A Synthesis of REA Reference Models

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Abstract. This paper introduces a new REA enterprise information reference model that integrates the transaction reference model of McCarthy and the conversion reference model of Hruby into a single model that accounts for both inter-enterprise and intra-enterprise processes. This new reference model should make it easier to represent services in REA models by allowing an explicit duality between transfer and transformation events, where McCarthy's and Hruby's reference models can only represent duality between one kind of events. First, the state of the art in REA reference models is addressed by presenting and comparing McCarthy's and Hruby's models. Second, the new, integrated REA reference model is presented.

Keywords: Reference model, Resource-Event-Agent, Ontology

1 Introduction

In this paper, a new enterprise information reference model that is based on the Resource-Event-Agent (REA) enterprise ontology [1, 2] is proposed. Although the REA reference models found in McCarthy's foundational REA article [3] and Hruby's book on business patterns design [4] are founded in the same enterprise ontology, they focus on different application domains, which lead to particular modeling compromises and models with different representational capabilities. McCarthy's reference model focuses on transactions between individual enterprises, by representing the exchange of resources (e.g. money for product) and the resulting resource transfers between trading partners. Hruby's reference model, on the other hand, focuses primarily on the processes inside an enterprise by representing exchanges and conversions (i.e. process input becomes process output), but not the resource transfers between trading partners. The reference model that is presented in this paper integrates both perspectives (i.e. transactions and processes) in a single reference model that is able to represent both and provides enough semantic power to model transfers, exchanges and conversions.

Section 2 discusses McCarthy's and Hruby's REA reference models and their specific characteristics. Section 3 presents the new, integrated REA reference model. In section 4 conclusions and future research are presented.

2 REA Reference models: State of the Art

The REA ontology knows three main primitives, namely economic resource, economic event and economic agent, which are abbreviated to resource, event and agent in the remainder of this paper. *Resources* in the REA ontology are defined as goods, services or rights that have utility, are scarce and under the control of a legal or natural person [3, 5, 6]. *Events* are occurrences in time that relate subsequent process states to each other and involve gaining (i.e. increment) or losing (i.e. decrement) control over economic resources [3, 6, 7]. *Agents* are natural persons that act on behalf of economic units (e.g. enterprises) and are accountable for or participate in economic events.

2.1 McCarthy's Reference Model

Fig. 1 shows a modernized version of McCarthy's foundational reference model [3], which was originally developped to represent exchange transactions between enterprises, as it appears in ISO's business transaction scenario standard [6]. This model differs from the initial model by decomposing the ternary 'control' relation in two separate participation (i.e. agent-event) relations, conforming to Weber's critique [8], and the merger of the economic agent and its subclass economic unit in the AGENT class. The STOCK-FLOW association between the RESOURCE and EVENT classes in fig. 1 shows which resources are involved in and affected by which events. The INCREMENT-DECREMENT association in fig. 1 represents the duality relationship between two events (i.e. one increment and one decrement). This duality balances the changes in resources due to events [5] representing of principle of economic reciprocity, which requires adequate compensation (i.e. increment event) for lost resources (i.e. decrement event). The EXCHANGE-INSIDE_PARTY association reveals the agent whose view determines which events are increment and which are decrements. The EXCHANGE-OUTSIDE_PARTY association relates the inside party's counterparty to the economic event.

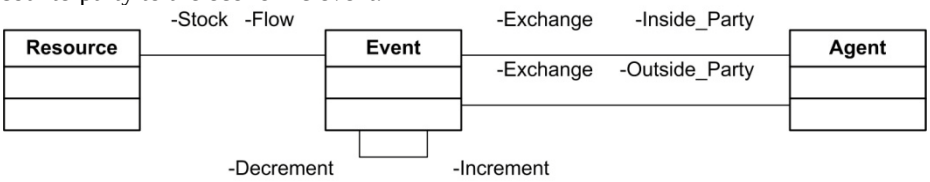

Fig. 1. McCarthy's REA Reference Model

2.2 Hruby's Reference Model

Fig. 2 shows Hruby's reference model, which focusses on representing economic events (i.e. conversion and exchanges) viewed from inside the enterprise, as it appeared in his business patterns book [4]. By explicitly discriminating increment and decrement events, it differs from McCarthy's reference model, which chooses to represent increment and decrement as roles of events and not as kinds of events.

Consequently, McCarthy's Stock-Flow relation is decomposed into different kinds of inflow and outflow relations, which identify the resources that are used and consumed (i.e. decrement) to produce (i.e. increment) new resources. Hruby's reference model also incorporates provide (i.e. PROVIDER-PROVIDE) and receive (i.e. RECIPIENT-RECEIVE) relationships that connect agents with decrement and increment events respectively. Consequently, a provide relationship relates a decrement event to the agent that experiences a resource decrement due to the event (i.e. inside party in McCarthy's model) and a receive relationship relates an increment event with the agent that experiences a resource increment due to the event (i.e. inside party in McCarthy's model).

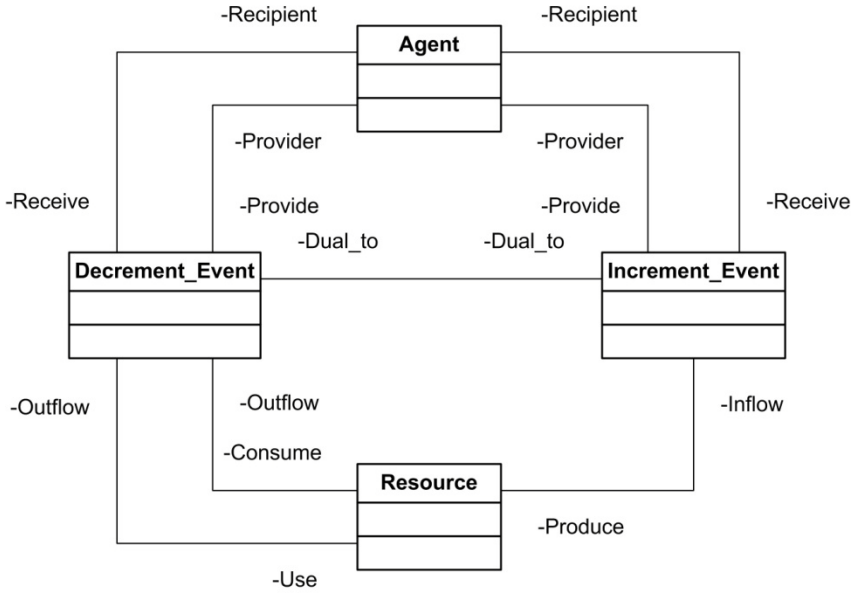

Fig. 2. Hruby's REA Reference Model

3 The Integrated REA Reference Model

A similarity in McCarthy's and Hruby's reference model is that they both use the agent concept to model trading partners and event performers. The downside of this choice is that trading partners cannot be explicitly discriminated from pure event performers (e.g. the trucker cannot be discriminated from the enterprise that ships the goods). To allow for this discrimination, we reintroduce the concept economic unit that was removed from McCarthy's original reference model as a superfluous synonym for the agent concept. Therefore, the agent and economic unit concepts need to be redefined. We redefine an *Agent* as the natural person that executes the event (i.e. the event performer) and an *Economic Unit* as the legal or natural person that loses or gains control over resources in decrement and increment events respectively (i.e. the trading partner). Consequently, economic units, which were originally

defined as a subclass of agent, determine the scope of the context in which economic activities take place. This new definition also fits McCarthy's original model, where economic units are inextricably bound with the inside party role that determines which events are classified as increments (i.e. losing control over resources) and decrements (i.e. gaining control over resources).

Fig. 3 reflects the central role of the economic unit concept in our integrated REA reference model. In this reference model, the explicitly modelled economic unit's view, which is modelled as the association between the ECONOMIC_UNIT class and the DUALITY, INCREMENT and DECREMENT classes in the fig. 3, defines which events are dual to each other and hence the duality that connects the explicitly modelled increment and decrement roles for the event that forms the centre of our reference model. This explicitly modelled view is the main difference with McCarthy's and Hruby's model, which allows us to integrate both the view from inside the enterprise (i.e. dependent or trading partner view) and the view of a third party that is not involved (i.e. independent or helicopter view). The agents in this reference model participate in events, representing that they execute events without experiencing their economic consequences (i.e. gaining or losing control over resources). These consequences are experienced by the economic units and explicitly represented by the INCREMENT and DECREMENT classes in the reference model that mediate between the ECONOMIC_UNIT and the RESOURCE over which they gain or lose control. The reference model also allows that a single EVENT can be viewed as an increment and decrement by the same (i.e. at the object level, a conversion event is modelled as an event of which the increment and decrement side relate to the same economic unit) or different (i.e. at the object level, a transfer event is modelled as an event of which the increment and decrement side relate to different economic units; recipient and provider respectively) economic units. AGENT-ECONOMIC_Unit relations (e.g. works for) were omitted from this model for the reason of conciseness.

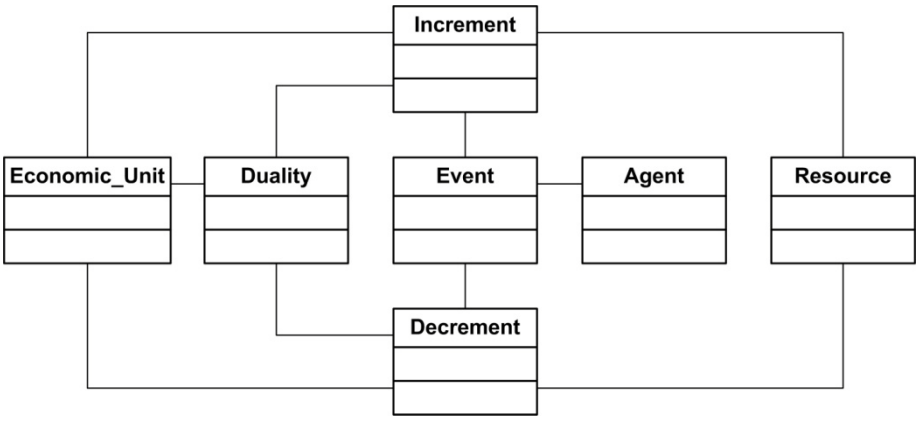

Fig. 3. Reference Model

4 Conclusions & Future Research

Our REA reference model integrates McCarthy's and Hruby's reference models. The integrated REA reference model resolves the ambiguous use of the agent concept, which makes the REA ontology easier to understand. By defining an explicit view on economic events, determined by the economic unit, this integrated REA reference model allows for representing transfers and transformations in a single reference model and discriminating transfers from transformations through their specific relation with economic units (i.e. transformation events relate to a single economic unit, transfer events to multiple).

Additionally, service modeling can benefit from this new reference model as transformation events (e.g. repairing a machine) can be related in duality with transfer events (e.g. money transfer), which was impossible in both older REA reference models as either of them was confined to represent transfers or transformations.

In the future we will also further explore the abilities of REA as a language for business modeling and use the integrated REA reference model proposed in this paper to create strategy tools (e.g. for determining the opportunity of vertical integration, simulating the return of business process redesigns). The basic simulation models (and part of their functionality) for the creation of such strategy tools were presented at the EOMAS conference in Amsterdam [9] and OnToContent conference in Vilamoura [10].

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