Conceptualizing Resources and Claims in Consensual Economic Exchanges

Ivars BLUMS [a,1] Hans WEIGAND [b] and Aleksandrs BLUMS [c]

[a] *SIA ODO, Riga, Latvia*
[b] *University of Tilburg, The Netherlands*
[c] *London School of Economics, United Kingdom*

Abstract. The Core Ontology for Financial Reporting Information Systems (COFRIS) is grounded on Unified Foundational Ontology (UFO). In this paper, we build on COFRIS and attempt to detail the concepts of Economic Resources and Claims found in accounting frameworks, and to extract their features which are common to accounting and reporting standards. Economic Resources (Claims) are conceptualized as extensions of Complex Social and Legal Relators of UFO, within the consensual transaction-centric model. The application of this conceptualization and COFRIS in general aims to assist with standard-setting and the development of information systems, to facilitate understandability and reuse. The conceptualization is illustrated by examples presented in an ontology-inspired Event Table and is used to analyze the revised IASB® Conceptual Framework for Financial Reporting.

Keywords. Accounting Information System, UFO, COFRIS

1. Introduction

Recently, even the international accounting and financial reporting standard-setters board (IASB®) has acknowledged that massive changes in relation to technology will have an impact on accounting and corporate reporting. The standard-setters in their efforts need to account for the existence of the computational accounting systems and technologies including the shared ledger [e.g., 1] and data analytics [e.g., 2], as well as ontology engineering methods and tools, which have proven to cope with difficult standardization issues [e.g., 3, 4, 5].

Information systems were traditionally held inside an enterprise and represented the company perspective on economic exchanges. Evidence from the environment, e.g. invoices from suppliers, was used by the enterprise's auditors and considered important, but there was no systematic connection between the invoices sent in company A with the invoices recorded in company B. The shared ledger concept, with immutability and consensus of such transactions and involved resources (claims) with the required addition of party-specific asset (liability) information, may provide a better foundation for Financial Reporting (FR), than independent reporting by each individual participant.

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[1] Corresponding Author.

Recent versions of international accounting standards which encompass the whole life of a contract cannot be implemented by accounting departments alone. Accordingly, SAP's is developing software on revenue standards implementation [6] which delegates the main part of *recognition* to the Sales [Purchase] department, but *measurement* to the Accounting department. Thus, accounting needs to be interpreted in a wider than traditional sense and is an important part of an enterprise conceptual model, and FR concepts must have enterprise-wide understandability. Presently, in the Enterprise Architecture (EA) realm, the shared ledger as well as the FR perspective is not always recognized, and the concepts of economic resources (claims), assets (liabilities), are often treated differently than within Financial Reporting.

At the same time, the conceptualization of present FR per se must be much broader than the *recognized* five elements (assets, liabilities, equity, income, and expenses) defined by CF required for FR *presentation*, but as a minimum should include intentional, contractual and other "un-recognized" phases of economic exchanges and involved resources (claims), required for FR *disclosure* in the *Notes* of Financial Statements.

The Core Ontology for Financial Reporting Information Systems (COFRIS) [7,8] is grounded on Unified Foundational Ontology (UFO) [3]. In this paper, we build on COFRIS and attempt to detail the concepts of economic resources and claims found in accounting frameworks, as well as to extract their features common to accounting and reporting standards. Economic resources (Claims) are conceptualized as extensions of Complex Social and Legal relators of UFO, and within the consensual transaction-centric model. The application of this conceptualization and COFRIS in general aims to assist at standard-setting to engineer domain ontologies of particular (more than 80) International FR standards (IFRS) [9, 10] (see Fig.1), enterprise policies, and with the development of information systems, to facilitate understandability and reuse.

Domain-specific Layer	**Domain Ontologies**	**Accounting and Financial Reporting Standards**	**DOFRIS-xx**
Core Layer	**Core Ontologies**	**Conceptual Framework for Financial Reporting**	**COFRIS**
Foundational Layer	**Foundational Ontology**	**Theory of Economics and Accounting**	**UFO-ABC, S, L**

Figure 1. Architecture and Foundations of Financial Reporting Ontology Network (based on [11]).

Section 2 provides a brief overview of the UFO ontologies used and previous works on accounting ontology. In Section 3 we introduce the concepts of Economic resources (claims) and detail their usage in Economic exchanges. Section 4 illustrates their usage through examples and presents an ontology inspired Event Table. Section 5, as a partial validation, compares the introduced consensual and correlative multi-level resources (claims) with the revised IASB Conceptual Framework for FR.

2. Background: COFRIS and the UFO Ontology Network

2.1. OntoUML

OntoUML [5] is an ontologically well-founded version of UML whose metamodel reflects a number of ontological distinctions and axioms put forth by UFO [3, 4]. In OntoUML, class constructs stereotyped by «Kind» represent object types that supply a uniform principle of identity for their instances. Specializations of classes representing

kinds are stereotyped as «SubKind», «Role», or «Phase». Instances of «Role» and «Phase» types can cease to be instances of these types without ceasing to exist and without altering their identity. Instances of «Phase» types are characterized by a change of their intrinsic property(s), instances of «Role» types are characterized by a relational property(s) acquired in relationships with other entities. «Mixin» types are universals that aggregate properties that are common to different Kinds and do not provide a uniform principle of identity for their instances; instead, they just classify things that share common properties, but which obey different principles of identity. «Category» and «RoleMixin» types represent an abstraction of properties that are common to multiple «Kind» types and, therefore, do not carry a unique principle of identity for their instances.

A particular *mixin object* pattern, analogous to [21], combines object types with higher-order types (or even generalized to Orderless Class). Such a combination is often required in COFRIS to model market participants and the underlying objects of resources (claims) and is depicted in Fig. 2. For example, an underlying singular object, such as a *car*, can be type-specified in the agreement phase but identified in the fulfillment phase. Another example for market participants is the statement from [10] that "It is not necessary to know the identity of the party (or parties) to whom the obligation is owed", but is important, when it is fulfilled.
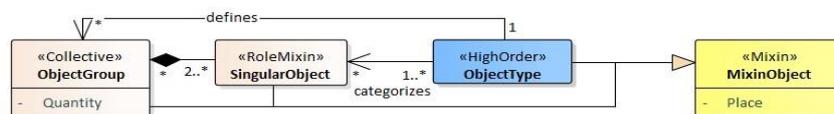

Figure 2. Mixin object pattern.

In addition to the object types, OntoUML class elements represent types of existentially dependent individuals that can only exist by inhering in other individuals, called *moments*. Those moments that inhere in one single individual are categorized as «Mode» or «Quality» types. While (individual) qualities are moments that change in a space of possible values (e.g. a color, a temperature, a weight), modes are complex individual moments that can have their own qualities that take their respective values in multiple independent value dimensions (e.g., a capacity, a complex intention). While inhering in a single individual, some modes and qualities can externally depend on other individuals that are independent from their bearers. Moments that existentially depend on two or more individuals are categorized as «Relator » types.

Instances of «Event» types [11] are perdurants. Perdurants unfold in time accumulating temporal parts. They are defined by the sum of their parts (their constituent subevents) and they bear to each other several temporal ordering and causality relations. Perdurants are manifestations of dispositional properties of moments (qualities, modes, and relators). Finally, perdurants are immutable in all their parts and all their properties.

In a social context, UFO [4] distinguishes between agentive and non-agentive substantial individuals. Agentive individuals can bear special kind of moments named *intentional moments* that are further specialized into *mental moments* (including *beliefs*, *desires* and *intentions*) and *social moments*. Each type of intentional moments necessarily has a propositional content, which may be matched by certain situations in reality. Among other types of intentional moments, *Intentions* refer to the desired state

of affairs to which an agent *internally commits* at pursuing. For this reason, intentions cause the agent to perform *actions*. *Actions* are intentional events, with the specific purpose of satisfying the propositional content of some intention of an agent. The propositional content of an intention is termed a *goal*. UFO contemplates a relation between *situations* and goals such that a situation may satisfy a goal. *Communicative acts* (special kinds of actions) can create *social moments* (*commitments* and *claims*) inhering in the agents involved in these communicative acts. Two or more pairs of mutually dependent commitments and claims form a kind of social relationship between involved social individuals, termed a *social relator*. A commitment (internal or social) is *fulfilled* by an agent A if this agent performs an action x such that the post-state of that action is a situation that satisfies that commitment's goal. Social relationships and interactions are further extended in several UFO grounded core ontologies, such as UFO-S [13] and UFO-L [14].

UFO-S is the core reference ontology on services [13], which characterizes the service phenomena as *activity* by considering service *commitments* and *claims* established between the service *provider* and *customer* along the service life phases: *offering*, *negotiation/agreement* and *delivery*.

Legal aspects of UFO-S contracts are elaborated in [14] within the UFO-L Legal ontology, that is based on Hohfeld's/Alexy's theory of fundamental legal concepts. The legal positions of UFO-L in addition to claims and commitments from UFO-S (i.e., right and duty) include pairs of other elements: permission and no-right, power and subjection, immunity and disability. All these legal relators originate from two classes of *entitlement* and *burden/lack*, which we refer to further as rights and obligations respectively. The above-mentioned right and obligation pairs form correlative associations [14], which are legal foundations for a shared ledger view [1]. In the core of UFO-L lays the concept of the *Legal Relator* as an extension of the social relator, which mediates two parties involved in correlative legal positions. In Fig. 3, the UFO-L Legal Service Agreement Ontology from [14] is depicted. Complementing UFO-S and thus diagram in [14], we regard an agreement (contract) not as a relator of four different modes, but as a relator of entitlement and burden/lack reciprocal legal relators each containing pairs of legal moments (as added in the Fig. 3). The exercising of rights and fulfilling obligations advances the phases of legal relators.

In [4], the UFO grounded ontological analysis of a resource was provided in the enterprise architecture and ArchiMate® framework context, that defined a resource as "a type-level entity, capturing the *role* of an (agentive or non-agentive) object in a particular context of usage".

The *underlying object* type is restricted to an "allowed type", and the context of usage is defined in the scope of a material relation (or in the scope of an event).

The *legal* and the *holder-specific* aspect of the resource as "an asset owned or controlled" was also regarded, but given the context, was not revealed to enough level of detail required for FR. For example, the employment contract, mentioned in the article, in the agreement (executory) phase is usually not regarded as an asset in Financial Reporting.

The *economic* aspect of a resource, that in an exchange, for a resource transfer or use, the right to receive another resource of a certain value is obtained, was outside the scope of that article.
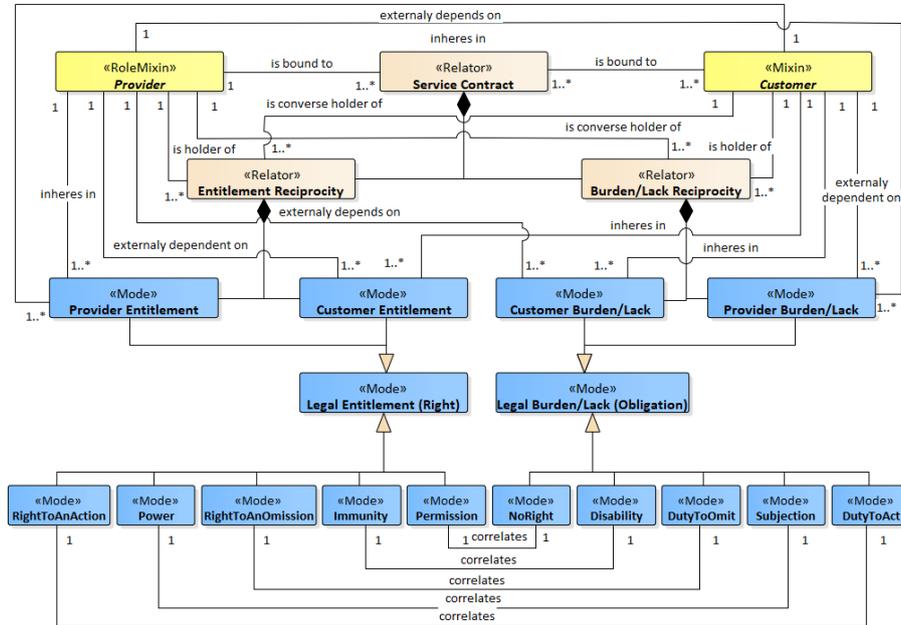
Figure 3. Legal Service Agreement Ontology in UFO-L. Adapted from [14]. Legal Relators added.

2.2. Other Previous Work

Recently, within the VMBO Workshop (see https://vmbo2018.e3value.com), there was a growing interest in the conceptual modeling of accounting, financial reporting, and economic resources, using the UFO Foundational Ontology. The models presented were largely based on Ijiri's economic exchange conceptualization [18] and the REA Framework [15]. These efforts covered fragments of the existing FR domain, represented by IFRS Standards [9] and their Conceptual Framework [10] and (while suggesting alternative ways) were sometimes not reasonably compliant with existing accounting frameworks.

To some extent summarizing these efforts, which are closely related to ours, Nicola Guarino in [19] admitted that "mapping the REA primitives on the UFO primitives was not an easy task, so that different choices were made". Overall, the *role* aspect of the economic resource was emphasized, that is indeed true for depicting a role (e.g., a fuel) that an object (e.g., the oil) plays in a particular usage case (e.g., a transportation). However, we view the following as additionally important for FR:

- possible exchange actions of the resource usage – functionality;
- permitted exchange actions – rights to transfer and use resource;
- intended exchange actions – purpose and ability to transfer and use resource;
- the phases of such exchanges, including the levels and phases of their fulfillment;
- the rights, amount, timing and uncertainty of a party to receive value from a counterparty, resulting from such exchanges, that from our view requires a complex social relator model of the economic resources (claims).

REA ontology generally doesn't regard Economic Resources as rights and views Claims as derivable, not ontological objects. Valuation related concepts are not explicitly regarded in the REA ontology. In [20] an attempt to bring REA ontology closer to accounting concepts was made, under the umbrella of UFO. While several choices, such as regarding resource as <<Kind>> were criticized in [19], an important conclusion from currency swap accounting was made about the phases: "The *Economic Resource* is typified into *Phase* classes according to the economic value specialization condition for distinguishing between Asset, Liability, Equity and Claim whereas this condition is considered as an intrinsic property of the resources" [20].

However, the economic resource, in this case is the underlying object, but not the bundle of rights. Considering that assets are economic resources controlled by an enterprise, while liabilities and equity are claims against an enterprise, we introduce the concept of an *Economic relator* that has Economic Resource and/or Claim phases.

3. Economic Phenomena

Most accounting frameworks [10, 12] state that the objective of *financial reporting* is to provide financial information about the reporting enterprise that is useful to existing and potential investors, lenders and other creditors in making decisions relating to providing resources to the enterprise, and the assessment of *amount*, *timing* and *uncertainty* of returns to be received in exchange for their investments. FR provides information about the economic resources of the enterprise, claims against the enterprise and changes in those resources and claims. It defines Economic Resources as sets of rights that have a potential to produce economic benefits and Claims as obligations to transfer Economic Resources.

3.1. Market Participants and Economic Exchanges

A Reporting enterprise that operates in an economic market, plays the role of a *market participant*. *Mixin market participants* are enterprises and physical persons, groups of enterprises and physical persons, and society at large, and their high-order types. Market participants hold resources (claims) - economic relationships, regulated by norms, over underlying objects, and are valuated in a certain currency of particular market. Market participants are able to commit and fulfil their commitments to exchange use and ownership of resources (claims) they control (indebt). At a macro level, as for national accounts, we can depict economic exchanges as valued (money mediated) transactions among market participants over a year or other period. More specifically for FR we can observe exchanges in which a particular market participant is involved. Participant's exchange efforts or other events provide value inflow and outflow of its resources (claims). The smallest exchange disposition inheres in a resource (claim).

The *contractual* economic exchange process involves two market participants and fulfils a contract. Those performed events that cannot be ascribed to a *contractual* or a *scheduled* (within an enterprise) exchange, are allocated to participant's exchange with society for a *period*. In [7] we follow UFO-S and treat exchange process as mutual provision of services among parties based on an *Offering* of interaction made by an

offer from one of two parties, followed by its acceptance (agreement) by the counterparty resulting in a *Contract* (of reciprocal obligations and rights to exchange rights and the use of rights over underlying objects, for mutual benefit), that is fulfilled through the *Exchange process*.

As in [16] exchange can be regarded as a production: "the buyer performs 'strictly an act of production', by converting stockings, for example, into money". On the other hand, Ijiri [18] has used the term *exchange* "to mean not only exchanges in the market, but also exchanges in production which may be considered exchanges between the entity and nature", that include internal production within an enterprise. Both interpretations prompt exchange generalization possibilities used in COFRIS, regarded as interactions of two parties. The parties can be <u>non-related, related, or different roles of the same market participant</u>.

3.2. Economic Relators, Resources and Claims

Economic relationships in COFRIS are represented by Economic Relators as extensions of Reciprocal Legal Relators. Generally, economic relationships have legal form, but also include *constructive* obligations and rights [10] built by economic necessity when a permitted action is in fact prohibited because of the economic loss consequences, nevertheless the obligation/right concept *assumes* a legal ontology.

An *Economic Relator* or *Resource (Claim)* is a reciprocal legal relator between parties whose purpose is to mediate a potential holder's transfer or use of rights[2] over an underlying object, and a counterparty's reciprocal obligation valued in money, that is fulfilled and manifests itself through economic exchange events (see Fig. 4).
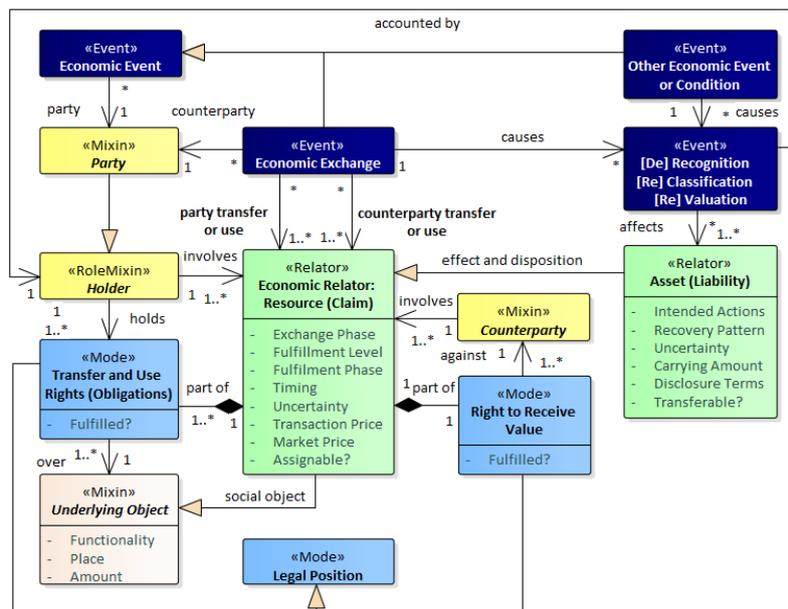

Figure 4. Economic Relators in green. Market Participants in yellow.

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[2] Includes 'Claims to transfer and use rights'

Next, we define the *fulfillment phases* of the Economic Relator:

- An *Economic Resource* represents a holder's [rights over an object that have a potential to be transferred or used to the benefit of a counterparty in exchange for an] economic claim against a counterparty – the right to receive value measured in money.
- An *Economic Claim* represents a holder's obligation to transfer or use rights over an object to the benefit of a counterparty.
- An *Economic Resource and Claim* represents a holder's obligation to transfer or use rights over an object to the benefit of a counterparty in exchange for an economic claim against a counterparty.
- A *Recognized Asset* is a present economic resource controlled by the holder (in the role of a creditor) as a result of past exchanges.
- A *Recognized Liability* is a present economic claim against the holder (in the role of a debtor) as a result of past exchanges.

For example, ownership[3] of an object is a permission to use and a power to transfer the object rights (the use protected from third parties by claim-rights and the transfer by immunity) in exchange for the right to receive economic benefits, subject to agreement of the counterparty. In a contract there is an economic resource <u>and</u> a claim – ownership and the right to receive value. If ownership rights are transferred, the right to receive value is accrued, if the right to receive value is received first, then the claim to transfer ownership rights is enforced.

Resources (Claims) are offered or consensual exchange future or actual action <u>participants</u>, while Assets (Liabilities) represent holder-specific *effects* and *dispositions* of exchange actions.

The *Underlying object* or simply a *Resource* is a Physical or Social Object and is characterized by its *Functionality*, and:

- *Quantity* (of collective objects, but the *Amount* of matter, time, or value) of underlying objects or a feature [of part] of the object, such as kWh for electricity, and is regarded as additive and holds some relation with the price;
- *Place* or *Container* that denotes the [fiat] location at [and in] which the object is or will be available for control.

Usual object classification in EA [17] precludes resource (claim) classification and includes ownership or rights of use of tangible objects: financial, i.e., present rights to receive cash or other resources (e.g., cash, securities, borrowing capacity), physical, i.e. has an opportunity to generate an inflow of cash or another resources (plant, equipment, land, mineral reserves), intangible objects: technology (patents, copyrights, trade secrets), reputation (e.g., brand, relationships; culture), and human skills.

An economic relator itself can be an underlying object thus modeling situations of power, e.g., when a debt (a right to receive from a converse holder) is transferred from one holder to a counterparty, or e.g., a note payable in Government bonds (an underlying object) gives the note holder the right to receive and the holder of the

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[3] We assume that the relation between ownership and right to receive value from an unknown counterparty is material, because some exchange value (probably uncertain) of the ownership rights should exist in society which can be assessed, e.g., as the market value or as regulated price or as entry price or as accumulated labor [16] or determined by a court.

Government bonds the obligation to transfer Government bonds. The converse holder of the bonds is the Government, but the underlying object is a cash. A chain of rights/obligations to receive, transfer/exchange resources (claims) is itself a resource (claim).

Timing (*Condition*) denotes a [due] date or period, condition, and order of expected entitlement of rights. E.g., a Financial guarantee is a right of the lender to receive cash from the guarantor, and a corresponding obligation of the guarantor to pay the lender, if the borrower defaults (a condition).

The valuation of Resources (Claims) is based at the carrying amount (for use, or e.g. cost-plus contracts), transaction price, or market price. The *Market Price* (*Fair Value* [9]) is the value of receipt rights (transfer obligations) for a transferred resource (claim) in an orderly exchange between market participants at the measurement date and could be regarded as being *in consensus with society*. The *Transaction Price* is the price agreed on between the parties when a contract is made and is *in consensus with the counterparty*.

The Resource (Claim) and its features concepts are consensual and correlative – agreed among the holders and converse holders, contract parties, and counterparties.

Assets (Liabilities and Equity Claims) are holder specializations of controlled (indebted) and recognized Resources (Claims) depicting *Intended exchange actions* and the *roles* in these actions (within rights) and object roles, subject to the business model, restrictions and capabilities of the holder, *Carrying amount* (Cost)*, Uncertainty* (Risk), *Recovery* (*Settlement*) *pattern* and other holder-specific qualities. *Cost* is used as a base for a measure of the added value of enterprise performance.

Some examples of economic relators with corresponding legal positions:

- A holder is at *permission* to use or consume the object, having disposition to receive (produce) benefits, valued at the carrying amount.
- A holder has the *claim-right* against another market participant to exclusive control of the object, i.e., other market participants would have an obligation not to use or consume the object in any way. The violation of this right has the disposition to produce an enforceable claim against others, valued at the carrying amount or market price.
- A holder has the *power* to transfer all (or some) of the rights over the object to the counterparty, in exchange for an enforceable right to receive against the counterparty, valued at the transaction or market price.
- A holder has the *immunity* from the involuntary expropriation of rights over the object by other market participants.

Economic Resources that are immediately consumed as transferred, for example, services, or not capitalized, for example, office supplies, are called *momentarily* assets in [10, 12]. Our interpretation is that in the first case there is a use of the rights, but no transfer of rights, and thus no assets. Likewise, liabilities are not only the "obligations to transfer" [10], but also could be obligations to use rights.

Economic Resources (Claims) play two major roles in economic exchanges, they are *factors* and *products* of some production processes. Production, while in many cases being trivial (i.e. consisting of property rights transfers plus transfers of transfer efforts transfers), is regarded here as a contracted or scheduled *performance* process where the Economic Resources (Claims) play the role of the *factors* to produce (or

combine into) another Resource (Claim) – a *product.* As stated in e.g., Archimate® [17] a *product* represents [rights for] a coherent collection of services and/or passive structure elements [goods], accompanied by a contract/set of agreements which is offered as a whole to (internal or external) customers.

3.3. Resources (Claims) in a Consensual Economic Exchange

As for other information systems, e.g., [11] one can distinguish between the standard, intended and scheduled, and performed processes of economic exchanges. We regard standard processes, involving market participants as actors, and economic relator participation. The exchange processes containing economic events are standardized through law, accounting standards and enterprise policies. These processes are intended and scheduled:

- by adapting standard processes;
- by offerings of the parties (providers) to their counterparties (customers) which specify the performance obligations and rights, and
- by contracts – accepted offerings by customers (see Fig. 5).

Legally speaking, an *offering* transfers power on the offeree, who by accepting it, creates an obligation and a right to exchange – a *contract*, in the offeror. As depicted by reified exchange events in Fig. 5, we distinguish the following contract (economic exchange) phases: *offered, lapsed, agreed, suspended, transferor breached, transferee breached, realized, settled*.

Figure 5. The economic exchange life and affected economic relator fulfillment levels.

The Resources (Claims) and their exchange-affected Assets (Liabilities) in addition to the *fulfillment phases*, are also characterized by above-listed *exchange phases*, complementing FR, where only recognized assets (liabilities) are *presented* while others are *disclosed*, but not conceptualized in CF.

Performed processes fulfil open or closed contract and performance obligations (POs) by transfer or use actions. A transfer action event conveys the role of the holder the economic relator from a transferor to a transferee and in return accrues a right to receive value – an Income Right against the transferee.

If some PO is wholly fulfilled by the transfers or uses, the Performance (Revenue recognition) event accrues a Revenue Right.

If all POs of one party are fulfilled, a Realization (Receivable recognition) event takes place that, brings the party's Contract relator to the Consideration Resource phase and counterparty's Contract relator to Contract Claim phase. The latter implies that all the remaining counterparty's now enforceable obligations to transfer should be settled by transfers that would conclude the exchange process.

In general, the results of <u>several</u> performance processes of transfer and use actions are combined in economic exchanges, in order to receive rights for results of other performance processes of equal value. Thus, for exchange process (contract fulfilment) we have provider and customer action plans, each comprising of three *fulfillment levels*: contract obligation realization (consideration settlement) of the whole contract, performance obligation fulfilment, and fulfilment of transfer and use obligations.

A consensual price – a right to receive value is ascribed to each obligation and is specified directly or as dependent on other prices, or counterparty obligation prices, or market prices. Higher level prices are aggregates of lower level prices, including the transfer of a combination effort component and the time value of money. For the contract as a whole provider rights value is normally equal to customer rights value.

Contract breaches can occur for each obligation type. As a general rule we argue for the following:

- If contract is in breach for the reasons other than counterparty nonperformance, by the transferee, the transferor has an enforceable right for all income rights;
- If contract is in breach for the reasons other than counterparty nonperformance, by the transferor, the transferor has an enforceable right for revenue rights of all performance obligations wholly fulfilled.

The rationale for the first case is that transferor has lost value due to the transferee, and for the second that, while having not wholly fulfilled the contract, the transferor has created the contracted performance value for the transferee.

4. Illustration

Example 1. As a simple example let us regard a smart vending machine that transparently prepares different sorts of coffee drinks. The potential customer (a Person or an Enterprise that has installed the machine for its employees) is addressed by the vendor through a touchscreen offering. When choosing the options, she comes to an agreement to receive a coffee drink, e.g., cappuccino, in exchange for a money transfer at the listed price. Next, different ingredients (factors) of the product are transferred to

the customer – a container (a cup), milk, foaming service and finally the coffee. Notice that some of the ingredients are prepared internally by the vendor such as the fresh-grind of the coffee, while others are transferred to the customer and then used for production, the latter being of <u>little separate use</u> for the customer.

The payment could be another "process" consisting of a cash payment and change, or payment by credit card. If the smart vending machine is connected to a shared Vendor's (and Customer's) Information System with shared ledgers of the supplier contracts, a VAT reporting system, and a Banking system, by some automatic tagging we can have all the information in consensus and in an immutable state for Financial Reporting. In addition, if the vendor is leasing the vending machine, or using some patent, the transaction can be shared with the lessor (patent holder) for pay per use accrual.

If we imagine a situation, where payment takes place after the delivery (e.g., by initially providing credit card details, but the actual withdrawal occurring later), she may order three cups of coffee, but if the coffee machine is out of some ingredients after the first two and a half cups (a contract breach by the transferor), she would be charged for the two delivered cups, because each of them constitutes a product under standard conditions.

Example 2. To depict the contracts and resource (claim) exchange instances in a more concise way we introduce an Event Table (see Fig.6)

Fulfil	Obligation	PO	Timing	Control	Object	Qty	Value	Place	Debited	Credited	Amt	Place	Debited	Credited	Amt
EID:11 ProviderAgreement 01.01.2018						CU:	k€	**Provider: P**			k€	**Customer: C**			k€
10	Contract		2018-2019	Control	Hospital	1	1000	Site 1	Receivable	Contract Asset	1000	Site 2	Contract Liability	Payable	1000
	Performance	1	2018	Control	Building	1	600		Income	Revenue	600		Building	Construction	600
	Transfer	1	2018	Service	Construction	120d	600		Contract Asset	Income	600		Construction	Contract Liability	600
									Expenses	Construction	500				
	Performance	2	2019	Control	Equipment	1	400		Income	Revenue	400		Equipment	PPE in Process	400
	Transfer	2	31.12.2018	Control	Procurement	1	300		Contract Asset	Income	300		PPE in Process	Contract Liability	300
									Expenses	Procurement	200				
	Transfer	2	2019	Service	Installation	20d	100		Contract Asset	Income	100		PPE in Process	Contract Liability	100
									Expenses	Labor	70				
	Consideration		31.12.2019	Control	Cash in Bank		1000	IBAN 1	Contract Liability	Receivable	1000	IBAN 2	Payable	Contract Asset	1000
	Receipt		01.01.2018	Control	Cash in Bank		400		Cash in bank	Contract Liability	400		Contract Asset	Cash in bank	400
	Receipt		31.12.2019	Control	Cash in Bank		600		Cash in bank	Contract Liability	600		Contract Asset	Cash in bank	600
EID:12 Customer Transfer 01.01.2018						CU:	k€	**Provider: P**			k€	**Customer: C**			k€
11	Transfer		01.01.2019	Control	Cash		400	IBAN 1	Cash in bank	Contract Liability	400	IBAN 2	Contract Asset	Cash in bank	400
EID:13 Provider Transfer 29.12.2018						CU:	k€	**Provider: P**			k€	**Customer: C**			k€
11	Transfer	1	2018	Service	Construction	120d	600		Contract Asset	Income	600		Construction	Contract Liability	600
									Expenses	Construction	500				
	Performance	1	2018	Control	Building	1	600		Income	Revenue	600		Building	Construction	600
EID:14 Provider Transfer 29.12.2018						CU:	k€	**Provider: P**			k€	**Customer: C**			k€
11	Transfer	2	31.12.2018	Control	Procurement	1	300		Expenses	Equipment	200		PPE in Process	Contract Liability	300
									Contract Asset	Income	300				
EID:15 Provider Transfer 31.12.2019						CU:	k€	**Provider: P**			k€	**Customer: C**			k€
11	Transfer	2	2019	Service	Installation	20d	100		Expenses	Labor	70		PPE in Process	Contract Liability	100
									Contract Asset	Income	100				
	Performance	2	2019	Control	Equipment	1	400		Income	Revenue	400		Equipment	PPE in Process	400
	Contract		2018-2019	Control	Hospital	1	1000	Site 1	Receivable	Contract Asset	1000	Site 2	Contract Liability	Payable	1000
EID:16 Customer Transfer 01.01.2020						CU:	k€	**Provider: P**			k€	**Customer: C**			k€
11	Transfer		31.12.2019	Control	Cash in Bank		600		Cash in bank	Contract Liability	600		Contract Asset	Cash in bank	400
	Consideration		31.12.2019	Control	Cash in Bank		1000	IBAN 1	Contract Liability	Receivable	1000	IBAN 2	Payable	Contract Asset	1000

Figure 6. Economic event table for Example 2.

In the header (in dark blue) of an economic event, we have an Event identifier (EID), and a Transferor type – Provider or Customer, that specifies the context. Further header attributes are:

- The Resource (Claim) Transfer Event type - *Offer*, *Agreement*, [Partial] *Transfer* or *Use*, *Performance* (Revenue Recognition), *Realization or Settlement*, or
- Asset (Liability) *Revaluation or Reclassification* Event type.

Date or Period, Transaction Currency Unit, Provider and Customer identification and their Local Currency Units with their spot exchange Rates, conclude the event header.

Event detail lines depict events that fulfil the contract, performance (PO) or transfer/use obligations identified by the referenced event and PO number, by transferring or using a promised resource (claim) in exchange for accruing consideration, revenue or income rights. The *Timing*, *Rights* (Control), *Object*, *Quantity* (Qty), *Price*, and *Place* concepts are described in Section 3. The Provider and Customer have their specific columns (in light blue) that depict the involved Debited/Credited Accounts and Amounts. However, those accounts should be regarded in the context of consensual columns (in dark blue).

Next, we describe the events of the example depicted in Fig. 6.

- EID:11 - An enterprise P enters into a contract to build a hospital for a customer C, (to fulfil some offering with EID:10), whereby P obliges to provide construction as a separate performance (project) within 2018, but the equipment procurement and installation project in 2019. The consideration for the whole contract comprises of a prepayment on 01.01.2018 and a final payment at the completion of the contract. These rights/obligations are depicted in the agreement details, but the effect of their fulfillment is specified by the *planned* accounts and amounts of the provider and customer.
- EID:12 C fulfils the obligation to transfer prepayment to P's bank account and accrues income claim against P for this amount.
- EID:13 P fulfils obligation by transferring goods and services for hospital construction promised in the EID:11 and accrues P's income claim of PO:1, thus completing the PO:1 fulfillment and recognizing revenue claim.
- EID:14 P transfers equipment.
- EID:15 P, by transferring the installation services, completes the PO:2 of equipment project that leads to overall contract fulfillment and accrual of consideration rights.
- EID:16 C completes the settlement and the whole exchange by cash payment to P's bank account.

5. IASB Conceptual Framework Resource Definition Analysis

In March 2018 IASB finally released the revised version of the Conceptual Framework (CF) for Financial Reporting [10]. The revised framework contains several conceptual improvements, including new resource (as rights that have the potential to produce economic benefits), asset and liability definitions. Our goal is to be reasonably compliant with the framework in engineering COFRIS. Another goal is to see where the CF could benefit from our ontological analysis. We list the following suggestions:

Firstly, Financial reporting should aggregate *transaction-centric* plus enterprise-specific, but not enterprise effect-centric information. Thus, economic exchange should be introduced as a unifying concept. Aggregating consensual transactions for FR,

instead of accounts, would provide additional opportunities for comparability with other enterprise processes, possibilities of application of process mining methods, and insights into the value co-creation processes.

Secondly, competitive *consensuality* (meaning that among parties there is an agreed shared ledger of contracts and their fulfillment, including provider and customer resources (claims) and required asset (liability) information) should be a quality aspect, even within the old context of audit reconciliations. Consensuality should be added to comparability, verifiability, timeliness, and understandability as qualitative characteristic that enhances the usefulness of information that both is relevant and provides a faithful representation of what it purports to represent and reduces *reporting uncertainty*.

Thirdly, *correlativity* in economic relationships, should be a standard-setting principle. The important intermediate resources (claims) of contract realization, performance and transfer should be defined. When correlativeness and consensus are not regarded as a principle, deficiencies emerge in standards already discussed by us elsewhere, such as concerning leases [11], contract assets and revenue [3].

Fourthly, Assets (Liabilities) are conceptualized only as recognized, while the other phases of exchange (contract), depicted in disclosures, should be conceptualized.

And fifthly, a unifying concept of an *Economic relator* should be introduced. A partial effort in the framework has been made by defining the concept of a Unit of Account as a group of related rights and/or obligations. The difference is that the economic relator is a more atomic building block that shows the value relationship, from which more complex units of account such as the contract (of three levels and phases of fulfillment, as shown in this paper), investment portfolio, cash-generating unit, and enterprise as complex economic relators can be built.

6. Conclusion

Financial reporting standard-setting, implementation and the corresponding information system development is at present a partially informal and long process and, as exemplified by other domains, may be improved using ontology-driven conceptual modeling approaches. Existing foundational and core ontologies, as shown by UFO ontology network usage, provide upper-level patterns from foundational UFO – A, B, C, and several UFO grounded ontologies, such as services, legal, transaction, enterprise, exchange, value and even software [11], for representing FR concepts and relationships.

An Economic relationship as a disposition of economic exchange events, is a fundamental and reuse facilitating pattern of capturing economic phenomena for FR. By extending the general exchange pattern it is possible to build patterns for particular standards to facilitate reuse. An ontological analysis allows for the explication of the core contract creation and fulfillment phases, economic relators – resources (claims), assets (liabilities) to capture the full partition of the economic phenomena which can be used for FR. Aligning FR concepts with UFO allows for better understanding of the meaning of FR concepts and their classification in the enterprise domain, for instance, for OMG Standards for EA. Elaboration of correlative associations between the enterprise and the counterparty, based on the legal and economic relator concepts, may

lay a foundation for consensus-based accounting in a shared ledger environment, where the conceptualization of assets (liabilities) will reveal holder-specific and potentially sensitive or shareable parts for contracts and FR.

Our first suggestions are described in Section 5, furthermore, a full validation of Resource (Claim) concepts of COFRIS by modeling most IFRS standards is needed.

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