

The Nature of Economic Events in the REA Model

When I started studying the REA model it surprised me that a model that has matured for so many years doesn't have a more detailed and precise description. For a while I kept searching for additional specifications or an updated version of the ontology from 2000 [1]. As I realised that it didn't exist (at least not publicly available) and that my reaction was quite common when starting work with the REA model, I began writing my own interpretation of the ontology and solutions to some of the issues I encountered. My masters thesis "REAListic - en REA model uden perspektiver" (only in Danish so far) presents this work together with an alternative model called REAListic.

I believe that an updated REA ontology would give great benefits. Currently there are too many unresolved issues to address for anyone who wants to use the model for implementing an enterprise system. Some of them will be implementation specific, but there are still many fundamental issues of general interest that aren't well defined. A common solution presented either as an updated ontology or additional standards would prevent everyone using REA from having to "reinvent the wheel" and it would facilitate reuse and adaptiveness of solutions.

With this paper I would like to introduce a couple of the issues regarding the basic REA model that I would like to see discussed. The first concerns the participation relations *inside* and *outside*. The second is on the semantics of economic events, and the differences between transfers and transformations.

The inside/outside relations

One of the main benefits of using an event-driven modelling approach is that all the basic facts of an event are recorded and nothing else. Afterwards different views of the same data can be used for different purposes like accounting or marketing. Another way to apply different views is when changing between an independent view (global view) and a dependent view where data for a single agent i.e. an enterprise or a single department are evaluated.

When dealing with B2B transactions or other types of inter-enterprise systems it would be advantageous to be able to create models in an independent view. I believe the REA model has some limitations in this area. The choice of the *stock-flow* relations *inflow* and *outflow* and the *participation* relations *inside* and *outside* require a dependent view where a single enterprise or other type of agent is chosen as basis.

According to the REA ontology it seems that the *participation* relations *inside* and *outside* are used in the sense internal/external when agents external to the chosen view are involved, and in the sense provider/receiver of a resource when only internal agents are involved. This doesn't seem intuitive, especially in the case of exchanges between two internal agents. Table 1 describes the semantics of the *participation* relations as I interpret the ontology. Because of the asymmetry some *inside/outside* relations will need to be changed if the data-model is to be seen in a different view (i.e. if calculations are to be performed on a single department instead of the whole enterprise.) I would suggest the *inside/outside* relations replaced by view-independent terms like *receiver* and *provider* or *to* and *from* as used in some of the ebTWG related specifications.

Table 1. The meaning of the inside and outside relations described by the view-independent terms receiver and provider

Agents Involved	Event Type	outside	inside
one ext. + one internal	inflow	provider	receiver
one ext. + one internal	outflow	receiver	provider
two internal	inflow	receiver	provider
two internal	outflow	receiver	provider

The *stock-flow* relations *inflow* and *outflow* also assume a dependent view. Seen from an independent view they are essentially just flow from one agent to another and would be sufficiently described by a direction-neutral term like i.e. transfer, combined with *provider/receiver* relations to agents instead of *inside/outside*. This way an event may also be represented in the same way by two agents, instead of having one agent call it an *inflow* event and the other calling it an *outflow* event.

To perform calculations like conclusions of materialization a dependent view must be chosen. That means the functionality of a system will need to have an agent specified as source of the dependent view, but there is no need to apply a limited view to the data model and data structures.

The semantics of economic events

The REA ontology operates with two types of exchanges – *transfers* and *transformations*. Each exchange consisting of at least two dual events. When modelling exchanges with REA the three axioms to be observed state:

Axiom1: At least one *inflow* event and one *outflow* event exist for each economic resource; conversely *inflow* and *outflow* events must affect identifiable resources.

Axiom2: All events affecting an *outflow* must be eventually paired in duality relationships with events affecting an *inflow* and vice-versa.

Axiom3: Each exchange needs an instance of both the *inside* and *outside* subsets.

It seems to me that the three axioms and the general descriptions of exchanges and events were made primarily with *transfers* in mind. I believe that there are differences between the two exchange types that need to be observed, and that the nature of *transformations* is inadequately described by the ontology.

The first axiom makes sense for both *transfers* and *transformations*. The second axiom is true for all *transformations* as resources cannot appear or change state out of the blue. Often a *transformation* involves at least three dual *transformation* events. I.e. production of goods by use of raw materials, labour and machinery. The *transformation* events will always be of a congruent nature. For *transfers* the second axiom is often true, but as described by

McCarthy in [2] for practical reasons single events with no dualities might be the best way to describe gains and losses and matched expenses i.e. like tax, heating or maintenance.

The third axiom is not quite clear to me. If *inside/ outside* is meant in the sense internal/external it clearly only concerns *transfers* as *transformations* will only involve internal agents. If it is meant in the sense *provider/ receiver* it might apply to both types of exchanges, with the addition that for *transformations* only a single agent may be both the *receiver* and the *provider*.

What is a transformation ?

Black and Black [3] describe how the purpose of a transformation is to increase the *want-satisfying power* of a resource. This can be done by changes of form or substance as described by the *use/ consume* and *produce stock-flow* relations in REA. But besides from that Black and Black also mention changes in location and changes in time. For instance "*A commodity which is in Madagascar when all the people who want it are in Europe has no want-satisfying power unless it can be transported to Europe*". As an example of the effect of time on a the want-satisfying power of a resource can be mentioned the increase of want-satisfying power for Christmas decorations in December compared to June, the ageing of wine and the fact that a harvested crop has no value unless it can be sold before it rots.

Age and location are two examples of properties of a resource that can be changed to increase or decrease the value of the resource. Many other properties can be changed to affect the value of an item. I.e. a broken bicycle can be fixed, a recycled bottle can be cleaned, an employee can be educated to give his or her services a higher value and so forth. So *stock-flow* relations called *move, store, educate, clean* and so on would all make just as much sense as *use* and *consume*. They would all indicate a change in some property of a resource as well as the value of the resource.

What are the functional effects of an economic event ?

When an event occurs something changes, but what is it that changes ? The REA ontology doesn't state what the functional effects of events are. In one way or another economic events affect the resources of an enterprise. But what properties of the resources are changed ? It is obvious that a *transfer* event changes the ownership or *custody* relation of a resource, and that it doesn't change the physical form of a resource as a *transformation* event can. But what about properties like the location of a resource ? As described above the location is a property that may be changed by a "move" *transformation* but in some cases like i.e. transfer of funds from one bank account to another the movement is instant, costless and congruent with the transfer of custody. In those cases it might seem reasonable to model the transfer as one event.

If a *transformation* event is to be modelled with relations to an *inside* agent and an *outside* agent it must be in the sense *provider* and *receiver* as no external agents can participate in *transformations*. In some cases the *receiver* and *provider* might be the same agent and in others they may be different. If two agents are involved a *transfer* of *custody* takes place. I.e. if a bicycle dealer applies spare parts, polish and elbow grease to an old bicycle to obtain a bicycle he can sell, he obviously has *custody* of all parts before and after the *transformation* and is the only agent involved in all the dual *transformations*. On the other hand *transformations* in larger enterprises may use raw materials from one

warehouse, labour supplied by a HR department, machinery from a production department and produce goods stored in a second warehouse. In this case the agent in charge of the *transformation* (most likely the production department) takes part in all the dual *transformation* events but only has custody of some of the resources that are used and produced. In this case it would make sense to model the change of *custody* of the used and produced goods that aren't in custody of the production department as part of the *transformation*.

One might argue that a *transfer* event is of a legal nature rather than physical changing only the *custody* of a resource, and that a *transformation* event changes anything else than the *custody*.

This would make sense, but modelling all movements of resources as *transformations* and all internal *transfers* of *custody* would be tedious indeed. For practical reasons it might be better to accept that some combined events exist. The combinations are limited though. Transfers can only be combined with resource movements that are costless and congruent with the *transfers*. Examples are transfer of funds, receiving items that are delivered by the seller and sale of items that are picked up by the customer. When *custody* of a resource is transferred as part of a *transformation* it will always be between internal agents.

Decisions as to what the functional effects of events are, have an impact on the design of models and a common specification of standards would make it easier to understand and compare models.

This was a compressed version of a couple of the ontology related issues I have been working on. I'm looking forward to discussing these and other issues more in detail at the workshop.

As when it comes to future research my focus on the REA model as a semantic model for describing economic events is to develop a model that is unambiguous and describes only the basic properties of its entities with no assumptions about the subsequent use of data. Based on a model like that, other areas I would like to do further research in include the description of generic REA types, data patterns and model templates. I believe this would give great benefits as to the ease and speed of creating REA models, as well as enhance the possibilities of reuse and easy maintenance when models change due to system evolution. Defining a series of standard transformations between REA patterns could also be interesting and would be one way to facilitate easier model updates.

References

- [1]: "The Ontological Foundation of REA Enterprise Information Systems", G..L. Geerts and W. E. McCarthy, August 2000.
- [2]: "The REA Accounting Model: A Generalized Framework for Accounting Systems in a Shared Data Environment", W.E. McCarthy, The Accounting Review (July 1982), pp. 554-78.
- [3]: "Production Organization", J.D. Black and A.G. Black, Henry Holt and Company 1929.