UFO-S grounded complex economic exchange framework for AIS

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Abstract. Although the field of Accounting Information Systems (AIS) has a long tradition, there is still a lack of a widely adopted conceptualization. The long-term goal of our research is the development of a modeling and recording notation for AIS. In this paper, an economic exchange is analyzed from a standpoint of UFO-S core ontology. The existing conceptual frameworks of IAS, Y. Ijiri and REA are regarded, and a conceptual model for economic exchange is proposed that includes offered, agreed, partial, control and object exchanges; and offering, agreement, process, obligation and property commitments and claims as economic resources.

Keywords: Accounting, UFO-S, exchange

1 Introduction

According to Wikipedia, an accounting information system (AIS) is a system of collecting, storing and processing financial and accounting data that is used by decision makers. Concerning AIS, scholars in [11] conclude the absence of a widely adopted conceptualization: “What are the concepts covered by AIS? Given the diversity of approaches and elements adopted and used by various AIS professors, this is not an easy question to answer. Some adopt an internal control perspective, others an REA approach, and still others a fraud prevention angle.” It seems logical that the AIS conceptualization should start with a Financial and Management Accounting Conceptual Framework, both for reporting and operational use, grounded in upper ontology. We follow Yuji Ijiri [1] who claims that accountability, including accountability for commitments, is the foundation and the goal of accounting.

The (Financial) Accounting at present is undergoing a substantial change with the introduction of a new Conceptual Framework - CF [4] and a number of worldwide standards jointly developed by IASB and FASB, such as Revenue from Contracts with Customers [5]. Some of the problems that still remain are the verbal form of the CF and standards, as well as the limited coverage of the economic exchange lifecycle, that leads to usage of the commitment and agreement concepts not integrated into the framework and being at best disclosed versus recognized. These problems lead to statements that e.g. IFRS guidance on disclosure is inconsistent, complex and difficult to understand. We have decided to ground our research in the UFO-S core ontology [6], present state of international financial reporting and accounting standards (IAS) conceptualization.

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[4, 5] and other works, including REA [3] extensions. The goal of our research is the development of a modeling and recording notation for AIS. The evaluation is done by modeling and verifying the new IAS, as well as several ERP systems and practical cases. We also analyze the alignment (using UFO [8]) with other enterprise related standards and frameworks, exemplified by PPS [25] and UBL [26]. The particular goal of this paper is a UFO-S grounded, IAS compliant conceptual model of the complex (process oriented) exchange lifecycle, including economic offers, agreements, enforceable obligations and their fulfillment by delivery process.

Section 2 describes the background of the research, section 3 introduces the overall exchange model, section 4 compares with related work while section 5 concludes with a discussion and future directions.

2 Background

2.1 Yuji Ijiri’s works and REA Ontology

Ijiri [1] introduces Economic exchange as “an action whereby the entity gives up control over some resources in order to obtain control over other resources”, with the enterprise’s Economic goal “to increase the monetary resources under its control”. He also postulates that the coordinated chain of economic exchanges comprises the operations of the firm. Ijiri regards two kinds of economic exchanges – the Exchanges in a market and Exchanges in production (Conversions) “which may be considered exchanges between the enterprise and nature”. Ijiri defines:

- Economic exchange as “an action whereby the entity gives up control over some resources in order to obtain control over other resources”;
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The principal enhancement (that allows for accounting of all phases of an exchange) to the initial Ijiri’s “Accounting measurement theory” was the addition in [1] of:

- Economic commitment as “an agreement to execute a new economic event in a well-defined future that will result in either an increase of resources or a decrease of resources”.

Further, Ijiri suggests extending resource control recognition criteria to commitments, forecasts, and budgets. In analyzing the exchange delivery process; Ijiri writes [1]:

“The axiom of exchanges requires that all changes in the resource set R be partitioned into a set of exchanges \( r = r^+ \), \( r^- \) which relates an increment \( r^+ \) and a decrement \( r^- \). Let us call that part of the transaction, either \( r^+ \) or \( r^- \), which occurs first the initiator of the exchange and the other the terminator of the exchange. If the change is an initiator of a new change, its likely terminator must be estimated in order to enter the transaction in the record… In order to fill the gap between the time of the initiator and the time of the terminator, an account (e.g., accounts receivable) is created so that the outstanding terminator is matched properly when that part of the transaction actually occurs. Thus, when the exchange is concluded, the terminator is matched with the original estimate”.

The accounting theory, contributed by Ijiri was used by W.E. McCarthy to develop an Entity-Relationship framework for economic exchange [2] called REA framework,
with the goal of “unifying views of different classes of EIS users in a database environment”. Additional concepts of inside [internal] agent; give, take, consume, use and produce resource flow types were introduced, the event accounting approach maintained. The conventional accounting artifacts such as debits, credits, accounts and double entry were declared redundant. The reciprocal commitments were later added to the REA ontology that resulted in the ISO 2007 standard [3], where REA is positioned as an accounting ontology. While analyzing the exchange delivery processes [13], REA didn’t detail any new concepts for the economic resources and has constantly advocated the dependency of Claims expressed e. g. in [2]: “economic resources in the schema do not automatically include claims such as accounts-receivable”, and in [3]:

“Materialization of Claims is sometimes needed when Trading Partners insist on documentation of partially completed exchanges (for example, when a Customer takes possession of an Automobile before paying for it in full). If needed, Claims can be instantiated by documents like invoices or by accounting artifacts like accounts-receivable. Their inclusion here is more a matter of business custom than ontological completeness.”

Notice, that REA [3] treat Resources as Goods, Services or Rights (in rem), where the latter doesn’t include Claims (rights in personam), mentioned in the above quotation.

We have the following slightly alternative views concerning the abovementioned economic process descriptions, claims and pure event approach.

1. Resources controlled by the enterprise, formed as a result of economic exchanges [of mutual control transfer], are conceptualized as rights, where rights are modeled as refined relationships between the enterprise and counterparty or community with respect to a thing.2. Features of the resource/relationship that need to be specified further include attribution to the committed process and related period, accountable agent and purpose. The resource/relationship can be classified and valuated. It has its own features (e.g. is verified, suspended; has uncertainty [5]). It may further evolve, based on environmental events and market circumstances; is triggering other economic events and forms a disposition for future economic events.

2.” To fill the gap between the time of the initiator and the terminator an account is created” [1, see above] and thus, accountability and other properties for this now independent resource – receivable or providable is required. This resource is an obligation claim/commitment which is enforced by natural or jurisdiction laws and of a greater binding power than the initial agreement claim/commitment of the “partially completed exchange” [3]. The claim concept is a fundamental one for social relations.

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2 These rights generally rest on a foundation of legal rights [4] of Contract and Property Laws. E.g. in American property law, a property right has long been described as a collection of legal relations between parties with respect to things. Property rights holders have legal relations against the government, against other holders in the same asset, against some specific others and against all others (default) [28]. The CF [4, para 4.12] and our model are tending towards the above interpretation. Another theory in civil law countries treats a property right as a relation between a person and an object.
3. “The original estimate of the terminator” [1, see above], at the time of finishing of the initiator, is the exchange value (or transaction price [5]). The terminator’s value after the “time gap” (of sometimes many years) may change its exchange value, as an object (e.g. market price change), so matching of fulfillment is done not with the “original estimate”, but with the current value, and not with the agreement, but the obligation.

4. As a resource, the terminator obligation may undergo different transformations and transfers, such as factoring, integration in portfolios and formation of another unit of account [4, para 4.57]; partition (e.g. an agent retains the rights for the principal amount receivable, but sells the rights for the interest receivables); and different ways of fulfillment, such as netting or forgiving; which constitute a rights exchange per se, not connected to the original exchange. Tracking of the original exchange may be useful for the cash basis of accounting. The possible advantages of such an approach and the specific usefulness of activity accounts [1] and claims as event imbalances [3] should be researched further, but they don’t constitute a general institutional solution today.

5. The obligations are created not only by exchanges, but also by delicts, court decisions, tax laws, and so-called constructive obligations [4]; i.e. they are separate objects, possibly without an explicit duality origin.

6. The initiators and terminators (in the citation [1] above) generally are separate processes – complex economic exchanges, where each part exchange may be performed separately and on parts of the participating objects, so the initiator is not “the change which occurs first”, but the one which finishes first. The intermediate resources need separate process resource concepts, matched with commitments and obligations.

7. The “unify views” goal may be achieved through alignment with upper and related domain ontologies.

2.2 International Accounting Standards (IAS) and the Conceptual Framework.

The current state of the economic exchange conceptualization is represented by the new IAS [e.g. 5] and CF [4]. The [4, para 4.5] defines a resource as a right that has the potential to produce benefits. We understand to produce benefits as services or a bundle of permitted action types to exchange a present resource for another with an increased value for the enterprise; and the rights definition in [4, para 4.6-4.39] as the specification of permitted actions, namely:

1. actions with the rights themselves - powers;
2. actions with the underlying object to be performed for the benefit of the party itself – property privileges; or
3. actions that another party has a present obligation to perform for the benefit of the party [conditioned on the passage of time] – claim rights.

An enterprise controls a resource if it has the present rights and ability to direct the use [enable actions] of the resource and obtain the benefits that flow from it [4, para 4.18].
The party (or parties) could be a specific person or enterprise, a group of people or enterprises, or society at large (community). The Enterprise is the focal party for our model and Counterparty the other party that participates in an exchange. Services are regarded by [4, para 4.9] as momentarily rights to obtain benefits until they are consumed (as resources). The lease is regarded as right to use, but not a service. We will provide other definitions of the IAS main concepts with our adaptions and additions in Section 3.

2.3 UFO and UFO-S

In search of an upper ontology for our framework, we were looking at one that includes event and social concepts as well as provides tools for a substantial ontology engineering support, and have chosen the UFO [8] with the OntoUML tool. A distinguishing concept in UFO is a Relator [7], which can be seen as reified relationship of aggregations of modes inhering in related entities, accounting for the way the related entities are involved in the relationship. Universals are abstract patterns of features that can be realized in a number of different individuals. In UFO, Substantial universal and Moment universal are kinds of universals whose individuals are substantial individuals and moments, respectively. There are different sorts of universals - substance sortals (Kinds), phased-sortals (Roles and Phases) and non-sortals (Categories, Mixins and Role mixins). A Category is used to represent a rigid mixin that subsumes different kinds, Rolemixin represents dependent anti-rigid non-sortals. These sorts were recently introduced for characterizing universals whose instances are existentially dependent endurants (i.e., moments such as modes and relators) [27], but these sorts and also events, that are used in our model, will be available for OntoUML only in the “upcoming” version. For this reason, we are using UFO stereotyped UML for our diagrams. The OntoUML stereotypes used in this paper represent universals. The core ontology of services UFO-S [6] was developed based on the UFO. It includes the lifecycle of an exchange [10] and was chosen as core ontology for our framework.

3 Complex economic exchange model description

We have conceived of an Economic rights exchange as an agreement and an interaction whereby, based on commitment, the enterprise gives up control relationship over some resources in order to obtain control relationship over other resources, based on the reciprocal claim. Now let’s start a more detailed analysis, applying UFO-S to construct our framework. Regarding the resources as rights, goods may be regarded as postponed potential services – appliances for receiver self-service, and the exchange scope enlarged to the full value creation - as proposed in Service-Dominant-Logic (SDL) [9] that states that the “exchange of service is the fundamental basis of all social and economic exchange” and “services as the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself” [9]. While we will not explore all the findings of this theory, mainly in the marketing field, we will accept this approach as unifying the view
of an exchange under an SDL-service concept, which covers service a) in accounting sense, b) goods, and c) benefits – receiver’s self SDL-service. Under this assumption, we have chosen the UFO-S as a core ontology for the economic exchange. Moreover, we think that UFO-S may benefit from our application, further called EXT, of introducing processes and goods as intermediates, because of its comprehensive and symmetrical approach, already introduced in [10] as a service system. In fact, all the examples that are used in the UFO-S description [6] are not services in the accounting sense, but rather leases or sales of goods; e.g., the example of the car rental is a lease, because the car (good) is temporarily transferred to the customer, although organizing a possibility of car rental for the customer could be regarded as a service, but implicitly.

In analogy with UFO-S, EXT 0.2 is a commitment-based economic exchange framework whose conceptualization, is based on the establishment and fulfillment of reciprocal commitments and claims between exchange participants (enterprise and counterparty) along the exchange life-cycle. In this paper, in analogy to [6] and other approaches [3, 26] we start with the three main phases of the exchange life-cycle, namely: exchange offer, acceptance, and delivery, but with enterprise and reciprocity as well as delivery process focus. The pattern of the enterprise’s interactions with a counterparty is the Social relator pattern [5], see Fig.1, that we apply to a broader class of exchanges following UFO-S approach.

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![Fig. 1](image1.png)

**Fig. 1.** OntoUML diagram of Social relator pattern, adapted from the presentation of [5].

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![Fig. 2](image2.png)

**Fig. 2.** UML diagram of Social relator shortcuts for the enterprise-centric view, within the Economic exchange of Economic resources (i denotes “inheres in” and ed – “externally depends on” formal relations).

We make the following modifications to the UFO-S model, because of our AIS and enterprise-centric orientation: We omit “service” for an offer, offering, negotiation, agreement, provider, customer, delivery; due to different usage of service term in accounting, and imply rights and control. Further, we rename UFO-S concepts following Social relator pattern and elements. We omit Enterprise qualifier for the roles, relators and modes and we use Counter qualifier of the above; we introduce exchange event - V for social relators and ± events for exchange value increase/decrease; we differ roles for different modes and differ event and relationship roles of the agents and regard
them for accountability. We often omit Counter.Commitments and Counter.Claims for brevity and use shortcut for Social relator depicted in Fig.2, where the E.relator is characterized by its Enterprise (as A or B) <<Mode>>, but mediation by its Enterprise <<characterization>>. Economic exchange decreases E.relators for total value $V$- and increases other E.relators for equal value $V$+. We use provide for enterprise actions towards the benefit of counterparty and receive\(^3\) for counterparty actions towards the benefit of the enterprise. Provide [action] exchanges [at least one] claim decreases for some commitment or/and some other claim increases. Receive exchanges [at least one] claim increases for some commitment or/and some other claim decreases.

We detail both the service offering and service agreement normative descriptions into separate provide plan and receive plan and further for these plans we introduce provide and receive event specifications respectively; and further develop the model to include resources, quantification and valuation. The logic of our commitment language is not worked out in this paper.

**An Offering.** In an analogy with UFO-S, at the beginning of an exchange relation there is a promise of the enterprise, a speech act that establishes a pattern of commitments and corresponding counter[party]-claims, that is called enterprise offer, and the resulting pattern of commitments and counter-claims enterprise offering relationship, that constitutes a document act [15]. Notice, that the offer and intention is for the exchange. The first section of the Fig. 3 shows a UFO stereotyped diagram with the main concepts and relations involved in enterprise and counter-party offerings. In analogy to UFO-S, an enterprise offer event results in the establishment of an offering between the enterprise as offering committer and a target receiver community. An offering relationship is composed of offering commitments from the offering committer towards the target receiver community and the corresponding offering counter-claims from the target community towards the offering committer. The actual content of offering commitments (and corresponding claims) is described in offering descriptions i.e., normative descriptions in UFO and in our framework contains the provide plans, that include the main features of a resource control transfer:

- Types, terms and conditions of the actions to be performed in providing,
- Types, quantities, valuation and locations of resources to be transferred,
- Required types and locations of provider and counter receiver.

Similarly, for the required Counterparty’s to be counter-committed receive plans. The enterprise’s commitment is conditional – it is committing if the counterparty will counter-commit.

\(^3\) To receive is generally easier than to provide, that may be one of the reasons why debits in accounting are at the left hand side and credits at the stronger right hand side.
What is established in the offering commitments also determines the level of flexibility for a subsequent acceptance phase, in which the enterprise and a particular counterparty establish a particular agreement. Because of that, offering commitments may be meta-commitments [6], but also concrete ones, requiring just acceptance. Offering-committer is the role played by agents when these agents commit themselves to a target receiver community by an offer event. In terms of UFO, the roles are Rolemixin, since it can be instantiated by parties of different kinds, e.g., persons and organizations. According to [6], Target receiver community is a collective that refers to the loosely coupled group of agents that constitute the community to which the exchange is being offered. An offering is the social relator and is the aggregate of offering commitments and the corresponding counter-claims. Offering commitments and counter-claims are social modes in the sense of UFO, i.e., offering commitments are intrinsic moments, which inhere in the offering-committer agent and are externally-dependent on the target receiver community. Offering counter-claims, in turn, are intrinsic moments that inhere in the target receiver community and are externally-dependent on the offering-committer agent.

To the axioms of UFO-S (omitted) we will add constrains that are relevant for reciprocity and exchange values – transaction prices:

- Each offering includes a provide plan and a receive plan
- For each offering, the transaction price of the provide plan is equal to the trans-
  action-price of its receive plan at specified time $t$.

Since we take an enterprise-centric view, as in accounting, we must regard the enterprise also as a receiver [customer] and the counter [party’s] offer and offering. The diagram in this case is similar to the provider case and is shown in Fig. 3. The major difference is that the target community is not modeled in this case, because the enterprise is the target receiver. The delivery phase of UFO-S and EXT may consist of actions of provider, provider-receiver interactions and receiver actions. Thus the offer and agreement phases, in addition to external plan specifications should include internal self-commitments for actions of the enterprise in the roles of provider and receiver [not depicted in Fig 3].

In EXT the concrete offerings are preferred, depicting capacities for a period.

**An Agreement.** According to UFO-S, an offering (either of enterprise or counterparty) is a base for an agreement negotiation event, in AIS though the fact of an acceptance is more relevant, see agreement sublevel in Fig 3. If the (negotiation) acceptance succeeds, an exchange agreement is established, and the enterprise starts to play the role of committer, while the counterparty starts to play the role of counter committer. Like an offering, an agreement is composed of commitments and counter-claims. However, in an agreement, the counterparty establishes counter commitments to the enterprise e.g., the commitment to pay, and the enterprise has a claim towards the counterparty (the counter claims and counter commitments are not shown).
An agreement should accept to what was previously established in the corresponding offering. As in the case of an offer, what is agreed between the parties (reciprocal commitments and counter-claims of both enterprise and counterparty) is described in agreement description (such as a service contract). Enterprise’s and counterparty’s commitments and claims are social modes. Enterprise’s commitments and claims are intrinsic modes that inhere in the enterprise and are externally-dependent on a counterparty. Counterparty’s commitments and claims are intrinsic modes that inhere in a counterparty and are externally-dependent on the enterprise. Due to lack of space, the axioms for agreements are not included.

In our model we introduce two (six) kinds of intentional resources [14] represented by E.relators – Agreement.commitment and Agreement.claim (similary for Offering and Counter offering, but without counterparty acceptance). We define:

An Agreement.commitment is the enterprise’s voluntary promise to guarantee to perform provide economic actions, according to the terms and conditions, voluntary agreed with and for the benefit of the counterparty, or for the benefit of itself [self-commitment], motivated and conditioned by reciprocal agreement.claim or natural laws.

An Agreement.claim is a counterpart of a Counterparty’s commitment - a voluntary promise to guarantee to perform actions resulting in receive economic actions, according to the terms and conditions, voluntary agreed with and for the benefit of the enterprise. The agreement (offering) commitments and claims are interrelated (not separate).

While we agree and emphasize that the enforcement of the commitments is of a much different nature than that of obligations enforced by law, we introduce the agreement resources. While the agreements are not institutionalized for the Financial reporting, partially because of lack of sufficient trust in them, there is a reasonable trust in those internally and mutually with the counterparty, besides they are objects of accountability and decision making, so nothing prevents us from using them on planning level.

Of course, the commitment concept is rather broad, and requires further research and classification. For this reason, the underlying value should be reported separately together with the included nonperformance obligation, preparation and communication costs and reserve type of commitment that effectively transfers part of the property rights, creating reservoir around the committed resource. Another important class of the agreements are known as Relational contracts [16], that regard economic exchanges as recurring, possibly long term relationships, that particularly allows for introduction of self-enforcement and reducing uncertainty of agreement and obligation fulfillment by using previous exchange information to estimate process resources and non-performance allowances. As for offerings, the meta-agreements also exist.

A Delivery. Delivery is the execution of actions aimed at fulfilling the commitments established in the agreement. Fig. 3, Factual level shows a UML class diagram presenting the main concepts and relations involved in the delivery phase according to our model. Due to lack of space, the UFO-S axioms for the delivery are not included. We apply the UFO-S model to provide more details of the delivery processes and its relation with accounting concepts.
The delivery actions *provide* and *receive* are economic *part-exchanges* that fulfill commitments described by certain plans, that happen over time, possibly separately.

Fig. 3. Complex economic exchange lifecycle pattern UML class diagram (Events in blue).

Each delivery action changes the enterprise’s resources and simultaneously create a temporary *Process resource* - a claim to the other party of this action, so the action
represents a part-exchange or consumption. In accounting Process resources are represented by accounts such as work in process, contract assets, contract liabilities, pre-payments, advances, period income/expenses. Similarly, to the [5] we define Process.claim as the enterprise’s right to contribution for resources that the enterprise has transferred to a counterparty when that right is conditioned on something other than the passage of time (on the fulfillment of the remaining committed actions); and Process.commitment as the enterprise’s obligation to transfer resources to a counterparty for which the enterprise has received contribution (or the amount is due) from the counterparty when that obligation is conditioned on something other than the passage of time (on the fulfillment of the remaining claimed actions). An important point is that these process obligations (enforced by the end of the exchange - e.g. by the fulfilling the commitment or by the breach of the contract) refer to the agreements and their current agreement partial fulfills and also may represent momentarily assets until they will be represented by their results. The Process.claims are valued at the standalone selling price [5].

The delivery actions fulfil a delivery plan and hence the commitment, that, when fulfilled, triggers the control (rights)-exchange or production, that exchanges the process resources for enforceable obligations of reciprocal delivery, by creating a new object that inherits the unfulfilled process plan. Similarly, to the [4, 5] we define Obligation.claim or Receivable as a present obligation of the counterparty to perform actions for the benefit of the Enterprise [conditioned on the passage of time]. Obligation.commitment or Liability a present obligation of the enterprise to perform actions for the benefit of the Counterparty [conditioned on the passage of time]. The fulfilling of agreement commitment recognizes revenue at transaction price [5]. The present (property) resources are claims against the community and together with the receivables constitute the assets of the enterprise.

Equity process.commitment or Owners claim is the residual interest in the assets of the enterprise after deducting all its liabilities.

Income is increases in assets or decreases in liabilities that result in increases in equity [for the related period], other than those relating to contributions from holders of equity claims (owners). Income and owners’ contributions are investment process.commitment resources.

Expenses are decreases in assets or increases in liabilities that result in decreases in equity [for the related period], other than those relating to distributions to holders of equity claims [4]. Expenses and owner’s distributions are investment process.claim resources.

Generally, the exchange model does not determine which delivery action – provide or receive will be executed first, also, an interaction may occur motivated either by agreement terms and conditions or by agent’s autonomy [17]. So e.g. in our example the customer may pay before the due date, because of advantageous currency conversion rate; or enterprise may pay a dividend that is not obliged by agreement, but motivated by decreasing the uncertainty and raising the share price.

When the reciprocal obligation is fulfilled again as a process, such an exchange combined with preceding rights-exchange may be called an object-exchange.
The transaction price equality is in force only for (or till) the moment of the rights-exchange, the remaining obligation may or should be revalued at a present value.

When commitment/claim of an agreement is fulfilled, the respective reciprocal mode changes to the obligation/right, the agreement cease to exist, but the contract of unfulfilled provide/receive plan (with all the sanctions) continues to exist.

When the beneficiaries have finally benefited from the exchange such an exchange may be called a service-exchange.

The part-exchanges may be planned, but also, may emerge during delivery as partial fulfillments of different aspects of the transferred control e.g.: The required combination of goods and services is not transferred fully (e.g. some provided mechanism may be useless without proper training); or the control of a resource is not transferred fully (e.g. only use rights transferred, but not ownership; or the title is transferred, but the possession or access not provided or vice versa); or only part of the object, function, quantity, location or duration required is delivered; or an excess resource is transferred. Each resource should contain criteria for partition or integration governed by the UFO mereonomic (not further regarded in this paper).

Example 1. Electricity supply offer in EUR to the enterprise (with functional currency of USD) for a current year. There is no negotiation, just acceptance or rejection.
1. Standing ready service component - an evidence of service as a commitment, monthly payable, independent of any supply.
2. Four options (a need for a resource choice operator):
   a. An option for a balanced payment:
      i. An object part-exchange processes during the year:
         1. balanced monthly payments provide process; versus
         2. electricity receive process upon request,
      ii. A reconciliation of the meter and payments at the end of the year at fixed rate – a rights-exchange – either there is payable to the supplier or receivable from it.
   b. Three options for a monthly exchange - measuring and payment:
      i. at a fixed rate; In this and other cases the exchange value in USD (for the object exchange duality) of the electricity will usually be different from the actually paid amount value, because of the different currency conversion rates at the day of invoice (rights exchange) and the day of payment.
      ii. at lower fixed rate for night hours to accumulate electricity to Tesla’s battery – a postponed service;
      iii. at market rate.

Fulfillment principles. We must distinguish the material layer that includes underlying object manipulations and a social layer that includes commitment/obligation/permission manipulations. While the fulfillment fulfills a planned event, the parts of it that determine fulfillment are the receiver and the resource, the provider may be any agent
of the counterparty and the fulfillment may be carried out in many partial steps or in a combined step, if not prohibited by agreement and it doesn’t alter the agreed price.

Given an agent’s autonomy, other than commitment motivated transactions may happen or be absent during delivery, such as over-delivery or unordered delivery. These transactions are allocated to the sanction clauses in agreements, policies, laws and regulations. Like in a data entry software application, no event should abort the system.

4 Related work
The recent VDML standard [18] provides value and exchange concepts even beyond the economic, generalizes and explains many other important concepts for value modeling that overlap with our analysis, their planning level though is restricted to valueProposal that is roughly similar to the Offering concept. The further details of agreements, commitments and obligations and their fulfillments are not regarded. The resource concept is regarded outside any deontic aspects, also, their ontology is not grounded in any upper ontology, except for SSM Measurement, and is not directly applicable to accounting, PPS 1.0 or UBL 2.1 standards.

Fundamental work in the commitment area is provided by Singh et al. [17]. While many concepts are directly comparable in the commitment area we differ from Singh in the elaboration of reciprocity and economic resources, value, economic or accounting view.

REA-DSL [19] that was a fundamental step forward for REA notation, the exchange processes were depicted there, but in the simplest form of time series. Unfortunately, it has not received any traction as a notation. The advanced REA concepts though are being realized in a practical system [20]. The differences previously mentioned between REA and our model have not received any substantial evidence yet, however, they should appear, (mainly for financial assets) during practical use of the system in future as well as a new version of REA notation. Integration of their framework with ISA-95 standard [23] may provide some hints for integrating our framework with the frameworks like PPS or UBL.

The POA framework [21] distinguishes possession and ownership delivery as separate delivery events based on availability, showing that the resource transfer is a process important for the AIS to detail, but doesn’t explore on other constituents of such process.

The framework described in [24] is based mainly on the REA framework and is different from our framework for the reasons explained earlier, but has a compelling approach for connecting accounting to BPM.

5 Conclusions
An economic exchange was analyzed from a standpoint of UFO-S core ontology [6], the existing approaches of conceptual frameworks of IAS [4,5], Ijiri [1] and REA [2] were regarded, a conceptual model for economic exchange were proposed that includes
offered, agreed, partial, control and object exchanges; and offering, agreement, process, obligation and property commitments and claims as economic resources.

While the number of regarded concepts is quite large, hopefully, they reflect the institutionalizations, which are important for the realistic models, which today are a concern in several domains including MAS, see e.g. [17, 22], where recently serious attention has been drawn toward timing and partial and aggregated fulfillment and delegation aspects.

Due to partitioning and integration of exchanges and resources, it may be costly and probably unnecessary to track object-exchange after rights-exchange.

The future directions involve elaborating the framework toward formalization, exchanges with owners, the community as well as conversion aspects and relation to other standards; further development of a textual, graphical and table-oriented notation.

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References
5. IFRS 15 — Revenue from Contracts with Customers.
7. Nicola Guarino, Giancarlo Guizzardi “We need to discuss the Relationship”: Revisiting Relationships as Modeling Constructs, CAiSE 2015.
15. R. Arp, B. Smith, Building Ontologies with Basic Formal Ontology MIT Press, 2015
18. OMG. Value Delivery Metamodel Vers.
20. Bernhard Wally et al: Model-Driven Retail Information System Based on REA Business Ontology and Retail-H. CBI (1) 2015: 116-124
25. Production Planning and Scheduling (PPS) Version 1.0. 29 September 2011. OASIS Committee Specification 01.