

REA Value Chain Applied on Production Planning Model

by

Frantisek Hunka

University of Ostrava, Dvorakova 7,
701 03 Ostrava 1, Czech Republic
E-mail: frantisek.hunka@osu.cz

Miroslav Hucka

VSB-Technical University of Ostrava,
17. listopadu 15/2172,
708 33 Ostrava-Poruba, Czech Republic
E-mail: miroslav.hucka@vsb.cz

Josef Kasik

VSB-Technical University of Ostrava,
17. listopadu 15/2172,
708 33 Ostrava-Poruba, Czech Republic
E-mail: josef.kasik@vsb.cz

and

Dominik Vymetal

Silesian University in Opava, Univerzitni nam.
1934/3 733 40 Karvina, Czech Republic
E-mail: vymetal@opf.slu.cz

Abstract

Value chain model is a network of business processes that are bound by inflows and outflows of resources. REA (resource-event-agent) is an ontology based on value oriented perspective of resources. REA value chain is a sequence of REA models (processes) utilizing REA ontology. The essence of value chain modeling is to get an overview over the business processes of the enterprise and to validate consistency of the whole model. In the current REA value chain model, only flows of resources at the operational level of the process models can be utilized. This fact considerably eliminates activities whose basis lies rather at the policy level (meta-level) such as planning, controlling and monitoring. To cope with the issue the paper designs means how to adopt REA value chain model to be able to effectively comprise the flows of entities between both the operational and policy level. This approach comes out from the current REA value chain and is generalized into the notion of controlling and controlled REA process models. Proposed solution not only helps to clear up relationships between different REA process models but also contributes to direct integration of acquisition and sales (revenue) REA process models. Designed approach is demonstrated on attached figures of the REA production planning model.

Keywords: Business Process Modeling, REA Value Chain, REA Ontology, Controlling and Controlled Process

1. Introduction

New modeling and system design techniques are required for information technologies that can support the enterprise in achieving and sustaining the necessary flexibility. Process modeling methods are dealt with by many authors. Let us mention e.g. (IDEF0 1993) etc. Profound analysis of process models has been done by Repa (2006). Let us stress that traditional process models do not depict property rights, resource control and value flows. Currently, the most popular approaches in the enterprise ontologies area are e^3 -value (Gordijn, Akkermans 2003), enterprise ontologies by Dietz (2006), and the REA ontology (Resources, Events, Agents) for enterprise processes (Geerts, McCarthy 1999; 2002).

The e^3 -value ontology stipulates that the actors exchange value objects by means of value activities. The value activity should yield profit for the actor. For deeper insight in e^3 -value modeling in e.g. (Gordijn, Akkermans 2003), it shows that this method only covers exchange and trade processes but leaves out production and conversion processes. The state-of-the-art e^3 -value model only focuses on operational level (what has happened) but not on management policies (what could or should happen).

The enterprise ontology, as developed by Dietz (2006), precisely defines basic concepts such as action and process that represent the actual core of business operations. However this ontology leaves out the economic fundamentals of business activities namely the value flows and property rights. Our object of interest is the REA ontology, because it links together business process modeling with the underlying economic phenomena. The structure of the further text is as follows: section 2 shortly describes main features of the REA ontology. Section 3 explains basic ideas of value chain and its application on the REA ontology. Section 4 is dedicated to the planning and production process models and explains proposed solution. Section 5 generalizes proposed solution and describes and explains the newly introduced notions of controlling and controlled processes and section 6 concludes the paper.

REA Ontology

The REA ontology (see Geerts, McCarthy 2002; Hruby 2006) is a powerful tool for business process modeling as it provides a set of benefits that enable the user to create a robust domain specific model whose integrity can be checked even during development with a precise definition of concepts and relationships among them.

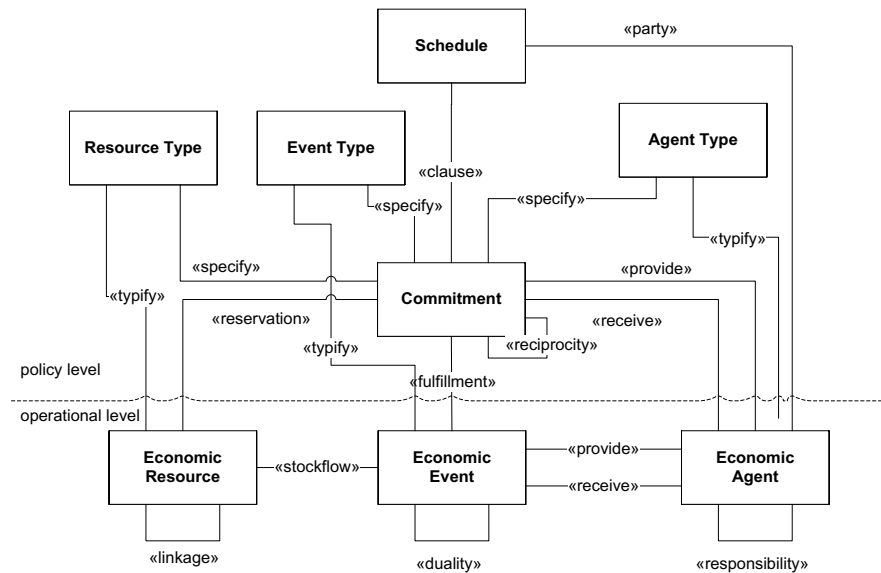


Figure 1 Basic Structure of the REA Conversion Process Model

The other progressive concepts of REA ontology can be summarized in a following way:

- it includes economic fundamentals of business activities,
- provides two general process models (exchange and conversion process models),
- implicitly offers two levels modeling - operational and policy (meta) level,
- REA process models utilize object oriented perspective and uses few powerful concepts on which the whole ontology is based and that are clearly comprehensible to domain specific users.

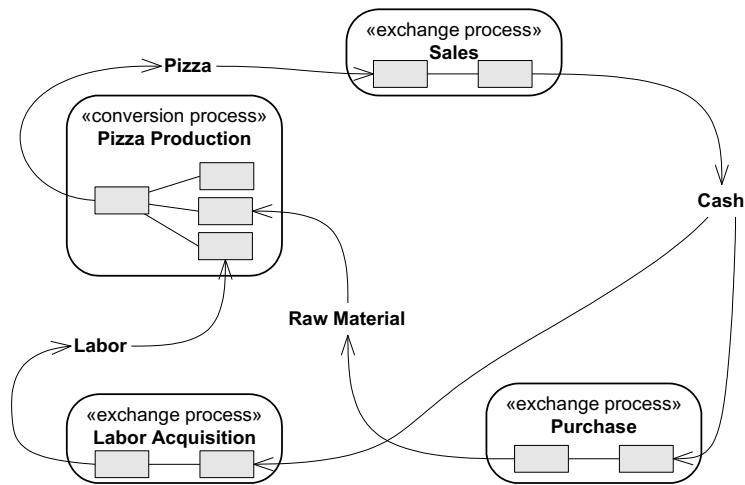
The two important semantic abstractions that are utilized between policy and operational level of the REA models are typification and grouping semantic abstraction (see Geerts, McCarthy 2006). The main use of these semantic abstractions are in defining constrains and guidelines. They may be also used for the categorization of physical entities. Basic structure of the REA conversion process containing essential entities and relations with operational and policy level is illustrated in Figure 1. Contrary to these semantic abstractions, planning process utilizes commitment entities and fulfillment relationships between the policy and operational level.

Value Chain

A value chain concept, developed and introduced by Michael Porter (1980) can be arranged as a series of input-output business processes with resource flows between them (see Dunn et al. 2004). A fundamental notion in value chain analysis is that a product gains value as it passes through a stream of production within the chain (in an enterprise). If a resource flow is created by REA resources and business processes are modeled by the REA exchange or conversion business processes, we can speak about a REA value chain. Input-output processes are modeled as REA exchange or conversion process models. The REA value chain is a network of business processes whose purpose is to directly or indirectly contribute to the creation of the desired features of the final product or service, and to exchange it with other economic agents for a resource that has a greater value for the enterprise. While the business processes are stick together by the duality relationships, the value chain model is weaved by resource inflow and outflow relationships. Examining the value chain construction in a detail way, we can find out that only the flow of resources is carried out at

operational levels of both REA process models. No entity can inflow or outflow at/from policy level of the REA models.

A simple value chain of REA models of conversion and exchange processes is illustrated in Fig. 2. However, a REA model is not only consisted of the operational level but contains a policy level too. The difference between both levels can be shortly described as follows. At the operational level the model records the day-to-day events of the domain. At the policy level the model records the general rules that govern this structure. Instances of the policy level govern the configuration of the instances at the operational level. More extensive value chains that cover planning, monitoring and controlling have to lead to active involvement of the policy level (meta-level) in the value chain concept. Current REA ontology and utilization of value chain are oriented only on resource flow at operation level of the process model.



Source: HRUBY (2006)

Figure 2 Simple Value Chain of REA Models

To model a given domain, e.g. production planning, there is a need to introduce some relationships and notions that allow to influence and control the entities at the policy level too. There is a challenge how to generate entities such as *Schedule* or *Contract* at the policy level.

2. Production and Planning Process Models

Production planning model captures planning and production processes of the enterprise. These processes are in an immediate sequence which means that the output of the planning process is an input for production process. Production planning process model can be viewed as a chain of planning and production processes.

Planning Process Model

Planning process model is a conversion process whose inputs are all needed resources and resource types. Traditional output of this process model is a resource at the operational level. The principal input entity of the planning process is *the Bill of Materials* (BoM). This entity represents

both a listing of all the assemblies, subassemblies, parts and raw materials that are needed to produce one unit of a finished product and also defines the way, in which a finished product will be manufactured. Thus the BoM entity creates the core input entity for the planning process model. Assemblies, subassemblies, parts and raw materials are in the form of “category items” and the way in which a finished product will be manufactured represents a target description. By Geerts, McCarthy (2006), target description can take at the least two different forms: standards and budgets. Standards often refer to engineering information while budgets provide quantified performance measures mostly related to a specific time period. For these reasons the BoM entity is located at the policy level of the process model.

The other input resources are at the operational level of this process model and represent planner labor and a computer that are used or consumed in the process model. Traditional output of the process model is a resource of schedule knowledge that contains all information needed in acquisition exchange process model to acquire all needed resources.

However, this process model should also create a schedule entity that is crucial entity at the policy level for the all REA conversion process models. This is necessary for placing the given process models in a complete REA value chain. To cope with that issue, the following solution was proposed, see Fig. 3. New resource type entity called production schedule was introduced at the policy level. This production schedule is related with the BoM by the planning policy association and with the production knowledge resource by the typification relationship. The task of the planning policy association is to create a corresponding production schedule entity utilizing the BoM.

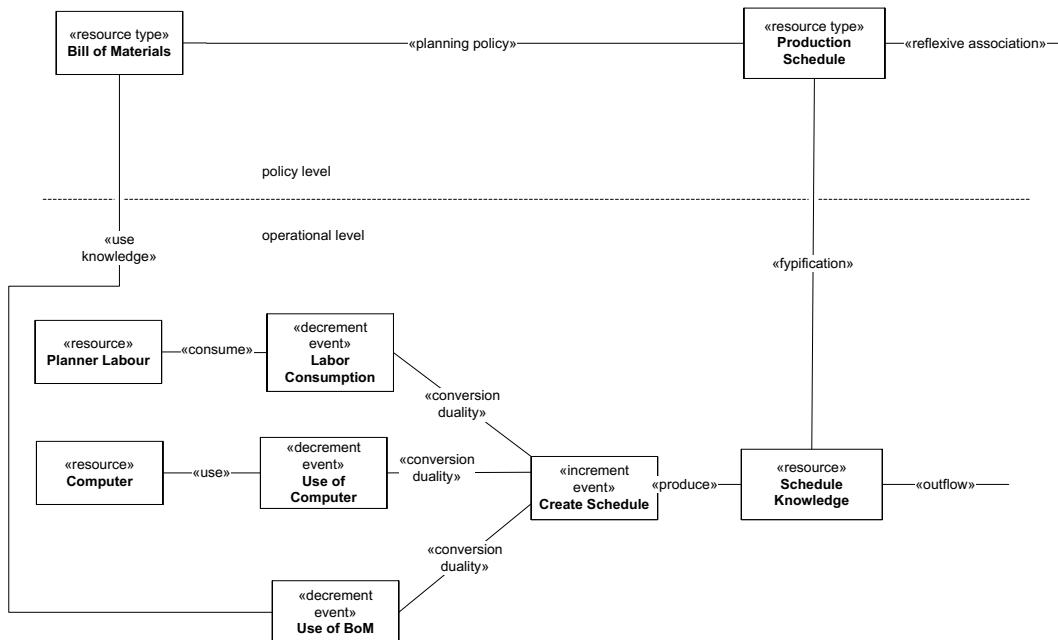


Figure 3 Planning Process Model

The BoM entity is also used at the operational level. At this level, the *use of knowledge* relationship specifies the amount of entities that are needed to be purchased in the acquisition process model.

Outflow of this process is not only at the operational level but also at the policy level. That is a new means that helps to face the REA value chain of mutually interconnected processes. Production schedule as a resource type and schedule knowledge as a resource.

Production Process Model

Production process model is a standard REA conversion process model that uses schedule entity from the planning process model for managing its activities. Via a clause relationship, this schedule entity is joined to decrement / increment commitment entities. In short, a schedule entity is composed from the lists of decrement and increment commitments that are used for elementary planning.

Each commitment entity is related with corresponding event entity at the operational level by fulfillment relationship. Comparison of the fulfillment and typification relationships is described in Hunka (2009A) Detail semantics of this relationship is explained Decrement commitments entities are in relation with increment commitment entities by conversion reciprocity relationship.

What is newly introduced in this REA process model is that it inputs resource type entity at the policy level. Production schedule resource type in the planning process model is related by reflexive association with production schedule in the production process model. A reflexive association is a newly introduced relationship between entities at the policy level. It expresses that a resource type from the planning process model is reflected in an entity type schedule of the production process model. The reflexive relationship expresses that the necessary data attributes are transferred into an entity with a different structure.

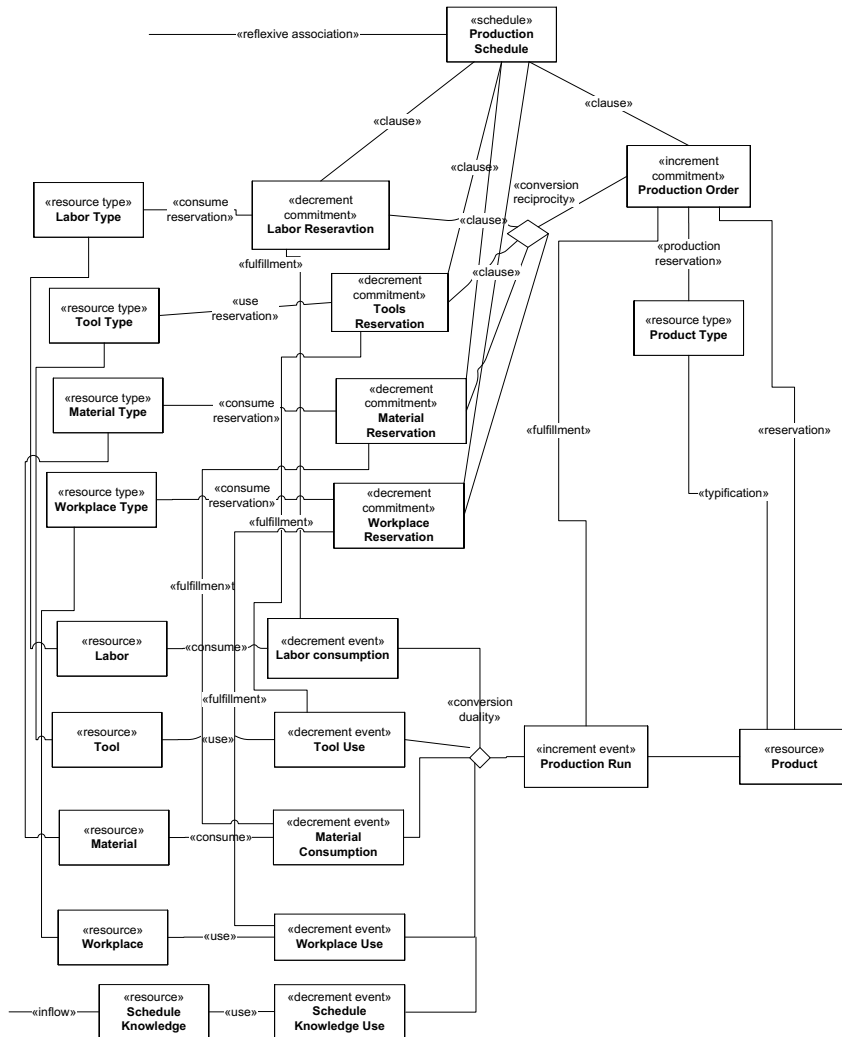


Figure 4 Production Process Model

By this means planning, monitoring and controlling process models can be effectively and simply joined in the REA value chain.

3. Generalization of Planning and Production Process Models in the REA Value Chain

To generalize proposed means of modeling planning and production process models a new notion for both process models is introduced. Let an REA model that produces a *resource type* at its policy level and a *resource* at its operational level is called a *controlling REA model*. An REA model that consumes (inflows) resource type and resource entities from the *controlling REA model* is called a *controlled REA model*. The notion of *controlling* and *controlled* process models has been previously introduced in Hunka et al. (2009B). A *resource type* entity of the controlling process is reflected in a *Schedule* entity of the *controlled process* at the policy level of the REA model. A *resource* of the controlling process outflows into a *resource* of the controlled process at the operational level of the REA model, expressing the amount of resource to be purchased to produce a final product.

The notion of *controlling* and *controlled* processes exists to distinguish among the standard relationship between REA models and newly introduced models joined at the policy level of the processes.

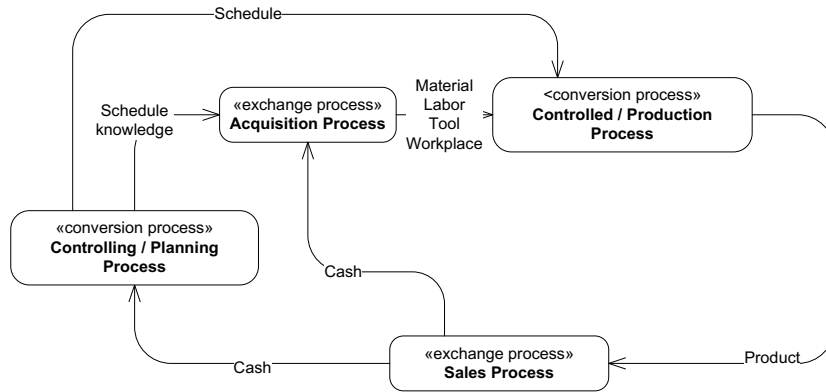


Figure 5 REA Value Chain of Controlling and Controlled Process Models

A *reflexive* relationship is a newly introduced association between entities at the policy level. It expresses that a *resource type* from the *controlling process* is reflected in an *entity type (schedule)* of the *controlled process*. This relationship enables the joining of a *resource type* in the *controlling REA model* with a *schedule entity* in the *controlled REA model*.

Fig. 5 represents the whole solution of the problem in the context of the REA value chain. There are two new traditional process models that enable to conclude the whole chain. They are sales process (revenue process) whose input is product and output is cash and acquisition process whose inputs are resources of cash and schedule knowledge and output is whole input products and raw materials needed for production process model. As can be seen from the Fig. 5, schedule itself represents entity type at the policy level and schedule knowledge stands for entity at the operational level.

4. Conclusion

The REA framework has a large potential for modeling business applications. The paper presents the way how to utilize these possibilities for more precise business models including processes such as planning, monitoring and controlling. The whole applications can be modeled in the form of the REA value chain. The benefit of the value chains structure is that it gives unique overall view of the whole business application and that single processes in the value chain can be further elaborated in a more detailed way. Newly introduced and delineated notion of controlling and controlled processes related by a pair of relationships generalized the proposed means of modeling.

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References

- Dietz, J. L. G. (2006) *Enterprise Ontology: Theory and Methodology*. Heidelberg: Springer Verlag Heidelberg.
- Dunn, C. L., Cherrington, O. J., Hollander, A. S. (2004): *Enterprise Information Systems: A Pattern Based Approach*. New York: McGraw-Hill/Irwin.
- Geerts, G. L., McCarthy, W. E. (2006) Policy-Level Specification in REA Enterprise Information Systems. *Journal of Information Systems*. Vol 20, No. 2 pp. 37-63.
- Geerts, G. L., McCarthy, W. E. (2002) An Ontological Analysis of the Primitives of the Extended REA Enterprise Information Architecture at <http://www.msu.edu/user/mccarth4/>
- Geerts, G. L., McCarthy, W. E. (1999) An accounting object infrastructure for knowledge-based enterprise models. *IEEE Intelligent Systems & Their Applications*, 14(4), pp. 89-94.
- Gordijn, J., Akkermans, H. (2003) Value based Requirements Engineering: Exploring Innovative e-Commerce Ideas. *Requirements engineering*. 8, No 2. [cit. 22.3.2010] URL: <http://www.springerlink.com/content/5ne64nnr0jun0nxk>.
- Hruby, P. (2006) *Model-Driven Design Using Business Patterns*. Springer-Verlag Berlin Heidelberg
- Hunka F, Hucka M, Kasik J, Vymetal D (2009A) Some Ontological Issues of the REA Framework in Relation to Enterprise Business Process. *Journal of Applied Economic Science*, Volume IV. Issue 2(8) 2009, pp. 203-209.
- Hunka F, Hucka M, Kasik J, Vymetal D (2009B) Detail REA Production Planning Model Using Value Chain Including Overhead Costs. *4th International Workshop on Value Modeling and Business Ontologie*. Amsterdam 20.- 21.12.2009.[cit. 2010-01-07] at <http://vmbo2009.blogs.dsv.su.se/files/2009/12/VMBOHunka.pdf>.
- IDEF0, (1993) Integration Definition for Function Modeling. National Institute of Standards and Technology, FIPS publication (1993): [cit. 10.9.2010] URL: <http://www.idef.com/pdf/idef0.pdf>.
- Porter, M. (1980) *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: Free Press, p. 398.
- Repa, V. (2006) *Podnikove procesy. Procesni rizeni a modelovani*. Praha: Grada Publishing.