Towards Modeling the Value of a System's Production – Matching DEMO and e3Value

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Abstract. This paper presents an alignment between two ontologies, DEMO and e3Value, with the aim of bridging the semantic gap between Value Modeling and Enterprise Ontology. DEMO contributes with a theory and method for designing and engineering enterprises. e3Value contributes with the notion of purpose through value semantics and system context. The ontology matching effort was guided to address three common concern areas: Demand/Offer definition, Actor and Transaction. The resulting ontology includes shared core concepts and introduces positive constraints which, we argue, improve system development efforts by combining two relevant and complementary approaches.

Keywords: System Design and Engineering; Enterprise Engineering; Value Modeling; Production Semantics; Purpose Modeling.

1 Introduction, Motivation and Approach

This paper presents an ontology integration effort between DEMO [1], from the perspective of Enterprise Engineering, and e3Value [2], from Value Modeling.

In previous work we have defined four-layer framework [3] with the objective of linking the concepts used in system design activities to their purpose. Our proposal consists in introducing the market concept into system modelling activities in order to support dynamics and mediate teleological and ontological visions of a system. The hypothesis is that a system is a value chain itself and can be further decomposed in a value model within the system's scope.

The e3Value ontology is directed towards e-commerce. The solutions market concept presented in [3] requires taking a broader approach. Particularly, we chose not to formalize the *economic independence* restriction of an actor, as it is to be relaxed for self-provisioned services modeling, with the purpose of future drill-down modeling of the system.

The objective in matching DEMO and e3Value is introducing value-oriented input for obtaining value-traceable outcomes in system design. We can summarize the mutual benefits as 1) being able to express the Value context of any Transaction as a manifestation of purpose; and 2) trace value-production to Coordination/Production Facts/Acts level, enabling system construction modeling.

The approach was creating a matching ontology between the two source ontologies instead of a single, merged, ontology. This results in compatibility with existing applications and research, particularly the e3 family of ontologies and tools.

2 Matching e3Value and DEMO

The main common concept between the two ontologies is the *transaction* between two actors. Therefore, the service value concept is based on e3Value by relating the Buyer/Seller dual-party semantics to DEMO's Using System and Object System. Due to tight space restrictions, only selected concept matches are presented.

DEMO's main theory book [1] has a relatively formal glossary of around 150 concepts and we are not aware of any implementations of its body of knowledge in Semantic Web-friendly languages. The presentation of the ontology matching is based on e3Value ontology and segmented according to three concern areas: Actor, Transaction and Demand/Offer definition (Value).

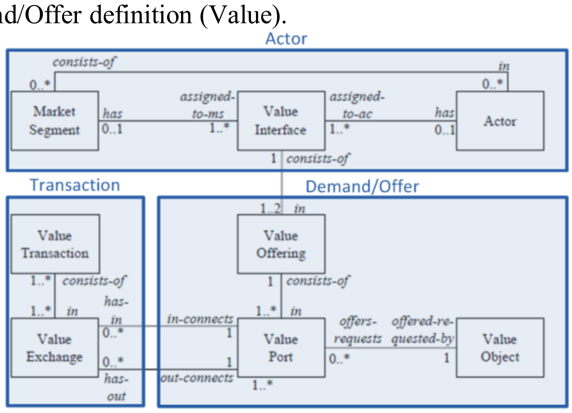

Figure 1. e3Value ontology – Concern areas segmentation

Actor. Actors are the active elements of both social systems and value networks. Like e3Value's *Value Exchange*, they belong to a system part as defined in DEMO's Phi Theory [1]. In DEMO, an actor is a *subject* fulfilling an *actor role* in a *transaction type*. The *initiator* and *executor* actor roles are bound by their common interest in bringing about a *production result*. In e3Value, both actors (*provider* and *requester*) are bound by the willingness to share value objects with the concept of reciprocity.

Transaction. The Transaction concern area indirectly represents the relationship between actors by associating Value Ports of different directions. A unitary DEMO transaction relates to a Value Exchange in e3Value. A *Value Transaction* involves at least two, according to the principle of *economic reciprocity*. *Value Port* and *Value Object* are connected to Actors by synthesizing meaningful Value Offerings, which aggregate Value Ports with the same direction.

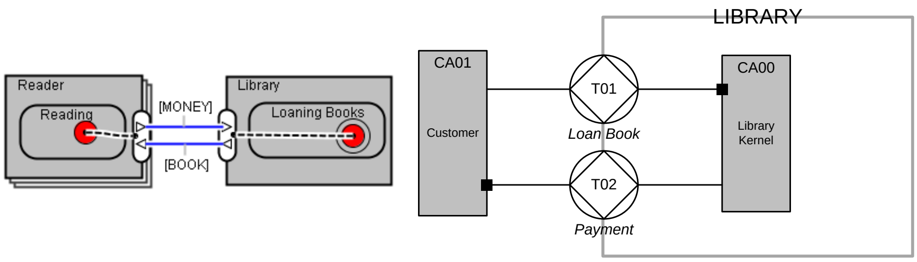

Figure 2. e3Value and DEMO simplified Library Examples

In economic transactions, it is common that one of the value exchanges is relative to the Money value object; it is also common that the executor of the transaction charges money for an offered good or service. However, this is not necessarily the case and, therefore, it is necessary to distinguish the initiator and executor of the transaction in e3Value semantics. Using the concepts of start stimulus and end stimulus confer direction of initiative to the trade.

Moreover, in the examples on Fig. 2, it is the Reader's **choice** to *use* the Library to get a Book in exchange for Money. Obviously, there can be alternative solutions to get a Book. The fact that it is a *choice* is important, as it positions the Customer as a *using system* [1] and, therefore, being the *initiator* of the transaction.

Another critical relation to the alignment is between *Production Fact* (DEMO's Transaction Result) and *Value Object's* exchange, as the production of each service transaction determines its effective contribution to the value chains it participates in. The principle of *economic reciprocity* makes it necessary for DEMO's transactions to have a counterpart. Actually, their production fact is related to *value object* transmission. In the simplified Library example, the requested production facts are:

- R01 - ***book** loan has started*
- R02 – *book loan was paid (**money**)*

For this simple case, it is trivial to relate the production fact and value object. However, it may be a little more complicated in the cases where the value-orientation is not present in the transaction definition and it is necessary to make value explicit. This is an important contribution of the alignment, as more explicit value will enable better analysis, decision rationale and innovation [4].

Demand/Offer definition. In e3Value, a *Value Port* represents the offer of a certain Value Object to the environment. The consummation of this offer is the production of a *fact* by performing a *Value Activity*. A restriction introduced by DEMO into e3Value is that actors in a social system must be *competent* to perform the c-acts and the associated c-facts for demanding and offering value:

- *hasInValuePort x => x is competent to perform **request** and **accept***
- *hasOutValuePort x => x is competent to perform **promise** and **state***

Also, in order to promise a given p-fact, the actor must be able to **execute** the transaction, by performing a **p-act**, and bring about the corresponding p-fact. Tracing value exchanges down to these primitives connects the value model to the construction of the system, established in adequately founded actor interaction theory.

Next Steps: Defining Purpose through system context. Exchanging value objects is the main reason a transaction occurs; the motivation behind the engagement, its purpose. We argue that the same approach can be taken to look inside the system. By modeling each of its elements as an actor role, each respective transaction represents the subsystem's contribution towards its environment (the original system). This contribution must be valuable; otherwise it should not be part of the overall system. Therefore, the *purpose* of a given system element is the set of value contributions existing upstream in the value chain.

Finally, we must note that modeling the whole value-chain as a single system impairs low-coupling and modeling abstraction, as assumptions regarding the solution of each element of the problem chain are frozen. The capability of engineering the chain and its individual components requires decoupling by contribution and the recursive application of the Using System, Object System dualism. This way, the solution to each element of the problem chain is modeled as an independent conceptual system development effort, allowing increased abstraction and isolating assumptions.

Conclusion and Future Work

In this paper we have discussed and defined an alignment between two ontologies, towards bridging the semantic gap between Value Modeling and Enterprise Ontology.

DEMO contributes with a systems development process that the construction and an transactional pattern for both design and operationalization of the system. e3Value brings purpose through value semantics and system context.

An ontology implementation based on a Protégé prototype was developed and, despite no extensive validation was done, several instantiations of real world scenarios confirmed the contributions. An important shortcoming for the main research is that simultaneous scenarios with alternative choices are not directly supported. However, by using the *scenario path* concept and recursively chaining systems together through value transactions, it is possible to model multiple value offer/value demand combinations. Extending the ontology for this purpose will be object of future work.

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