Conceptualizing Social Relators and Economic Exchange Contracts for Reporting Purposes

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Abstract. In the last decade, several UFO-grounded economic exchange ontologies have been developed, notably COFRIS, OntoREA, REA^2, and ATE. We think it is time that a next step is made into the direction of the corporate reporting standard setters, for which an ontological approach is of high potential value. In this paper, we first define requirements for exchange conceptualization and present the latest developments in COFRIS - a core ontology for financial reporting information systems, focusing on contracts within the new versions of the UFO-B theories and the OntoUML tool. Then we compare it with the conceptual framework and standards for accounting and financial reporting and discuss COFRIS against other UFO grounded exchange and contract ontologies.

Keywords: IFRS, UFO, COFRIS, Economic Exchange Contracts

1   Introduction

Concepts of Economic Exchanges and their governing contracts (hereinafter Contracts) play a fundamental role in enterprise accounting and reporting. Table 1 shows that a major part of local/international corporate reporting standards (hereinafter Standards) are dedicated to different types of Contracts, or at least specify accounting and reporting requirements for capturing exchanges of specific economic resource categories.

Table 1. The main Contract-related International Accounting and Reporting Standards.

International Standard [1]	Key Exchangeable
IFRS 2 Share-based Payment	Shares
IFRS 3 Business Combinations	Business
IFRS 5 Non-current Assets Held for Sale and Discontinued Operations	Non-current Resources
IFRS 6 Exploration for and Evaluation of Mineral Resources	Mineral Resources
IFRS 9 Financial Instruments	Financial Instruments
IFRS 13 Fair Value Measurement	Resources and Obligations
IFRS 15 Revenue from Contracts with Customers	Goods and Services
IFRS 16 Leases	Rights of Use
IFRS 17 Insurance Contracts	Insurance Policies
IAS 2 Inventories	Inventories
IAS 7 Statement of Cash Flows	Cash and Cash Equivalents
IAS 16 Property, Plant and Equipment	PPE
IAS 19 Employee Benefits	Employee Benefits
IAS 21 The Effects of Changes in Foreign Exchange Rates	Foreign Currency

IAS 23 Borrowing Costs	Loans
IAS 24 Related Party Disclosures	Party Information
IAS 38 Intangible Assets	Intangible Resources
IAS 40 Investment Property	Investment Property
IAS 41 Agriculture	Biological Resources

The conceptualization of the contracts is based on the generalization of contract law. The rules relating to certain categories of exchange, such as consumer, employment, insurance, and information-licensing contracts, have developed specialized content to the point that they are often treated as distinct legal fields [4]. Nevertheless, exchanges and contracts in standard setting have common core objects, relationships, and events that are required to be reported. Particular contract types should be extensions of these core objects. This principle is only partially implemented in existing Standards. The Standards also suffer from internal inconsistency and semantic interoperability problems. Therefore, an ontological approach has great potential value, especially in the situation when the volume of standards of corporate reporting constantly increases, and their quality can be improved through digitalization and multilateral observation [10].

The concept of an Economic Exchange is broader than a Contract governed [4]. In spot markets, such as public bazaars, involved parties manage reasonably well without formal contracting. Contracting becomes worthwhile when there is a temporal element to the exchange or at least one party is uncertain about the actions of the counterparty. E.g., when the good to be exchanged needs to be produced or the service being rendered takes time.

Conceptual modeling of Contracts has a long history, recently warmed-up by Smart Contract technology (see, e.g., [5]). As mentioned, contracts govern the exchange of economic resources (and obligations), including goods and services (resp, equities and debts), between exchange parties.

Corporate Reporting, including Financial, ESG, and Tax Reporting, serves the needs of uncertainty-adjusted evaluation of actual and potential benefits and sacrifices to the donors from enterprise performance and position. It *recognizes* and *measures* the *effects* of exchanges on enterprise *situation* (position) of economic resource control rights and obligations, as well as enterprise activity *events* (performance) that have led to changes in the situation within a period. The specifics of contracts are in the separation in time of formation and fulfillment processes, and separation in time of parties' role and transaction performance within those processes. Due to these separations, temporary rights (obligations) and intermediate activities emerge that constitute the essence of the contract capturing in a legal sense and thus are first-class entities for accounting in addition to the exchange per se.

Requirements for such Contracts cover Contract and Property Law, Economics, IS, Corporate Reporting and Accounting, thus, to facilitate standard setting, a Foundational Ontology is needed, that at least contain building blocks in Law and Economics. Such an ontology is Unified Foundational Ontology (UFO) [11], with its subontologies [e.g., 13-17] and the ontology engineering tool OntoUML 2.0 [12]. The new version of the tool incorporates an extension of OntoUML to address events and their relations [13] and allows to verify and convert models to gUFO – a lightweight implementation of the UFO suitable for Semantic Web OWL 2 DL applications [14].

In this paper, we build forth on COFRIS – a core ontology for financial reporting information systems [7, 9, 10]. The methodology of our ontology research is dialectical. We start with the contract law and accounting theories and list requirements for Contracts (Section 2). Grounding on Foundational Ontology we present the extended social relator and contract ontology in more detail within the new version of the UFO theories and the new tool (Section 3). We compare our ontology with the conceptual framework and several standards (Section 4) and discuss it against other UFO grounded exchange and contract ontologies (Section 5). Section 6 concludes and outlines future work.

2　　Accounting Requirements for Specification of Contracts

The recognition, categorization, and measurement of activities and resources involved in a contract are captured for accounting and disclosure purposes based on the Common Standards and the Policies of an Enterprise. Several aspects of such capturing are based on information that is not specified, nor governed by default rules, in a Legal Contract. For example, the IAS Standard 24 *Related Party Disclosures* [1] requires exchange parties to disclose their *relatedness* and to follow specific rules in measurement.

Information about an exchange has a correlative part and a subjective part. The Correlative part refers to shared propositional content, such as performance obligations, rights to be transferred, prices for services or goods, and needs to be consensual between exchange parties, and/or is observed independently by the third party. The Subjective part of each party, such as internal valuation, uncertainty, and function of the resources (obligations) received or transferred [10].

The involved resources' source, target, provenance, and even measurement information are also important for sharing among parties. Including reporting aspects may increase the legal quality of the contracts. For instance, it is essential for both parties that a contract is concluded in compliance with IFRS 17 [1], and the going concern state of each party is assessed and uncertainties disclosed per IAS 1 [1]. The addition of the required information in the Contracts becomes easier and more faithful when performed within Smart Contracts whereby parties add correlative and own parts via the Contract posting application [9].

Financial Statements require the presentation of aggregated effect information, but Statement Notes often disclose transactional data. The data disclosed for Offerings, Contracts, Fulfillments, Taxation, Registers that protect ownership, or reduce health and safety risks through traceability, Customs, Markets, and Other Parties are on the transaction level. Advances in Multilateral IS [10] and especially Big Data [26] make such transaction-level data more easily accessible and reconcilable.

Offering and Contract information assessment and disclosure become increasingly important as a market forming mechanism, stewardship evaluation, and timely avoidance of non-compliance.

Concerning the main functions of Accounting Information Systems (AIS), we distinguish between *capturing* and its extension – *recognition*. In short, capturing and involves any processing of transfer or receipt of economic resources (obligations), including offerings, executory contracts, and other off-balance items, while recognition

includes only including those that are categorized per Standards as Assets (Liabilities) for Balance Sheet. In essence, recognition and measurement involve future aspects.

As described above the most elaborate exchange form involves contracting. Contract formation (Offer and Acceptance) and fulfillment lifecycle information include:

1. Exchange Parties, their types, or markets, legal and reporting state and their general relationship (relatedness) during the lifecycle.
2. Exchange Party Roles and Third parties involved in Contract formation and fulfillment.
3. Contract type, legislation, currency, time, duration, completion phase through the lifecycle.
4. Reciprocal Performance Obligations, their conditions, timing, valuation, and phases during the lifecycle.
5. Transfer Obligations of Economic Resources (Obligations) and their phases (e.g., the nature of the goods or services that the enterprise has promised to transfer).
6. Valuation of the Consideration in return for the transfer.
7. All Economic Events of Contract formation, modification, and fulfillment.
8. Assessment and Posting of Contract formation and fulfillment. Affected Asset (Liability) and corresponding Equity, Income, and Expenses Accounts of each Party.
9. Transaction or Aggregate Level of Information Disclosure. Open, Anonymized, or Sensitive Information. Immediate, Periodic, or Postponed Disclosure. Public and Partial Disclosure. (Disclosure is not further regarded in this paper)

In addition to Contract Law theories, we should consider the Accounting theories and particularly Ijiri's Theory of accounting measurement [6], which introduced fundamental axioms of control, quantity, and exchanges. Ijiri defined Economic Resources as having utility and scarcity for enterprises, Assets as resources presently or resources [of a specified type] expected to be placed under the control of an enterprise, and Liabilities as resources [of a specified type] that are expected to be released from the control of an enterprise. He argued for recognition criteria widening to include contracts and commitments. Ijiri regarded contract fulfillment lifecycle - *Executory*, *Partially Executed*, *Half-Executed*, and *Executed Contracts* [6, p.134]. Ijiri's theory suggests that all measurement can be based on so called historical cost and inferred from exchanges (subject to several requirements).

The existing practice includes also present value measurement that involves observable economic exchanges in the market and uncertainty estimation.

International Standards [1, 2] assume the economic exchange concept as something given; the following local definition approximates international exchange interpretation well enough: "*a reciprocal transfer between two entities, resulting in one entity acquiring Assets or Services or satisfying Liabilities by surrendering other Assets or Services or incurring other Obligations*" [3, ASC 845-10-20].

In order to accomplish faithful and relevant reporting, we agree with Guarino [18, 26], that "referring to the relationships [i.e., Assets, Liabilities, and Equity of an Enterprise] is unavoidable when we need to describe what changes in time, while referring to the event [e.g., Transfer of Economic Resources] is unavoidable when we need to describe contextual aspects that go beyond the relationships themselves".

Explicit event modeling allows the enterprise to benefit from capturing of event's *local*, *cumulative*, *contextual*, and *modal* aspects, but also analyze each exchange event as an agent's service for the principal – an issue of importance for standard setting and online platform policies. Contextual aspects of an exchange event primarily are the current economic system, financing, and market mechanisms. These aspects are depicted by exchanges of identical or similar [1, IFRS 13] economic resources and obligations in the market at transaction or reporting time.

As seen from the above exchange definition accounting depicts events as the changes in the situation and the nature of events, e.g., the services acquired or surrendered, as expense and revenue accounts. We think that due to the bilateral and even multilateral nature of the contracts and exchange, the independently observed events and their properties should be the starting point for standard setting. In this context it is important to distinguish among:

- *Resources* (services and goods) as characterizations or objects of transfer events,
- (Transferred) *Economic Resources* as rights that have the disposition to produce economic benefits,
- (Changes in) *Assets* as Economic Resources controlled by the enterprise.

3 The Extended UFO Social Relator Pattern

We build our contract ontology on a general condition that a transfer agreed between two parties of an Economic Resource (or Obligation) produces a Right (resp., Obligation) to the Consideration, which is measured in monetary terms (Valuation), and if a Consideration is received first then the transfer obligation becomes unconditional. This situation is represented by an Economic Relator, as a specialization of Social Relator in UFO-C Ontology. However, there are several ways of how this relator is worked out. In 3.1, we briefly summarize UFO. In 3.2, we discuss the different positions on Social Relator and based on that, present a new Extended Social Relator pattern in 3.3. This pattern will be the basis of the Economic Exchange pattern in Section 4.

3.1 UFO Background

In UFO [10, 14] *Concrete Individuals* comprise *Objects* (John, his car, the IASB 2018 Conceptual Framework), *Reified Aspects* of concrete individuals (John's height, his service agreement with Amazon), *Events* (the acquisition of GitHub by Microsoft) and *Situations* (the situation in which John weighs 80 kgs). A concrete individual has *Begin Point* and *End Point*.

In UFO-A reified aspects are further divided into intrinsic aspects and extrinsic aspects. An *Intrinsic Aspect* depends on a single concrete individual in which it inheres, such as the Moon's mass; mental dispositions, such as Bob's math skills. Intrinsic aspects are divided into *Qualities* in case the aspect is measurable by a certain value space (e.g., Bob's weight), and *Intrinsic Modes*, which are not given a direct value (e.g., Bob's capabilities). *Extrinsic* (or "relational") *Aspects* are reified relationships, e.g., John and

Mary's marriage, Mary's employment contract at NASA. A *Relator* mediates reciprocal relationships of two or more concrete individuals. Extrinsic aspects can also be reified one-sided relationships, e.g., John's admiration for Obama (which depends on Obama but does not characterize him) [14].

In UFO-B an *Event* is a Concrete Individual that 'occurs' or 'happens' in time [13, 14]. Events are those "things that happen to or are performed by" endurants, e.g., actions and processes, such as an offer, negotiation, acceptance, transfer; as well as natural occurrences such as an earthquake. The relations between objects and events may be captured with «participation», «creation», «termination» properties. Part-whole relations between events can be represented with the «component of» and other relations. An event also can have «historicalDependence» from another event. An event can be related to the endurants that are created or terminated in it. E.g., John and Mary's marriage was brought into existence in their wedding ceremony, by «manifestation» property can be used to identify specific aspects that manifest themselves in an event. Endurants play *processual* (or historical) roles in events in contrast to *relational* roles in relators. *Situations* can be used to represent certain configurations of entities that can be comprehended as a whole. When that configuration is actual (present in reality), we say that a situation is a fact. Events «bringAbout» Situations.

Individual Type is a Type whose instances are individuals. *Kinds* are sortals that classify their entities necessarily and that provide a uniform principle of identity for their instances. Instances of a kind can (contingently) instantiate *Roles* in relational contexts or instantiate *Phases* in intrinsic contexts. E.g., a person can move in the extension of the role Employee by participating in Employment relators. Relators (as well as qualities) are existentially dependent entities. E.g., the Employment of Mary in NASA can only exist if both Mary and NASA exist. This particular relation of multiple existential dependency is stereotyped as «mediation». A role-like anti-rigid non-sortal that can be played by individuals of multiple kinds is termed a *roleMixin*, and by kinds and types - a *Mixin*.

OntoUML [12] is a language whose meta-model has been designed to comply with the ontological distinctions and axiomatization put forth by UFO [11]. OntoUML diagrams represent types and types of the types by the «type» stereotype.

In UFO-C [15] the key construct is a social relator of reciprocal social commitments (and claims) between social agents. Unambiguous understanding of this concept, the distinction between relator and extrinsic mode, its lifecycle and foundation events, legal and monetary extensions are fundamental to exchange modeling.

3.2 The Social Relator

We remark that since the 18th-century economics is monetary, i.e., exchanges are mediated by money, and resources are treated as rights and measured in money. Hence an exchange and a market can be viewed as a mechanism where resources are exchanged for money (value) and money is exchanged for other resources. Money allows for partitioning and combining of exchanges, and consequently of their specification in contracts. Thus, the *economic* contract comprises reciprocal social relators that comprise *economic* social relators relating resources with monetary consideration.

An Economic Relator specializes Legal Relator (UFO-L [17]) which specializes Social Relator (UFO-C [15]) which in turn specializes the basic notion of Relator (UFO-A [11]). Per UFO-C, "Social Commitments and Claims [Counter-Commitments] always form a pair that refers to a unique propositional content, and a Social Relator is an example of a relator composed of two or more pairs of associated [correlate positions] commitments/claims", see the central line of boxes in Fig.1.

In contrast UFO-L [17] postulates that a "legal relation is reified by means of a Legal Relator, which mediates entities that stand in correlate positions (e.g., if agent A has a right to action [i.e., a claim, but not a commitment] X against agent B then B has a duty [i.e., a commitment] to action X towards A).", i.e., one pair of correlate positions.

Recently gUFO [14] made the subject clearer by explaining that "Extrinsic aspects [but not relators] can also be reified one-sided relationships, … They can also be used to reveal parts of relators, e.g., John's rights towards Amazon, Inc. (in the scope of a service agreement) and Amazon's reciprocal duties, Amazon's rights towards John, John's reciprocal duties". We follow this distinction in our ontology.

In addition, there are several UFO related papers including ours's where the «relator» stereotype is used instead of the extrinsic «mode». Examples are decorating Service Offering [16], and Exchange Offering [7, 21] with "definitely" «relator», and also Economic Resource [9] with «relator».

We regard the abovementioned extrinsic modes as mixin relator, we suggest introducing a relator type and a lifecycle pattern for social, legal, and economic relators and their commitments (legal positions). Such types would be gradually *materialized* by specialization and instantiation of category, mode and quality types. Offered by a committor in an event, accepted by a counter-committor in another event, fulfilled partially through a transaction or breached by non-performance of either committor, realized in full by either committor, and then breached or settled by the other.

The positions that we recognize in *Social Relator* are reciprocal obligations (commitments to norms) with correlative rights (entitlements to norms); obligations and fulfilled obligations; and reciprocated fulfilled obligations.

The contract schemas have to be simple enough and the elements and relationships that are implied or inherited should not make diagrams overcrowded. In UFO-L, each right has a correlative obligation. We think that after explaining this fundamental principle, it does not make sense to depict the correlative obligation of every right in every diagram like in UFO-L or UFO-S related works.

3.3 Extended Social Relator

Before introducing our Basic Economic Exchange pattern, we present a new Extended Social Relator Pattern, depicted in Fig.1. To simplify Fig.1 we assume that the Committer offers and performs first, and omit its multiple roles and situation types.

The creation of the Commitment modes as instantiations of the Commitment Types by Committers is represented by the «creation» stereotype [13] with the *Offer* event (which creates a power of acceptance) and historically dependent *Acceptance* event. Social Relators with one Commitment instantiated are in the *Offered* pre-phase, while with both Commitments instantiated in the *Executory* phase. The termination of Commitment modes as specializations is represented by the «termination» stereotype [13] which relates historically dependent *Fulfillment* or *Settlement* events to a class

stereotyped «phase» which is instantiated by the endurant when it takes on a "historical" nature[1]. In such a phase, endurants have still observable, but immutable properties. Social Relators with one Commitment fulfilled are in the *Unconditional* phase, and with both Commitments fulfilled in *Fulfilled (Settled)* phase. In Figures 1 and 2, types of types are represented in violet, types of agents in pink, events in yellow, relators in green, extrinsic modes in grey and situations in orange. In this relator pattern legal positions (and their correlatives) and thus the economic relator will progress through the «phases» created by events and situations. Conditional Commitment «termination» will create an Unconditional Other Commitment. The propositional content of the commitments can be time and context-dependent. We assume that an Unconditional Social Relator is materialized at the moment of fulfillment of Commitment. It is important for our ontology that commitments are externally dependent and that their fulfillment events are not simply actions as in [21], but transfers, i.e., transactions for the (benefit) of the counter-committer, and bring about the results (effects) in Situations of both parties.
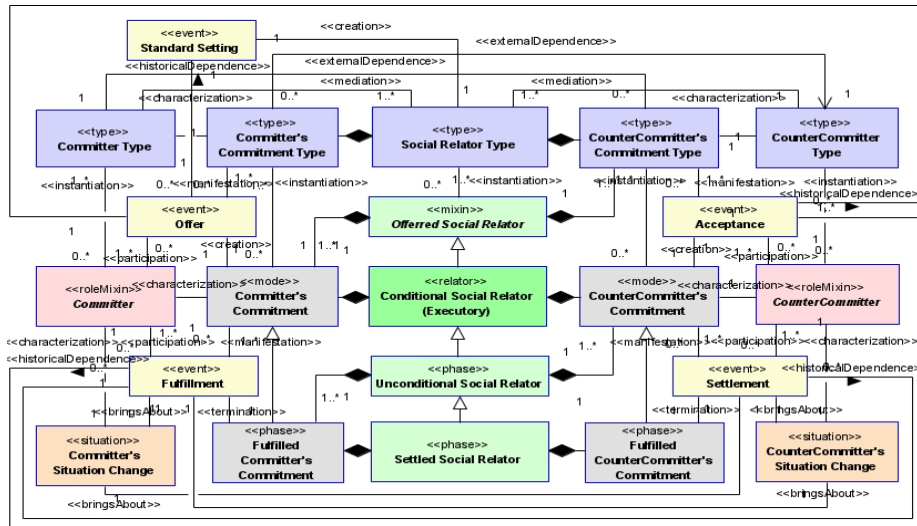

Fig. 1. OntoUML diagram of an Extended Social Relator Pattern.

3.4   Basic Economic Exchange Contract Pattern

An *Exchange Contract* is a complex legally enforceable economic agreement concluded between two *Exchange Parties* - economic agents – a party and a counterparty, that comprises of reciprocal conditional performance obligations by the exchange parties as obligors to transfer economic resources (obligations), see first the «type» part of Fig. 2.

A Conditional performance obligation (POB) of an *Obligor* to the *Obligee* is an Economic Relator phase. A *Conditional POB* comprises an obligation to transfer an economic resource (or an obligation) of a specified *Resource (Obligation) Type* and a reciprocal right (resp obligation) to the *Consideration* for the transfer, of a specified *Valuation Type*. The latter component requires a single *Contract Currency*. The valuation price,

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[1] A different approach is taken in [20], whereby commitments cease to exist after fulfillment.

which approximates a consideration for a resource (obligation), is agreed to be constant or determinable by a market price or by counter consideration during fulfillment. The valuation of the contract is equal for both parties at inception. POBs are correlative and consensual.

The last column of Fig. 2 depicts the recognition and measurement of the exchange process via the changes in *Units of Account – Assets (Liabilities)* and corresponding *Equity* (Income and Expenses) Accounts i.e., in the situations of *each* exchange party.

The contract formation process starts with the instantiation of a contract type into *Exchange Offering* by a party or its agent playing a processual role [13] of the *Offerer* that via an *Offer* event transfers *Offeror's* (a relational role) instantiated POBs to the multiple *Offerees* of a specified type. Offeror's POBs are conditioned by an offeree POB of a specified type required in consideration. The offeror makes its own *Assessments* of the recognition and measurement for the offering. An offeree playing an *Acceptor* role continues with a lapse or *Acceptance* event, instantiating its POBs, transferring the created contract to the Offeror, and making its assessments, that concludes the formation.

The Economic Exchange process is structurally decomposed into generally concurrent *POB fulfillment* processes of resource (obligation) transfers by each exchange party in the processual roles of the *Transferor* (or fulfiller), *Transferer*, and *Transferee*. A Resource (Obligation) *Transfer* fulfills and terminates the transfer obligations, instantiates the promised resource (obligation) type, terminates the obligations or rights for a resource of the transferor party, and creates the rights and the value for the transferee. At the same time, the specified consideration valuation is accrued, and the POB is turned into a fulfilled phase and becomes a resource and a *Contract Asset* of the transferor (*Liability* of the transferee). A *Fulfilled POB* is a separate object that can be measured and sold. Its timing is contract fulfillment or breach. The transfer event is characterized by the transferred resource (obligation), for a simple transfer of services the «participation» would be of the transferer, but for *Economic Transfer*, the «participation» involves consumed rights and value. POB fulfillment changes the *Executory* contract into the *Part-Executed*. The completion of fulfillment by one party - triggers the *Value Exchange* event – a termination (an exchange) of all monetary consideration rights (obligations) of both parties, which turns the contract into the *Half-Executed* phase and all unfulfilled POBs into *Unconditional POB* phase that become *Payables* of the debtor (*Receivables* of the creditor). The completion of fulfillment by both parties – the *Settlement* - causes the termination of the contract.

The contract formation can also include the Value Exchange Negotiation and other subevents like the contract fulfillment; however, they are less important for standard setting. An Economic Resource (Type) is a characteristic of the Transfer (resp. Transfer Obligation) and is a claim right for a service and a power for a good. The transfer results in changes in Assets and Liabilities and corresponding Income and Expenses. A more refined model would consider the production processes at the parties' sites.

In summary, we have two components at the lowest level – a transfer obligation and a consideration – with *Promised/Expected* and *Fulfilled* phases. Fulfilling by a transfer event of either of these components progresses four possible phases of POBs – *Conditional*, *Fulfilled*, *Unconditional*, and *Settled*. Fulfillment of the POBs progresses Contract fulfillment phases – *Executory*, *Part-Executed*, *Half-Executed*, and *Executed*. The whole exchange process comprises the accumulation of the transfer and value exchange

parts. Contract fulfillment is recognized by balanced posting events in the accounts and their phases of the exchange parties.
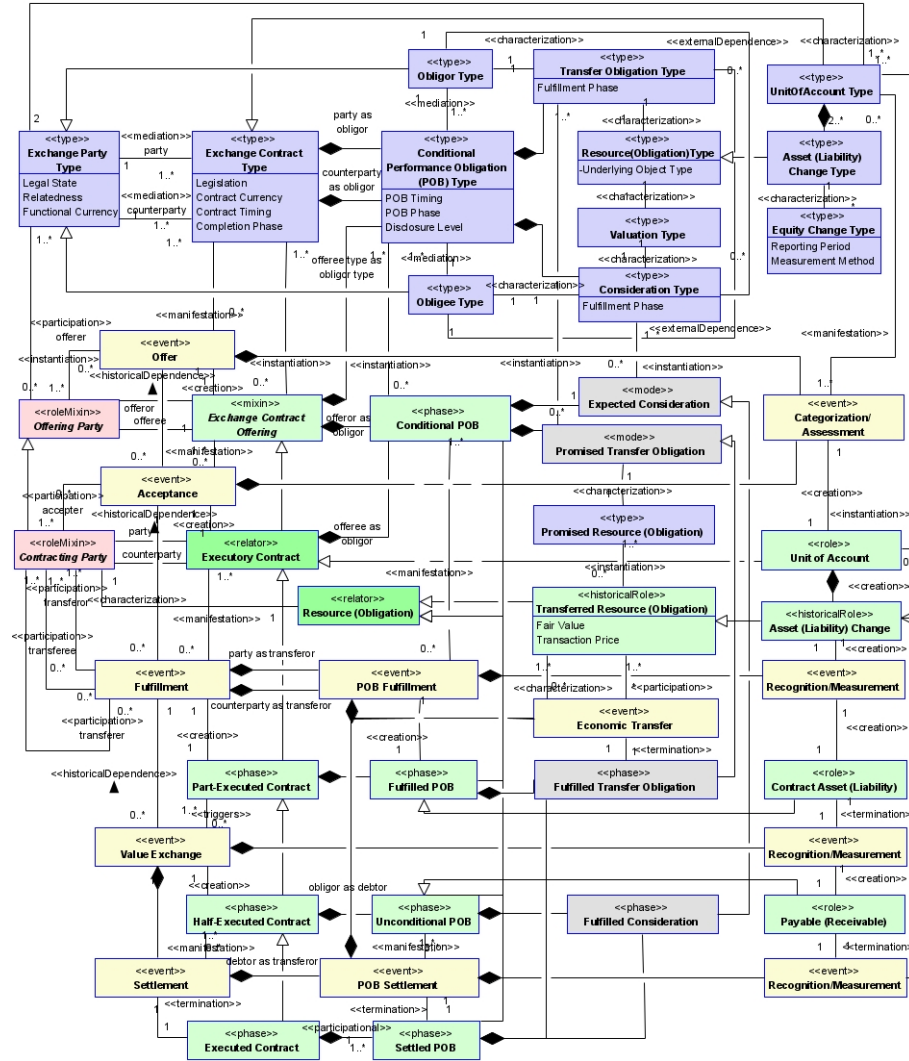

Fig. 2. COFRIS. OntoUML diagram of Basic Economic Exchange Contract Pattern.

4 Comparison with Reporting Frameworks and Standards

We think it is necessary to confront any contract ontology, including ours, with the Corporate Reporting Standards. On the one hand, we have to check the completeness and correctness of our ontology, and on the other hand, we want to see whether it can be of use for improving the current formulations in the Standards. Within the scope of this article, this confrontation is limited to a few observations. The IASB 2018 Conceptual

Framework for Financial Reporting (CF) [2] introduces the concept of a *Unit of Account* as a bundle of Rights and Obligations that can be recognized, measured as a whole and derecognized as a whole or in parts. That means such an object can be transferred in parts, and valuated upon a contract and is like our concept of a 'Resource (Obligation)'. In contrast, when regarding transfers in the definition of Liabilities, not Units of Account but only Economic Resources in a restricted sense are regarded. That can be understood in general because liabilities are obligations to transfer resources and transfer of liabilities transfer resources eventually, however not in a particular Contract. Standards, for example, IFRS 13 *Fair Value Measurement* [1] support transfers of Obligations, or even large bundles of Rights and Obligations, such as Business Enterprises as a whole – IFRS 3 *Business Combinations* [1].

Per CF 4.57 [2], "An executory contract [is a Unit of Account and] establishes a <u>combined</u> right and obligation to exchange economic resources. The right and obligation are interdependent and cannot be separated. Hence, <u>the combined right and obligation constitute a single asset or liability</u>. The entity has an asset if the terms of the exchange are currently favourable; it has a liability if the terms of the exchange are currently unfavourable." Similarly, in our model, the contract is represented by the relator of reciprocal obligations and rights and their valuation. Initially, the total valuation is equal to zero and off-balance, if a party's obligation value becomes greater than the counterparty's then the contract is the liability of the party, or an asset otherwise.

Per CF 4.58 [2], "To the extent that either party fulfils its obligations under the contract, the contract is no longer executory. If the reporting entity performs first under the contract, that performance is the event that changes the reporting entity's right and obligation to exchange economic resources into a right to receive an economic resource. That right is an asset. If the other party performs first, that performance is the event that changes the reporting entity's right and obligation to exchange economic resources into an obligation to transfer an economic resource. That obligation is a liability."

The difference with our model is that we distinguish between a conditional and unconditional right to receive (resp, obligation to transfer) consideration, where the former is before and the latter after the realization and both are phases of the Contract and POB. For example, if a party makes a transfer and fulfills only part of the contract, a *conditional* right to receive consideration is accrued, but complete fulfillment by one party raises an *unconditional* right to receive.

We will finish our short analysis regarding some aspects of the most comprehensive Contract Standard – IFRS 15 *Revenue from Contracts with Customers* [1]. In addition to the duplication of concepts of the CF (that could be avoided through core contract ontology), IFRS 15 states that an Enterprise "shall recognise revenue when (or as) the entity satisfies a performance obligation by transferring a promised good or service [ie a subset of Economic Resources] to a customer." This Standard conforms to the Basic Contract Pattern. The main purpose of the Standard is to estimate the Amount of Consideration (i.e., Revenue) that the Enterprise expects to receive (vs Promised) in exchange for transferring its goods and services.

Per para. 105 of IFRS 15, "When either party to a contract has performed, an entity shall present the contract in the statement of financial position as a contract asset or a contract liability, depending on the relationship between the entity's performance and the customer's payment. An entity shall present any unconditional rights to consideration separately as a receivable." This statement not only proves the first-class concept

omnipresence but also in contrast with CF, regards contract asset (liability) as a contract phase and not as a new object. At the same time, it proves that contract assets and receivables are material, but not computable, and can be subject to exchange and impairment, per para. 107: "A contract asset is an entity's right to consideration … An entity shall assess a contract asset for impairment." Standard particularly requires offsetting contract asset and contract liability.

5   Related Work

The conceptual modeling theory of Economic Resources, Events, and Agents (in fact of Economic Exchanges, and Contracts) started in the late 70s with the development of REA accounting model by McCarthy [22]. While our research was largely based on REA accounting model initially, we briefly list some issues not explicit in REA as also raised in [27, 7, 24] which do not allow REA to cover essential accounting requirements:

- Any economic or accounting theory includes the recognition, measurement, and disclosure of resources, obligations, and uncertainty in quantified *and monetary* terms.
- The recognition and measurement of changes in assets and liabilities of an enterprise are *not* determined exclusively by exchanges and participating economic resources.
- Economic Resources are rights over goods, services, and rights that are transferred (in the past), but *Assets* are Economic Resources controlled by an Enterprise (future).
- Economic Claims (in REA sense) are not computable imbalances between currently incomplete promised and transferred resources. Claims are ("materialized" at the moment of transfer) *consideration obligations* and *phases of contracts* and can be transferred and exchanged themselves.
- Environment, Government, Market, and Owners of an Enterprise (*Equity Claim Holders*) context deserve a special recognition of the theory.

Table 2. Comparison of Economic Exchange Ontologies.

Contract	Phase		Information Processing		
Ontology	Formation	Fulfillment	Recognition	Measurement	Disclosure
REA ISO [23]	commitments	basic	partial	no	no
REA^2 [25]	no	basic	partial	no	no
UFO-S [16]	commitments	services	no	no	no
UFO-L [17]	legal positions	services	no	no	no
ATE [21]	commitments	services	no	no	preferences
OntoREA [24]	no	basic	balance-sheet	derivatives	basic
COFRIS v 0.5	detailed	detailed	detailed	basic	basic

During the last decade, several attempts were made to ground and improve an REA Ontology in UFO. The approaches are quite different, often not consistent, and still do not cover all concepts developed in REA (e.g., internal agents, production). That was also due to the fact of rich development efforts within UFO itself. First attempts to compare REA conceptualizations in UFO were reviewed and found not fully compliant [18]. Separate from REA, UFO service and legal exchanges were regarded in [16, 17]. These did

not involve resource nor obligation transfers and did not regard the measurement and recognition issues (cf. [7]). In 2007 (2015), REA Ontology as ISO Standard [23] was published and introduced the independent view of collaboration space as a business activity space where an economic exchange of valued resources is viewed independently and not from the perspective of any business partner.

An Economic Exchange is an exchange of transfers of valued economic resources. A transfer can be regarded, although not always observed, as an effort of one economic agent - a transferor - towards another - a transferee. This effort, say, delivering of goods, or providing services can be measured, in nature, quality, and quantity of physical objects or labor, but also in rights (obligations) and value that is transferred-to or used-by the transferee. This describes our understanding of the independent view.

These transfers affect the Situations of both Parties, forming that can be regarded as a dependent view. Each party recognizes and measures transferred and received resources (or obligations) in their accounts of Assets (Liabilities) and corresponding Equity, Income, and Expenses. Their categorization and measurement depict their purpose, cost, uncertainty, and future exchange or use value. In REA the distinction between resources and assets is not always clear – "An economic resource - good, right, or service of value, under the control of a Person" [23]. We think that a service cannot be under the control of an enterprise, because it is consumed at the moment received or produced. It is a resource as a participant of transfer that can only affect resources other than services, i.e., those that are controlled by the enterprise.

Laurier et al, formalized part of REA-ISO using OntoUML, called REA^2 [25]. The approach was based on an original approach of introducing agent-resource, resource-event, and event-agent relators and centers on the roles of the relata. However, the approach of involving events as relata was not supported by the UFO-B model [13].

It is allowed (or required) by the Standards [2] that both parties recognize, measure, and disclose an exchange differently, hence "an automated transformation of view-dependent data into view-independent data and vice versa" [25] is not possible in general. However, it is important to recognize the *maximally* consensual and independent recognition, measurement, and disclosure of an exchange for relevant, faithful, understandable, verifiable, and comparable reporting [10]. That makes the works in [25] important.

An endeavor to improve REA, by modeling traditional accounting logic, and to provide UFO grounding is OntoREA [24]. OntoREA models recognition of the results, it does not include the independent view and the lifecycles of contract formation and detailed fulfillment. The most recent model [24] is from our view generally correct but covers only the final states of future and spot market contracts. From the fundamental accounting concepts, the Income and Expenses, at least as different from owner-initiated equity changes, are not covered. There are also definitional differences with our ontology concerning Economic Resource and its subtypes – Assets and Liabilities are not positive and negative resources, but a positive and negative control over resources [of a specified type]. Like all reviewed ontologies, OntoREA has goals additional to the ones of the standard setting, such as a deep consideration of Derivative instruments and Uncertainty representation. The latter underlines the distinction between the old accounting [and the ontologies which do not include recognition and measurement] related backward looking perspective into the past and the finance related forward looking perspective into the future [24]. Forward looking perspective can include forecasting and planning, and their mathematical modeling as suggested in [6] and [24], although standard-

setting today does not require it [1]. An ontological issue raised in [24] is the anti-eternalist view [26] of events, which is different than in other regarded exchange ontologies and in UFO-B, where the events are the past events and future events are specified by types of event types.

The foundational ontologies must indeed develop and incorporate new or previously unresearched concepts. However, to fulfil their role of understanding and communication, they need to be relatively stable, or even standardized, and include alternative concepts only with proper explanations of use. We find the anti-eternalist view as one of such alternative issues. In our ontology, we prefer a materialization metaphor, which allows to depict event types progressing from conditional specification of situation change effects to specification of concrete action in time, space, and social context.

A separate Action Based Core Ontology for Economic Exchanges - ATE [21] evolved in the UFO Economics project, claiming to cover REA Ontology. Its main contribution from our standpoint is the introduction of the *preference* concept. Standards do not explicitly require capturing preferences for an enterprise. However, they can be inferred by, e.g., comparing lapsed and accepted offerings, or other historical information for some exchange type or by comparing the transaction price with the market price (fair value). These options are included in our model. Perhaps other UFO developments in economics such as risk, value, trust, decision, game theory can enrich the exchange concept and the ontologies listed in Table 2 in the future as well.

ATE includes phases of contract formation, but surprisingly in ATE economic exchange is portrayed as a set of actions, while they are reciprocal transactions aimed from one agent to the benefit of another. There is no resource (obligation) participation, no recognition, nor measurement. ATE is also experimenting with another approach to conceptualization employing the future event *constitution* relationship [26].

Regarding ATE we must emphasize that a depiction of exchange and services through actions is not sufficient and recognition of action results in the situation of each exchange party is necessary (in economics in general not only for accounting).

6 Conclusions and Future Work

Extended Social Relator and Basic Economic Exchange Contract patterns are proposed for Enterprise Reporting standard-setting. Patterns are based on Contract Law and Accounting theories, grounded in UFO and OntoUML with recent updates. An initial comparison with the Reporting Conceptual Framework and Standards shows compliance, with minor inconsistencies among them and a possibility to move some Standards' conceptualizations to the Framework. We compared COFRIS with other UFO grounded work in Contract conceptualization and indicated why the latter is not yet sufficient for standard setting. It is important to admit that some of our crucial contract modeling aspects are still in the development and experimentation stage. Nevertheless, we conclude that the new OntoUML tool and advances in UFO modeling of Economics and Law will allow our COFRIS ontology to be proposed for Enterprise Reporting standard-setting to relevant Boards. For this purpose, future work comprises updating all existing COFRIS models, a developing Production Pattern, validation by modeling of Contract types listed in Table 1, and development of the standard-setting methodology using COFRIS.

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