

Common Core Conformant Definitions for an Ontology of Commercial Exchange

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Abstract

In “Toward an Ontology of Commercial Exchange” [11], we proposed human readable definitions for terms that are central to an ontology of commercial exchange. This paper furthers that project in two ways. First, the definitions have been modified to be compatible with the Common Core Ontologies (CCO). CCO is used in a wide variety of domains including the industrial and military domains. Having a commerce ontology compatible with CCO allows data about the exchange of goods relevant to those domains to be tagged with compatible ontologies. Second, we propose preliminary formalizations of these definitions, with the aim of informing the creation of an ontology which can be used to assist in reasoning over business-related data.

Keywords

Basic Formal Ontology, Buying, Commercial Exchange, Common Core Ontologies, Selling

1. Introduction

In this paper, we offer preliminary formalizations of the definitions found in [11] that are conformant with Basic Formal Ontology (BFO) [8][13], with the BFO-based as mid-level Common Core Ontologies (CCO) [7][12] ecosystem, and with principles of ontological realism more generally. Ontological realism is the practice of asserting classes in an ontology, only if there is good reason to think that asserting that class reflects the way the world actually is [2][16]. The goal is to provide a strategy for developing and refining a set of classes that extend directly from CCO in order to provide the beginnings of an ontology of commerce in general which can support the Industrial Ontologies Foundry (IOF) and other ontology initiatives which face the need for an ontology that can be used to annotate commerce-related data. These domains include the military domain and industrial domain among others [1][14][15]. In what follows, we present our CCO conformant definitions of commerce entities and for some, offer a brief discussion justifying our definitions and responding to objections. Herein, we adopt the act view of commercial exchanges defended by Massin and Tiefenbach O. Massin and E. Tiefenbach, *The Metaphysics of Economic Exchanges*, *Journal of Social Ontology* 1.2 (2017) 167-205. in which what is exchanged are acts, which include both what is traditionally meant by a service, as well as the acts required to provide or bestow a good onto another.

We do not defend or justify definitions that come from CCO itself or the document acts ontology (D-Acts) [17] as these definitions have in some cases been handled already in [11] and because it is not within the scope of this paper to offer a critique of prior ontologies. Rather, we accept them as they are in composing our definitions, using ‘CCO’ and ‘D-Acts’ as prefixes for correspondingly derived content. We use ‘OCE’ as prefix for definitions taken from terms in the ontology of commercial exchange proposed in [11] but modified here to be CCO conformant.

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2. CCO Definitions

The definitions we present in this section are taken from CCO and BFO [7][8][11]. We present them here as background to the definitions in section 3 which form the focus of our work. ‘Definition’ and ‘Def.’ in all that follows are used in what follows to refer both to definitions proper (which are statements of jointly sufficient and individually sufficient conditions for the application of the defined term) and to elucidations (which are designed as an aid to understanding but do not meet all the requirements for being a definition proper) [2]. We organize the terms by (1) continuants, those entities which exist fully at a time and persist through time, (2) occurrents, those entities which do not exist fully at a time, but unfold through time, and (3) the relations that can obtain between entities. It is not our goal to discuss or defend these definitions. However, we present them here because these terms are technical and used extensively in the definitions that we present in section 3.

2.1. Continuants

CCO: Action Regulation =def. a Directive Information Content Entity that prescribes an Act as required, prohibited, or permitted, and is the output of an Act which realizes some Authority Role.

CCO: Action Requirement² =def. an Action Regulation that requires some Act.

CCO: Agent =def. a Material Entity that is capable of performing Intentional Acts.

CCO: Artifact =def. an Object that was designed by some Agent to realize a certain Function.

CCO: Directive ICE =def. an Information Content Entity that consists of a set of propositions or images (as in the case of a blueprint) that prescribe some Entity.

CCO: Financial Instrument =def. an Artifact that is designed to be a tradeable asset and that is legally sanctioned.

CCO: Group of Agents =def. an Object Aggregate that has only Agents as parts.

CCO: Information Content Entity (ICE) =def. a Generically Dependent Continuant that generically depends on some Information Bearing Entity and stands in relation of aboutness to some Entity.

BFO: Material Entity =def. a material entity is an independent continuant that has some portion of matter as proper or improper continuant part.

BFO: Object³: b is an object means: b is a material entity which manifests causal unity of one or other of the types CUn⁴ listed above & is of a type (a material universal) instances of which are maximal relative to this criterion of causal unity.

² ‘Action Requirement’ is used synonymously with ‘obligation’ in this paper.

³ The use of the term ‘object’ is roughly the same as the colloquial use of the phrase ‘physical object’, which includes things like, cars, dogs, trees, computers, etc.

⁴ See the BFO documentation [8] for detailed descriptions of the various kinds of causal unity.

BFO: Object Aggregate =def. b is an object aggregate means: b is a material entity consisting exactly of a plurality of objects as member_parts at all times at which b exists.

CCO: Organization =def. a Group of Agents which can be the bearer of roles, has members, and has a set of organization rules.

CCO: Portion of Cash =def. a Financial Instrument that is designed to be a ready medium of exchange.

BFO: Role =def. b is a role means: b is a realizable entity & b exists because there is some single bearer that is in some special physical, social, or institutional set of circumstances in which this bearer does not have to be & b is not such that, if it ceases to exist, then the physical make-up of the bearer is thereby changed.

2.2. Occurrents

CCO: Intentional Act =def. an Act in which at least one Agent plays a causative role and which is prescribed by some Directive Information Content Entity held by at least one of the Agents.

BFO: Process: p is a process =def. p is an occurrent that has temporal proper parts and for some time t, p specifically_depends_on some material entity at t.

CCO: Social act =def. an Intentional Act having an Objective that affects, is performed by, or is performed on behalf of, a community or Group of Persons.

2.3. Relations

BFO: bearer_of =def. a relation between an independent continuant (the bearer) and a specifically dependent continuant (the dependent), in which the dependent specifically depends on the bearer for its existence

CCO: has_output =def. y has_output x iff x is an instance of Continuant and y is an instance of Process, such that the presence of x at the end of y is a necessary condition for the completion of y.

BFO: has_process_part =def. x has_process_part y iff x and y are instances of Process, such that y occurs during the temporal interval of x, and y either provides an input to x or receives an output of x, or both.

BFO: inheres_in =def. a relation between a specifically dependent continuant (the dependent) and an independent continuant (the bearer), in which the dependent specifically depends on the bearer for its existence

CCO: prescribes =def. x prescribes y iff x is an instance of Information Content Entity and y is an instance of Entity, such that x serves as a rule or guide for y if y an Occurrent, or x serves as a model for y if y is a Continuant.

3. OCE Definitions

OCE: Deontic Role =def. a Role that inheres in an agent and which is externally grounded in the normative expectations of some Group of Agents, to which that Agent belongs, concerning how that Agent should behave.

More formally:

‘x is a deontic role’ means:

- i. x is a role
- and there is some y, z such that
- ii. y is an agent
 - iii. x inheres in y
 - iv. z is a group of agents
 - v. y is a member of z , and
 - vi. x is grounded in the normative expectations of z

This definition of deontic role we have modified from the D-Acts definition that appears in [11] in order to make it consistent with CCO. We appeal to *groups* in this definition (as opposed to the social contexts used in D-Acts) in order to construct a definition that uses other terms found in CCO. The definition (elucidation) of ‘group of agents’ in CCO is very loose and would trivially encompass all social contexts as understood by D-Acts. This is because a group of agents, according to CCO is simply an aggregate of agents.

The terms ‘ground’ or ‘grounding’ can often carry widely different meaning, especially within philosophical contexts. Here, we simply use the term to refer to the set of conditions upon which a realizable entity is dependent for its existence. A role, for example, depends on a set of external circumstances, which the bearer of that role finds itself in. In this case, we say that those external circumstances *ground* the role. While we do not here propose any theory of grounding, our very general use of the term is (we hope) compatible with many or all of the theories, to which one might appeal to explain grounding.

OCE: Act of Commercial Exchange =def. Social Act in which at least two Agents or Organizations participate and in which at least one of the Agents or Organizations, y , provides a good or Portion of Cash to the other Agent or Organization, z , or realizes some process directly or indirectly for z , in order that z provides a good or Portion of Cash to y , or realizes some process directly or indirectly for y .

Again, more formally:

‘x is an act of commercial exchange’ means:

- i. x is a social act
- and there is some y, z such that
- ii. y is an agent
 - iii. z is an agent
 - iv. $z \neq y$
 - v. y and z participate in x
 - vi. x has a process part, which involves y providing some good or portion of cash to z , or that involves y realizing some process either directly or indirectly for z , and
 - vii. x has a process part, which involves z providing some good or portion of cash to y , or that involves z realizing some process either directly or indirectly for y .

It is important to emphasize here that an agent might be a single individual, a group of persons or even an organization. Accordingly, this definition can account for a group entering into a commercial exchange with another group. It can also account for a swap between three or more agents, such as

when agent A, B, and C arrange an exchange such that: agent A gives an apple to agent B, who gives a banana to Agent C, who in turn gives an orange to agent A. In a case like this, three acts of commercial exchange take place: (1) A transferring a banana to B in exchange of B transferring an apple to C, (2) B transferring an apple to C in exchange of C transferring an orange to A, and (3) C transferring an orange to A in exchange of A transferring a banana to B.

OCE: Act of Payment =def. Social Act in which one Agent or Organization provides some good, usually a Portion of Cash, to another Agent or Organization, in order to fulfill some Action Requirement.

‘x is an act of payment’ means:

- i. x is a social act
- and there is some y, z, w, u such that
- ii. y is an agent or organization
 - iii. z is an agent or organization
 - iv. $y \neq z$
 - v. y and z participate in x
 - vi. u is a good, usually, a portion of cash
 - vii. w is an action requirement
 - viii. w prescribes that y provide u to z , and
 - ix. x fulfills the prescription set out in w .

Our definition of **Act of payment** does not limit what can be used as payment to only money, as we do not wish to imply with our definition that no payments can take place within a barter economy. Moreover, our definition implies that merely giving someone money is not payment. For instance, if an act of payment occurred merely when I gave someone a ten-dollar bill, I would be paying my small niece anytime I gave her ten dollars (to spend at a carnival, for example). To solve this problem, we require that payments require there to be an obligation that is fulfilled through that payment. Moreover, while it is somewhat controversial what exactly counts as money [4][5], we remain agnostic in this paper about what money is, deferring to the definition of the CCO term ‘Portion of Cash’. However, our definition does imply that an act of payment must contain as a part some document act [6].

OCE: Act of Buying =def. Social Act that is a part of an Act of Commercial Exchange, in which one Agent, x , receives a good from the other Agent, y , or where y realizes some process directly or indirectly, for x , and in which x is obligated to realize some Act of Payment, which y receives.

‘x is an act of buying’ means:

- i. x is a social act
- and there is some y, z, w, u such that
- ii. y is an act of commercial exchange
 - iii. x is a part of y
 - iv. z is an agent
 - v. w is an agent
 - vi. u is an act of payment
 - vii. z receives some good from w , or w realizes some process for z .
 - viii. z is obligated to realize u , and
 - ix. w receives the benefit of u .

OCE: Act of Selling =def. Social Act that is a part of an Act of Commercial Exchange, in which one Agent, x , provides a good to the other Agent, y , or where x realizes some process directly or indirectly, for y , and in which y is obligated to realize some Act of Payment, which x receives.

‘x is an act of selling’ means:

- i. x is a social act
- and there is some y, z, w, u such that

- ii. y is an act of commercial exchange
- iii. x is a part of y
- iv. z is an agent
- v. w is an agent
- vi. u is an act of payment
- vii. z provides some good to w , or z realizes some process for w
- viii. w is obligated to realize u , and
- ix. z receives the benefit of u .

Act of buying and act of selling have very similar definitions. The difference between them is just that if I am an agent in an act of buying, then I am receiving some good or service, but if I am an agent in an act of selling, then I am providing some good or service. It should be emphasized that these definitions do not appeal to the use of money, although they will very often involve money. What these definitions imply is that in every act of commercial exchange there will be two acts of buying and two acts of selling. Because in an exchange each agent provides some good or realizes some process for the other, each of those agents also receives a good or have a process performed for them. As a result, there are two acts of buying and two acts of selling. This view of exchanges was originally defended by Walras [10]. Others, such as Menger, have denied this view of exchanges, instead stipulating that currency can be used to distinguish an act of buying from an act of selling, such that the agent providing the good and receiving the currency is participating in an act of selling [9].

We chose to construct these definitions in accordance with the Walras view for several reasons. First, we wish to allow that acts of buying and selling occur in barter economies as well as economies that make use of currency. Moreover, we wish to allow for a money economy to exist, in which some acts of buying and selling take place without using currency, as, for example, when stocks, real-estate, or pieces of art are used to purchase other items. Second, we wish to allow currency to be bought and sold using other currency, as for example, when one uses U.S. dollars to buy euros. Third, because there are two acts of buying and two acts of selling in any commercial exchange, we leave it in the hands of the users of this ontology to collect and record data about whichever act they are most interested in recording. For example, if an act of selling is recorded by a retailer when they sell an item to a certain customer (perhaps associated with a customer number or credit card number), then it will be easy to infer with the aid of the ontology that the other corresponding acts of buying and selling have also occurred.

One might think that appealing to Walras's idea that in an exchange there are two acts of buying and two acts of selling departs from the principles of ontological realism. However, if we consider a simple exchange, for instance, Ellie giving Abby an apple in exchange for one dollar, we are able to isolate four distinct acts. One act is Ellie relinquishing ownership of the apple, another is Abby taking ownership of the apple. A third is Abby relinquishing ownership of her dollar, and the fourth is Ellie taking ownership of that dollar. Of course, this example does not take into account the complexities of exchanging rights or services, for example. Nevertheless, if we have an interest in capturing the relevant parts of a simple exchange of goods, it seems quite plausible that there are four acts taking place there, which correspond to the Walras account.

Moreover, while there are classes of entities in the Resource-Event-Agent (REA) enterprise model that have much ontological merit [18] for handling things kind of exchanges, we did not incorporate them directly into our ontology because they are not conformant with existing BFO and CCO definitions, to which we are trying be interoperable with. Still, we recognize the value in incorporating content from such a widely used framework and hope that this will be the focus of future work.

OCE: Price Quote Document =def. a Directive ICE that prescribes some Act of Commercial Exchange and specifies some Portion of Cash to be transferred in the Act of Payment, which is a part of that Act of Commercial Exchange.

' x is a price quote document' means:

- i. x is a directive ICE
- and there is some y, z, w such that
- ii. y is an act of commercial exchange

- iii. z is a portion of cash
- iv. w is an act of payment
- v. w is a part of y
- vi. x prescribes y , and
- vi. x prescribes that z be used to carry out w .

OCE: Act of Price Quoting =def. Social Act which has output some Price Quote Document.

‘ x is an act of price quoting’ means:

- i. x is a social act

and there is some y such that

- ii. y is a price quote document
- iii. x has output y

OCE: Invoice =def. a Directive ICE that includes a description of goods provided or services rendered, and prescribes some Act of Payment for those goods or services.

‘ x is an invoice’ means:

- i. x is a directive ICE

and there is some y such that

- ii. y is an act of payment, and

iii. x lists a set of goods or services provided and prescribes y as compensation for those goods and services.

OCE: Act of Invoicing =def. Social Act which has output some Invoice.

‘ x is an act of invoicing’ means:

- i. x is a social act

and there is some y such that

- ii. y is an invoice, and
- iii. x has output y

4. Conclusion

Because the definitions we develop in this paper are all BFO and CCO conformant, which makes them suitable for inclusion in an ontology of commercial exchange for users of other BFO- and CCO-conformant ontologies, we hope to provide a jumping off point for developing a commercial exchange ontology that can interact well with existing and developing ontologies, for example within the military and industrial domains.

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