic event`. This cash-disbursement decreases the cash : inventory (i.e. (i.e. credit), for which the double in the journal entry is a `: liability` decrease (i.e. debit) that settles the liability generated by the `purchase : economic event`. As such, in the acquisition cycle, the `: liability` operationalises the second REA axiom *"All events effecting an outflow must be eventually paired in duality relationships with events effecting an inflow and vice-versa."* [3]

When consuming `raw material : inventory`, as shown by the `consume : economic event` in figure 2, the `raw material : inventory` decreases (i.e. credit), for which the double in the journal entry is a `: cost` increase (i.e. debit, and an equity, which is a subtype of liability, decrease). When the `Conversion Duality` produces `final product : inventory`, this is booked by means of a

[4] https://www.xbrl.org/the-consortium/get-involved/gl/

`produce : economic-event` journal-entry in which the `final product : inventory` increase (i.e. debit) has a revenue increase (i.e. credit, and an equity, which is a subtype of liability, increase) as a double.

A `sale : economic event` that decreases the final product : inventory (i.e. credit), while its double in the journal entry is a `: UOMe` (i.e. You owe me, as a subtype of asset) increase (i.e. debit). The acquisition duality is then established by settling the `: UOMe` by means of a `cash-receipt: economic event` that increases the `cash : inventory` (i.e. debit), for which the double in the journal entry decreases the `: UOMe` (i.e. credit).

4 Conclusion

Although the formalisation of the mapping will require considerably more research and effort, the pattern in figure 2 already leads to the following observations:

- The REA-construct `economic event` is a sub-type of the double-entry bookkeeping construct `journal entry`
- The double-entry bookkeeping construct `inventory`, which is a subtype of the double-entry bookkeeping construct `asset`, is related to the notion of `custody` in REA
- debits make the view-defining `self : economic agent` richer (e.g. inventory increase, liability decrease, cost increase (i.e. liability decrease))
- credits make the view-defining `self : economic agent` poorer (e.g. inventory decrease, liability increase, revenue increase (i.e. liability increase))
- alternation debits and credits enforce a clockwise value flow in the REA value-chain from the perspective of the view-defining economic agent (i.e. the shareholder) as shown in figure 2

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5 Appendix

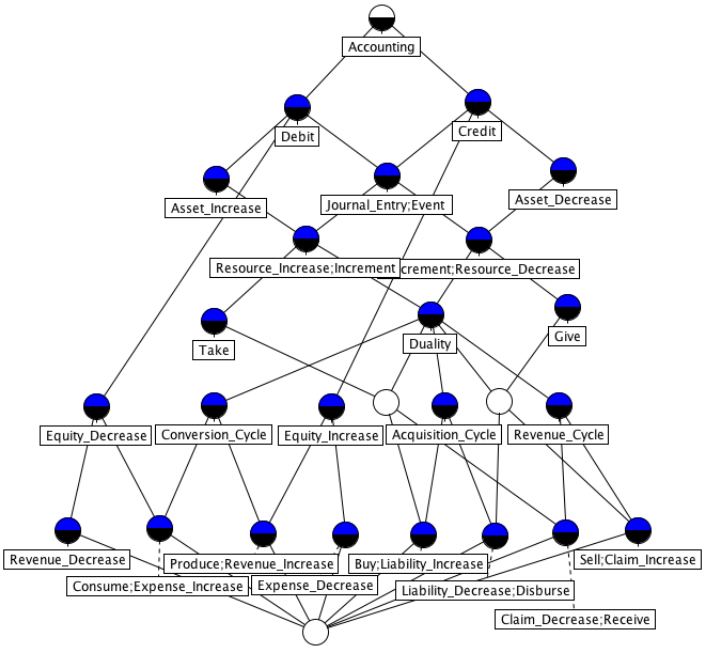

Fig. 1. Example Conceptual Graph

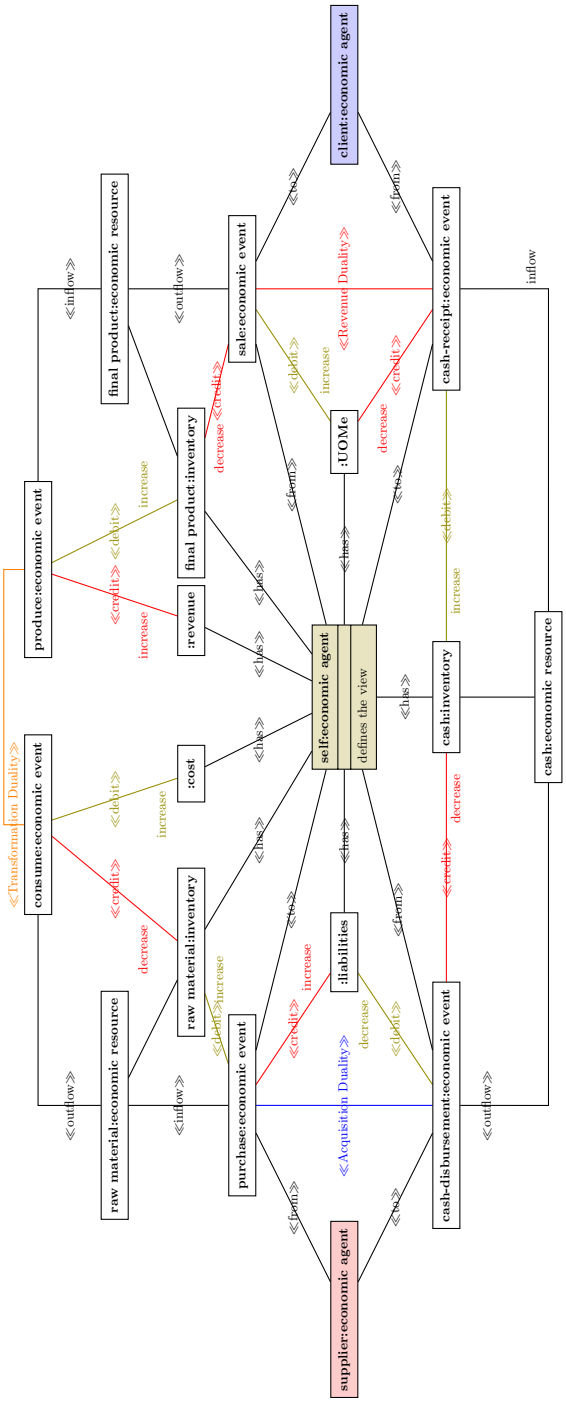

Fig. 2. Scruffy REA Value Chain object-model pattern for accounting, which is inherently in the trading-partner / dependent view, and that should eventually become "neat"

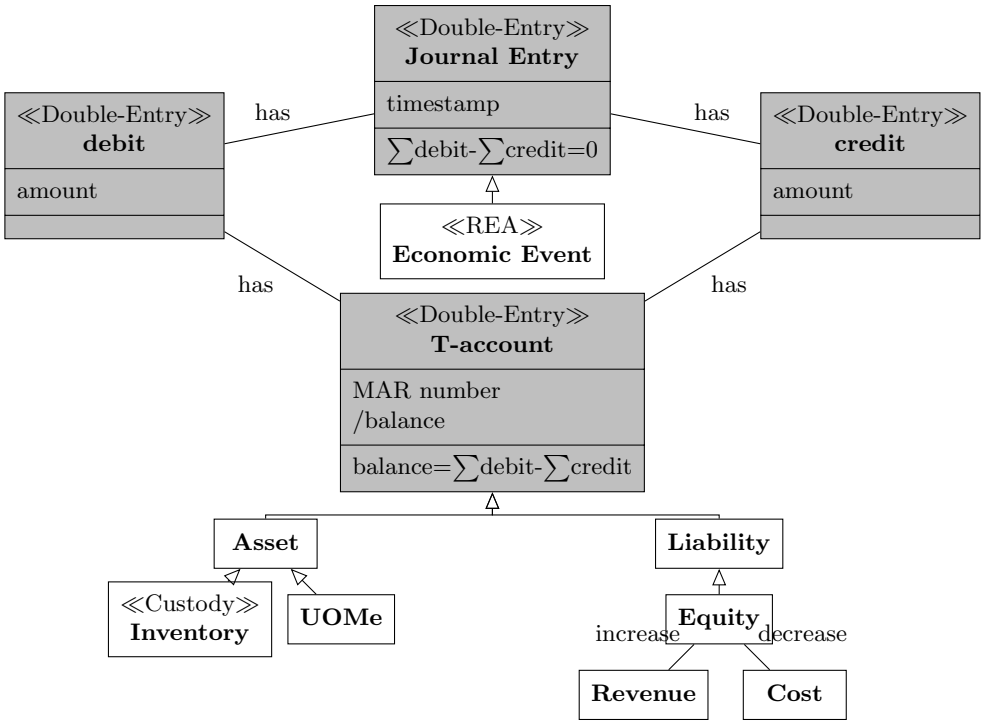

Fig. 3. Scruffy mental model that goes with the REA Value Chain pattern and should eventually become a "neat" meta-model for it

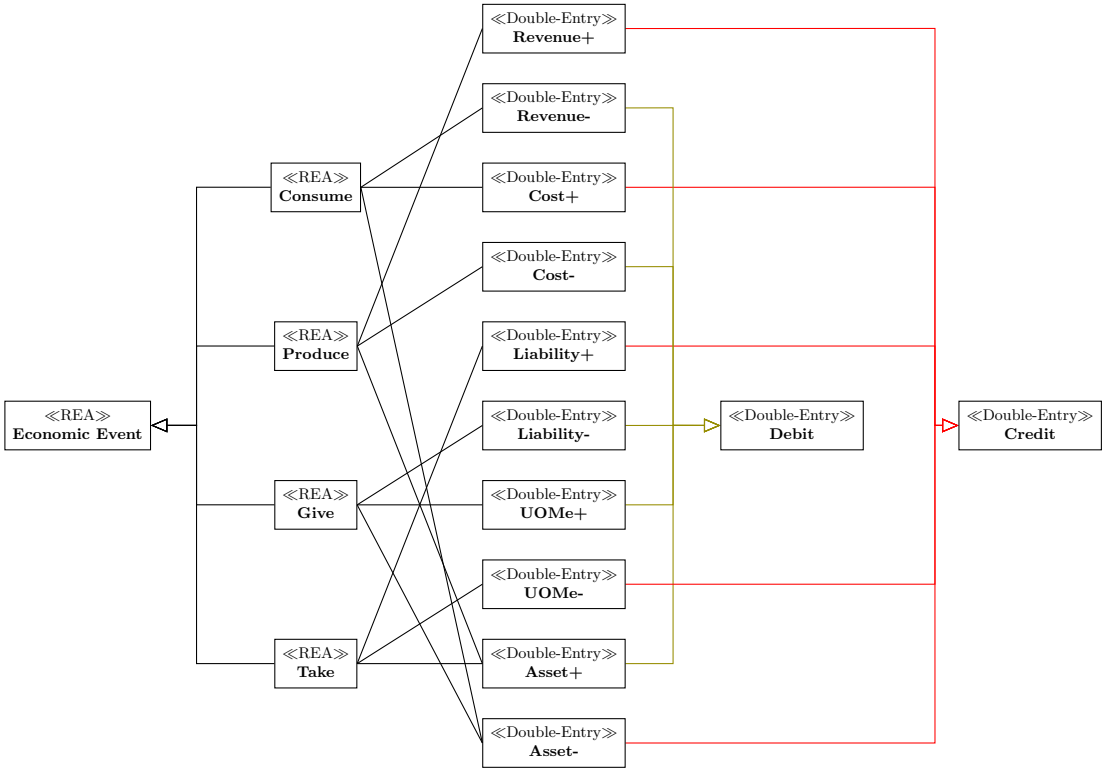

Fig. 4. Scruffy mapping of REA and double-entry bookkeeping and should eventually become a "neat" meta-model for it