STPO:
The synthesis of a TOVE Persons Ontology

Chris Partridge

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ISIB-CNR
Corso Stati Uniti 4
I-35127 PADOVA (PD)
e-mail: mbox@ladseb.pd.cnr.it
fax: +39 049-829.5763
tel: +39 049-829.5702

The Synthesis of a TOVE Persons Ontology

Chris Partridge[1 & 2]

[1] BORO Program, England
partridge@BOROProgram.org
http://www.BOROProgram.org/

[2] National Research Council, LADSEB-CNR, Italy
partridge@ladseb.pd.cnr.it
http://www.ladseb.pd.cnr.it/infor/ontology/BusinessObjectsOntology.html

Abstract:

This is a report of the results of the Synthesised TOVE Persons Ontology (STPO) project. This project's goal was a synthesis of a Persons Ontology from the TOronto Virtual Enterprise (TOVE) project's Organisation Ontology. The report is both an introduction to the interim ontology developed by the project and also a summary of its development.

1 'The STPO Final Report'

This is a report of the results of the STPO (Synthesised TOVE Persons Ontology) Sub-project – a step of the CEO (Core Enterprise Ontology) Project. It is intended as both an introduction to the interim ontology developed by the project and also a summary of its development.

The body of the report focuses on the work of the STPO. Background information on the CEO and its approach (as implemented in the STPO) can be found in the report *The CEO Project: An Introduction* (Partridge 2002a).

The STPO is the first step of the CEO project whose eventual aim is the construction of an 'industrial strength' ontology to be used as a tool by enterprises to significantly improve the semantic aspects of their information systems. This first step is a synthesis of a Persons Ontology from TOronto Virtual Enterprise (TOVE) project's Organisation Ontology[1] - which is called the Synthesised TOVE Persons Ontological Model (STPOM).

1.1 The synthesis stage of the CEO project

STPO is only a small first step in the overall CEO project – it is just the first step in the first 'synthesis' stage, as shown in Figure 1 below. The synthesis is a kind of informed, intelligent re-construction or recovery on the basis of a sound framework ontology[2]. It has as its goal the harvesting of insights from current 'state of the art' enterprise ontologies and their synthesis into a single coherent

[1] The TOVE project's aim is to produce an Enterprise Model of which the Organisation Ontology is part. They have published a number of versions of this - the particular version that is considered here is Fox, et al. (1996) *An Organisation Ontology for Enterprise Modelling*.

[2] And so does not fall neatly into one of the usual categories; for example, those of integration, merge and use in Gomez-Perez, et al. (1999) *Some Issues on Ontology Integration*, that assume an underlying homogeneity among the ontologies.

whole. This will then be used as the foundation for the development of an industrial strength CEO.

The planning of the synthesis stage started with an informal review of what was available. This indicated that the 'state of the art' is immature, in particular that:

- there are not many enterprise ontologies (though there are many resources from which these could be mined), and
- those that exist have not yet reached 'industrial strength' as ontologies for semantic interoperability of operational enterprise systems.

This second point is one of the reasons why the STPO needed to undertake a synthesis rather than a merge/integration. This should become clearer as this analysis of TOVE proceeds.

The review selected the following ontologies for synthesis:

- TOronto Virtual Enterprise - TOVE (Fox, Barbuceanu et al. 1996) (Fox, Chionglo et al. 1993) (TOVE:http),
- AIAI's Enterprise Ontology - EO (Uschold, King et al. 1997) (Uschold, King et al. 1998) (EO:http),
- Cycorp's Cyc® Knowledge Base – CYC (Lenat and Guha 1990) (CYC:http), and
- W.H. Inmon's Data Model Resource Book - DMRB[3] (Inmon, Silverston et al. 1997)

For planning purposes the review also made a rough intuitive guess at what the major core enterprise categories might be – sufficient to act as a basis for scoping the synthesis sub-projects. It proposed these three major categories:

- *Person (AKA Party[4])*, (where this includes both natural persons and organisations) who can enter into a
- *Transaction*, which often include agreements which involve an
- *Asset*.

The synthesis project was sub-divided on the basis of the selected ontologies and the proposed major categories – as shown in Figure 1 below. The intersection of the TOVE ontology and the Person core category was selected as the scope for the first synthesis project.

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[3] In its own terms, this is a universal data model. However, from our perspective, it is in many respects an ontology. We considered having a number of commercial data models in the sample, but found that they were very similar – so there would be no real benefit. Inmon, et al. (1997) *The data model resource book* and Hay (1996) *Data model patterns* were neck and neck as the commercial data model representative. We selected Inmon (1997) as it seemed slightly more accessible. Note, a two volume revised edition of this has since appeared: Silverston (2001a) *The data model resource book 1,* Silverston (2001b) *The data model resource book 2*.

[4] Within the data modelling community, Party is the common name for what we are calling Person here.

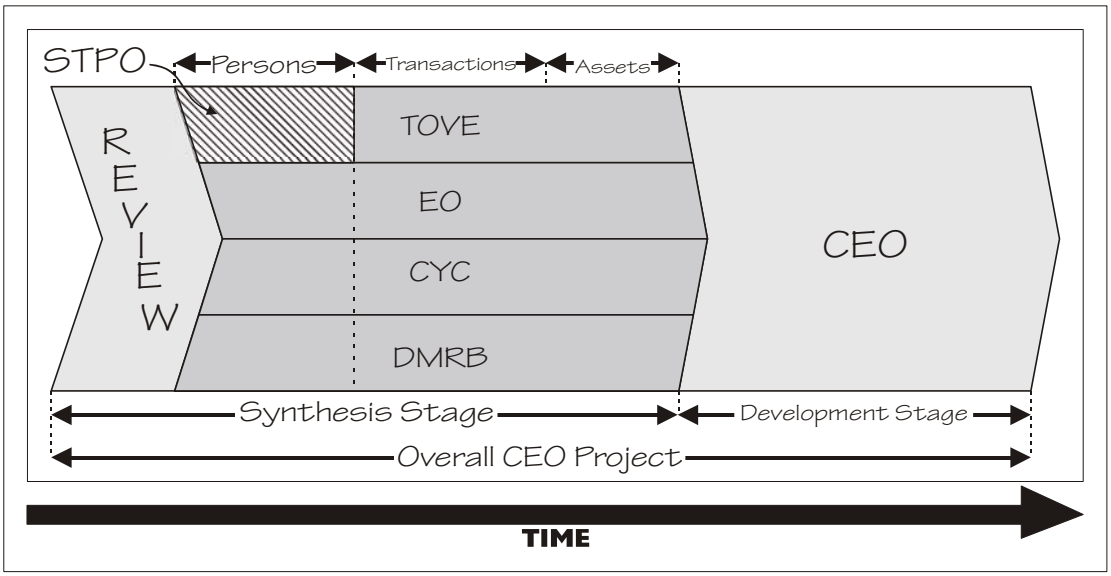

Figure 1 – The synthesis stage of the CEO project

1.2 Collaboration

In the initial stages, the STPO project collaborated with the Italian segment of the European IKF (Intelligent Knowledge Fusion) project[5]: in particular with the pilot IKF-LEX project. IKF/IF-LEX is lead by ELSAG BankLab SpA and its goal is to provide semi-automatic support for the comparison of banking supervision regulations.

1.3 Organisation of this paper

This paper is organised into these three main parts:

- *Introductory*: The first sections of the paper contain this introduction and a description of the context for the overall CEO project and this STPO project. They outline the goal and scope of the projects as well as the ontological approach taken.
- *Main*: The body of the paper describes the synthesis of the STPO ontology from the TOVE ontology. This is done in three stages based upon the three major elements of the TOVE ontology.
- *Conclusions*: The final sections of the paper discuss further work that needs to be done in the CEO project – both in terms of analysis and expanding the ontology – and the conclusion that can be drawn from the work done on the STPO project.

[5] http://www3.eureka.be/Home/projectdb/PrjFormFrame.asp?pr_id=2235

2 The CEO project

In this section, the main points relevant to the STPO sub-project are briefly described. As noted earlier, further details of the CEO Project can be found in (Partridge 2002a).

2.1 The CEO's goal, scope and prime deliverable

The overall goal of the CEO project is to provide a tool for enterprises to *significantly* improve the semantic aspects of their information systems.

The CEO is intended to be a Core Enterprise Ontology, which means its scope is the major core categories of the enterprise field.

The CEO's prime deliverable is an ontological model – which provides a semantic framework that can be used for many tasks, including the development, deployment and inter-operation of systems. Technical terms, such as 'ontology' and 'ontological model', are explained in (Partridge 2002a).

2.2 The STPO sub-project

The STPO's goal and scope have been refined from the CEO's.

2.2.1 The STPO's goal, scope and prime deliverable

The goal of the STPO is the harvesting of insights from TOVE and their synthesis into a single coherent whole within an ontological model – the STPO-M. This will then be used as the basis for further synthesis projects.

As noted earlier, the choice of the enterprise category Person gives us one boundary on STPO's scope, TOVE gives us another. So the STPO's focus is on the intersection of these – the person-relevant elements of TOVE.

The STPO's prime deliverable is an ontological model that builds upon TOVE's insights to arrive at something closer to 'industrial strength'.

2.3 The CEO's requirements for a useful ontology

From the CEO perspective, ontology is a technology and the ontological model a tool for semantic integration. There are a number of requirements that it needs to meet to fulfil its purpose. The main general requirements identified in (Partridge 2002a) are divided into these engineering-based ones:

- Teachability
- Consistent applicablility

And these science-based ones:

- Relevant precision and sufficient formality
- Sufficient simplicity and relevant generality
- Appropriate unity and explanation
- Relevant fruitfulness

- Relevant repeatability – re-usability

2.3.1 TOVE's stated requirements

TOVE lists some similar key requirements in Section 3 of (Fox, Barbuceanu et al. 1996), under the heading 'Ontology Competence'. It is worthwhile to note the similarities and the differences.

TOVE regards the most importance criteria to be what it calls competence. This asks: "How well does it support problem solving? That is, what questions can the representation answer or what tasks can it support?" In practice, it uses the easily tested 'questions that need to be answered' as a yardstick for measuring competence: though how to arrive at a comprehensive set of competency questions is a moot point. The CEO and TOVE are in some kind of broad agreement inasmuch as competence is similar to the notions of 'relevant' and 'appropriate' used in the CEO requirements.

TOVE mentions generality asking "To what degree is the representation shared between diverse activities such as design and troubleshooting, or even design and marketing?" This implies that TOVE has a more modest goal in this area that the CEO – limiting their stated interest to term harmonisation across domains.

TOVE mentions perspicuity, asking: "Is the representation easily understood by the users? Does the representation document itself?" These questions bear a weak resemblance to the explanation and usability CEO requirements.

Interestingly, TOVE mentions minimality: "Is there a core set of ontological primitives that are partitionable or do they overlap in denotation? A minimal set of terms should be in the ontology." This minimality requirement is related to the CEO's requirement for simplicity and generality.

TOVE also mentions transformability, extensibility, granularity and scalability. But as expressed, these seem to be properties of the representation rather than the ontology – and so not relevant to our enterprise.

2.4 The CEO's Framework for the Synthesis

The CEO uses a framework of three hierarchies (described in detail in (Partridge 2002a)) each generated by its hierarchical relation. These are:

- Typonomy - generated by the instance-type relation,
- Taxonomy - generated by the super-sub-type relation, and
- Partonomy - generated by the whole-part relation

The initial review identified that, in general, the sample ontologies did not take full account of these frameworks – this is particularly true for TOVE. This is one aspect of the immaturity of the current crop of ontologies. An important part of the analysis will be developing a model of these framework for the objects recovered from TOVE.

3 TOVE's Person scope

The notion of Person (Party) includes both people and organisations: it encompasses all the entities that can enter into contracts and so acquire rights and obligations. TOVE has a number of person-relevant elements. The initial STPO analysis identified that these three main elements[6] (and their sub-elements and their inter-relationships):

- Organisation (and Organisation-Unit),
- Organisation Agent (with Individual-Agent and Group-Agent as 'sub-classes'),
- Organisation-Position,

There is also a related main element that is not in scope, but is relevant to the analysis:

- Organisation-Goal.

These elements and their relations, which I shall call TOVE's Organisation Ontology, is diagrammed below. A list of all the elements in the TOVE ontology is given in Appendix A.

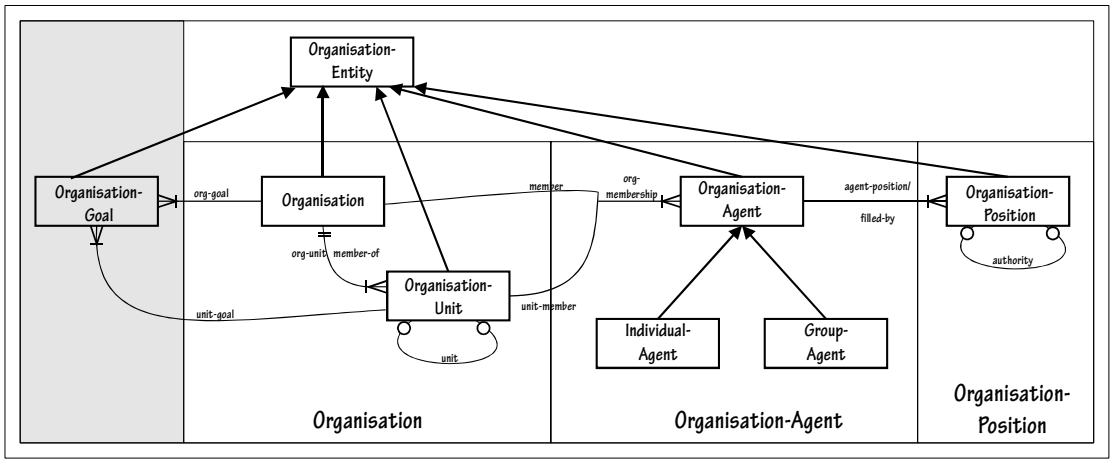

Figure 2 – TOVE's Organisation Ontology

To simplify things, this diagram (and the STPO analysis) does not distinguish between relations and their inverses. To aid traceability back to the original TOVE relations, both the relation and its inverse's names are shown by a single diagrammed relation line.

Unfortunately TOVE does not seem to include any obvious way of identifying the inverse of a relation. So the STPO has had to use its judgement, based upon context, to identify inverses. In some cases TOVE makes this more difficult than it need be by using quite different names. For example, Organisation_org-

[6] TOVE talks of concepts – i.e. the representation rather than the represented. To minimise confusion I have used the term 'element' rather than 'concept'.

unit_Organisation-Unit and Organisation-Unit_member-of_Organisation seem to be inverses – despite the quite different senses of org-unit and member-of.

3.1 The notion of organisation

Organisation is one of the main person-relevant elements within TOVE's Ontology. TOVE, and the rest of the sample, use the term organisation in a sense common in enterprises, which takes it as a type of person. In other contexts, the sense is sometimes stretched to include what might more naturally be called a system ('a regularly interacting or interdependent group of items forming a unified whole') – taking in such things as animals (including humans), which are a functioning 'organisation' of their bodily parts. The STPO, like TOVE and the other ontologies, keeps to the enterprise sense that includes such things as[7]:

- a voluntary association of individuals for common ends; especially: an organized group working together or periodically meeting because of common interests, beliefs, or profession.
- an enduring and cooperating social group whose members have developed organized patterns of relationships through interaction with one another.
- a community, nation, or broad grouping of people having common traditions, institutions, and collective activities and interests.
- a chartered commercial organization or medieval trade guild.
- an association of persons for carrying on a commercial or industrial enterprise.

These extracts all refer, in one way or another, to groups of people. However, one of the things the STPO analysis showed is that the enterprise notion of an organisation is not dependent upon this – and this independence needs to be recognised to account for examples such as single person companies and sole proprietorships.

3.2 TOVE's organisation ontology's intuitions

The goal of the STPO is to extract from TOVE its insights, both into the formalisation and the explanation of the enterprise – and synthesise them into a coherent whole.

The kind of insights TOVE has captured includes a number of basic intuitions about the nature of organisations, which most people regard as correct in at least some situations. The kinds of intuition are:

- An organisation can and does perform activities.
- An organisation can be composed of units and typically has members.
- People can be members of organisations.

[7] These are based upon extracts from a variety of dictionaries.

- Some (maybe all) of the organisation's activities are performed by their members in some form of collaboration.
- An organisation typically places some constraints on the activities its members can perform on its behalf.
- Organisations have positions.
- People occupy positions in organisations.

These need to be recognised and explained by any CEO and the synthesis of TOVE provides us with the opportunity to do this.

TOVE provides us with an obvious order in which to proceed with the synthesis – its three main concepts:

- Organisation (and Organisation-Unit) (Section 7.1)
- Organisation-Agent (and Individual-Agent and Group-Agent) (Section 7.2), and
- Organisation-Position (Section 7.4).

4 TOVE's Organisation

We can look at the section of TOVE covering Organisation as attempting to answer these two questions:

- What kind of thing is an organisation? (Organisation and Organisation-Unit)
- How is an organisation composed of other organisations? (org_unit and unit relations)

4.1 What kind of thing is an organisation?

This first question is asking for, from a formal perspective, a taxonomy, particularly the super-types of Organisation. To get at TOVE's taxonomy, the STPO had to look at its informal descriptions, as its formal ontology has little to say on the matter. Effectively there is no super-type of Organisation – the specified super-type, Organisation-Entity, is just a catchall for the entities in the ontology. And there are only two sub-types: Organisation and Organisation-Unit.

4.1.1 TOVE's informal answer

Its informal description in Section 7.1 – *Organisation* – points towards an answer to the question:

> 'To begin, an organization consists of a set of Organisation-Agents (said to be members of the organisation), a set of Organisation-Units (recursive subcomponents having a structure similar to organisations) and an Organisation-Goal tree that specifies the goal (and its decomposition into sub-goals) the members try to achieve.'

This reflects some of the intuitions mentioned earlier. Organisations can 'consist' (in one sense) of members or 'consist' (presumably, given that these are

represented by different relations in its model, in another sense) of other organisations (units) – which, in turn, can also have members and units. However, to be useful the senses of 'consists' need to be specified more precisely. Does either of the senses of consist imply set membership, mereological fusion or something else? It seems unintuitive that an organisation is the set of two sets and a tree, but if this is really what is claimed, then it needs to be explained.

The informal description in Section 2.0 – *What is an Organisation* – is less intuitively obvious:

> 'We consider an organisation to be a set of constraints on the activities performed by a set of collaborating agents.'

Organisations clearly have something to do with activities, but, intuitively, an organisation (such as IBM) is not a set of constraints. (Maybe the authors meant 'to have' rather than 'to be' a set of constraints.) However, this description does imply potentially useful identity conditions, which seem capable of differentiating one kind of limit[8] case – where two organisations have the same members[9]. In this case, they could be different because they involved different activities (and so different constraints) or the same activities with different constraints. Presumably, if they involved the same activities with the same constraints, they would be the same organisation.

As these examples show, one of the major difficulties of providing an ontological explanation is crafting something that does not have awkward (or even worse, inconsistent) implications. If we take TOVE's description of organisations as sets (of constraints) seriously, this raises a number of difficult-to-answer questions about Organisation-Unit and its member relation – such as:

- If an Organisation-Unit is similar to an Organisation (as TOVE implies by saying they have "a structure similar to organisations"), then is it also a 'set of constraints'?
- What is the member relation between Organisation (a set) and Organisation-Unit? Is it set-membership or something else? If Organisation-Unit is a 'set of constraints', then the relation would seem to be more like sub-set.

Different descriptions are a useful mechanism for capturing different intuitions. But where there is more than one description – there is the possibility of inconsistency, as the two informal TOVE descriptions above show. Taken

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[8] Limit cases are useful in determining whether criteria are merely good 'rules of thumb' or always apply by pushing an aspect to a limit – in this case, pushing membership as a criterion for identity to the limit.

[9] Discussed, for example, on pp.220-1 of Gilbert (1992) *On social facts*, where the groups are differentiated as being qua this and qua that. And in Simons (1987) *Parts* p.168 4.9 Parts of Groups "… the same plurality of individuals may simultaneously satisfy two or more sets of group-constituting conditions. The groups may therefore coincide in membership without being identical – extensionality goes."

literally[10], they suggest that organisations are of different inconsistent types. How can a 'set of constraints on activities performed by a set of collaborating agents' be something that consists of three things; the same 'set of Organisation-Agents (said to be members of the organisation)', a set Organisation-Units and an Organisation-Goal tree? An added problem in this case is that the descriptions do not tie in with our raw intuitions, which do not regard individual organisations, such as IBM, as sets of any kind.

4.1.2 People's intuitive notion of organisation

The analysis needs to start with a reasonably clear idea of what an organisation is. TOVE does not really supply this, though it gives us some raw material. The STPO makes an initial attempt to develop one now, by fitting organisation into a taxonomy.

4.1.2.1 Organisations are elements

It seems plausible to say that individual organisations, such as IBM, are not types with instances (or properties with instances or sets with members or universals with exemplifications, or whatever mechanism there is in the top ontology to deal with this kind of fundamental particular-universal distinction). This seems relatively innocuous. How could IBM as an organisation be a type that had various IBMs as its instances? And it ties in with the way people seem to regard organisations. This means in terms of the STPO typonomy that organisations are elements.

4.1.2.2 Organisations are concrete

Element is a very general type. The STPO can be more specific and say that organisations are also concrete elements: in the sense that they have temporal and spatial extents. This is not an original view, (Smith 1999), for instance, says "Agglomerations [which includes organisations] are, ontologically speaking, spatial objects. Their lives or histories are spatio-temporal objects. … Agglomerations are spatial objects which inherit their spatial properties from the spatial properties of the relevant members or participants." Adopting this view is important for the STPO analysis, as it provides the basis for investigating organisations' spatial and temporal boundaries.

In some contexts, we ignore an organisation's physical extent in way we do not with prototypical physical objects. It is not as easy to kick (or pick up and throw) a company as it is a stone. However a little reflection reveals their concrete characteristics. The temporal extent of modern companies is particularly clear. Companies are clearly founded. For example, IBM was founded as Computing-Tabulating-Recording Company (C-T-R) in 1911 – as a result of the merger of the International Time Recording Company, Computing Scale Company, and the

[10] We are not claiming that the builders of TOVE intended their informal descriptions be taken so literally. We are looking for a literal explanation and the problem is that TOVE does not give one.

Tabulating Machine Company – and renamed International Business Machines Corporation in 1924. Companies also clearly go out of existence – as the International Time Recording Company, Computing Scale Company, and the Tabulating Machine Company did in the merger that founded IBM. If we were to look at the founding of IBM in more detail, we would find the activities that constitute the founding – meetings, document signings and registrations and so on.

Similarly organisations have a spatial extent. People talk about companies being in a place. For example, IBM's website says it was based in New York City when it was founded. Though when a company is particularly scattered – as IBM is today – it is not informative to state its complete spatial location. For example, it would seem strange to say that IBM is on the planet Earth – though this is not false, just not useful. But people still talk about parts of a scattered company – for example, saying that IBM has a presence in South Africa.

Some people may be feeling concerns about the vagueness of the spatio-temporal boundaries of organisations, particularly at the granularity of everyday medium-sized objects, such as ourselves. However, vagueness is a general problem that dogs most, if not all medium sized objects – it is not specific to organisations. For example, the boundaries of medium size objects, such as cats, stones and chairs are not clear at the microscopic level. Vagueness only really becomes of practical interest if it hinders us from doing something.

Nevertheless, in the case of organisations, there is useful work that can be done to crispen their boundaries. For example, it is clear that organisations' spatio-temporal extent is, in many cases, related to, maybe dependent on, the spatial (and sometimes temporal) extent of the people that are participating in (part of) them. Similarly the temporal extent seems dependent upon the temporal position of events – such as a companies founding or its dissolution. It is much less clear what the nature of this dependency relation is. One of the aims of the STPO analysis is to clarify this.

4.1.2.3 Organisations are physical

The STPO also assumes, at least as a working hypothesis, that organisations are physical: in the sense that they are material, composed of matter. (Searle 1995) talks of institutional facts [which include organisations] needing to have a physical realisation. Using money as his example, he says (p.34) "[J]ust about any sort of substance can be money, but money has to exist in some physical form or other. … What is true of money is true of chess games, elections, and universities. All these can take different forms, but for each there must be some physical realisation."[11] The STPO finds this position congenial as it puts organisations and

[11] This passage does not make clear whether John Searle is claiming that the representation or the represented needs to be physical. The position that the representation is physical is reasonable. The position that the represented is physical needs some explanation, particularly in the case of synthetic assets such as financial options. This will be part of the task of the Asset stage of the synthesis.

human beings (both persons) in the same category and explains simply how organisation have causal properties. It also sharpens the questions that can be asked about identity conditions.

Within the CEO's meta-ontology there is no distinction between element, concrete and physical – these collapse into a single type. However, for now in the STPO analysis we include these as separate elements, when the synthesis analysis is relatively complete it should be clear that nothing is lost by collapsing these into single type – and that the result is a simpler structure.

4.1.2.4 Organisations are persons

From an enterprise perspective, one of the most important distinguishing features of an organisation is that it is a person. What unifies the categories of organisation and natural person is that their instances have the power to enter into transactions on their own behalf, intentionally acquiring rights and obligations. This is central to the CEO's notion of persons. What distinguishes them is that organisations instances are intentionally constructed, whereas natural person's, we assume, are not[12].

4.1.2.5 Persons are physical

This raises the taxonomic questions as to whether persons – things with the capability to acquire rights and obligations – are also physical. Persons includes humans, what might be called natural persons, as well as organisations. Natural persons are clearly physical. Theologians may want to argue that God is a person and neither physical nor concrete. However, God rarely plays an explicit part in the context of enterprise systems, so it would seem feasible to regard all persons as physical and concrete. As a working hypothesis the STPO assumes this.

4.1.2.6 Re-identification

Acquiring rights and obligations implies an important practical characteristic for persons and hence for organisations: that it is important to be able to re-identify them over time. Persons enter into transactions with an organisation and so acquire rights or obligations with respect to it. They would, understandably, be uncomfortable if they could not re-identify it. Furthermore, the members of an organisation need to be able to re-identify the organisation of which they are members. For this to work, it must not just be possible in principle, but recognised by people as reasonably easy to do in practice. Among other things, the intentions that underwrite an organisation need to inspire a degree of confidence that this is likely to happen.

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[12] Ignoring for the moment the arguments that suggest that natural persons (unlike their natural bodies) are also intentionally constructed. For a summary of these see Olson (1994) *The world on paper* pp. 238-9 – and for a more detailed argument see Snell (1982) *The discovery of the mind*.

4.1.2.7 Organisations persist through time

The need for re-identification re-affirms the intuition that an entity that is an organisation has to persist in time. That 'being an organisation' cannot be explained as an attributive property like 'being red' or 'being tall', which can be true at a moment in time, irrespective of the past and future.

It also links into another common feature of organisations, that they can come into and go out of existence – that they are born and that they usually die[13]. The original intentions bring the organisation into existence. Typically, more formal organisations are constructed in a framework that spells out in detail how this commitment should be made: legal company creation is an example. In less formal cases, there may not be an easily identified agreement event. Certainly there are no rules enforcing an explicit agreement event. What sometimes seems to happen is just a growing awareness among the people involved that they are somehow agreeing to act together – as a person.

4.1.2.8 The emerging STPO taxonomy

The STPO taxonomy is emerging. Organisations are concrete, physical elements. They are also Persons. This raises the question of whether Person can also be classified as concrete, physical elements. It seems a reasonable hypothesis that Persons are concrete elements. However, given that Persons are causal agents, the STPO makes the stronger assumption that Persons like Organisations are also physical elements. The final STPO ontology does not depend upon this assumption, but making it helps to focus its analysis.

4.1.3 Organisations are intentionally constructed

Organisations are not the prototypical example of concrete physical things, so it helps to characterise what makes them different. A common explanation is that they are (types of) intentionally constructed objects.

4.1.3.1 Explanation in terms of intentions

(Searle 1983; 1995) offers an explanation of organisations in terms of collective (social) intentionality. (Searle 1983), on p.4, suggests that what marks intentionality is a representation that is directed towards an object. (Searle 1995), on p.43, suggests that what marks institutional objects is that they obey a rule of the form "X counts as Y for C" – for example, that this piece of paper counts as a £10 note for the English. Here the collective intentionality of the English underwrites the existence of the £10 note. This involves, at least, belief (which involves representation). For example, if the English stopped believing that the English currency was money – it would stop being (in some sense) money. But more than belief is necessary, there also needs to be a commitment to accepting

[13] Organisations can, in principle, be immortal, but they usually are not.

the money as payment for goods – and so on. This principle is, in fact, enshrined in English Law – where shopkeepers are obliged to accept legal tender.

(Searle 1995), on p.118, also recognises that the creation of many institutional objects is marked by the performance of a ritual – for example, marriage is marked by a marriage ceremony. Typically it is specific intentional events, focussed on the intentional objects that mark the temporal boundaries of institutional objects. For example, a marriage can be formally dissolved by a divorce (an intentional legal ritual). However it can also be ended by a physical catastrophe that kills one or both of the partners[14]. Identifying and classifying the events that mark the temporal boundaries of organisations will provide us with the basis for their persistence conditions.

(Bratman 1987; 1999a) also offers the material for an explanation in terms of intentions – where he uses this term in its everyday sense of 'a determination to act in a certain way'. Michael Bratman focuses on the use of plans in practical reasoning and describes the nature of plans in terms of partial intentions. People make plans because, in practice, human reason is too limited to be able to examine every situation anew as it occurs – so they (we) have to spread the load by planning in advance. Obviously, these plans cannot cover every detail, as some aspects will be left unspecified. Using his example: Anne may plan to go to the cinema tonight without specifying which cinema or what time, because she does not yet know when she will finish work.

When we adopt a plan we are making an intention to carry it out. This intention is a representation in John Searle's sense (it is directed at something) and, as Michael Bratman is at pains to point out, it has more commitment than a mere belief or description. Again using his example: Arthur can believe that he is going to be shot at dawn tomorrow without making any commitment to make sure this happens. However, if Arthur intends to be shot at dawn, we expect him to have some sort of commitment towards making this happen.

Plans are also useful when trying to co-ordinate the activities of a group – where it is impractical to specify everything in advance, particularly if circumstances can change. They are a mechanism for generating a common commitment without having to spell out the details in full.

This has clear parallels with Margaret Gilbert's notion of a social group's joint readiness to do something[15]. She also clearly explains how this readiness is selective, picking only relevant activities. How even if (using her example) the Library Committee and the Food Committee have the same members, when they meet as the Library Committee they discuss the purchase of books not menus. This feature makes it difficult to accept that organisations or social groups are simply constituted by their members.

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[14] These kinds of physical catastrophe also destroy parts of the intentional agreement. In the marriage example, the destroyed person's mental representation of the marriage – and so have an intentional aspect.

[15] Explained on pp.185-6 of Gilbert (1992) *On social facts*.

4.1.3.2 Irreducibility of collectivities

Gilbert takes a stronger view – not only are social groups not simply constituted by their members, but that they are not reducible to merely the actions of their members acting independently. The actions need to be considered as, in some sense, joint. Searle takes a parallel view with regard to collective intentionality – that it also is not reducible to singular intentionality. While the irreducibility thesis seems correct, and Gilbert's arguments are persuasive, some elements of the context that both her and Searle give need extending for an enterprise ontology.

4.1.3.3 Non-collective (singular) organisations

Gilbert focuses on plural subjects. As this stands, it is not a wide enough basis for an analysis of what an organisation is. This is because, in practice, there are many organisations that are not plural subjects, not collectivities. Classic examples are sole proprietorships and corporations sole. The final ontological model of the enterprise has to recognise that organisation includes these singular (non-collective) subjects.

Sole proprietorships are the oldest, most common and simplest form of business organisation: they are business entities owned and managed by a single person. A corporation sole consists of one incorporated office and provides for a succession of office holders. This entity has been recognised by English law for over 500 years. This form of corporation grew out of a need to institutionalise the monarchy, separating what the person occupying the throne did (acting *ex officio*) from what the monarch did (acting *in officio*) – and to help ensure that the commitments of the monarch did not die with the person occupying the throne. The legal maxim "The monarch never dies" is true, because "the monarch" is an office, not a human. The same form was subsequently used by the Church to find an orderly and secure way to hold and pass title to church property. The English Crown and the Archbishop of Canterbury are both examples of corporations sole. As we shall see later, other types of offices (positions), such as Chairman and Managing Director, are also kinds of organisation – with similar notion of acting *in officio* and *ex officio*.

What seems to characterise these single, often serial, subjects, like their plural counterpart, is that they are intentionally constructed. Some kind of intentional agreement provides the central unifying principle that pulls together their activities. The issue is whether Gilbert's analysis can be extended to include these cases.

In Gilbert's case this means extending it to cover non-collective (singular) subjects. One way to do this is to look at borderline cases of plural subjects that come close to being singular. One such case is where the subject is not always plural. One could find situations where a team of soldiers undertake a mission and all but one are killed before the final soldier completes the mission. It seems to make more sense to regard the single person carrying out the joint commitment as still being a part of the team – though the only part at that time – than regard the

team and its mission as disappearing as the second to last member of the team dies.

One can imagine a less convincing case, where a subject is never plural, though it might have been. Consider, a case where someone starts up a team with a clear objective: for example an expedition to the South Pole. If the team is assembled and reaches its objectives, one would regard the early efforts of the sole member as part of the team's preparation. However, what happens if a team is not assembled and the 'sole member' decided to undertake the expedition by him or herself. In both cases we talk about an expedition. In the second case, the potential for plurality seems to give some weight towards regarding it as a valid subject.

It seems to me that this analysis tends to show that plurality and singularity are not a essential features of subjects. There are many cases where subjects are at one time singular and another plural. There are also many cases where they have always actually been plural – but it is possible that they might have been singular. This leads me to believe that one can apply much of the Gilbertian analysis to the singular case.

4.1.3.4 Non-collective (singular) intentionality

Searle focuses on collective intentionality – where the subject of the intentionality is a collectivity, a plural subject. The Searlian analysis divorces the collectivity underlying collective intentionality from the (socially) intentionally constructed object. This places no barriers to the existence of singular subjects. One example he offers is 'Miss Alameda County'[16]. For Searle, these singular subjects are constructed (and maintained) by collective intentionality. So it does not exclude the classic enterprise cases of singular subjects.

However, there is one aspect of the analysis that needs clarification. Does it imply that the intentionality that constructs singular subjects necessarily has to be collective? If so, this would exclude a Robinson Crusoe from constructing singular subjects. However, there nothing in Searle's analysis that specifically implies that this is so – it is more that his focus is on collective intentionality. (Searle recognises that there are 'singular intentional facts', but he states that his interest is in the institutional objects that involve collective intentionality[17] and so singular intentionality is not much discussed.) With our focus on the enterprise, rather than collective intentionality, we need to include a wider range of intentionality, one that encompasses both singular and collective varieties. It seems that for organisations, at least, the key element is what the intentions are, rather that whether they are collective.

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[16] See p.96 of Searle (1995) *The construction of social reality*.

[17] Ibid. *The construction of social reality*, on pp.121-2, "distinguishes between singular intentional facts, such as I want a drink of water now, and collective intentional facts, such as the fact those hyenas are attacking a lion." He goes on to identify institutional facts with collective intentional facts and social facts as a special subclass of these.

4.1.3.5 Plural subject's members' intentions

(Gilbert 1992), on p.199, proposes what might be called the '*we test' for the existence of a plural subject[18]:

> "A person X's full-blooded use of 'we' in 'Shall we do A?' with respect to Y, Z and himself, is appropriate if and only if it expresses his recognition of the fact that he and the others are jointly ready to share in doing A in relevant circumstances."

She also says that "it is assumed that people are jointly ready if and only if it is common knowledge among them that each has openly* manifested to all his quasi-readiness to share some action in the circumstances in question." Gilbert (as does (Bratman 1999a)) builds upon an idea of (Lewis 1969) that some kind of common knowledge of the intention, or at least its main elements, is an aspect of the joint readiness (a kind of collective intentionality). This makes sense if one wants to link responsibility to knowledge.

While this is a good characterisation of many social groups, particularly of the sort Gilbert uses for illustrative purposes – it is less suitable as a characterisation of enterprise organisations. The trouble is that it assumes that every participant in a plural subject has the common knowledge and is jointly ready – that every participant has to have the right level of intentionality. Gilbert realises this and explains (on pp.230-2 of (Gilbert 1992)) why a firm that may not be, in her terms, a plural subject either because it has excluded common knowledge by largely automating its operations (not enough common knowledge) or because it is a non-harmonious collection of people (not enough commitment to joint readiness[19]). She suggests that the difference between her characterisation and the enterprise's may lie in the distinction between familial and business relations[20].

It is clear that there is no requirement on all participants in enterprise organisations to commit to joint readiness or to have the common knowledge needed to support it. The work on information economics suggests that in large organisations this kind of common knowledge would be the exception rather than the rule: see, for example, Kenneth Arrow's work. Organisations do not have to be harmonious or unautomated – cynics may note that a lack of harmony and high levels of automation are common in many modern organisations. Clearly all organisations are not plural subjects in Gilbert's strict sense.

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[18] Gilbert regards the use of 'we' in ordinary discourse as a good test for plural subjects. However she suggests the use of '*we' as there is no guarantee that 'we' will only refer to plural subjects. Note that the ordinary language '*we test' works for organisations generally, including non-collective organisations. For example, the English Monarch traditionally uses 'we' when speaking *in officio*.

[19] Nevertheless, as observed in the previous footnote, these organisation pass the (admittedly rough) Gilbertian '*we test'. Employees typically use the 'we' pronoun when speaking on behalf of the company – despite automation and disharmony.

[20] For which sociologists have offered explanations: Tönnies' distinction between community and society and Weber's between communal and associative relations – see e.g. p.230 of Gilbert (1992) *On social facts*.

Gilbert discusses (on p. 232-3) a phenomena she calls 'complex groups', in which she accounts for some of the features of enterprise organisations. She notes that someone can join a club without being aware of its purpose, and commonly be regarded a member of the club. Gilbert argues that the joining of the club indicates, presumably, "a willingness to jointly pursue with the other members whatever as yet undisclosed purposes the club has." She also notes strategies for delegating the responsibility for the details of decision making.

However, I suspect that the difference between these kinds of enterprise organisation and Gilbertian plural subjects has been exaggerated. This becomes clearer if one examines another case of complex groups noted by Gilbert: infants. It seems right to say that these are not yet capable of the kind of common knowledge needed for a Gilbertian plural subject but that this does not seem to hinder them from being parts of families, which we normally regard as good examples of social groups[21].

Gilbert argues that she is "isolate[ing] the phenomenon which is central to collectivity existence as intuitively understood." It seems to me a more common sense position is to regard infants' membership of the family as the simple central case and common knowledge as a more peripheral sophisticated case – though one that may now be relatively common in educated adult society. The argument from common knowledge assumes that there must be some form of representation of the membership in the minds of the members. Consideration of animals and humans' unreflecting behaviour suggests that the tendency to act together is instinctive – maybe, in some senses, more natural than acting alone[22]. Searle makes a similar point, proposing a non-representational background of attitudes and predispositions underlying most forms of social construction[23]. In many cases, the original ties that bind together collectivities may be instinctual and only later become rationalised into notions of common knowledge and joint readiness. If this is so, then non-harmonious organisations and ignorant members (including infants) are unproblematic. However, explaining and accounting for responsibility may become more problematic – as it is in real life.

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[21] Though, as Ibid. p.234 points out, not everything one might wish to call a family would qualify as a social group. And the membership of the group is not always clear; one could question whether a 'black sheep' who has had his or her connections with the family severed was a member.

[22] As Hume (1739-40) *A treatise of human nature* notes "Everyone has observed how much more dogs are animated when they hunt in a pack, than when they pursue their game apart. We might, perhaps, be at a loss to explain this phenomenon, if we had not experience of a similar in ourselves." Book II Of the Passions, PART II Of love and hatred, SECTION XII - Of the love and hatred of animals.

[23] And this non-representation aspect of socially constructed objects needs to be recognised analysing them – see the discussion of this in Partridge (2002b) *A new foundation for accounting* – which also notes the analogies with discussions of rule-following in recent philosophy.

4.1.3.6 Adding intentionally constructed objects to the STPO taxonomy

The purpose of the preceding sections is to make a case for including the insights of Bratman, Gilbert and Searle into the explanation of what an enterprise organisation is. It is also making a case for regarding the full range of groups and organisations as a unified category. It is not intended to provide final arguments – there is clearly much more work to do here. However, it provides a good working hypothesis for the STPO.

The main elements of the preceding analysis need to be incorporated into the STPO's taxonomy. The type, intentional object (AKA intentionally constructed object), needs to be recognised as does the fact it is a sub-type_of organisation. This raises the question of how it relates Intentional Object to the rest of the taxonomy. A quick analysis reveals no clear answer. It may seem a modest assumption that the instances of Intentional Objects are all Elements – in other words, that Intentional Object is a sub-type_of Element. But there are cases, such as Sterling, that are clearly both types and Intentional Objects. And if Intentional Object has a type instance, Sterling, which is not obviously physical or concrete, then it seems that it cannot be a sub-type_of Physical or Concrete. For now, as it seems to be irrelevant to the Persons analysis, the STPO leaves Intentional Objects as a sub-type_of Object. The finer details of this level of the taxonomy can be decided later – when there is more evidence.

The notion of organisation has a number of related senses. For the sake of simplicity and regimentation, and because it serves the CEO's purpose, the STPO proposes to identify organisations with intentionally constructed persons. From a taxonomy perspective, this make organisation the intersection of Intentional Object and Person. As the review of the STPO analysis proceeds, it should become clearer why this is a sensible decision.

4.1.4 Precisifying organisation

At a simplistic level, people lump organisations, social groups and other collectivities together with a host of other types of things in a category labelled collections. They also tend to identify the collections, including organisations, with their members. From this perspective, it may feel as though shifting the burden of maintaining identity from the members to an intentional agreement is merely postponing the hard analysis, or even worse, a case of "'postulating' what we want", which as Russell[24] memorably said has "the advantages of theft over honest toil." However, the need to precisify organisation makes the simplistic notion of collection that identifies it with its members an untenable basis for the identity of organisations.

[24] On p.71 of Russell (1970) *Introduction to mathematical philosophy*.

4.1.4.1 Organisation as a collection of members

As a number of commentators have pointed out, naïve set theory textbooks provide good examples of the simplistic notion of collection, where collection is regarded as a synonym for set. For example, on p.177 of (Suppes 1957) we find: "By a set we mean any kind of collection of entities of any sort … Many other words are used synonymously with 'set': for instance, 'class', 'collection', and 'aggregate'." Page one of (Halmos 1960) offers "a pack of wolves, a bunch of grapes, or a flock of pigeons are all examples of sets of things … To avoid terminological monotony, we shall sometimes say *collection* instead of *set*. The word 'class' is sometimes used in this connection." (See pp.91-2 of (Marcus 1993) for more examples.) From this simplistic perspective, organisations are regarded as a collection of their members. This is perhaps not surprising when a common definition of collection is 'a group of things that have been gathered together'.

For the more sophisticated applications that the CEO is interested in, more precision is needed (relevant). As Ruth Marcus notes the simplistic approach "obscures commonplace distinctions that we make between assortments, collections, and classes." It ignores the distinction between mereological sums and sets[25], what used to be called, pre-Frege, distributive and collective sets (TOVE's informal descriptions do the same). It does not recognise that the identity conditions for organisations have to be able to differentiate between two organisations with the same members. It provides no explanation for the way in which the membership of a 'collection' (whether mereological sums, sets or something else) shifts over time – and how this affects the identity conditions[26] or how to differentiate between organisations with one member and the member. It also cannot explain organisations with no members. Finally, it obscures the distinction people make between an organisation or social group and the collection of its members at a time. Where, for example, it makes sense to say: these two organisations (or social groups) have exactly the same (collection of) members – implying that there are three things, not one or two.

4.1.4.2 Organisation's identity

The precisification of the notion of organisation, in terms of intentional agreement, developed in the STPO explains these distinctions.

What unifies the organisation is its on-going intentional agreement. Someone becomes a member of the organisation, when they become a (member-)party to

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[25] Margaret Gilbert also seems to be uninterested in the distinction – she says (on p.430 of Gilbert (1992) *On social facts* "One may be tempted to think of societies as mereological sums of singular agents, or as sets of singular agents, in the logician's sense. Though strictly speaking it may be correct ..."

[26] For more on this problem see Ch. 7, §3 *The shift to object semantics* in Partridge (1996) *Business Objects: Re - Engineering for re - use*.

the agreement. From then on, a member's activities are part of the organisation's activities if they are included as such under the intentional agreement.

An interesting limit case that illustrates this point is where someone, Jane say, runs two sole proprietorships. In this case, she is party to two different intentional agreements. And these, typically, are associated with different activities: in other words, when Jane is checking the books for the first sole proprietorship, she is not doing anything for the second sole proprietorship. Note that both organisations may include book-checking activities. It is not the type of the activity that ultimately determines which organisation it is part of – but whom the activity is for.

The intentional agreement is what gives the organisation its identity. The intentional agreement (not the members per se) is what preserves the organisation's identity through time. Members can join and leave an organisation without affecting its identity – but terminate the intentional agreement and the organisation ceases to exist. The notion is fruitful in explaining seemingly difficult cases, such as the difference between two companies that have the same members. There are two different intentional agreements.

The intentional agreement is also important for determining the spatio-temporal extent. The agreement often directly gives us a good basis for determining the organisation's temporal extent. The beginning is, and the end often is, an intentional performance (Searle's term) focused on the agreement – such as legal company registration. In abnormal cases, the end may be the result of an unrelated catastrophe – which destroys the intentional agreement. As, for example, in many legal jurisdictions, the death of a partner dissolves the partnership. Furthermore, intentional agreement indirectly determines the spatial extent – by licensing selected members' activities, and these, as activities of the organisation, help to determine its spatial extent.

4.1.4.3 Intentional agreement's identity and extent

The analysis so far has shown that the intentional agreement is a far more plausible candidate as a basis for an identity condition than the members. However, to completely escape a (Russellian) accusation of "'postulating' what we want", there needs to be sufficient confidence that an adequate characterisation of intentional agreements can be made – as it seems that there is a clear understanding of what a member is[27].

The organisation is not identical with, but depends upon the intentional agreement. From the perspective of Persons, we do not need a taxonomy of intentional agreements, but some idea of what an adequate characterisation would be. Intentional agreements are a species of Transaction – another segment of the CEO synthesis. The transaction segment will develop the taxonomy of intentional agreements.

[27] The STPO analysis of member, described later, shows that the understanding is not quite as clear as it seems.

A good starting point is John Searle's analysis, mentioned earlier, of intentionality as representation, whether mental, verbal or written. This helps us to locate the agreement. In the case of collective intentionality, John Searle's focus of interest, the various representations are a nexus jointly representing the intention[28]. Margaret Gilbert's discussion of plural subjects' joint readiness can be seen as working in a similar way. The representation aspect of intention helps to explain how it can be shared by a number of different people at different times – the different representations represent the same thing.

4.1.4.4 Organisations' ontological identity

We now focus on the second main technique of the CEO approach, determining identity conditions. I briefly touched on this earlier, when I noted how TOVE's descriptions hinted at identity conditions that could differentiate two organisations in the limit case where they have the same members. Now we consider what the identity conditions for the notion of organisation the STPO has developed could be.

Firstly it is worth noting that membership is a good rule of thumb for differentiating organisations. If two organisations actually[29] have different members at a particular time, they are different organisations. This is clear if we see them as intentionally constructed and maintained – at that time there are two different groups of members as parties to the (different) intentional agreements. As it is usually unlikely that two organisations have the same members, we can use this as a rough rule of thumb.

But this membership-at-a-time criterion is not fine-grained enough for all situations. It does not deal with the limit case, where two different organisations have the same members (in TOVE-speak, Organisation-Agents that are in an org_membership relation) at the same time. For example, a football club and a chess club might have exactly the same members at the same time – indeed might have exactly the same members at all times (though this is really unlikely) – without being the same organisation.

Membership does have the seeds of a suitable identity criterion. Recall the intuitions about organisations that we started with. One of them was that an organisation can and does perform activities and that some (maybe all) of the organisation's activities are performed by their members. This suggests that one way of differentiating them is by their activities. The activities of the football club (participating in football matches) and the activities of the chess club (participating in chess competitions) are different. They happen in different places at different times.

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[28] In Figures 1.1 and 1.2 on p.26 of Searle (1995) *The construction of social reality*, there is a good illustration of the mental representations.

[29] We need to consider actual membership, as we can normally talk about the same organisation as possibly having different members at a time – as the intentional agreement typically leaves space for the possibility of members joining and leaving.

Strictly speaking the STPO considers the organisation's participation in activities. It wants to say that in a football match, the two clubs participate in the same match (the same activity), but their participation in the activity (which it will also call an activity, for simplicity) is different – as it involves different clubs (organisations). Note that the one also needs to consider all the activities in the organisation's life – not just the activities at a particular time. Otherwise, whenever two or more organisations have no activities, they would be identical. It is also possible that an activity can be part of (done on behalf of) two organisations – for example, where one person represents two organisations in a meeting. If this were the only activity of the organisations, then they would, momentarily, be identical[30].

Activities (participations as activities) give us a better basis for differentiation. But do they give us a reasonable initial basis for complete identity? Or, in other words, is it possible for two different organisations to have exactly the same activities? The STPO found it impossible to think of an example where this might be the case. So, provisionally, takes this as an identity condition. Note this characterisation serves several purposes – an important one being to direct the kinds of questions the STPO analysis (and more generally the CEO analysis) should ask – about an organisation's activities – and the answers it expects to receive[31].

The STPO strengthens the identity condition into a characterisation of the nature of organisations. The STPO subscribes to a perdurantist or process metaphysics and regards an organisation as the process that includes the fusion of the participations (activities) of its members. Someone who, on the other hand, favours an endurantist metaphysics – with a continuant/occurrent distinction – can think of an organisation as a continuant constructed somehow from (among other things) its members – and the organisation's life as containing the occurrent fusion of their participations (Smith 1999). In this case, the life gives us an identity condition for the underlying (continuant) organisation as there is a one-to-one relationship between the organisation and its life. The life has to be the life of the organisation, which must have only one actual life.

However, the endurantist fusion of participations is not sufficiently strong. Extensionalism is difficult for an endurantist to sustain. Without it, it becomes sensible to treat what commonsense considers as a single activity (for example,

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[30] This can cause problems for the standard accounts of mereology – a point we return to later. Smith (1999) *Agglomerations* makes a similar observation – "[T]he City of Hamburg is part of the German Federal State of Hamburg. But Hamburg Stadt is not identical with Hamburg Land. Hence the standard mereological remainder principle (according to which, if one thing is part of but not identical to another thing, then there is some third thing which makes up the difference between them) here breaks down."

[31] And also what kind of counter-examples to look for. This is a point made by Kuhn (1970) *The structure of scientific revolutions*, p. 37 about the role of scientific theories: "… one of the things a scientific community acquires with a paradigm is a criterion for choosing problems that … can be assumed to have solution.

signing a contract) as a number of distinct co-located activities – differentiated by the participation of different organisations. Determining whether there are different organisations cannot rely on whether the participations have different spatio-temporal locations. There arises a need to find a new way of differentiating organisations.

The CEO's extensionalist perdurant meta-ontological strategy resolves this (Partridge 2002a). It fits the perdurantist fusion identity condition into a more general extensionalist condition. It assumes (again as a working hypothesis) that spatio-temporal location is an identity condition for physical elements. That, in other words, no two physical elements (including activities and organisations) can occupy the same spatio-temporal location and that if they do they are identical. It is obviously a sufficient condition as if two physical objects have different spatio-temporal locations, they must be different – the assumption here is that it is also a necessary condition. Organisation and activity, as sub-types_of physical object, inherit this identity condition. One can deduce from this, and the CEO's extensional mereology, that as an Organisation is the fusion of its activities, its spatio-temporal location is identical with the fusion of the spatio-temporal locations of its activities.

4.1.5 Synthesising TOVE's ontology

There are both similarities and differences between TOVE and the STPO ontology outlined so far. These two now need to be synthesised – with the similarities highlighted and the differences resolved.

4.1.5.1 TOVE recognises intentionality

TOVE seems sympathetic to this analysis in terms of intentionality. The intentional agreement (plan, joint readiness) can be seen as related (maybe indirectly) to its "set of constraints on the activities performed". It also notes approvingly other work where organizations are "made of social actors that are intentional, having motivations, wants and beliefs and strategic, evaluating their opportunities and vulnerabilities with respect to each other." And "the social activity by which "agents" generate the space of cooperative actions in which they work", where "[t]he pragmatic nature of communication [is] the way of creating commitments among participants". Organisations "as systems of communicative action through which people engage in actions by creating, modifying and deleting commitments that bind their current and future behaviors."

4.1.5.2 TOVE's Organisation-Goals as agreements

In our view, TOVE takes a stronger position than is needed on the natures of the plans that underlie organisations. It states both formally and informally that organisations have to have goals. For example, it claims (in Section 7.1) that "…an organization consists of … an Organisation-Goal tree that specifies the goal (and its decomposition into sub-goals) the members try to achieve." And formally requires that an Organisation have at least one goal.

We can read this as TOVE saying that a goal is an essential component of an organisation's intentional agreement. Its intuition that there are relationships between organisations and goals is sound. Organisations are things that can intend to reach a goal, and when they do, this is embedded in their intentional agreements. But TOVE's claim that they necessarily have to have a goal is too strong[32]. It is just not true that organisations always have to have a goal – and that their members always share this goal.

There are some organisations, which (at some time) have no clear idea of their goal. In these cases, we say that the organisation has 'lost its way'. We can also find some organisations that claim to have a goal, where closer examination reveals that their members have little interest in achieving it. These might be poorly run – but this does not stop them being organisations. The TOVE insight could be more accurately expressed as that for some organisations (for example, commercial ones) it makes for a more efficient operation if there are clear, agreed goals. Then TOVE's ontology is better regarded as describing good practice rather than reality.

4.1.5.3 TOVE's formal ontology for organisation

There is one striking difference between TOVE's ontology and the STPO taxonomy. In TOVE's ontology there are two kinds of 'organisation' (Organisation and Organisation-Units), but no general concept of organisation that subsumes them. Though TOVE informally recognises that what it calls Organisations are similar to Organisation-Units. For example, it says they are "recursive subcomponents having a structure similar to organisations" (Section 7.1) and "Organisation-Unit recursively describes the sub-organizations that compose an organisation" (also Section 7.1).

TOVE is missing the commonsense concept of Organisation, which would subsume the two TOVE concepts. Introducing the concept would bring it into line with most other ontologies (including all the others in our sample).

One way of appreciating the problem with TOVE's Ontology is to recognise that in it both Organisation and Organisation-Unit are fluents[33] – "where a fluent is a predicate that may hold of an entity at one time and not hold of the same entity at a different time" (Section 4.1).

What makes them fluents is their dependence upon the org_unit relation. In TOVE an Organisation-Unit is something that has to have one and only one org_unit relation with a particular Organisation. Similarly an Organisation has to have one or more org_unit relations with Organisation-Units. But, these org_unit

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[32] As p.18 of Gilbert (1992) *On social facts* also notes "intuitively speaking not all social groups involve a goal or end, in spite of the impression given by some writers." She offers the counter-example of a family to support her case.

[33] It is probable that this was not TOVE's intention; it might have gone unrecognised because, in the stable contexts in which they used their ontology, the fluent nature was not apparent.

relations can change over time, transforming an Organisation into an Organisation-Unit or vice versa.

For instance, a company can spin-off a subsidiary or division as a separate company. This happened in March 2000, when 3Com spun off its wholly owned subsidiary, Palm Computing Inc. Before then Palm was an Organisation-Unit and then it became an Organisation (before it was originally bought in 1995 by U. S. Robotics, which in turn was acquired by 3Com in June 1997, it was an Organisation). There is no reason why it should not be bought and merged into another company at a later date – becoming an Organisation-Unit again – and through all this still remain the same entity.

4.1.5.4 Introducing a general concept of Organisation

The underlying issue is not so much that TOVE's concepts are fluents, but that people's intuitive concept of organisation is not – for good practical reasons. People think of organisations, such as Palm, as being such for all their lives. TOVE's Organisation seems to correspond more to a notion of Top-Organisation (and so the STPO will call it Top-Organisation from now on). It is intuitively more correct to say that Palm is (and always will be) an organisation that started life as an Organisation-Unit and then became a Top-Organisation.

It makes sense to introduce the intuitive non-fluent notion of Organisation (which most other ontologies already have) to the synthesised ontology – and subsume Top-Organisation and Organisation-Unit under it.

4.1.5.5 Disjointness in TOVE's formal ontology

To complete the tidy up of the organisation taxonomy, the STPO needs to clarify one aspect of the interpretation of TOVE's formal ontology.

Though TOVE says that it has the means to state that two entities' extensions are disjoint (in Section 6.0), its ontology does not make use of it. In particular, its axioms do not disallow the possibility of an entity that is both an Organisation and an Organisation-Unit at the same time. This seems unintended, as disjointness is a natural interpretation. Also, if they overlapped, there would be a redundant duplication of these relations (and their inverses):

- Organisation_org-unit_Organisation-Unit and Organisation-Unit_unit_Organisation-Unit, and
- Organisation_member_Organisation-Agent and Organisation-Unit_unit-member_Organisation-Agent.

For the purposes of the STPO analysis, it is assumed that these and the other main entities in the TOVE ontology are disjoint. The STPO also takes care not to make the same 'mistake' – and always states clearly in the synthesised ontology where entities are disjoint – and where they overlap.

4.1.6 The revised organisation taxonomy

Before we examine the organisation composing relation, we take stock of the revised taxonomy the STPO synthesis has been developing. This development is summarised in a series of steps that provides a kind of traceability over the synthesis:

- Introduce the general (non-fluent) Organisation concept – subsuming the Top-Organisation and Organisation-Unit fluent sub-types.
- Introduce Person as a super-type of Organisation.
- Introduce Intentional Object (AKA Intentional(ly Constructed) Object) as a super-type of Organisation.
- Introduce Physical as a super-type of Person.
- Introduce Concrete as a super-type of Physical.
- Introduce Element as a super-type of Concrete.

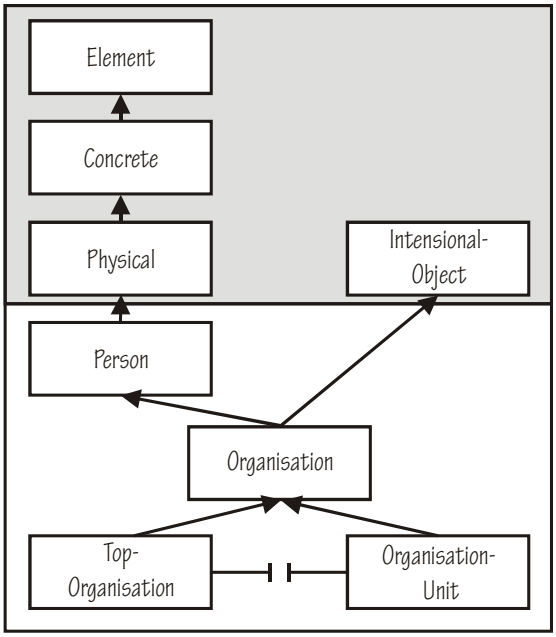

Figure 3 – Revised Organisation Taxonomy

The figure includes elements of a top level taxonomy: Element, Concrete, Physical, Person and Intentional Object. Though it is not shown here, it is clear that the various sub-types of Element are (necessarily) instances of the type Type. As noted before, this is intended to provide a sufficient framework for the analysis here rather than a fully fledged top ontology. Also – learning from TOVE's 'mistake' – the figure clearly shows that Top-Organisation and Organisation-Unit are disjoint.

Strictly speaking, unanalysed fluents have no place in the CEO's extensionalist ontology. In particular, the extensionalist notion of sub-type does not cater for fluent sub-types of non-fluents. So the sub-typing of Top-Organisation and Organisation-Unit shown in Figure 3 is suspect. However, we need to

accommodate these in the ontology for now; further analysis in a later section will resolve these problems.

So far in the taxonomic analysis, the STPO has characterised Organisation in terms of its super-types. This is not really adequate. It needs to extend the taxonomy downwards with sub-types and introduce a typonomy of common selected examples. This is done in Appendix B. One of the reasons for relegating this to an Appendix is that, at this stage of the CEO, these are only indicative and subsequent analysis is likely to lead to some revision. But it serves its purpose of indicating the range of things that are organisations in our sense. That this is much wider than just commercial organisations, ranging from religious and military organisations, through projects to mutual funds.

4.2 How are organisations composed of other organisations?

The previous section described the kind of thing an organisation is in terms of its taxonomy and identity conditions. This section focuses on one aspect of its partonomy – how an organisation can be composed of other organisations. A number of TOVE's informal descriptions refer to this:

> "an organization consists of … [among other things] a set of Organisation-Units (recursive subcomponents having a structure similar to organisations) …"

And in TOVE's formal ontology, it is characterised by two relations:

- Organisation_org_unit_Organisation-Unit, and
- Organisation-Unit_unit_Organisation-Unit.

We start by looking at the STPO's natural initial interpretation of these two relations as sub-types of a more general unit_of relation that is, in turn, closely related to the mereological part_of relation. The STPO also explains why it thinks the distinction TOVE makes between its two unit_of relations is superfluous, forced upon it by its unusual decision not to have a general super-type Organisation subsuming Top-Organisation and Organisation-Unit.

4.2.1 A kind of part of relation

TOVE's intended interpretation of its org_unit and the unit relations is not completely clear, but a natural initial interpretation of both is as a sort of part of relation. People are unlikely to actually say "MegaBank's Treasury Department is an org-unit of MegaBank", but if they were to hear this, they would naturally interpret it as "MegaBank's Treasury Department is part of MegaBank". Similarly for the Foreign Exchange Section that is a part of the Treasury Department.

This interpretation gets some support from the other ontologies in our sample. For example, under the heading "Parts of Organizations", CYC describes the #$subOrganizations relation between #$Organizations:

> "(#$subOrganizations ORG1 ORG2) means ORG2 is a sub-organization of ORG1, whether it is at the very next organizational level down, e.g., (#$subOrganizations NationalLeague-Baseball NationalLeagueEast-Baseball), or several levels down the heirarchy, e.g., (#$subOrganizations NationalLeague-Baseball NewYorkMets)."

Note, in passing, that CYC implies that sub-organisation, like part_of, is transitive.

The Enterprise Ontology (EO) makes a similar point in Section 5.2 – The Structure of Organisations, where Note 4 says

> "By virtue of being MANAGED by an OU [an Organisation Unit], an OU may informally be thought of as being 'part of' the MANAGING OU."[34]

At first glance, the part_of interpretation also accords with the activities identity criterion introduced earlier. It seems natural to say that the activities of a part (as noted earlier, strictly speaking the part's participation in the activity) are also the activities of the various levels of larger wholes. That, for example, the deal done by the Foreign Exchange Section is also an activity of MegaBank and its Treasury Department. Though, as explained later, within the STPO this does not imply unit of can be regarded as simply mereological.

4.2.2 Generalising to unit_of

Once the part_of interpretation reveals the similarity of the TOVE relations, a natural next step is to subsume them under (what the STPO has called) a unit_of relation from one Organisation to another. (This aligns STPO with both CYC and EO, which have a single relation).

Having introduced this generalised relation, the STPO can examine its cardinality – relative to its sub-types. It is optional many-to-many at both ends. Clearly Organisations can have many unit parts and can be unit parts of many Organisations. And Organisations do not have to have unit parts or be unit parts.

This raises the more subtle question of whether there can be lone Organisations – ones which neither have nor are units. This is clearly possible. Small companies are Top-Organisations that often do not have any parts that would qualify as organisations. However in TOVE's formal ontology, its axioms stipulate that Top-Organisations always have Organisation-Units. This would imply that small companies that are not divided into obvious organisational components, are not organisations[35]. And that when they grow big enough to have units, they become organisations.

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[34] Though the EO use of managing to characterise the unit_of relation seems, upon analysis, to be based upon a misunderstanding.

[35] Which was not, obviously, the authors' intention.

4.2.3 Eliminating unnecessary TOVE complexity

The part_of interpretation allows us to reduce the complexity of the TOVE ontology by eliminating superfluous elements.

4.2.3.1 Eliminating TOVE's two unit part relations

The unit_of relation seems a natural way to talk of Organisations' composition. TOVE's two relations seem less natural. This raises the question of why TOVE thinks there are two different types of relation involved here. It is difficult to divine this from the paper, but a possible explanation is that without a general Organisation concept, they were forced to construct two relations between its sub-types.

TOVE's two relations can be constructed from the unit_of relation. An org_unit relation is a unit_of relation between a Top-Organisation and an Organisation-Unit – and a unit relation is a unit_of relation between Organisation-Units. So that once the STPO has the general unit_of relation there seems to be no need for its sub-types, so the STPO can eliminate them from its ontology.

4.2.3.2 Eliminating TOVE's Top-Organisation and Organisation-Unit

This elimination also seems to remove any need for TOVE's Top-Organisation and Organisation-Unit concepts, which were dependent upon the eliminated org_unit relation. The STPO can define them in terms of Organisation and the unit_of relation. A Top-Organisation is an Organisation that has units, but is not a unit of another Organisation. An Organisation-Unit is an Organisation that is not a Top-Organisation. So the STPO can eliminate these too.

4.2.4 Categorising types of organisation units

TOVE's use of Organisation-Unit may raise the question for some people why they did not characterise the way in which the units of an organisation are typically structured. Introductory textbooks often describe a supposedly typical functional or geographical structure of divisions and departments. However, as TOVE rightly decided, and the EO explicitly states, this does not reflect what actually happens:

> *"Section 5.2 The Structure of Organisations - ORGANISATIONAL UNIT (OU):*
>
> Note 1: The term OU is deliberately defined with no constraint on its size or place within an organisation. Furthermore, no special terms for OUs of any particular size are defined (e.g. division, department). This is because no consistent use of such terms can be found across different enterprises, or even within a single enterprise over time. Therefore the existence of a very small and simple unit, even corresponding with a single PERSON, or a very large and complex structure (e.g. a multi-national CORPORATION) can equally be represented as an OU."

This rightly recognises that there is no general or standard structure of organisations, of the kind that should feature in a CEO. However, there will be some standard kinds of units that can usefully be included in a detailed ontology. Examples would be; marketing and accounting department. These are not within the scope of the STPO, but will be worked into the CEO ontology later.

4.2.5 Distinguishing unit_of from managed_by and controlled_by

It is important to distinguish unit_of from the related notions of managed_by and controlled_by. There is a normal sense of controlled_by and managed_by that is used to describe the command and control hierarchical arrangement of the parts of a whole common in many organisations: where, for example, the Head Office has authority over the branches. In these cases, we can explain the control structure as sanctioned by the plan/intention underlying the organisation.

TOVE's analysis does not include the managed_by and controlled_by relations between organisations. However, it does include an authority relation between positions – and this is discussed in the later section on position.

There is another (less obvious) sense in which we think of wholes controlling their parts – where the functioning of the units are subservient to the functioning of the whole. When this happens, unit_of implies, in normal circumstances, controlled_by and/or managed_by. So, for example, we can say that MegaBank's unit part, Treasury Department, is controlled_by it.

Some care needs to be taken here to distinguish the two senses[36]. The Treasury Department is not under the control of Megabank, in the first sense – it is not MegaBank that issues it instructions. Furthermore we need to recognise that the breakdown of control in either sense does not, by itself, imply that the unit_of relation no longer holds. For example, one might say that the Treasury Department is still a unit but is out of control – that is, no longer obeying MegaBank's board, and so no longer controlled_by MegaBank.

This distinction between unit_of and controlled_by is relevant as it explains how an organisation can be controlled_by another, without being a unit_of it. The classic example would be the legal perspective of wholly owned subsidiaries[37]. Here the subsidiary is controlled_by the parent company, but it is not a unit_of it – for example IBM UK plc is controlled_by IBM Inc, but is not (technically/legally) a unit_of it.

The word 'technically' indicates that some care needs to be taken about which organisation is being spoken of. From the legal perspective IBM Inc. and IBM UK plc do not overlap. But for most people working in IBM there is a single global company. When IBM's CEO talks about IBM's employees, he or she is talking about the whole company, parent and subsidiaries combined. In other

[36] It is not clear that the EO has done this.

[37] This involves ownership – which is another related but distinct notion.

words, legal IBM UK plc and IBM Inc. are units_of a global commercial IBM. In legal discourse this distinction is described as the difference between legal form and commercial substance

4.2.6 Distinguishing legal and commercial organisations

In the context of normal discourse, people do not (because they usually do not need to) distinguish between commercial and legal organisations. This imprecision also means that most of us are not familiar with how the commercial and legal notions can interact – particularly when, for a period of time, they coincide[38]. The imprecision can rub off onto the notion of organisation and unit_of. If legal and commercial IBM UK currently coincide, when we use the name 'IBM UK' which one are we talking about? When we ask "Is IBM UK plc a unit_of IBM?", if we are not clear about which IBM we are talking about, the unit_of relation can seem unclear.

It will help to clarify things with a series of examples – based upon the earlier Palm spin-off example. This neatly illustrates different ways in which legal and commercial organisations can be regarded as a units_of each other.

In the earlier example, we looked at two organisations: 3Com and Palm. At the beginning of 2001, Palm was a wholly owned subsidiary of 3Com and then in March it was spun off as a separate company.

Taking the beginning of 2000 as our start point, we can identify the organisations involved. From a (US) legal perspective 3Com is a (US) legal company (a type of (US) legal person), which owns Palm – another (US) legal company. From a commercial perspective, 3Com is a company with a handheld division, Palm. This clearly implies that there are two 3Coms (and two types of company), the legal one that merely owns Palm and the commercial one that includes Palm as a unit part (as noted before, here lawyers usually talk about legal form and commercial substance). (In this context there is no need to differentiate between legal and commercial Palm as they coincide – for consistency let's talk about legal Palm.) I suppose what we would say is that (commercial) 3Com has two (US) legal parts, legal 3Com Inc and legal Palm Inc. When legal Palm is spun off, the commercial-3Com loses a part – whereas the US legal-3Com doesn't. This situation is represented schematically in the space-time map[39] below.

[38] As, at that time, they share phenomenological properties, this raises the ancient philosophical issue of whether two things can be in the same place at the same time.

[39] For those unfamiliar with the iconography of space-time maps see Ch. 8, §3.1.1.1 *Drawing events on a space-time map* pp. 179-80 in Partridge (1996) *Business Objects: Re - Engineering for re - use*.

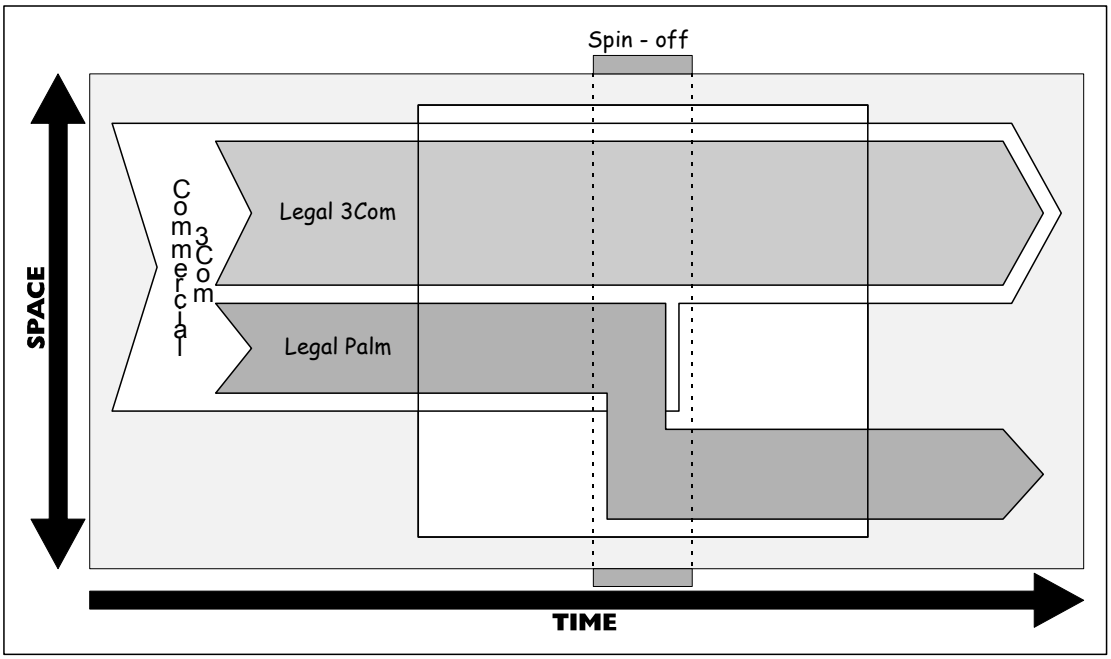

Figure 4 – 3Com Organisations space-time map

These maps are idealised, ignoring irrelevant features. In this, and most other cases, the spatially scattered nature of the organisations is factored out – to make their unit_of relation clearer.

This space-time map also illustrates a further problem with TOVE's Top / Unit distinction; it is context dependent. In a legal context, both legal-3Com and legal-Palm are Top-Organisations (with legal_unit_of relations). But in a commercial context, before the spin-off commercial-3Com was a Top-Organisation with legal-3Com and legal-Palm as (commercial) units. Unless it is made explicit, this kind of context dependence creates enormous difficulties for inter-operability.

Note in passing that the legal perspective ties in with the fusions of activity identity thesis described earlier. As Palm is not a unit_of legal-3Com, its activities are not necessarily part_of legal-3Com. In other words, the activities of Palm are not necessarily the activities of legal 3Com – and so there is no reason to hold legal 3Com (legally) responsible for them. And this is the position the (US) law takes.

It is important to note that when the relevant jurisdiction (the United States) recognises only legal-3Com as a legal person (one that can have rights and obligations), it is not denying the existence of commercial-3Com, just declining to legally enforce its rights and obligations. To illustrate this consider a jurisdiction where US legal-Palm is not recognised as a legal person (for example, one where it has not been registered). This jurisdiction is not disagreeing with the US jurisdiction about the nature of US legal-Palm, just limiting its responsibilities towards it.

The law allows many different forms of merger and acquisition. In the example above Palm is recognised as a legal company both before and after the spin off. However, Palm could have been absorbed by 3Com after the original takeover – and become part of legal-3Com. In this case, we would have three Palms rather than two 3Coms. Where legal-Palm#1 would cease to exist after the takeover, with commercial-Palm continuing to exist as a division of 3Com, and then a new legal-Palm#2 incorporated in the spin-off – as represented below. There are two legal Palms as US law does not allow for a single company with this kind of gappy existence[40].

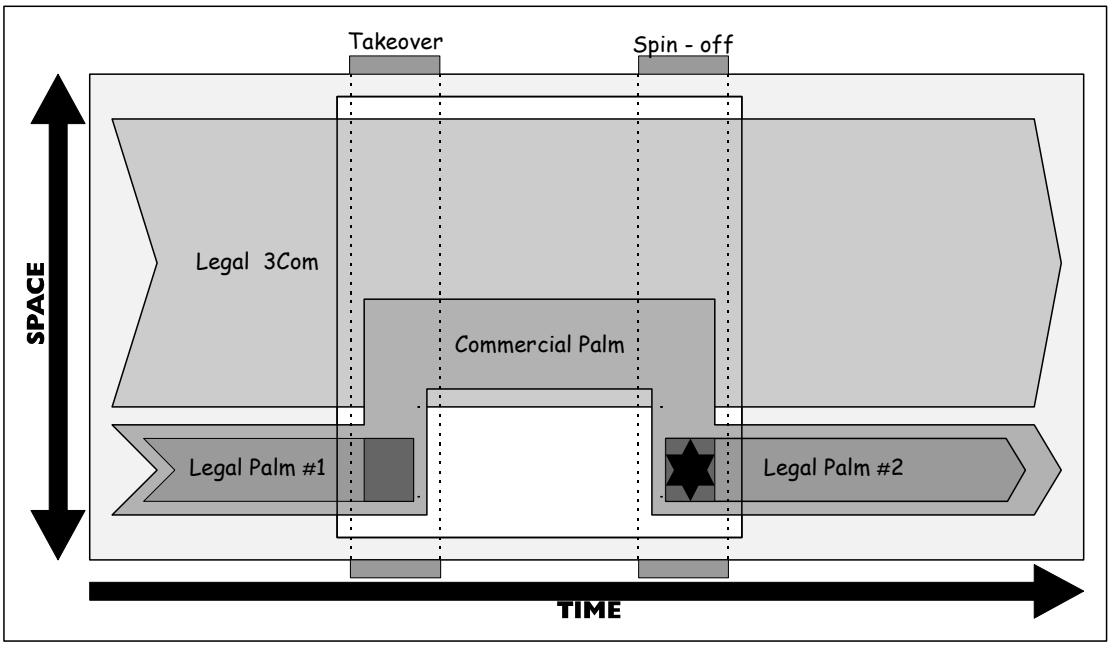

Figure 5 – Palm Organisations space-time map

As can be seen, between the takeover and the spin-off there are no legal Palms, commercial-Palm is a unit_of of legal-3Com and commercial-3Com and legal 3Com are co-incident (assuming, for simplicity, that 3Com has no other subsidiaries).

4.2.7 Number of perspectives

In many cases, people may try and simplify things by opting for a single perspective on organisation, and may choose the legal perspective as it is more regimented and so less dogged by vagueness than the commercial one. However, as these examples have illustrated, in reality there is a need to consider a number of perspectives, which leads to a variety of different organisations and compositions.

[40] A temporal gap where there are intentionally no members. One can imagine accidental situations where, for a time, there are no members; here the law allows the company to continue to exist.

Even within the legal perspective there are finer perspectives to consider. If the domain is going to include more than one legal jurisdiction (likely in an enterprise ontology), then it is important to recognise that a legal perspective is dependent upon a legal jurisdiction, so there are a number of them, one for each legal jurisdiction[41]. Also, to complicate matters, the law (and commerce) change (evolve) over time – and the legal (and commercial) perspectives change with them. At this stage, STPO is just considering the perspectives needed to clarify our understanding of the nature of organisations. More work will need to be done on regimenting the relations between legal jurisdictions and organisation before they will be ready for inclusion in the CEO.

4.2.8 Organisations as states of Organisations

Legal Palms #1 and #2 are examples of a common phenomenon where one organisation is a state of another. Where, depending upon how extensional your ontology is, X is a state of Y either when X is spatially co-incident with Y for its whole life or, more strongly, X is a temporal part of Y. One reason this occurs, exemplified here, is that the (relevant) law places constraints on the legal form an organisation can have. It does not allow a limited company (such as Legal Palm #1) to change form into a division of another company. So when this happens, in the law's eyes the legal limited company ceases to exist.

This creates a situation where one organisation is a state of another – as illustrated in Figure 5, where Legal Palms #1 and #2 are states of Commercial Palm. This has implications for their spatial extents. In the CEO's extensionalist ontology, if one entity is a state of another – then at any time when the state exists, their spatial extents are co-located. So Legal Palms #1 and #2, when they exist are co-located with Commercial Palm.

A similar more common commercial situation happens when partnerships incorporate. The partnership and incorporated organisations are states of a 'longer' commercial organisation.

4.2.9 Successor relation

The initial takeover in the Figure 5 illustrates a missing relation in the ontology. The STPO has proposed persons as a core enterprise category, where persons are capable of having rights and obligations. But what happens to the rights and obligations when an organisation is taken over and dissolved, as happened to legal-Palm#1? Typically these would be inherited by legal-3Com as the successor of legal-Palm#1.

This successor relationship is a well established legal notion that has important practical implications. For example, if legal-Palm#1 has issued bonds, after the takeover who is responsible for paying them on maturity. Typically 3Com inherits this obligation as Palm's successor. If the ontological model has no notion of successor, then it cannot track this – so the STPO includes the successor relation

[41] The EO does not recognise this.

in STPO. Note that this is not a fluent relation – it either holds or doesn't eternally. Also note that there can be multiple successors where rights and obligations are divided.

4.2.10 The revised Organisation/unit_of ontology

We are now at a convenient point to take again stock of where we are – and tie down the revised ontology for TOVE's (Top-)Organisation and Organisation-Unit in a way that provides some kind of traceability over the transformations. The steps that we have followed are:

- Introduce the unit_of relation – subsuming the org_unit and unit relations.
- Eliminate the redundant org_unit and unit relations – their role now taken by the unit_of relation.
- Eliminate the redundant Top-Organisation and Organisation-Unit concepts – as these can be defined in terms of the unit_of relation.
- Introduce the successor relation between Organisations.

The result of these steps is diagrammed below,

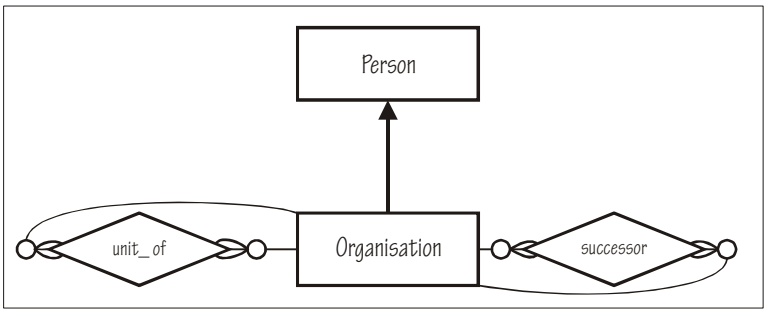

Figure 6 - Revised Organisation unit_of Ontology

It is worth noting that the STPO analysis has produced an ontology that is both simpler and more general than the corresponding TOVE ontology. The generality has enabled the elimination of a number of redundant less general entities.

4.3 Relating part_of and unit_of

The unit_of relation has a mereological feel, a unit(-part) is a unit_of a (unit-)whole[42] – this clearly has something to do with the mereological part_of relation. It would be simple if the relationship was just subsumption, but things are not so straight-forward. This will become clear as we look at the complicating issues in a series of examples.

4.3.1 TOVE's endurantist perspective

Before we do this, we need to be clear about the implications of a meta-ontological decision. We need to be more precise about the part_of and unit_of

[42] My dictionary defines 'unit' as: a single thing, person, or group that is a constituent of a whole.

relations: to be clear whether we are adopting an endurantist or perdurantist perspective of them[43]. The CEO has already established its preference for a perdurantist position (see (Partridge 2002a)). TOVE does not talk in these (philosophical terms) but its use of the term fluent implies if not an endurantist perspective at least an endurantist flavour. Interpreting TOVE's position is made more difficult because, even though they describe what a fluent is (a "fluent is a predicate or function whose value may change with time"), they do not say which of their 'predicates', including org_unit and unit, are such.

For fluents, TOVE defines a "predicate $holds_T\ (f,\ t)$ to represent the fact that some ground literal f is true at time t." (Expressing this ontologically rather than linguistically: the instantiation relation between a type and an object can come into and go out of existence over time.) For now, we assume that part_of and unit_of are relational fluents and so whether the relation holds between two objects is assessed at a time. It is easy to give an informal description of how the part_of relation works: for objects X and Y, X is part_of Y at a time *t*, if at *t*, the spatial extent of X is part of the spatial extent of Y. Obviously this implies that X can be a part_of Y at one time and not at another. Given the STPO presumption that an organisation is (at least, in part) the sum of its activities, this implies that, in some sense to be analysed, X is a unit_of Y, if the activities of X are also part of the activities of Y.

Then it turns out that the relationship between the relational fluents is more complicated than subsumption. This can be interpreted as unit_of being a kind of intentional (intention-with-a-t) mereology that is linked to but not subsumed by part_of's standard mereology: where unit_of gets its intentionality from organisation's intentional nature.

4.3.2 Part_of subsuming unit_of

At first sight things look simple. It looks as if part_of subsumes unit_of. Units seem to be clearly parts – it seems that if at a time t, A is a unit_of B, then A is a part_of B. For example, both the Board of Directors and the Treasury Department are units_of MegaBank, and are also parts_of (all activities of the Board of Directors are also activities of MegaBank) – and this seems true for other parts. Furthermore, clearly not all parts are units. The combination (fusion) of the Board of Directors and the Treasury Department is a part_of MegaBank – according to the normal notion of part a fusion of parts is also a part. But this combination is not normally regarded as a unit – because it is not an organisation (as there is no intentional agreement to bless the union/fusion). So (at time t) being a unit_of implies being a part_of and being a part_of does not imply being a unit_of. This suggests subsumption.

[43] The terms 'endurantist' and 'perdurantist' are taken from Lewis (1986) *On the plurality of worlds*, where 'persist' is intended to be neutral with regard to the 'endure' and 'perdure' interpretations.

It also looks as if we can characterise the subsumption. First unit_of is restricted to organisations, and furthermore, the organisations have to have agreed to the unit_of relationship. Merely accidentally being a part is not enough, as these – rather contrived – examples show.

A sub-committee of the board of Acme Manufacturing, consisting of two directors, is meeting. These two directors are employees of Zenith Investments. They are working as directors as part of their duties for Zenith, and so their activities as directors is on behalf of Zenith. Furthermore Acme and Zenith have no other relationship – so neither are units_of the other. Consider these three possible situations at the time of the meeting:

1. This is the only activity of Acme, but that Zenith has other activities going on. Then, at that point in time, Acme is a proper part_of Zenith.
2. This is the only activity of Zenith, but that Acme has other activities going on. Then, at that point in time, Zenith is a proper part_of Acme.
3. There are no other Acme or Zenith activities, and so Acme and Zenith are co-extensive. (Whether there is a part relation depends on the position taken with regard to improper parts.)

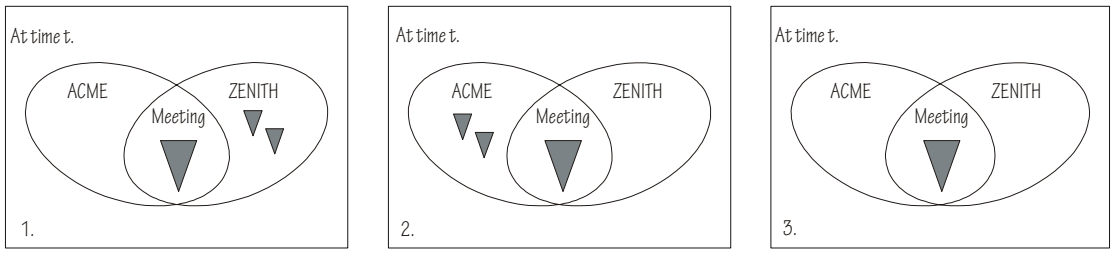

Figure 7 – Acme's three possible situations

It seems here that parthood does not imply unithood. Intuitively, the accidental overlapping of the activities, without any intentional agreement to be part, does not seem to be strong enough to create a unit_of relation. This means unit_of must be something stronger than a mere mereological relation.

4.3.3 Problems with part_of subsumption

Closer inspection reveals problems with subsumption – counter-examples to the earlier hypothesis that all units are also parts. Consider what happens if there were a time when Acme were in fact a division of (and so a unit_of) Zenith, but there were no Acme activities. Then, as Acme does not exist at that time, it could not be a part_of Zenith. In fact, at any time when there were no Acme activities, it would not be a part. But we are happy to talk of Acme being a unit at these times. So there can be times when there is a unit_of relation but no part_of relation. Unithood does not necessarily imply parthood. So unit_of cannot be subsumed under part_of.

It may seem that the original assumption of organisations as kinds of occurrents, as fusions of activities is at fault. However an assumption of organisations as the

fusion of their continuant members creates even more problems. One can recreate the above example by considering situations (times) where the unit has no members. Furthermore, one has to give up the notion of mereological extensionality to deal with situations where the same members compose more than one organisation. This requires different composing relations, which cannot be simply differentiated by the type of the whole[44] – which are all organisations.

4.3.4 Unit_of 's historical and intentional nature

So the source of the problem is not the original simplifying assumption that organisations are fusions of their activities. It is rather the non-intentional and ahistorical nature of the temporalised part_of relation. We can see this by returning to the first Acme example.

Assume that nothing changes at the point in time of the meeting, but that Acme had acquired Zenith at some before the meeting. Then at the time of the meeting Zenith would be a unit_of Acme. The reverse would be true if Zenith had acquired Acme. So what dictates whether Acme and Zenith have a unit_of relation at the time of the meeting depends upon what has happened before – not what is happening at the time. This shows the historical nature of the unit_of relation. To assess whether it holds at a time, we need to know some history[45]. And the relevant piece of history has to do with Acme and Zenith's intentional agreements about unit_of relationships. So not only organisations, but their unit composition is intentionally constructed.

For Acme to become a unit_of Zenith requires an intentional agreement involving both parties – and this intentional agreement is enough to practically guarantee that it happens. There is a relation between intentional and standard mereology. It is not that the standard subsumes the intentional, but that the intentional implies the standard – at times where the parts exist. Or, more simply, that the intentional agreement that Acme is a unit_of Zenith is sufficient to guarantee that at times where there is an activity of Acme, it is a standard mereological part_of Zenith. It is an intentional activity that creates the unit_of relation and dissolves it. Often the activities involve the freely given agreement of all parties, but not always[46].

To illustrate the guarantee, return to our examples. Where Acme is a unit_of Zenith, then all of Acme's activities are perforce parts of Zenith. This is the way the intentional composition of intentional persons works.

There is an element of modality (possibility) in the guarantee. It is saying that it is impossible (unless there is some change in intentional circumstances) that Acme's activities are not part of Zenith's. Turning this around, any possible activity of

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[44] A solution, for example, advocated in Simons (1987) *Parts*.

[45] On the subject of the historicality of intentions see Bratman (1999b) *Intention, plans, and practical reason*, particularly Ch. 6 *Agent Rationality: The Historical Theory.*

[46] The dissolution can be one sided – as for example the American Declaration of Independence dissolved the unit_of relation with Britain, without its agreement – though with its eventual acceptance.

Acme (given that the same relevant intentional circumstances hold) is also an activity of Zenith's. This gives us one way to explain why we can say, at a point in time where there are no Acme activities, that Acme is still a unit_of Zenith. It is because the range of relevant possible Acme activities (at that time) are indeed a standard mereological part_of the range of possible Zenith activities. Underlying this is the strategy behind the original intention/guarantee. Instead of specifying the types of activity that will count as units[47] – it specifies that they all count until the agreement is ended.

It is important to note that the guarantee only works one way. Where one organisation is accidentally part_of another – as in the original Acme examples above – there is no unit_of relation, because there was no historical (and is no current) intention constructing one. One organisation is just accidentally part_of another. One can use modality (possibility) to strengthen the argument. In the accidental case, it is perfectly possible (with no change in intentional circumstances) that there could have been no part_of relation.

In order to capture the meaning of unit_of, one needs to take account of both the historical intentional element as well as the part_of guarantee. To do this within an endurantist perspective, one needs to separate the standard part_of mereology from the intentional unit_of mereology.

4.3.5 A single mereology

As the last sentence implies, one can integrate standard and intentional mereology into a single more general mereology by taking a different meta-ontological path, by adopting a perdurantist perspective. This naturally avoids the problem cases by capturing the historicality implicit in the unit_of relation. This is explained below, followed by a finer-grained analysis of the unit_of relation.

4.3.5.1 A perdurantist perspective

The perdurantist perspective takes what has been called a four-dimensional perspective. This assumes that instantiation holds simpliciter: it does not vary over time. It is easy to give an informal description of how the part_of relation works in this scheme: for physical objects X and Y, X is part_of Y, if the spatio-temporal extent of X is part of the spatio-temporal extent of Y. Obviously this makes it literally non-sense to say: X is a *part_of* Y at one time and not *part_of* it at another. We would more naturally say in this situation X is temporarily part of or overlaps Y – in other words, X and Y share a part.

Under this scheme, we can continue to assume that an organisation is (at least, in part) the sum of its activities. And also that, in some sense to be analysed, X is a unit_of Y, when (i.e. for the period of time that) all the activities of X are also intentionally part of the activities of Y.

[47] As we will see later, this is the mechanism behind member intentional agreements.

4.3.5.2 Perdurantist units

Space-time maps are a good way to illustrate this perspective. Take Figure 5 - Palm Organisations space-time map, and consider the relation between legal-3Com and commercial-Palm. Extensionally there is a relatively simple (perdurantist) part_of relation. There is a temporal stage (the full spatial extent for a period of time) of commercial-Palm during which is it a unit of 3Com. And this unit is part_of legal-3Com. This unit is shown explicitly in Figure 8 below.

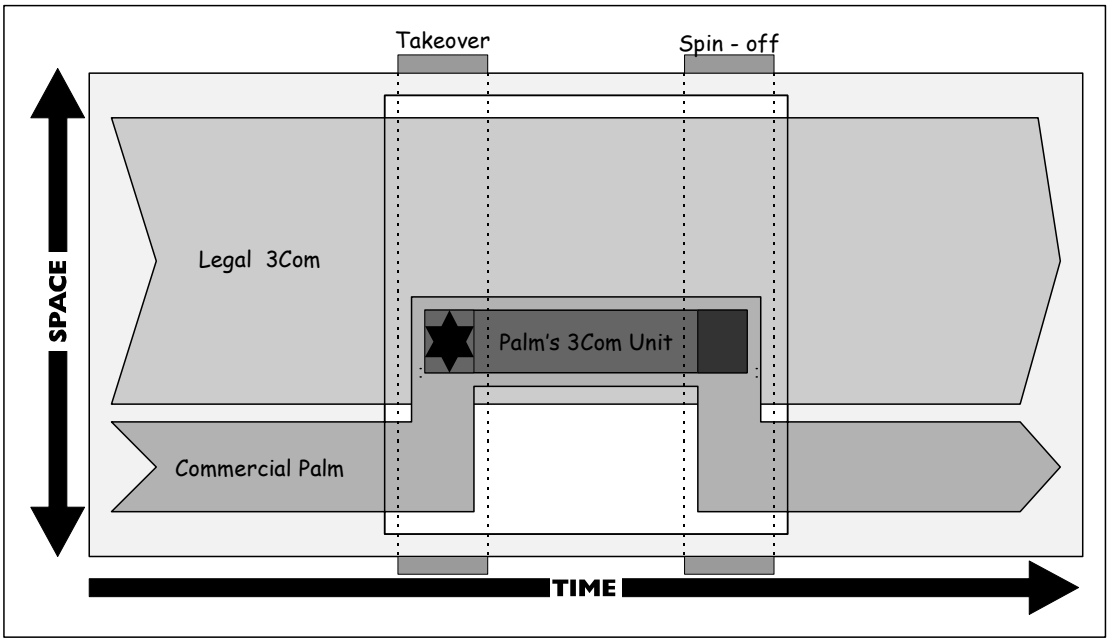

Figure 8 - Palm Unit space-time map

Not every temporal part of commercial-Palm or part of legal-3Com is a unit. What distinguishes the unit is its intentionality: that commercial-Palm has intentionally agreed to be a unit of legal-3Com. This is captured by taking intentional sub-types of the part_of relation, such that this Unit is a unit_stage_of commercial-Palm and a unit_part_of legal-3Com. And, in general, all units have to have these relations.

One of the important aspects of Unit that the Gilbertian analysis reveals is that Unit is a plural subject – as it is an agreement between two subjects to do something together. One indication of this would be rights and obligations of the Unit that do not apply to the the unit organisation of which it is a stage. There is a simple clear example of this; the right and obligation that the activities of the Unit are also activities of the united organisation.

So far we have been considering the more exotic, but not uncommon, cases. It is worth noting that some of these distinctions are not needed in the simplest cases. For example, where there is a division that lives its whole life as a unit within the organisation, the division is the unit.

This perspective has no problem with cases where the unit has no activity at a time – because it is not restricted to a time. It may occur to some people that this

endurantist problem case could be generalised to the perdurantist perspective. This would involve positing that there is an organisation whose unit engages in no activities at any point in time, so logically cannot be a part_of the organisation it is a unit_part_of. However, it seems reasonable to say that this is only a possible unit and so only a possible part of the organisation – whatever that is.

4.3.5.3 The initial perdurantist Unit ontology

To clarify things before going on, the ontology developed so far is explicitly described. To fill out the analysis done above, the STPO introduces into the taxonomy the types Part and Temporal-Part for those objects that play the part role in the part_of and temporal_part_of relations. For simplicity, the STPO makes Part a sub-type of Physical. The STPO also introduces Organisation-Part and Organisation-Stage for organisation parts and temporal parts. For neatness, it chooses to regard improper temporal parts as temporal parts – which implies that Organisation-Stage subsumes Organisation. It also recognises that Unit is subsumed by Organisation-Part and Organisation-Stage. As usual, for traceability the STPO lays out the steps one by:

- Introduce the part_of relation.
- Introduce Part as a role of the part_of relation – and a sub-type of Physical.
- Introduce the temporal_part_of relation – as a sub-type of part_of.
- Introduce Temporal-Part as a role of the temporal_part_of relation – as a sub-type of Part. Temporal parts are temporal slices that include all the spatial extent of their wholes at any time at which they exist.
- Introduce the organisation_part_of relation with Organisation playing the whole role, and Organisation-Part playing the part role, and subsuming it under part_of.
- Subsume Organisation-Part under Part.
- Introduce the organisation_stage_of relation with Organisation playing the whole role, and Organisation-Stage playing the part role – as a sub-type of temporal_part_of and organisation_part_of.
- Subsume Organisation Stage under Temporal Part. Note that Organisation Stages include any temporal stage of an organisation – not only those whole boundaries are marked by an intentional event.
- Subsume Organisation under Organisation Stage.
- Introduce Unit – as a sub-type of Organisation.
- Introduce the unit_part_of relation with Unit playing the part role, and subsuming it under organisation_part_of.
- Introduce the unit_stage_of relation with Unit playing the part role, and subsuming it under organisation_stage_of.

The result of these steps is diagrammed below,

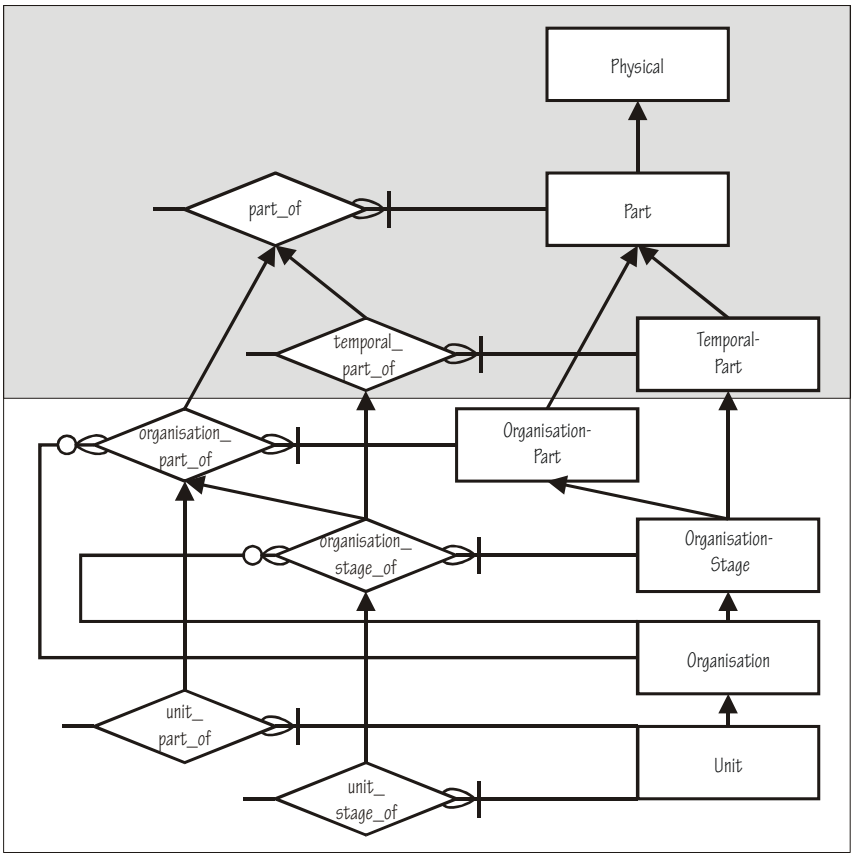

Figure 9 - The initial perdurantist Unit ontology

The figure helps to make explicit that the differences between the unit_part_of and unit_stage_of relations are characterised by different spatio-temporal relations the Unit has with the Organisation. Units are temporal slices of the organisations they are a unit_stage_of. There is no temporal gappiness of the Unit relative to the Organisation it is a stage of – though there may be 'absolute' temporal gappiness; when there are no unit/organisation activitites. Units are parts of the organisations they are a unit_part_of and so possibly spatial parts (at a time). In other words, they are not necessarily temporal slices, in fact it would be unusual if they were.

4.3.6 Revising TOVE's unit_of relation

The perdurantist perspective provides a neat extensional picture of the elements involved in a unit_of situation, but it does not yet include something that corresponds with our ordinary language's unit_of relation between the two organisations. The perdurantist temporarily part of or overlapping relation noted earlier is similar but not identical – it is a necessary condition but is nowhere near sufficient. TOVE's fluent (endurantist) unit_of is (imprecisely) similar. We start by precisifying this – looking at its identity conditions, to identify what kind of object it is.

In TOVE unit_of is clearly a fluent whose value varies over time. It has to be assessed in terms of a predicate $holds_T$ *(unit_of, t)* where *t* is a time. The question

is how to interpret this ontologically. What object is *holds$_T$ (unit_of, t)* representing? The simplest answer is a three-way relation between two organisations and an instant of time. This relation's identity can be treated extensionally; in other words, regarded as simply dependent upon its constituents' identity, where two relations with the same constituents in the same 'places' are the same relation. This is because any two organisations at any one time can only have one unit_of relation[48].

However, this interpretation also means that at different moments of time, there must be different relations. That for example, 'Palm is a unit_of 3Com at 17:10' involves a different relation from 'Palm is a unit_of 3Com at 17:11'. This does not accord with common sense. People have a feeling that these kinds of relationship not only can and do persist through time, but they can be dissolved and subsequently new relations arise between the same participants. In other words, they have identity over time. It makes sense to say: "Acme was a unit of Zenith twice, once in the seventies and again in the eighties."[49] And this is backed up by the analysis in terms of intentional agreements. There are two different 'relations' because there are two different agreements.

One way to capture this identity is to revise the three-place relation: replacing the instant of time with a specific period. This would replace the infinite multitude of 'instantaneous' relations with a single 'persisting' one. For this to match our intuitions about unit_of's identity, the period would need to match the term of the related intentional agreement. This is more precise and seems to have the requisite amount of identity, in the right places – the relation remains the same over the period, but it regarded as a different relation when the period is different.

This relation would not be a fluent in its proper sense – its value would not vary over time. For example, if it were (a fluent) then one would expect that if the predicate were true for a period, it would also be true for every sub-period – and this is not so. However, one could apply a variant of the "predicate *holds$_T$ (f, t)*" to this relation, which determined whether the time instant *t* is within the period element of the relation. This is effectively determining whether (speaking perdurantistly) the time instant overlaps the Unit. In this case, the "predicate *holds$_T$ (f, t)*" is used to index the time of the statement rather than a function of the truth of the relation itself.

Once one has made this interpretation, a natural next move is to replace the time period in the relation with its corresponding Unit. After all this is what determines the period. This gives us a relation between the two organisations and their unit – with the same relevant identity conditions. And it is both simpler and more

[48] An apparent counter-example to this is not really one. If there were two parallel signings of contracts between representatives of the same two parties, then there would be two contracts that lead to the same unit_of state of affairs.

[49] This would be a sensible answer to a TOVE competency question, of the form: "How many times has Acme been a unit of Zenith?"

explanatory. It is also more explanatory as it is equivalent to the combination of the unit_stage_of and unit_part_of relations.

This seems to accord well with people's intuitions of unit_of. Our use typically omits mention of the Unit because it is obvious what it is when an organisation only has a single unit. In cases where there are multiple units ("Acme was a unit of Zenith twice, once in the seventies and again in the eighties."), we naturally recognise them.

This unit_of relation also seems to respect our intuitions that the participating organisations are somehow essential to being a unit. It turns out that this is not quite right – but the explanation of this depends on further analysis, which we now start.

4.3.7 States of affairs and affairs

The STPO analysis suggests a general explanation of unit_of and its relation to the participating organisations that encompasses the intuitions we have about endurantist fluents. It suggests that unit_of belongs to the general category, state of affairs[50] (SoA for short), that its constituent Unit belongs to the category called affair. The unit_of SoA is underwritten by an intentional agreement in which the organisations are participants – one participating as a unit_part_of the other as a unit_stage_of. State of affairs capture (and so explain) some of the characteristics of fluent predicates. Note that the STPO is using these names in a technical way that is different from ordinary usage – where states of affairs are often regarded as static and events dynamic[51].

The CEO's full-blown top ontology will need to describe these general categories, their nature and their identity conditions. The analysis here restricts itself to the scope of the STPO, focussing on 'unit_of' and other SoAs that are revealed by analysis. It is intended to be 'good enough' for the STPO and will hopefully provide a good idea of what will be required in the more general analysis – which will almost certainly lead to some revisions. In particular it leaves open what the connections are between relations and states of affairs; whether relation is a sub-type of SoA.

4.3.7.1 The composition of a state of Affairs

There are SoA types, such as unit_of, and SoA elements that instantiate them. For simplicity STPO ignores, for the time being, the possibility of second-order SoAs; in other words, it assumes that SoA types only have SoA elements as instances.

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[50] See Armstrong (1997) *A world of states of affairs* for a discussion of states of affairs and a useful examination of identity criteria. It also discusses whether there is any additional ontological commitment in a SoA over and above its components – see the discussion on supervenience and ontological free lunches on pp.12-3.

[51] For example, Barwise and Perry (1983) *Situations and attitudes* says that "In ordinary language the term "situation" is used in a very general way, both for static situations, called *states of affairs*, and more dynamic situations called *events*."

The SoA elements have an internal structure. This involves:

- the participants' participating relations, (and so, indirectly, the participants),
- the participants' participations, and
- the affair – the fusion of the participations.

There are a couple of major constraints:

- the participants' participating relations are sub-types of part_of – therefore the participants' participations are parts_of them
- the affair is the mereological sum of the participations – and so overlaps all participants. Affairs are elements – a sub-type of physical – and so are subject to element's extensional identity conditions.

The identity of a SoA element is extensional – determined by its components. Two SoAs with the same components are identical.

SoA types involve:

- Type(s) of participating relation,
- Type(s) of participant, and
- Type of affair

The general distinction between affair and participation is not needed for the unit_of SoA, as they coincide. The Unit affair is both the participant's participations and also the fusion of their participations. However, unit_of is an exception, typically the distinction is needed. For example, the participations of attendees at a meeting do not spatially overlap or necessarily temporally extend as long as the meeting event.

The SoA type, unit_of, has as as its components:

- Type(s) of participating relation,
  - Unit_part_of, and
  - Unit_stage_of
- Types of participant/affair
  - Unit

4.3.7.2 The SoA (type) taxonomy

The SoA types fit into a taxonomy structured by their sub-type relation. All the SoA elements fall under the general type SoA Elements that sits at the top of the SoA taxonomy. The unit_of SoA fits under this general type in the taxonomy. This is diagrammed in the figure below.

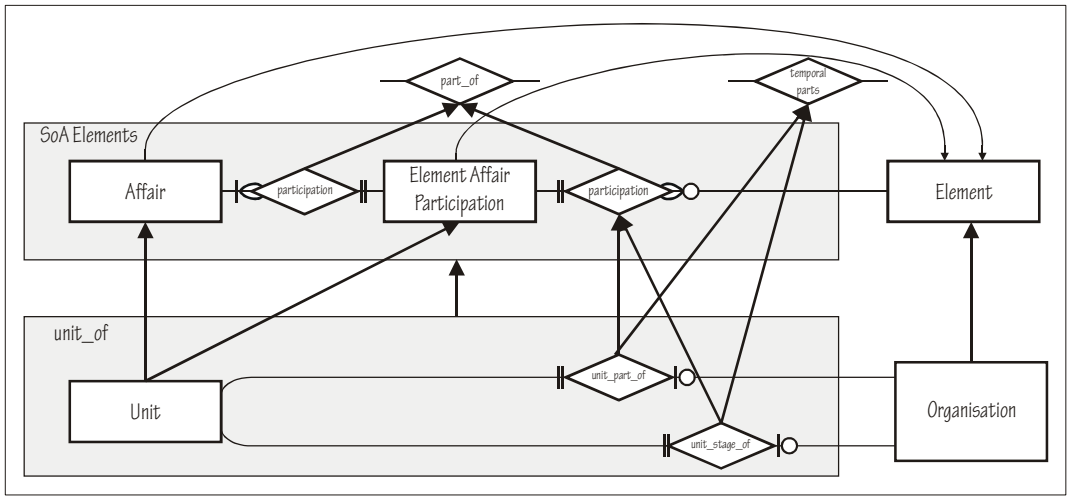

Figure 10 – Unit_of SoA taxonomy

In this and the following figure, the SoAs are shown diagrammatically encapsulating their constituents. In Figure 10, the general SoA Elements type encapsulation is shown as a box containing its constituents: the affair, the element participations in the affair and their participation relations. The unit_of SoA is also shown as a box, with a sub-type relation to the general SoA Elements type, encapsulating its constituents: the Unit affairs, which is also the participations and the unit_part_of and unit_stage_of participating relations.

4.3.7.3 Unit_of SoA type's elements

The instance-of relation between SoA types and elements creates a SoA typononmy. When a SoA type is instantiated, there are constituents of the SoA element that correspond to each of the constituents of the SoA type. This is shown in the figure below for the unit_of SoA type for the SoA element shown in Figure 8's space-time map.

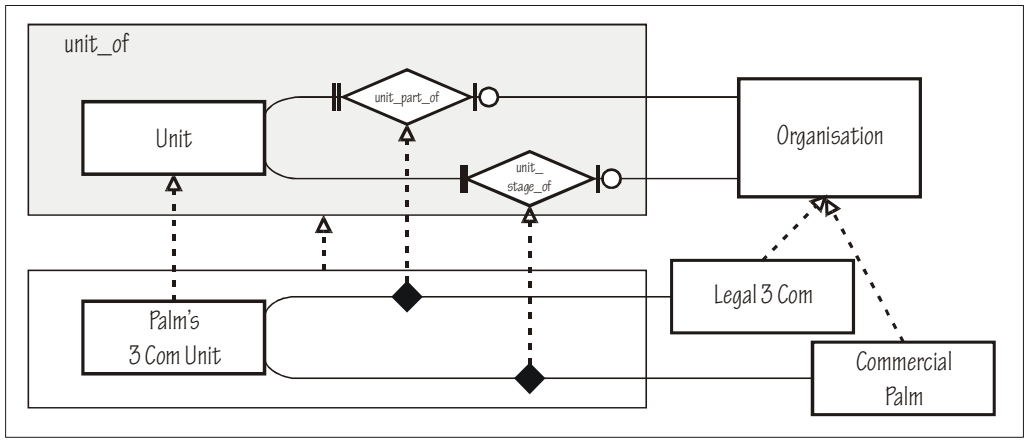

Figure 11 – Unit_of SoA typonomy

4.3.8 Unit_of and unit

We can now describe unit_of and Unit in more detail using the SoA perspective. As Figure 10 shows, Unit is a sub-type of the general Affair type and unit_of is a sub-type of the general SoA Elements type. As Figure 11 illustrates, their elements seem to have these additional general features, which we have already noted in one way or another:

- Their participants are Organisations,
- Their Organisations' participations are identical with each other and the Unit, and
- There are two participation relations: unit_part_of and unit_stage_of.

In addition, we know that:

- The unit_stage_of participations are temporal parts of their corresponding participants.
- Distinct unit_of SoAs with the same organisation constituents have temporally non-overlapping Units.

This seems to give the right kind of identity constraints in the right places:

- If the unit_of has different constituents, it is different.
- It is possible for there to be two unit_of SoAs with the same two constituent organisations, but not at the same time.

If you consider the space-time map in Figure 8, you can see the elements of the SoA – and maybe thereby mentally synthesise the SoA. There are the constituents, legal-3Com and commercial-Palm, there is their (joint) participation, the Palm's legal-3Com Unit – part_of both organisations. As noted above, due to the nature of the Unit event, both participations have the same extent as the affair. In the space-time map, the participation relations are mapped rather than represented with an icon.

The ontology diagrammed in Figures 10 & 11 shows the same situation in a different way, with the unit_of SoA and its structure made explicit. In these figures, the cardinalities of the relations are shown relative to the SoA encapsulation – rather than to the universe. The reason there is a difference is that a Unit can be a constituent of more than one SoA. Consider commercial-3Com. This, like legal-3Com has a unit_part_of participation in Palm. While commercial-3Com and legal-3Com share the same Unit – they belong to different unit_of SoAs. So within the unit_of SoA, for each Unit there is only one unit_part_of participation. However, when considering Units generally, there can be more than one.

Though this may initially seem strange, it makes intuitive sense. In most contexts we only consider Units with one unit_part_of and one unit_stage_of participation. This can make us feel that somehow this is an essential feature of the event of being a Unit. However, if we consider the commercial-3Com and legal-3Com

situation described above, we think of there being a single event of Palm's being a Unit.

Similarly we think of each of Palm's activities as being an activity (a type of event) simpliciter – we do not multiply it each time we consider a different participant. If Jane in Palm's Sales Department were to sign a new contract (for Palm) – we do not have a plethora of contract signing events: one for her, one for Palm's Sales Department, and so on. We have just one event with a number of participants (this point is made in more detail in (Partridge 2002c)).

4.3.9 SoA's sub-type relation

We have an intuitive notion of the sub-type relation that generates the SoA taxonomy – for example, we are comfortable with Figure 10, which shows unit_of-SoA as a sub-type of SoA. However there is some work that needs to be done to translate the intuition into a formal framework. For example, a precise analysis of SoA's sub-type relation shows that (unlike for simple extensional elements), it has more structure and is only indirectly extensional. Extensionality is necessary but not sufficient: not only do all the elements of the sub-types need to be instantiated by the super-type, but also the sub-type's constituents (in particular, the participation relations) need to be sub-types of the super-type's constituents. The SoA super-sub-type relation is indirectly extensional as it is indirectly dependent upon the extensional sub-typing of its constituents. This is one of the items that will need to be clarified in the formal analysis of states of affairs.

4.4 Mereological Guidance

A key role for the top ontology is to guide the analysis by suggesting what might be relevant questions. Mereology is a particularly useful element of the top ontology in this respect. It can be used to suggest relevant questions – the STPO used it, as described here, to analyse STPO's and TOVE's conception of unit_of. Of course, in neither scheme is unit_of subsumed by part_of – but the close analogies suggest useful questions.

4.4.1 Improper unit parts

One question facing those analysing the notion of part_of is whether to allow improper parts of a whole – that is: Can a thing be part_of itself? We can ask the same question of unit_of. If it were true, it would imply that an organisation could agree to be a unit_of itself, which seems odd. It appears that Unit's intentional nature rules improper Units out. This makes unit_of 'anti-reflexive'; organisations cannot be units_of themselves. TOVE does not seem to have formally recognised this constraint.

4.4.2 Acyclicity

A core feature of part_of is its partial ordering structure. Does unit_of have a similar structure? Certainly it seems to in one respect – being acyclic and so anti-

symmetric. Though this is not formalised in TOVE, it is clear that its unit relation cannot hold (at a time) in any situations where an Organisation-Unit is a unit of its units or one of its units' units (or units' units' units, etc.). Similarly for the org_unit relation over Organisation.

The situation is more complicated for STPO's unit_of. STPO mimics acyclicity, and so anti-symmetry, at a time by the nature of its participating unit_part_of and unit_stage_of relations. However, simple (atemporal) anti-symmetry of unit_of's organisation constituents (unconstrained to a time) is too strong as it excludes this odd (limit) valid situation. Assume that Acme is now a unit_of Zenith, later on Zenith gets into trouble and sells Acme. Acme does well and a couple of years later buys Zenith – making Zenith a unit_of Acme. Clearly this type of situation is possible, and has almost certainly happened. Both schemes cope with this: TOVE's by only applying the constraint at a time, STPO's by making the Unit affair a constituent of the unit_of SoA.

4.4.3 Transitivity

Part_of is a partial ordering and so transitive, but it is not obvious that unit_of is as well. TOVE certainly does not made clear whether its two fluent unit_of relations are. If A is a unit_of B and B a unit_of C, TOVE does not tell us whether A is always a unit_of C.

People seem to intuitively assume that unit_of is transitive. They are happy to say that as the Settlements Section is a unit_of the Securities Department and this is in turn a unit_of MegaBank, then the Settlements Section is a unit_of MegaBank[52]. If we assume that TOVE's fluent unit_of – holding at a time – is transitive, this captures the intuition well enough.

Asking this question of STPO's unit_of unearths an interesting issue. Units are bounded by intentional agreements and unit_of SoAs have the parties to these agreements as participants. People's intuitions seems to support transitivity at a time – so how do the intentional agreements support this. For example, assume that MegaBank sets up the Securities Department[53] and that the Securities Department subsequently sets up the Settlements Section. For there to be a unit_of between the two organisations, they should be parties to an intentional agreement that this is so. Transitivity (at a time) suggests that the Settlements Section is a unit_of MegaBank. However MegaBank does not seem to be an explicit party to the Securities Department's intentional agreement to set up the Settlements Section, so how can the Settlements Section be a unit_of MegaBank?

One can explain this by considering the Securities Department to be entering into the agreement on behalf of MegaBank – acing as its representative. In this way,

[52] For example, CYC (in the earlier extract from its description of sub-organisation) explicitly makes the point that it is transitive.

[53] More accurately, the board of directors acting on Megabank's behalf.

MegaBank participates – implicitly – in the agreement[54]. A rule for working out who the implicit participants are would be something like this: All the organisations that, at that time, are unit_of the Settlements Section, and all the organisations that, at that time, have the Securities Department as a unit_of. Clearly STPO's unit_of is not transitive in quite the same way as part_of is.

One way of explaining this rule is to see the direct parties in the intentional agreement typically acquiring rights to later act on each other's behalf in making further types of unit_of intentional agreements – so indirectly involving them. The acquiring party is empowered to make agreements for being itself acquired and the acquired party is empowered to make agreements for acquiring.

This empowerment is not absolute as intentional agents can always revise their agreements – even break them (if they can get away with it). The American Declaration of Independence can be seen as an example of this. This is not so uncommon in modern enterprises – as, for example, the recently announced 'Declaration of Independence' of the French consulting arm of PwC and its movement to Arthur Anderson shows.

4.4.4 Restricted combination - allowing joint ventures

In a standard mereology there is no restriction on parts combining to form wholes. As noted earlier, every combination of Units does not form an organisational whole. Only combinations sanctioned by intentional agreements of the right sort count.

But TOVE seems to place an even tighter restriction than this. It specifies that an Organisation-Unit has only one org_unit relation with a Top-Organisation, and vice versa. This divides each Top-Organisation and its units into a disjoint group[55]. This is quite a strong claim. It bars Organisations from ever sharing units. So a project that is a joint venture between two organisations – where the project is unit_part_of both organisations – is, in principle, impossible. This cannot be true – and TOVE gives no justification as to why it should be. TOVE appears to have (unintentionally) formally specified too strict a structure. The STPO did not synthesise this restriction into its ontology.

4.5 Introducing bounding events

A number of the interesting events that affect the lives of organisations, events such as mergers and acquisitions can be characterised in terms of combinations of construction and dissolution of the organisations that are involved. Introducing the construction and dissolution events for person into the CEO provides us with a way to describe the combinations events that characterise the 'interesting' enterprise events – a useful explanatory tool. The general name for construction

[54] Of course, the securities department is a part of MegaBank and so MegaBank is, in some sense, a necessary participant.

[55] TOVE clearly intends but does not formally specify that its unit_of relation is constrained to this disjoint group.

and dissolution events is are bounding events as they mark the entities' temporal boundaries.

Strictly speaking, neither the combination events nor their bounding event components are within STPO's scope, as they do not feature in TOVE's ontology. However, given their usefulness it makes sense to begin their introduction into the ontology here.

These bounding events have already appeared in earlier discussions. Figure 5 shows the dissolution of legal-Palm#1 and the construction of legal-Palm#2. Figure 8 shows the construction and dissolution of Palm's 3Com Unit. These figure also show that the terms construction and dissolution are being used in a technical sense here. When we use these terms in ordinary language, we often include a variety of events of events many of which are not within the extension of the bounded entity. As the figures show, the bounding events being referred to here are the temporal boundaries of the bounded entity.

We introduce bounding events at two levels. Firstly a framework for the bounding events is introduced and then secondly, these are used to characterise a few typical illustrative examples of mergers and acquisitions, culled from the Palm examples. The selected examples are:

- spin-off, and
- takeover.

This analysis can be expanded later (in the CEO) into a sufficiently comprehensive account.

The bounding events discussed here mark the start and end of Persons. There are situations where Persons have an intermittent existence[56] with interim temporal boundaries – these are not considered here.

4.5.1 The bounding events framework

The bounding events framework is relatively straightforward. The introduction of it into the STPO ontology is described below in a series of steps.

The STPO's ontology also notes a key feature, the way these events bound the objects they are constructing and dissolving.

- Introduce the type Temporal Bounding Events as a sub-type of Physical (and so Element).
- Introduce the temporal_bounding relation as a sub-type of part_of.
- Introduce the start_bounding and end_bounding relations, and subsume them under the temporal_bounding relation.

[56] I am grateful to Bill Anderson whi gave me a good military example; the Russian Army apparently regularly mothballs its military units and then revives them. He discusses US military organisation in Anderson and Peterson (2001) *An Ontology of Modern Military Organizations and their Structure*.

- Introduce the general Construction Event and Dissolution Event as sub-types of Bounding Events.
- Introduce Person Bounding Events as a sub-type of Bounding Events.
- Introduce the temporal_person_ bounding relation as a sub-type of the temporal_bounding relation with Person playing the bounded by role and Person-Temporal-Bounding-Event playing the bounding role.
- Introduce the person_start_bounding relation as a sub-type of the start_bounding relation with Person-Construction-Event playing the bounding role.
- Introduce the person_end_bounding relation as a sub-type of the end_bounding relation with Person-Dissolution-Event playing the bounding role.

The result of these steps is diagrammed below,

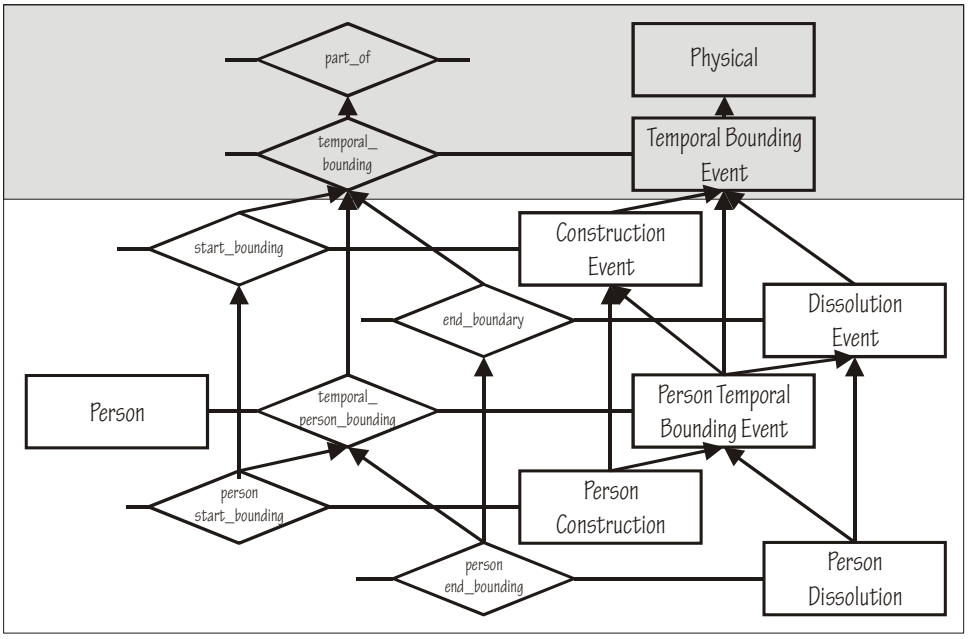

Figure 12 – Person bounding events ontology

The organisation and unit bounding event ontology fits under the person bounding ontology. The steps for doing this are straightforward and so are omitted. The diagram below shows the result.

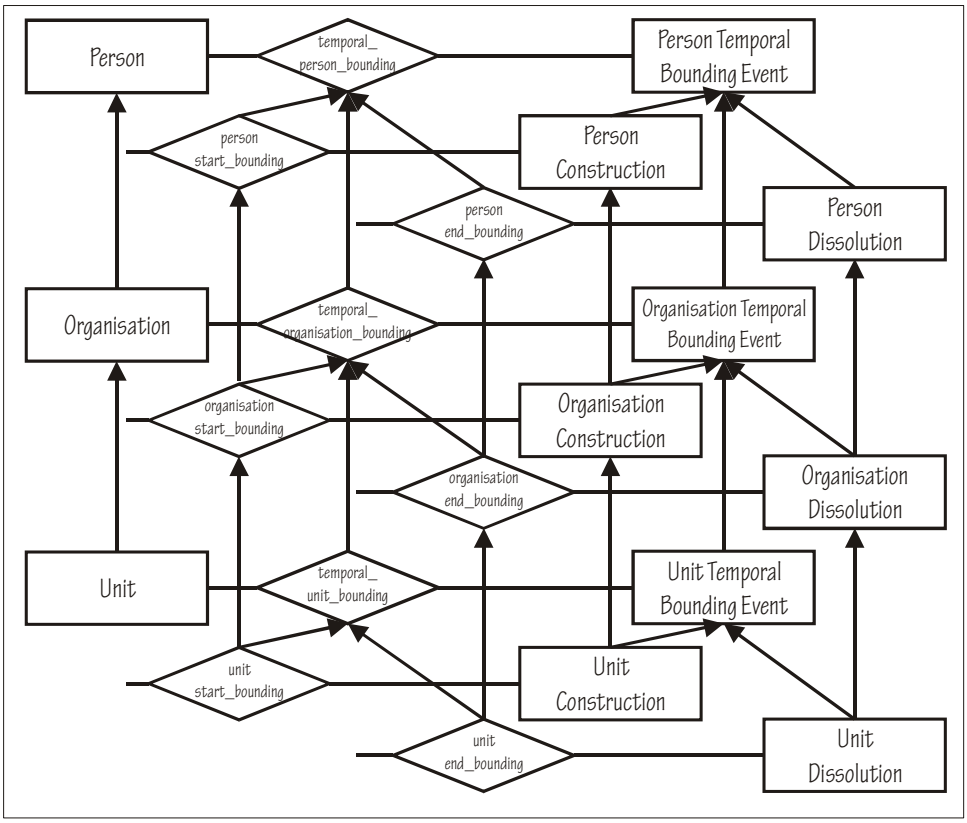

Figure 13 – Organisation & Unit bounding events ontology

4.5.2 Characterising mergers and acquisitions

One way to characterise these enterprise events is to recognise that they are dependent upon specific events in the life of the intentional agreements that support the Organisations and Units. For example, the signing of an acquisition contract (as happened in the situation diagrammed in Figure 5) will typically intentionally refer to the construction of a Unit. In many cases it actually marks the construction. In these cases, at the beginning of the activity the to-be-acquired organisation, and therefore its activity, is not part of the acquiring organisation – at the end it is.

This insight can be used to characterise the various different types of mergers and acquisitions that typically occur to enterprises in terms of the configurations of bounding events that happen to the overlapping of legal and commercial organisations. As the 3Com and Palm examples illustrate mergers and acquisitions typically involve groups of related bounding events. For example, Palm's acquisition, diagrammed in Figure 5, involved the dissolution of legal-Palm#1 as well as the construction of a 3Com Palm Unit.

4.5.2.1 Characterising spin-offs

Figures 4 and 5 both show spin-offs. Figure 4 shows the Palm subsidiary being sold off – a sell-off subsidiary. Figure 5 shows a Palm division being spun off – a

spin-off component. What they have in common is that an organisation (Palm) that is a unit_of the commercial spinning off organisation (3Com) is detached from it – so there is a Commercial Unit Dissolution (the unit is not shown in these figure – it is shown in Figure 8 – for the spin-off situation). What differentiates them is the nature of the unit prior to the spin-off. In the sell-off case, the to-be-spun-off organisation is a subsidiary (not a legal Unit) of the legal spinning off organisation. In the spin-off case, it is a Unit, and the spin-off creates a new legal organisation. Presumably the legal organisation construction is after the unit dissolution.

There are obviously other possible configurations. For example, the Palm division could have been merely transformed into a wholly owned subsidiary. In fact, the sell-off may well take place in two stages: with a separate legal subsidiary being set-up before it could be sold. But we leave these details for another time and another project.

The ontology for the Spin-off event as a sub-type of the general type M&A-Event, from the bounding event perspective, is shown in the figure below.

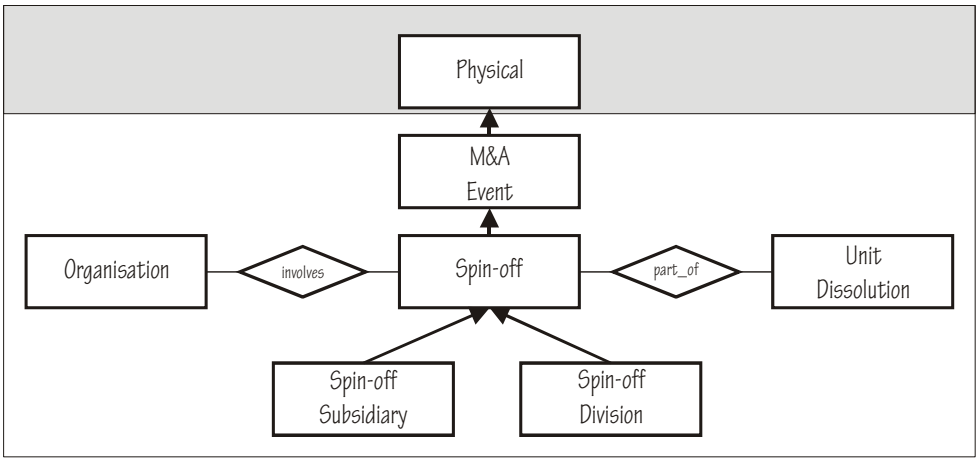

Figure 14 – Spin-off events ontology

4.5.2.2 Characterising takeovers

Corresponding to what might be considered the reverse of a spin-off, there is Takeover. This is where the taken over commercial organisation becomes a Unit of the taking over commercial organisation – involving a Unit-Construction event. This has (at least) two sub-types: Takeover-Absorption (see Figure 5) and Takeover-Holding. Where these are differentiated by whether the taken over organisation (Palm in the example in Figure 5) is absorbed into the legal taking over organisation, or just held as a subsidiary.

In the Takeover-Absorption case, the taken over organisation is absorbed – in effect, its legal form (and so typically the organisation) is dissolved, with the taking over organisation as legal successor and the commercial taken over organisation becomes a Unit of the taking over organisation. Practically the absorption may be in two stages, with it first becoming a wholly owned subsidiary

and then being absorbed. In the Takeover Holding case, the taken over organisation becomes a subsidiary of the legal organisation, but a Unit of the commercial organisation. The ontology for this, from the bounding event perspective, is show below – with Take-Over as a sub-type of the general type M&A-Event.

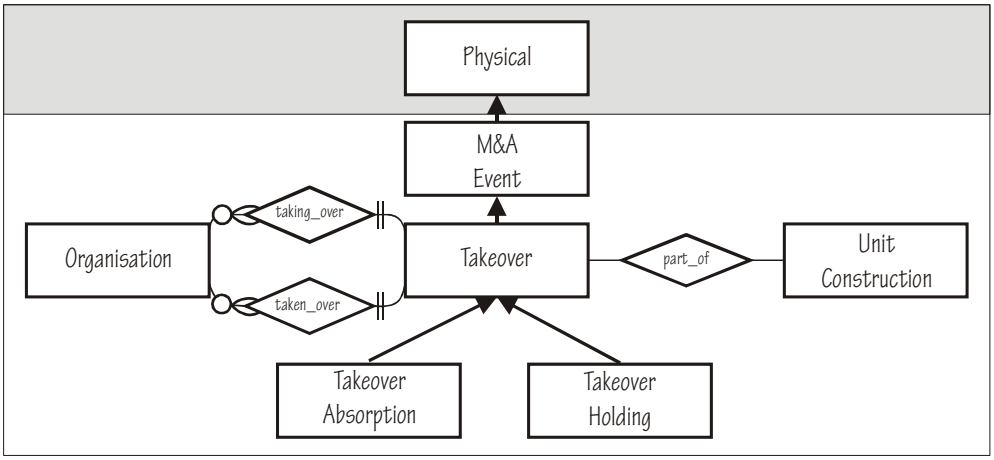

Figure 15 – Take-over events ontology

4.5.2.3 Other types of M&A event

Much of the variety of typical M&A events can be characterised in terms of the construction and dissolution of legal and commercial organisations and units. For example, a merger of equals that is effected by one of the companies exchanging its stock for the other's seems, from a legal point of view, much like a Takeover Absorption event. A legal organisation is bought and dissolved and the buying legal organisation inherits its responsibilities. However, from a commercial point of view it is different, as the new commercial entity is regarded (at least, officially) as a combination of the two original organisations – rather than having the merged companies as parts or one organisation as a part of the other. As with most things in the real commercial world, it may not be clear what is actually (unofficially) happening. At some stage in the CEO project these events will be characterised.

4.5.3 Bounding events and their intentional 'legislators'

Taking a simple view, it is possible to conflate the intentional agreement that 'legislates' the bounding event with the event. For example, to regard the signing of the takeover contract and the construction event for the unit as one and the same object. However, consideration of spatial and temporal boundaries show that this is imprecise.

The simple view has, as might be expected, some basis. In many cases, the intentional agreement that legislates the construction also marks its temporal boundary. For example, where the signing of a contract legislates the construction

of a unit, it can also mark the point in time that it is constructed. The boundary needs to be marked and it makes (parsimonious) sense to use the signing.

However, the legislating event clearly does not have the same spatial extent as the construction event. For example, we might identify Palm's participation in the contract signing as such a legislating event. At the beginning of this, it seems sensible to say Palm was not yet part_of 3Com, but that by the end it was. However, it is the representative of Palm that signs the contract, so it is a moot point how far the full spatial extent of Palm is included in the extent of the contract signing.

Furthermore, there is no reason why the legislating event necessarily has to mark the temporal boundary. Many financial contracts are signed for a fixed future settlement date. One can also imagine a friendly contract where it is agreed that there will be a settlement but that the exact date is not fixed.

4.5.4 Intentional agreement participants

In simple cases, the participants in the (intentional agreement that legislates the) construction of a unit (or organisation) are also participants in its dissolution. Consider this case. C(ompany) sets up a unit part D(epartment) – and then later D sets up a unit part S(ection). For completeness, assume that D then closes down S and later C closes down D. This is diagrammed in the space-time map below.

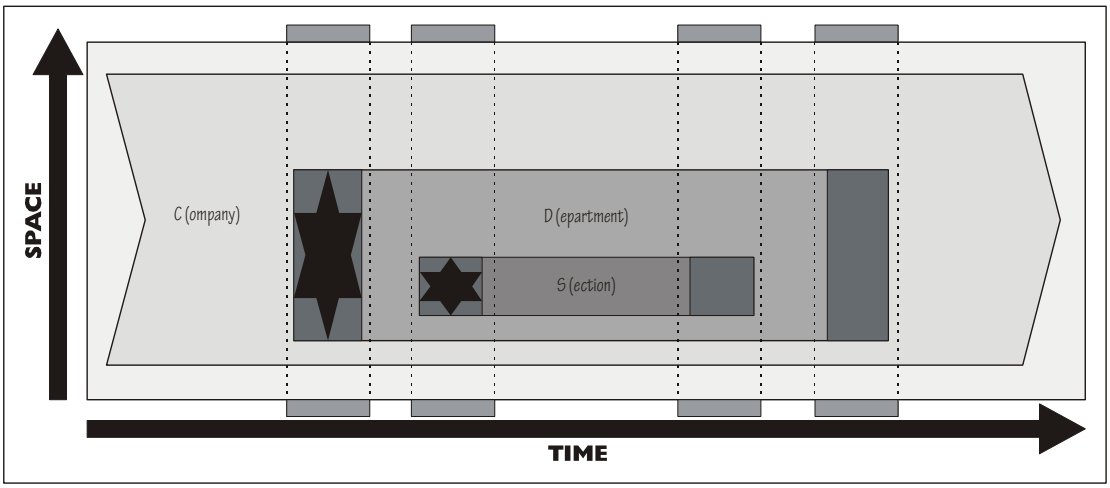

Figure 16 – Participants – a simple case – space-time map

It is an easy mistake to assume that this is necessarily so. The connections between the construction and dissolution events are not so tight as the simple cases imply. To see this, consider a slightly different case. C(ompany) sets up a unit part D(epartment) – and then later D sets up a unit part S(ection). For completeness, assume that C then closes down D but keeps S around until some later date, when it closes it down. This situation is illustrated in the figure below.

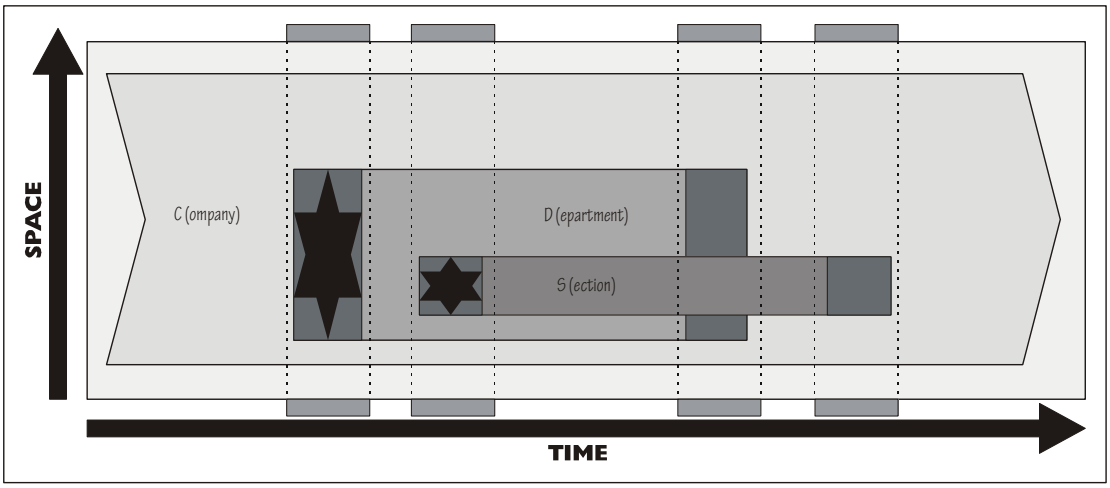

Figure 17 – Participants – a less simple case – space-time map

Here D is directly involved in creating S. But once it is closed down, it cannot be directly involved with S; it is not involved, even indirectly in the dissolution of S.

In the simplest of cases, the direct participants in an intentional agreement that legislates the construction of a unit and the participants in the unit are the same. But this is not necessarily so. For example, there may be only a single party directly involved in the intentional agreement, acting on behalf of all the parties. For example, a corporate re-organisation may be the result of a sequence of more or less formal consultations and provisional agreements that is finally ratified at board level. The board is the only direct official party to the final formal agreement. Or more perversely, if the HR Department is empowered to carry out the re-organisation, it may end up being not only the only party directly involved, but also not a participant in any of the new Units that are created (as it is not re-organised).

5 TOVE's Organisation-Agent

The second main division of the TOVE ontology is Organisation-Agent. As TOVE notes (in Section 7.2), the concept of Agent is "found in almost all of the literature …". It is an important concept, one that the STPO needs to fit it into its taxonomy. However, as CYC notes "[t]his is one of those concepts which is important yet very hard to define precisely". Within our sample of ontologies, the STPO found a number of descriptions, which gave it enough raw material to start the analysis.

5.1 What is an Agent?

TOVE describes an agent as follows:

> An "agent performs activities in order to achieve one or more goals. An agent can be a human being, a computer program, or a group of people and/or programs. … Individual-Agent and Group-Agent are subclasses of

> Organisation-Agent. They represent either individuals, like employees and contractors, or groups like teams, boards of directors, etc."

CYC has a good, more extended, description:

> "An agent is something which can show independent action, whether conscious or not. … Most animals are considered agents, in most contexts; so are most organizations. Most plants are not agents, in most contexts. Inanimate devices are sometimes considered agents, in certain contexts. Here is some elaboration, to help convey the intended meaning of the basic criterion for agenthood: It must seem that a kind of decision-making is going on, even if it's down at the `mindless' level of the reflex reaction of a spider leg to heat, or the reflex reaction of a Human Resources Department rejecting an applicant with no formal degree. It generally 'sounds right' or 'feels natural' to assign causality to agents, rather than some larger or smaller entity. E.g., it is more natural to say 'Fred wrote an essay' than to say 'Fred's left hand wrote an essay' or, at the other extreme, to say 'The Solar System wrote an essay'."

The EO has this to say about POTENTIAL ACTORS, which broadly corresponds to the notion of Agent:

> "Certain ROLES in RELATIONSHIPS are special in that the playing of these ROLES entails some notion of doing or cognition (e.g. performing an Activity, or holding an Assumption). We refer to an ENTITY playing such a ROLE as a ACTOR (roughly synonymous with 'agent' in other ontology work). A ROLE played by an ACTOR is an ACTOR ROLE. Only certain ENTITIES can play such ROLES, they are called POTENTIAL ACTORS. Currently this includes Persons, OUs [Organisation Units] and in some cases Machines."

The STPO describes a Person as something that is capable of intentionally acquiring rights and obligations – which under all three descriptions above makes it an Agent. Furthermore there are Agents that are not Persons. To illustrate this, consider a computer trading program (in the extract quoted above, TOVE offers computer programs as examples of agents). When it executes a trade, it is showing independent action. The trade also results in new rights and obligations, but not on the program, on the organisation that owns it. The program cannot intentional acquire rights – for example, we would not think of holding it responsible for its 'mistakes'. So it is an Agent, but not a Person.

This makes it clear that Agent subsumes Person. And as Person subsumes Organisation, Agent also subsumes Organisation. What distinguishes an Agent from a Person is that an Agent does not have to be capable of intentionally acquiring rights whereas a Person does.

This raises the question of whether Person's super-types – concrete, physical and element – should be generalised to Agent. It seems sensible to regard Agents as elements – in other words, Agents cannot be types. A potentially more contentious issue is whether to regard them as concrete and physical. Given the STPO's

working assumption that, within the context of the enterprise, persons are physical, it would seem feasible to regard agents as such as well. This is the assumption the STPO makes.

The resulting taxonomy is illustrated below.

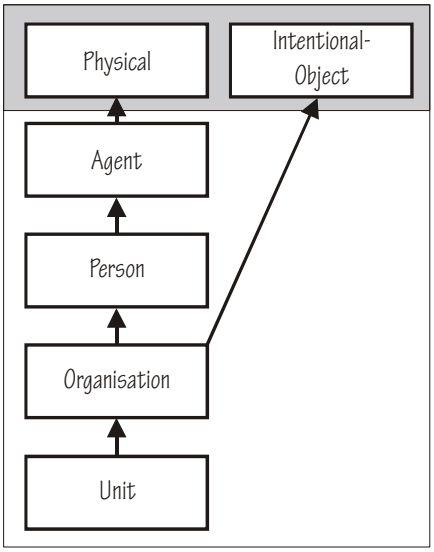

Figure 18 – Proposed Agent-Person-Organisation taxonomy

5.1.1 TOVE's major divergences

The STPO synthesis needs to resolve the three major ways in which TOVE's taxonomy diverges from this:

- TOVE (informally) regards Agents and Organisations as disjoint.
- TOVE makes a distinction between Group-Agents and Organisations, and
- TOVE introduces the sub-class of Agent, Organisation-Agent.

5.1.1.1 Disjoint Agents and Organisations

Though it is not formally stated, it is a natural interpretation of TOVE that its Agents and Organisations are disjoint[57]. TOVE does not make clear why it wants this. In restricted contexts that focus on how the Agents within an organisation work together, this may be a workable structure. But when we want to look more generally at how organisations interact, it is inadequate. For example, it does not provide a framework for explaining how an organisation can be responsible for its actions in a way that its employees are not – as in TOVE organisations are not capable of performing activities. As far as the STPO could tell this disjointness was an oversight – and should not be synthesised into its ontology.

This is not to say that there are not arguments in the literature for reducing organisations to activities of human agents. Weber can be read as putting forward arguments against the creation of a new organisation type of entity – and he is one

[57] Recall that TOVE does not explicitly specify disjointness, so we need to interpret it.

of the sources noted by TOVE. His contemporary Durkheim, working in the same field, took the opposite view regarding organisations as emergent entities[58]. However, TOVE seems to subscribe to both and neither view – recognising group-agents but also not recognising organisations as agents[59].

5.1.1.2 Distinguishing between Group-Agents and Organisations,

Similarly, it is unclear what distinction TOVE is striving for by having distinct notions for Group-Agent and Organisation. One may want to distinguish accidental groups from those that have somehow formed an intention to act together. But this is not what TOVE is doing. Its examples of group-agents – "groups like teams, boards of directors, etc." – are not accidental. In fact one of their examples – board of directors – is normally considered to be an exemplar of an organisational unit.

Furthermore, it is not clear what distinguishes being a member of a group (which is not included in TOVE's formal specification) and being a member of an organisation. Treating the Group-Agent as a mere collection is not sufficiently precise for our purposes. As already noted a couple of times, the requirement to distinguish two Organisations with the same members means that, without a sufficiently sophisticated criterion of identity, this is too gross a simplification.

One possible speculative explanation is that TOVE introduced Group-Agent as a workaround to enable it to let groups have agency – as (within TOVE) organisations do not. Anyway, TOVE does not give any explanation of this distinction, and, as far as the STPO can tell, it seems as though there is no real substance to it. The best approach for the ontology is to consider Group-Agents as Organisations.

5.1.1.3 Organisation-Agent

TOVE introduces the notion of an Organisation-Agent. The formal ontology states that an Organisation-Agent has to be a member of an Organisation or Organisation-Unit. A natural interpretation is that an Organisation-Agent is just an Agent that is a member of an organisation. As an Agent can join or leave organisations, this makes Organisation-Agent a fluent with respect to Agent – as an Agent does not have to be a member of an Organisation/Unit.

Furthermore, TOVE use of Individual-Agents and Group-Agents implies that these must be Organisation-Agents. As these presumably exhaustively classify Agents, this seems to mean that all agents are Organisation-Agents. This seems to

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[58] The idea of organisations being entities is, of course, much much older – for example, Section 462 of Plato's Republic talks of the state as being an organism like the humans that compose it.

[59] There are many other cases of people subscribing to both views, though not like TOVE at the same time. For example, Mill (1848) *A system of logic*, in Bk. 6 Ch. 7 Sec. 1 p.573, says "people do not form a new kind of substance when they come together in society". But in Ch. 3 p.31 of Mill (1863) *Utilitarianism* describes people as belonging to a social group.

be just a mistake (rather than a lack of precision or generality). Neither being an individual nor being a group seems in any way to depend upon being a member of an organisation. Counter-examples – individuals and groups that not are members of any Organisation – are not difficult to find. Anyway, not only does the purpose of Organisation-Agent seem unclear, it seems redundant, so it is not synthesised into the STPO.

5.1.1.4 TOVE's Agent

There is a related lack of precision with TOVE's notion of Agent. It is not clear whether this is a fluent or not. That is, whether an agent is something that is actually performing activities or something that can (but might never) perform activities. The EO explicitly makes the distinction by talking about Actor (the fluent) and Potential-Actor (the non-fluent).

There is some evidence that TOVE thinks it is a fluent. In the extract quoted earlier, it offered "employees and contractors" as examples – and, as used by TOVE, these are fluents. But a more precise analysis shows that these are 'roles' that people play – and they can play a number at the same time. For example, William could be an employee of a number of companies and a contractor at others. In this case, is there one agent (William) or many (his roles)?

The STPO suspects that TOVE did not appreciate the difference, and would want to say there is one Agent – and treat Agent as a non-fluent. And this is the sense synthesised into its ontology.

5.2 Types of Agents

TOVE makes a commonsense division of Agents into what it calls Individual-Agents and Group-Agents[60]. It offers human beings as examples of the first and boards of directors of the second. TOVE claims this distinction is made on the basis of whether or not the Agent is composed of a group of agents (that is, more than one agent) – what we will call an 'agent composition criterion'. Though this composition relation is not included in the TOVE ontology (under the STPO re-interpretation of Group-Agents as Organisations, the member relation is a good candidate for this).

5.2.1 Oversimplified assumption

A more precise analysis of the distinction reveals that the assumption that an Agent is either an individual or a group of more than one Agent is an over-simplification. It also reveals that TOVE's examples (and our intuitions), overlap with, but do not match up to its criterion.

Sole proprietorships provide a counter-example. When these have no employees – a common situation – they consist of a single owner, the sole proprietor. It is not

[60] Western legal systems make a similar distinction between natural and legal (artificial) persons. However, this division is based on a natural/artificial distinction and so allows singular artificial persons – for example, corporations sole.

clear how to classify these under TOVE's composition criterion. They are not a group, so should be Individual-Agents. But Individual-Agents have no composition relations – whereas we intuitively see sole proprietors as 'composed' by the person occupying the position. Hence, our intuitions feel more comfortable if we include them, along with boards of directors, in the general classification of organisations.

The same kind of problem dogs TOVE's prime example of Group-Agents: boards of directors. Under its composition criterion these should always be composed of more than one Agent. This is often but not always true. In some jurisdictions, small companies are allowed to have a single director. By the composition criterion, these boards of directors are Individual-Agents not Group-Agents. Furthermore, as these companies grow, the number of directors will typically increase, and so (presumably) the non-group boards will become Group-Agents – making TOVE's Individual- and Group-Agents fluents. Also boards of directors can resign en masse – leaving a situation where our intuition tells us there is still a board of directors, but it has no members – so by TOVE's composition criterion neither an Individual- or a Group-Agent.

5.2.2 The commonsense distinction

STPO's analysis shows that TOVE's examples capture a commonsense distinction – which the composition criterion does not quite capture. The reason people distinguish human beings from boards of directors and sole proprietors, in so far as it has a basis, is not concerned with whether there are one or more agents involved. It has more to do with how the Agent is constructed. Human conception / construction is driven by biology and chemistry, whereas the construction of boards of directors or sole proprietors is driven by intentionality.

The distinction may turn out, in the end, to be a practical one based upon degree rather than kind. For example, when we network a number of applications (or agents) using existing hardware, wiring, etc. is this done physically or intentionally or both? However, for the kinds of objects in the enterprise this distinction currently seems to be practically useful. It is proposed that the distinction used in the STPO is based upon construction – and TOVE's Agent sub-types renamed to reflect this.

5.3 Revised agent taxonomy

At this stage, the STPO summarised the ways in which its proposed agent taxonomy differs from TOVE:

- Recognition that Person (and so Organisation) is subsumed under Agent – implicitly rejecting TOVE disjointness between Organisation and Agent.
- Eliminate the redundant, fluent, Organisation-Agent.
- Group-Agent re-interpreted (and re-named) as Intentional-Person (Intention(ally Constructed) Person) and identified with Organisation – the name 'Organisation' retained for informal use.

- Individual-Agent – Group-Agent distinction re-interpreted as Naturally-Constructed-Person – Intentional-Person. And Individual-Agent re-named as Naturally-Constructed-Person, shortened to Natural Person.

The revised STPO agent taxonomy is shown below.

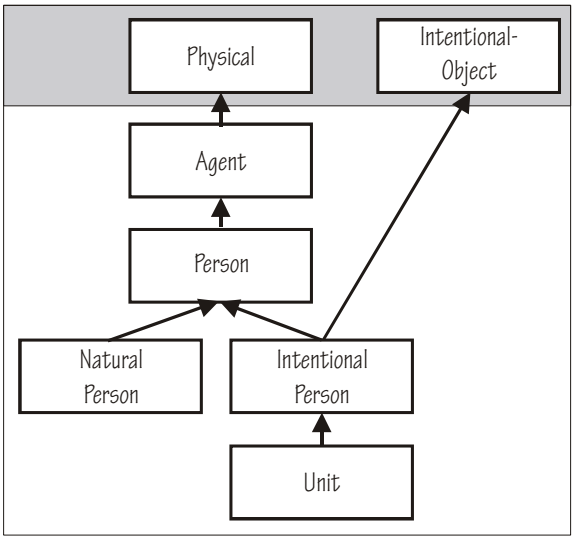

Figure 19 – Revised agent taxonomy

5.4 TOVE's membership of organisations

TOVE rightly says that "[a]n organisation … typically has members", where the having is done via an org_membership relation (see Figure 1). Members are important because, as TOVE says "[s]ome (maybe all) of the organisation's activities are performed by their members in some form of collaboration." TOVE restricts membership to Organisation-Agents, who must be members of Organisations – a constraint we look at later. This allows Group-Agents (but not Organisations) to be members of organisations. This goes some way to recognising that organisations can be members of organisations – as, for example, companies are members of the London Stock Exchange.

5.4.1 Another form of composition

TOVE's informal descriptions of membership do not attempt to explain the nature of membership. But the STPO analysis reveals it as a kind of composition (in Armstrong's view as a kind of partial identity). In ordinary language, we talk of people being members of (in TOVE having a org_membership relation with) a club or association. And the activities that these members carry out on behalf of the club are (part_of) the activities of the club. For example, if a chess club plays in a chess competition, this means that the club's members play chess, representing it. The chess club playing – part of the activities of the club – and the club members' playing are the same activity – an overlap of the members and club's activities. And (as TOVE says) the members' activities are typically how organisations undertake activities.

An organisation's activities are typically ultimately grounded (via membership) in the activities of natural persons. This may involve more than one level of membership. Where an organisation is a member, the grounding works through an extra level – a representative from the organisation member undertakes the activity. For example, a business that is a member of a chamber of commerce may send its managing director to a meeting as its representative.

5.4.2 Organisational members

TOVE's ontology *cannot* describe organisations that have organisations as members. This is because it restricts membership to Agents – and, as Agents are disjoint from Organisations, Organisations cannot be members. This is mitigated somewhat by TOVE allowing Group-Agents (as Agents) to be members. TOVE's restriction does not reflect actual common practice, where Organisations are often members: for example, Chambers of Commerce typically have businesses as members, the EU has states as members, and so on. No change to the STPO is required to remedy this as an earlier revision eliminated this problem – the rejection of TOVE's disjointness between Organisation and Agent, and the subsumption of Person (and so Organisation) under Agent. So in the STPO, Organisations are Agents and so can be members.

5.4.3 Intentional, historical composition

Understandably, as they both describe an organisation's composition, there are many similarities between TOVE's unit_of and member_of relations (and the analysis will show that these are reflected in similarities between STPO's unit_of and member_of SoAs). Like unit_of, member_of is an intentional mereological relation with an historical aspect. For example, a person becomes a member_of the club as the result of an intentional agreement involving her and the club – and remains a member of the club until the ending of her membership, which is also normally an intentional activity, though usually more one sided. TOVE says "[a]n organisation typically places some constraints on the activities its members can perform on its behalf". These constraints form part of the intentional agreement.

The historical aspect of member_of, even more than with unit_of, leads, within the TOVE's endurantist perspective, to a divergence between standard and intentional mereology (the STPO's perdurantist stance avoids this divergence). A person is a member_of even at a time when she is not performing club activities – and so no part of her activities (or her) are part of the club's activities. At a point in time, we assess the situation on the basis of whether she and the club have *previously* made and not subsequently dissolved a membership agreement. From both an endurantist and, more literally, a perdurantist point of view, there is an extent to this membership, which last from the moment of joining until the moment of leaving.

As with unit_of, the partial nature of the construction agreement means one can give a modal (possible) explanation for this – in that she could be doing

something on behalf of the club, and if she were, her activities would have been part of it.

5.4.4 Only some activities are parts

But agreeing to be a unit carries different responsibilities from agreeing to be a member. The core difference is that members only agree that some of their activities are parts – whereas units make an unrestricted agreement. This reveals itself in the way in which, for example, not all the activities of a chess club member are activities of her club. There are clear-cut cases, such as sleeping and brushing ones teeth, which are activities of the person and not the club. Similarly, there may be chess playing activities that are not part of the club's activities, because they are done at home, outside the confines of the club. We humans normally think of ourselves carrying out intentional activities – we, not our hand, sign the cheque. This implies the spatial extent of the activity is the whole natural person. This includes membership activities. So a person's membership – the fusion is their membership activities – is usually a sequence of temporal slices. This means that the membership is usually temporally gappy relative to the person – but spatially overlaps the whole natural person, at the relevant times.

Where organisations are members, their membership works in a different way. An organisation's units can carry out its membership activities – though these need to be units not merely parts. The sum of these unit's activities – the organisation membership – may then not be a sequence of temporal slices of the organisation, as the unit's activities do not involve the whole organisation. For example, when Acme's managing director attends a meeting of the Chamber of Commerce, only his activities count as member activities of the Chamber of Commerce. And Acme's may well have other co-temporaneous non-member activities, that will not count as parts of the membership.

One can see that this difference between organisations and natural persons is driven by the fact that natural people (at least, the ones we are familiar with) do not have spatial (person) sub-units, who can carry out the membership activities – whereas typically organisations do. This also explains why singular organisations, such as sole proprietorships, are a sequence of temporal slices of their singular natural person member – there is no sub-unit of the natural person to carry out any sole proprietorship activities.

The temporal gappiness is carved out by what the intentional agreement commits to. Where this is formulated, as it often is, in terms of the classes of activities done by the member on behalf of the organisation – for example, a saleswoman's selling activities for her company – it creates the conditions for temporal gappiness. A person will only engage in the relevant activities from time to time.

Where there is the possibility of temporal gappiness – where only some of the person's activities are counted as membership activities – this raises question of how the boundaries are drawn. Depending on the needs and capabilities of the parties, the boundary restrictions are more or less formally specified in the intentional agreements. For amateur clubs the constraints usually do not need to

be documented in any detail. But employee contracts (which intentionally construct the membership relations) usually are. When these involve trade union demarcation agreements, the details can be quite specific.

The restrictions need not be expressed in the agreement between the parties – they can be given in the legal framework within which the agreement is made. For example, where it is commercially important, Western law provides a framework that helps to regulate cases closer to the borderline. For example, providing rules for determining when unscrupulous employees are falsely claiming to act on the their organisation's behalf.

It is worth noting that intentional membership agreements can contain extrinsic and well as intrinsic constraints – not only specifying which activities count as parts, but placing constraints on non-part activities. A typical type of extrinsic constraint is one on members' behaviour that is not on behalf of (part_of) the organisation. The example that springs to mind is the mercenary "Mad" Mike Hoare, who in 1981 led a failed coup to take over the Seychelles. He had qualified as an accountant and was (I believe) expelled from the Institute of Chartered Accountants for behaviour likely to bring the profession into disgrace (intriguingly his earlier successful mercenary work in the Belgian Congo was not put in this category). The mercenary activities are clearly extrinsic to his membership of the Institute and the accounting profession – but they, nevertheless, fall within the scope of the intentional agreement.

5.4.5 Intransitive member_of relation

The restrictions have another effect – they mean member_of is not generally transitive (for comparison, see the earlier discussions of the transitivity of unit_of). One can see this as a practical result of the intentional agreement having constraints on the types of activities. If membership were to be generally transitive, there would have to be some way to guarantee that the constraints always align, and this is practically impossible.

For example, one type of membership with reasonably clearly defined 'constraints' is employment. But when company A employs company B to do something, there is no presumption that company B's employee's are employed by company A. Even though the activities that company B carries out on A's behalf are part_of company A (and company B, of course).

Where the memberships are of different types, the alignment is even less likely. For example, consider Jane, who is an employee-member of MegaBank, whose employment contract prohibits investment in shares. And Megabank is a member of the London Stock Exchange (LSE), whose members have the right to buy shares on the exchange. There is no sense in which Jane's employee_membership of Megabank makes her a member of the LSE in the same way as MegaBank is.

Where membership needs to be inherited, this can be specified in the intentional membership agreement. So the agreement between the member states of the EU constructed a European Citizen membership (a different type of membership) for the member states' members.

5.5 STPO's reified members

The informal analysis sketched above shows the similarities between TOVE's unit_of and member_of relations. The STPO analysis synthesises TOVE's member_of relation into a member_of SoA, in much the same way as its unit_of relation was synthesised into a unit_of SoA.

5.5.1 Reifying members

The informal explanations used the natural language term 'membership' and related terms without being precise about what objects they refer to. The STPO synthesis of Unit provides us with an example of how these objects can be reified. Units are the stages of organisations marked out by the unit_part_of and unit_stage_of participation relations. Members can be seen as marked out by the member_part_of and membering_part_of participations in a similar way – where the more relaxed intentional member conditions no longer constrain the re-ified member to being a stage. They can also be seen as the fusion of a person's member activities for the organisation – which makes the Member the overlap of the Person with the membered Organisation.

As with Unit, the Gilbertian analysis of (certain kinds of) agreements as plural subjects leads us to the conclusion that Members are subsumed by Person

5.5.2 Introducing the member ontology

We can now spell out the steps in the STPO analysis for the member ontology, one by one:

- Introduce the person_part_of relation with Person playing the whole role, and Person-Part playing the part role, and subsuming it under part_of.
- Subsume Person-Part under Part.
- Subsume Person under Person-Part.
- Introduce Member – as a sub-type of Person.
- Introduce the member_part_of relation with Member playing the part role and Person playing the whole role, and subsuming it under person_part_of.
- Introduce the membering_part_of relation with Member playing the part role, and Person playing the whole role and subsuming it under person_part_of.

The resulting ontology is shown below.

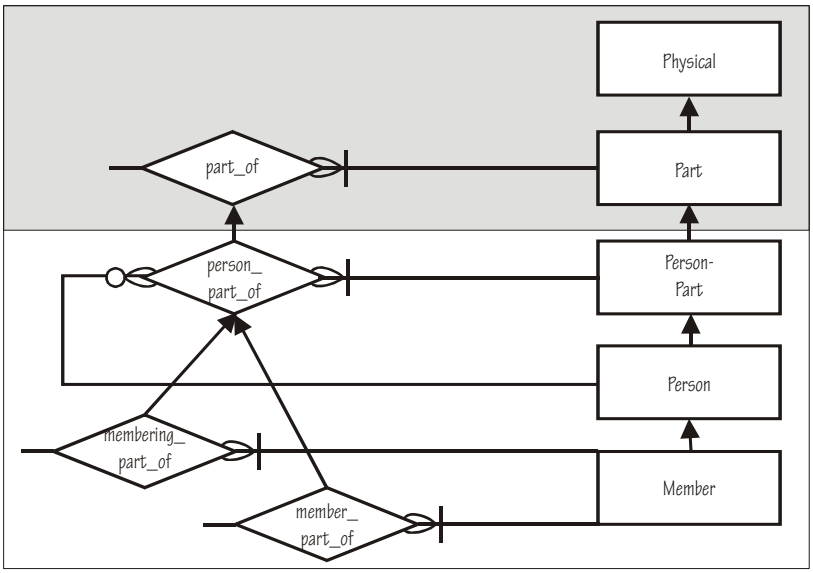

Figure 20 – The person member ontology

Note that we have not assumed that only organisations (intentional persons) have members. This may turn out to be the case, but we have not got enough evidence at the moment to substantiate or explain this.

5.5.3 The member_of SoA perspective

As already noted, there are differences between Member and Unit. A key one being that a member's participation can be spatially and temporally gappy. However, there are also many similarities. Members, like Units, are affairs (in our technical sense) with participants. And in an analog with what happened to TOVE's unit_of relation, TOVE's org_member relation can be interpreted as a member_of state of affairs. A comparison of Figure 20 above with the earlier ontology for unit in Figure 9, clearly shows the structural similarities. This suggests that the pattern for members and units could be generalised – a point we return to in a later section.

It may be helpful to spell out member_of's SoA structure. This is done in the two figures below. The first shows the elements of the SoA member_of type.

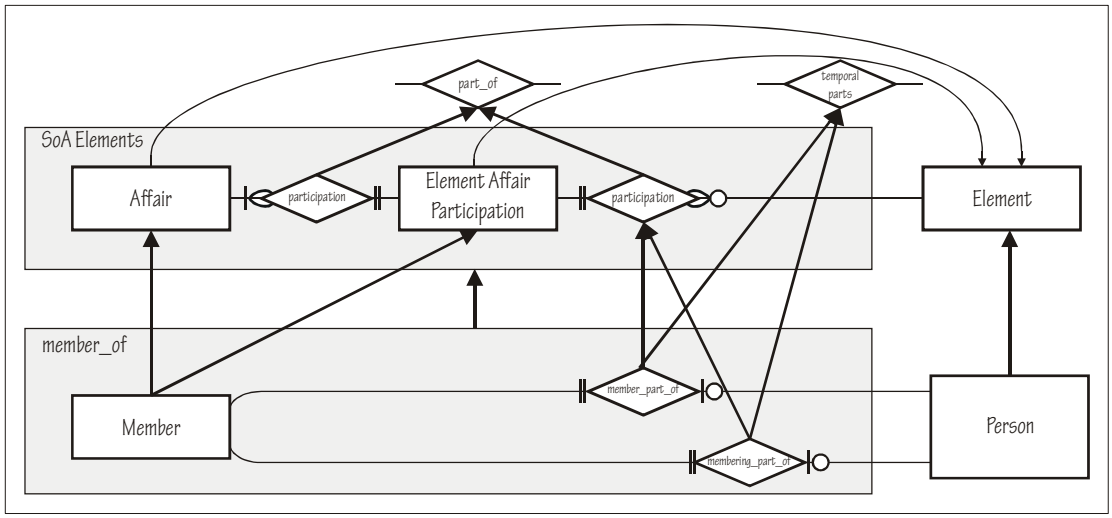

Figure 21 – Member_of SoA Taxonomy

This shows that member_of (like unit_of) has no need for the general SoA distinction between affair and participations. These are the same in a member_of SoA.

The second figure, below, shows an example of a member_of SoA instance.

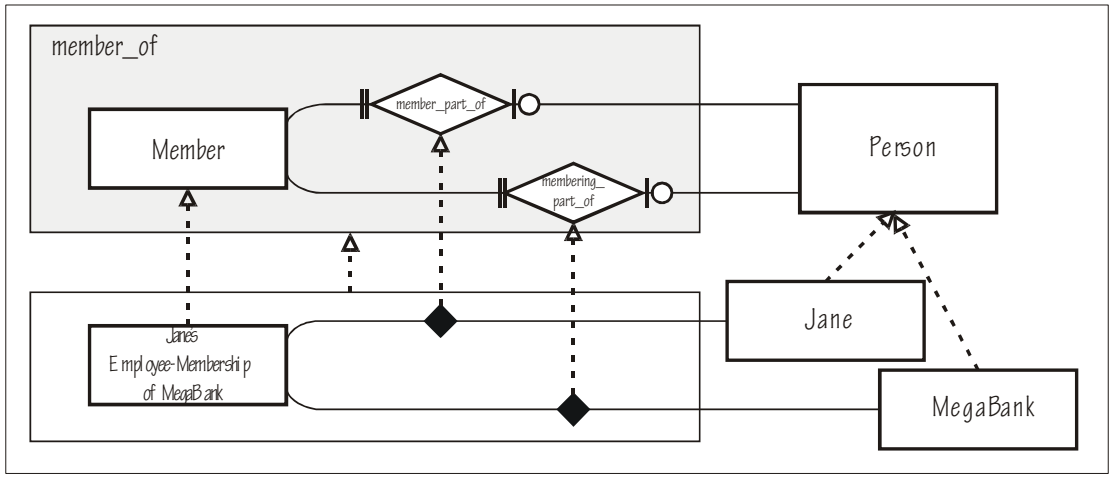

Figure 22 – Member_of SoA Typonomy

5.6 Precisifying member

This framework provides the foundations for making Member more precise.

5.6.1 TOVE's Agent roles as members

In an extract quoted earlier TOVE offered "individuals, like employees and contractors" [7.2] as examples of Agents. It was pointed out that it would be sensible for TOVE to make clear the differences between a 'type', such as an

individual (presumably human being), and the 'roles that she can play', such as employee and contractor. An analysis of bounding conditions would have made clear there is a difference.

TOVE's language seems to imply that it has reified these 'roles' as objects separate from their participants – though its suggestion that they are Agents makes in unclear whether this is what they intended. Within the STPO ontology, these are clearly sub-types of Members.

In practice, there are many different types of Members, typically with different restrictions. Often people can participate in a number of Members in an organisation and its units. For example, Sarah will become an employee (member) of the legal-organisation IBM UK when she enters into an employment contract. It may only be at a later stage that she becomes a team-member of the department she is assigned to. As these memberships are different, they can have different life spans. For example, Sarah may remain a team member of the department as it is spun-off and a new employee membership negotiated.

In the enterprise field, there are a number of reasonably common types of member, which will need to be included in the final CEO. However the scope of STPO is restricted to TOVE, so only the two informally mentioned by it are included at this stage, that is:

- Employee (and associated employee_of SoA), and
- Contractor (and associated contractor_for SoA).

Officially the difference between the two is that a contactor contracts to do certain work defined in term of the results to be accomplished. He or she can carry out the work according to his or her own methods and without being subject to the control of an employer. Whereas an employee contracts to work under the control of an employer, using the methods specified by the employer. However, the tax benefits associated with being a contractor may mean that this 'definition' does not always work in practice.

5.6.2 A succession of participations

How are members dependent upon their participations? In the simplest case, where a Member has only two participants – one participating as a membering_part_of and the other as a member_part_of – intuitively one might feel some simple dependency. The dependency seems less clear in cases where there are a number of Organisations participating as member_parts_of – where these are units of one another. For example, Jane may join Palm – and so also join 3Com, of which Palm is a commercial unit. Provided that Palm remains a unit of 3Com until Jane leaves, both Palm and 3Com participate as member_parts_of. In this pattern there is only one unit_part-of participant modulo unit_of.

What characterises these two cases is that the extension of the participations is the same as the Member (and so, in the extensional scheme of things, identical). Is this a necessary feature of participations? Can a Member persist for longer than a particular participation? This is possible for other events – for example, the people

attending (participating in) a party (an event) do not necessarily have to come at the beginning and leave at the end. However, for Members this initially seems intuitively unlikely. Surely, commonsense says, if the participants change, the Member no longer persists. When Jane leaves Palm and joins Acme, her Palm Member is dissolved and an Acme Member is constructed.

However there are good counter-examples to this intuition. Employment contracts provide a well-documented area for looking at the persistence of membership – when it persists and under what conditions it dissolves. Consider, for example, 3Com's takeover of Palm shown in Figure 5. Jane is a (legal) employee of Palm and as a result of the takeover becomes a (legal) employee of 3Com. Her original Palm employment contract allows 3Com to be a successor – so that there is a single contract (intentional agreement) covering the whole period. Corresponding to the contract is an Employee (-Member) with a succession of employer participating (member_part_of) relationships – first Palm and then 3Com. One can imagine Jane saying "I have been an employee for years – I signed up with Palm but then we were taken over by 3Com."

As this example illustrates it is not the change of participants that is critical, but the persistence of the intentional agreement. In the first example above (Jane leaving Palm), the leaving terminated the employment contract. In the second example (the 3Com takeover), the employment contract persisted through the change of employer.

There may still be a lingering intuition that while member_part_of participations can have successors (as in the example above), membering_part_of participations are immutable. In the prototypical case of employment we do not normally think of one person succeeding another in the employment contract. However this is not impossible. There are some trades in which people talk about the job being handed down from father to son (this used to happen in the old London docks).

This provides more evidence of the need to sharpen our intuitions with regard to the relevance of the intentional agreement in the identity of a Member – taking precedence over its participants. However, our intuitions about the constraints upon participation do contain an insight. In the examples there is a succession of participants with, at any one time, one participant (modulo unit_of).

Succession creates an interesting situation with respect to member_of SoAs. In the Jane example, there is an employee Member but no corresponding employee_of state of affairs as there is no single employer to participate in it. So not all Member events have a corresponding member_of SoA. However, there is a Jane-employee_of- Palm state of affairs. This is dissolved during the takeover and replaced by a Jane-employee_of-3Com state of affairs. As this discussion shows there is further analysis that needs to be done, pick out the various ways in which Persons can participate.

Similar considerations apply to the notion of Unit and the more general notion of Person Constituent that subsumes it and Member. These more complex cases look as though they are amenable to an analysis in terms of Gilbertian plural subjects –

where the participations in the plural subject are not as rigid as simple Member and Unit. However, this analysis is left to a later part of the synthesis.

6 TOVE's Organisation-Position

The third and final TOVE category included in the scope of the STPO analysis is Organisation-Position. The notion of position is an important one within the enterprise field, which TOVE describes as "a formal position that can be filled by an OA in the organisation. Its examples of positions include "president, laboratory director, senior researcher, sales-representative, etc.".

6.1 Clarifying position

The word position has a number of senses – so the STPO started by clarifying which one it was focusing on.

6.1.1 Position's multiple senses

People use position in a number of senses – these include:

- *A particular position* within an organisation normally with specific responsibilities, which is typically occupied by a person. Organisation charts typically show organisation positions and their place in the organisation along with organisation units. Good examples of a position (also sometimes known as an office) is the British Monarch and the American President. This is the sense that the STPO and the other ontologies in the sample focus on.
- *A type of particular position*, such as Managing Director, Chairman, Monarch or President. These are used to classify individual particular positions – in other words, the particular positions instantiate these types.
- *A grade or level within an organisation*, as in "John has been promoted to executive grade 6. Misleadingly, grades are sometimes given names that are also used to refer to particular positions. For example, in the same organisation, vice president may be a grade, whereas Vice President Marketing may be a particular position – and confusingly one may not need to have a grade of the same name to occupy the position.
- *A space within an organisation unit*. For example, someone may say: "There is a dealer position to fill on the FX desk". But not be talking about a particular position (see first sense above). A simple test is to ask whether the position has an identity that transcends the person occupying it. So, for example, if three dealers resign and three more are appointed, do we expect to be able to determine which of the new dealers succeeded which of the original dealers?

From the STPO Person perspective, it is the first sense that is most relevant and we focus on this.

The TOVE examples (mentioned above) can be misleading as they do not clearly distinguish between the senses – for example, is their 'laboratory director' a particular position (the LADSEB-CNR Laboratory Director), a type of position 'Laboratory Director' or a grade in the organisation?

6.1.2 Reifying position

TOVE (like EO) has position as an entity in its own right separate from the person that plays it. Other ontologies (for example, CYC) take a different perspective and treat position as a role that is played by a person – in other words, as a fluent predicate applying to a person. The key difference is that in TOVE/EO there are instances of position, whereas in CYC the position predicate applies to instances of persons at a time.

For the kind of precision required for an enterprise ontology, TOVE and EO are right to reify position (in the sense STPO and it are using it) and treat it as a person in its own right, with its own rights and obligations, separate from those of the person occupying the position. A good example of why this is needed is the notion, mentioned earlier, of Corporation Sole in English Law – of which the prime example is the English Monarch.

The Monarch is treated (in Law) as a person separate from the persons that (serially) occupy the position – with separate rights and duties. When the Monarch signs a treaty or declares war, it is the Monarch that is making the commitment and not the person occupying the position. When a new person starts to occupy the position, the Monarch still retains the commitment[61]. When the person does something outside the powers of the monarch – acting ultra vires – the person and not the Monarch is responsible. In this case the activity is solely part of the activities of the person. When the person acts intra vires, the activity is part of the activities of both the person and the Monarch – but the Monarch acquires the rights and obligations. There are clearly two different things acquiring different rights and obligations. Furthermore the Monarch is clearly performing intentional activities – and so qualifies as a person. The crowning of a Monarch is the intentional construction of an intentional person. Other positions are similarly constructed intentionally. This makes Position, in STPO terms, an intentional person, an Organisation.

CYC's strategy of treating position as a fluent predicate can be interpreted in two ways. Firstly, one could use a general monarch predicate and regard Queen Elizabeth as an instance of this. In this case, one could not track the succession of English Monarch's. Secondly, one could have specific predicates for each individual position. Then there would be an English Monarch predicate of which Elizabeth Windsor would become an instance when she ascended the throne. In

[61] For a more extended description of a reified position see the description of a chairman position in Ch. 7, §3.3.3 *Chairman thought experiment* on pp.153-4 of Partridge (1996) *Business Objects: Re - Engineering for re - use*.

this case, one would have to allow these predicates to have rights and obligations – and explain why some predicates do and others do not have this property.

6.2 TOVE's position ontology

Analysis identified three major ways in which this STPO approach to position diverges from TOVE's ontology:

- Organisation-Position is disjoint from both Agent and Organisation,
- Organisation-Position is not directly related to Organisation, and
- Organisation-Positions are filled by Individual-Agents.

These divergences need to be explained away or synthesised into the STPO.

6.2.1 TOVE's Position is disjoint from its Organisation

A natural interpretation of TOVE is that its Organisation-Position is disjoint from both Agent and Organisation. The disjointness from Agent may be a workable structure in (very) limited contexts, but it is clearly not sufficiently general. Neither is the disjointness from organisation. Both are examples of missed opportunities for generalisation[62].

Like STPO, other ontologies have recognised the opportunity; for example, the Enterprise Ontology, which says the "smallest [ORGANISATION UNIT] may correspond to a single PERSON, in fact a particular PERSON could be seen as corresponding with more than one small OU" – though its explanation of correspondence here may leave much to be desired.

Once the STPO has recognised Position as a sub-type of Organisation, which is in turn a sub-type of Agent, TOVE's disjointness becomes untenable.

6.2.2 TOVE's Position is not related to Organisation

TOVE's Organisation-Position is only indirectly related to Organisation via Organisation-Agent. Where an Agent only occupies one position this may not cause problems. But when an Agent occupies more than one position, it is impossible (using the TOVE ontology) to determine which organisation the position is part of.

For example, if John is the Managing Director of Acme and Chairman of Zenith, then in TOVE's ontology he fills these positions and he is a member of both organisations, but (in what appears to be an oversight) we cannot tell which positions belong to which organisations. TOVE essentially say John is a Managing Director and a Chairman – but does not tell us which organisations these belong to. If John were instead Chairman of Acme and Managing Director of Zenith, TOVE would end up with the same ontology. In TOVE's terms, it

[62] In partial defence of TOVE, when Durkheim produced a list of *social* organisations he specifically excluded positions, offering James the First as an example. Note, however, that Durkheim was interested in social organisations – not organisations in the enterprise sense.

cannot answer this competency question: 'Is the Chairman of Acme related to Acme – and if so, how?'

Once we accept the STPO (and EO) approach that position is a type of organisation – we can see it has organisation's composing relations. Occupying a position is a subtype of the membering_part_of relation, and Positions are typically unit_parts_of their composing organisations. This gives us an ontology where we can answer the competency question. It also saves us the complexity of an extra couple of relations.

6.2.3 TOVE's Organisation-Positions are filled by its Individual-Agents

TOVE assumes that only Individual Agents, roughly corresponding to STPO's natural persons, can occupy positions. As they themselves note, this is too strict: "… in general we assume that positions are filled by individual agents. Note however that a group agent may also fill a position." Even this is still too strict – organisations can also occupy positions, examples illustrating this are plentiful. For example, the European Union, the Presidency of the Council (a position) is occupied by one of the member states. As, for example, happened on January 1st, 2001, when Sweden (a state) took over the position. Clearly persons can occupy positions whether they are natural or intentional (organisations).

6.2.4 STPO's revised taxonomy

Certainly under the STPO notion of organisation (intentional person), positions such as the English Monarch, the Managing Director of Shell and the President of the US all qualify as instances. They are both persons and intentionally rather than naturally constructed. All the analysis seems to indicate that positions are types of (STPO) organisations.

This may seem strange because in English we do not normally call these organisations. However, if we consider the actual use reflected in organisation charts and such like, which decompose the organisation into divisions, departments, sections and positions – then it would seem more likely that positions have something in common with the other unit parts of the organisation.

6.3 Analysing position

If Positions are sub-types of Organisation – what differentiates them from other organisations?

6.3.1 Differentiating position

What differentiates a Position from the other Organisations is that it is intended that it is occupied by one person at a time – in other words, its intentional agreement includes the intention that it is a position. Other organisations might have only one member but this is accidental rather than intended. So, for example, if a Board of Directors only ever had one person (at any one time) as a member this would not make it a position. Sole proprietorships (the business) are a similar

example, as there is no intention that they should only have one member. The sole proprietors are another matter. These are the owners of the sole proprietorship, and it is intended that sole proprietorships are only owned by a single person. So, in STPO terms, sole proprietor is a type of position.

From a practical point of view, restricting the membership of an organisational element to only one person (at a time) has the advantage of simplifying decision-making – there is no need for voting procedures. Hence positions often have decision-making responsibilities.

6.3.2 Positions with multiple members

Things get a bit more complicated when we consider (relatively common) situations where there are multiple members – such as two joint managing directors. If we assume that there is still the intention that only one person should occupy the Position – and that circumstances have forced the unintended situation – then as the intention is intact, it is still a position. The application of the intention is pragmatic, assuming reasonable endeavours rather than a logical definition. But the endeavours need to be reasonable. If the number of people occupying the position – or the length of time they occupy it – should become too great this calls into question the integrity of the intention, and so whether the organisation is really a position.

6.3.3 Position and organisation identity

There is another relevant aspect of the pragmatic nature of intention – that it is provisional. Acme could establish a Managing Director position – and explicitly state (and intend) it is going to be a position forever. However, when circumstances change it is at liberty to revise that decision.

We can see the results of this where a number of managing directors are organised into a board. For example, the German Bank Dresdner has a Board of Managing Directors, which currently has nine members. This has joint responsibility for the management of the company, and decides on the assignment of individual areas of business to its members. Clearly this board is not a position.

If we consider how this situation may have arisen, then this sharpens our intuitions of identity for positions. If we assume that Dresdner Bank was once so small that it only had one managing director – which would have been a position. Then it seems perfectly possible that this position evolved into the current board. It also seems possible, even likely, that it is the same organisation that was a position and is now a board. This reveals position as a form of an organisation – rather than a type. So one can think of the ‘managing director’ element having a position form at one time and evolving into a board form over time. It is this element that is often called one of the executive organs of the company – and not the position per se.

If the organisation (position) does not change form, then the organisation and the form are (in the CEO’s extensional scheme of things) identical. So many managing director positions are organisations. Whereas if the organisation does

change form – then the position form is a temporal stage of the organisation. So Dresdner's managing director position and board of managing directors are temporal parts, unified by form, of the managing director organisation.

This raises the question of whether these temporal stage forms are themselves organisations. Whether, more generally, positions are necessarily organisations. Certain types of forms can necessarily be organisations. There is clear example of this in certain legal jurisdiction's treatment of legal forms. In many jurisdictions, if an organisation changes legal form – for example, a partnership incorporates – then the law treats the two forms as two separate persons, where one is the successor of the other[63]. However in this case the necessity does not seem to attach to the legal form independently of the legal jurisdiction – but is enforced by it. We can imagine a legal jurisdiction that allowed changes of these kinds of legal form without dissolving the person (they have different identity conditions and so are different types). It seems that the Dresdner-type cases work in this way.

There is an intentional agreement that underlies the managing director organisation, giving it identity. The position temporal stages do not have the same kind of agreement. Furthermore, people do not think of these temporal stages as acquiring rights and obligations that terminate with the stage. There seems no reason to assume that the rights and obligations of the managing director are dissolved merely because it shifts its form from a position to a board.

This insight changes our understanding of the taxonomy. Position now becomes a type of Organisation-Stage rather than an Organisation. This does not exclude cases where a Position is an Organisation, it merely allows for cases where it is a temporal stage.

6.4 Position's composition 'relations'

There seem to be two kinds of commonsense composition that need to be accounted for. People talk about someone occupying a position (TOVE has this relation in its ontology); Organisation charts show positions as parts of companies (TOVE does not have this relation). How are these explained?

6.4.1 Positions that are Organisations

STPO has a straightforward explanation in cases where Positions are Organisations. As such they inherit the unit_ of and member_ of SoAs from Organisation. A person occupying a position is a person participating as a member_of the Position / Organisation. A Position within a Company is a Position participating as a unit_of the Company.

[63] The Enterprise Ontology covers the legal forms of an enterprise – specifically partnership and corporation – and we will synthesise these into the CEO when we synthesise the EO.

6.4.2 TOVE's composing relations

TOVE goes some way to describing the commonsense composition. TOVE's has only one composing relation: Organisation-Position filled_by Individual Agent. In the STPO, this is re-interpreted as the member_of SoA – inherited from Organisation.

TOVE has no 'relation' corresponding to unit_of for its Organisation-Position (this seems a bit of an odd oversight given its ubiquity in descriptions of the enterprise).

6.4.3 Member_of composition

Organisations, at a point in time, can but do not have to have members – and often have many members. Positions also, at a point in time, can but do not have to have a member. There can be empty positions. Positions, as noted earlier, can have more than one member at a (point in) time – though not an excessive number for an excessive length of time.

Once Position's occupied by relation is subsumed under member_of, inherited from Organisation, there seems to be no need to apply any additional constraints to the member_of SoA (and associated member relations) for Positions – and so the occupied by relation is redundant, not adding any relevant information.

6.4.4 Unit_of composition

Organisations may but do not have to be units_of one another. However, one normally associates a Position with an Organisation – in other words, a Position is typically a unit_of an Organisation. But is it necessarily so? There are counter-examples. Consider titles such as Duke of X, or Count of Y. They may be 'constructed' in a particular society, but they are not necessarily part of that society or any other organisation. The Duke of X may be born in England (English Society) but move to other countries without him or his children losing their title.

One also normally assumes that a Position does not have any units – at least at a point in time. It has temporal stages – but these are not persons and so not units. However consider this. The Queen of Britain, 'in her role as Queen of England', is (automatically) also Queen of Canada, Australia and New Zealand and a host of other countries scattered around the world from the Bahamas and Grenada to Papua New Guinea and Tuvalu. So every activity of the Queen of Canada is also an activity of the Queen of Britain. This seems to make the Queen of Canada a unit_of the Queen of Britain. It seems as if the specialisation of the unit_of relation to Position is not simple and unrestricted, as the unit_of a Position also seems to be necessarily a Position. However this needs more analysis – and for now we assume that the specialisation is simple and unrestricted.

Position inherits Organisation's unit_of SoA, and – given the assumption above – there seems to be no need to apply any additional constraints to it (and its associated unit relations) for Positions – and so it is redundant.

6.4.5 Non-organisation positions

The intentional composition unit_of and member_of SoAs are between organisations. As noted earlier, a position may only be a temporal stage (unified by form) of an organisation. In this case, it does not participate in the organisation's SoAs. This example may make the point clearer.

Consider what happens if Mr Smith is Acme's Managing Director (a position) and Acme change their constitution so that the position evolves into a Board of Managing Directors – taking Mr Smith as its 'founding member'? Is the member relation with the MD Organisation, or with the MD Position? If it were with the MD Position, then we would expect Mr Smith to resign his MD Position and be appointed to the MD Board. However, in this example, this does not happen. Mr Smith's participation as a member_of is unaffected by the change in form from position to board.

This analysis allows us to unbundle statements such as "Mr Smith occupies the Managing Director Position" as Mr Smith occupies (is in a member_of SoA with) the Managing Director Organisation – which is currently in a Position state. This more precise formulation allows us to deal with the problematic cases where the position evolves into a board.

More generally, statements about position composition can be unbundled into statements about organisations. The consideration of cases where positions are organisations shows that the STPO ontology already has the relevant structures to deal with these.

6.5 TOVE's Position authority relation

TOVE claims "…positions define certain authority relations with other positions in the organization. The "laboratory director" position for example also implies authority over any "senior researcher" position in the respective organisation unit." It is true that the intentional agreements that unify a position may well, at any one time, include agreements about authority relations.

However, these can change over time – and anyone who has experienced a serious re-organisation can testify, authority relationships can be changed substantially. It may be true that we may wish to regard the "laboratory director" position type as having specific responsibilities – in that case, when an instance has those responsibilities re-organised away, the instance would no longer be of that type – and the type revealed as a fluent.

The whole issue of authority is wider than just positions. As noted in the analysis of organisation, there are typically authority relations between organisation units – and between positions and organisation units. There are also well-known problems of determining whether control or authority exists between organisations – with some jurisdictions giving a formulaic definition of a subsidiary in terms of a 51% holding. There are also features that need to be explained – such as why authority can be delegated and responsibility not. A general framework needs to be developed that can cope with this. There is

insufficient data in TOVE to do this; the CEO's commitment to empirical investigation means that it cannot undertake a proper investigation. This will need to be done later in the CEO synthesis, when sufficient data is available.

6.6 Position ontology

The STPO analysis has resulted in these changes:

- TOVE's Organisation-Position is renamed Position and subsumed under Intentional-Person-Stage.
- TOVE's filled_by relation is re-interpreted as a relation with Organisation rather than Position, subsumed under member_of and eliminated as redundant.
- Intentional-Person-Position is introduced to indicate that Position overlaps Intentional-Person.

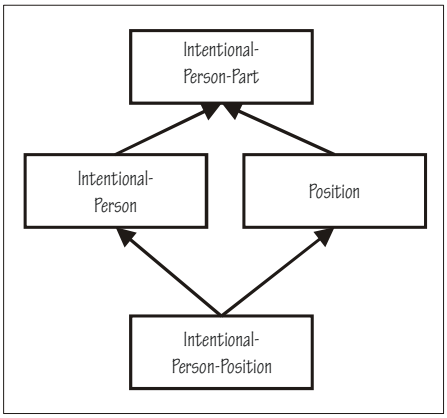

Figure 23 – Position ontology

There is no need to include the composition relations as these belong to Intentional Person.

7 Generalising STPO

The STPO analysis has uncovered two areas ripe for generalisation. These are:

- Unit and Member, and
- Participation relations

7.1 Generalising Unit and Member

The common nature of Unit and Member not only raises questions about how they are related – but also suggests that they can be generalised.

7.1.1 Generalising to Party

Standing back and looking at unit_of and member_of, one can see that these are different ways for persons to participate in organisations. In ordinary language the words get drafted in to do multiple tasks – in this more formalised structure it

makes sense to use each name for only one task. However, this presents us with the task of choosing these names – where there is no obvious candidate. The STPO proposes to call the generalisation of Unit and Member, Party – and by extension the SoA, party_of. The generalised ways of participating are to be called party_to (generalising unit_part_of and member_of) and partying_part_of (generalising unit_stage_of and membering_part_of).

Party is meant to capture all possible ways in which a Person can intentionally participate in an Organisation. The interesting question is whether Unit and Member exhaust the ways in which Persons can be Parties. At the moment this is difficult to assess as Member has little or no restrictions on the way in which a Person can participate – and Unit seems to be a limiting case of a member, one where *all* its activities are unrestrictedly parts. However, this is not to say that further analysis will not turn something up.

The phrase (used above) 'the ways in which Persons can be Parties' suggests another potential issue. Unit and Member are forms of intentional agreement – and one of the characteristics of intentional agreement is that they are revisable. So, in principle, the form of a unit agreement could be revised to make it a member agreement – and vice versa. This would then make Unit and Member, like Position, forms of organisations – and so organisation stages – rather than organisations. However, there is no empirical evidence to suggest that this happens[64]. With the current evidence, it seems sensible to assume that units and members are parties.

7.1.2 Transitivity of Members and Units

In previous sections, the transitivity of unit_of and member_of has been examined. The generalisation to party_of suggests questions about how transitivity works across member_of and unit_of. A natural question is whether (and how) membership is necessarily (synchronically) inherited up the unit hierarchy.

For example, what happens if Sarah joins an organisation that is a unit of another? She is a member_of this organisation, but is she then also a member_of the top organisation? Consideration of commercial practice, where membership is often more formalised, furnishes relevant examples. Consider the legal_employee_of SoA in terms of legal employment (in Western law). This regards one as a legal_employee_of a specific (legal) organisation. If Sarah is (legally) employed by Palm Inc., then she is not legally employed by 3Com (at a time when Palm is a commercial – but not legal – unit_of 3Com – see Figure 5).

The next question is whether there are specific types of membership which can be (synchronically) inherited up the unit hierarchy. There seem to be some. For

[64] A potential example may be a person who becomes a priest. He or she starts as a member of the church and then when the priest is consecrated, he or she becomes a unit of the church. This needs more analysis; in particular, whether these are two stages of the same party, or different parties with a successor relation.

example, if Susan works for (is a working member of) IBM UK's Marketing Department, then we have no problem saying that she also works for IBM UK and IBM. Inheritance depends upon the type and nature of the SoA types involved.

7.1.3 Introducing a general party ontology

We firstly lay out the general party ontology below and then fit the unit and member ontologies underneath it.

7.1.3.1 The general party ontology

The steps for the general party ontology are:

- Introduce Party – as a sub-type of Person.
- Introduce the party_part_of relation with Party playing the part role and Person playing the whole role, and subsuming it under person_part_of.
- Introduce the partying_part_of relation with Party playing the part role, and Person playing the whole role and also subsuming it under person_part_of.

The resulting ontology is shown below.

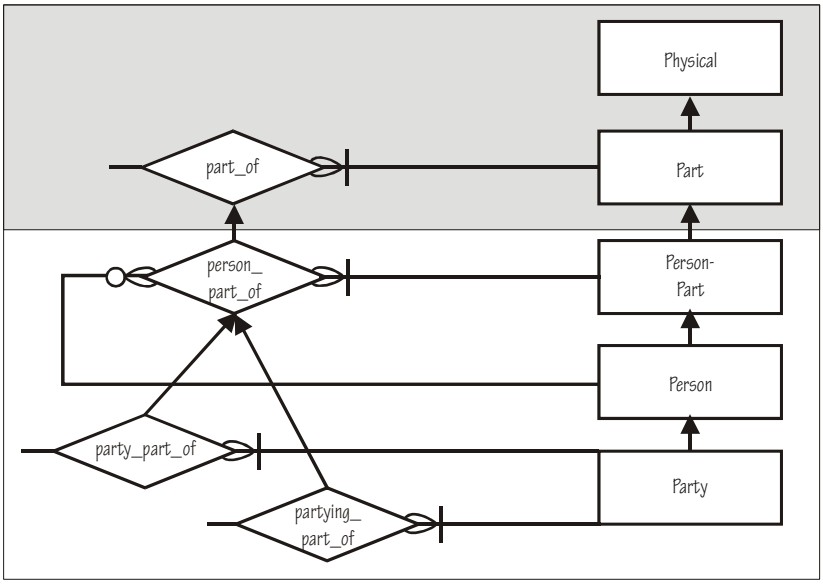

Figure 24 – The general party ontology

7.1.3.2 The subsumed member and unit ontology

The member and unit ontologies (diagrammed in Figures 9 and 20) fit neatly under the general ontology. The necessary steps are:

- Recognise Member and Unit as sub-types of Party.
- Recognise member_of and unit_part_of as sub-types of the party_part_of relation.

- Recognise membering_part_of and unit_stage_of as sub-types of the partying_part_of relation.

The resulting ontology is shown below.

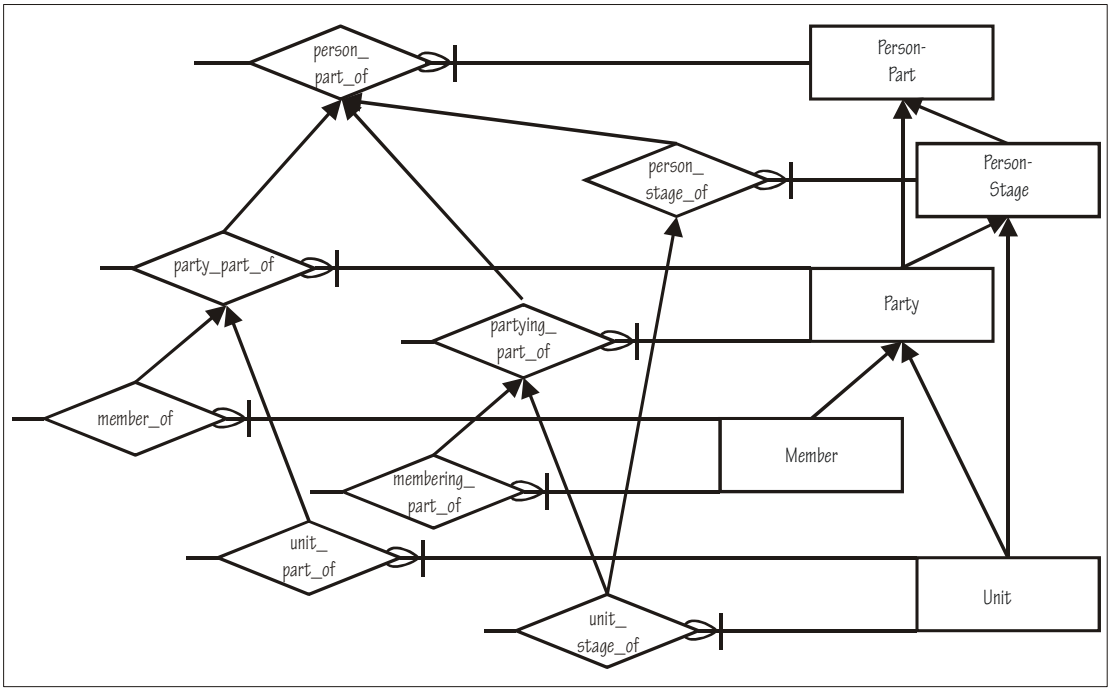

Figure 25 – The subsumed member and unit ontology

7.1.3.3 The SoA perspective on generalised party_to

It may help if the SoA perspective on party_to is also shown. This is done in the figure below.

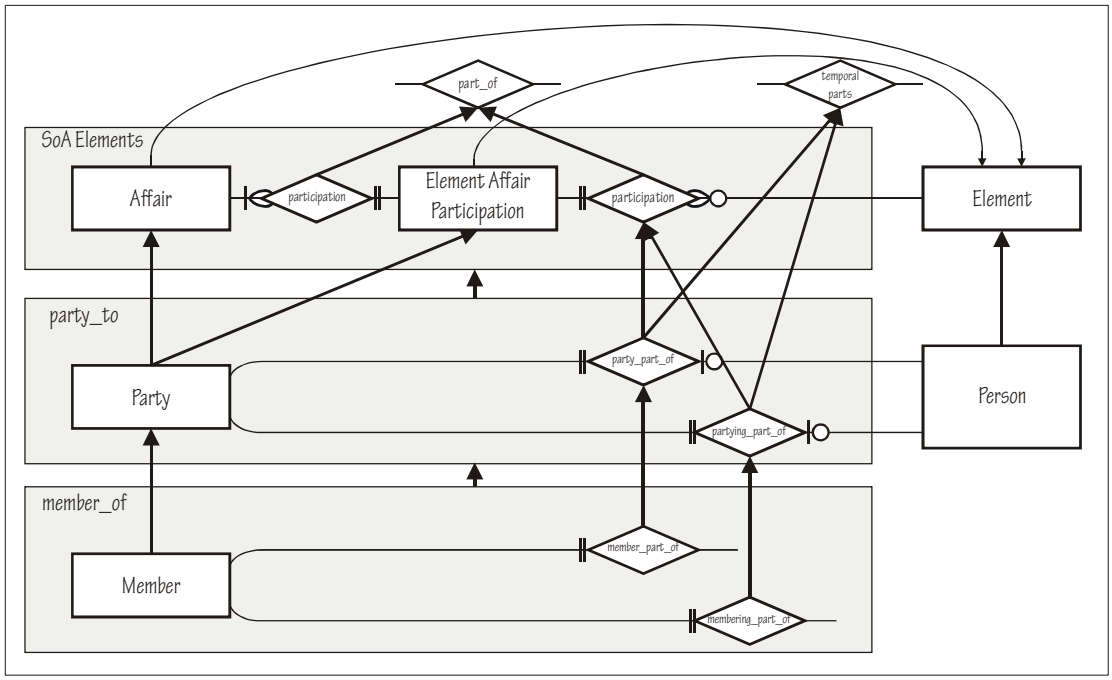

Figure 26 –Party_of SoA taxonomy

This shows the taxonomy including member_of but excluding unit_of.

7.2 Extending the range of the participation relations

One of the ways in which the generality of the ontology can be compromised is unnecessary restrictions on its relations – thereby excluding valid situations. So, within the STPO, it makes sense to test the restrictions on the participation relations.

7.2.1 Restrictions on being Units

In TOVE there is the restriction that only an Organisation can be a unit_of an Organisation and vice versa. In other words, the participants in a Unit – as a unit_stage_of or a unit_part_of – are always Organisations.

7.2.1.1 Restrictions on being a Unit

Restricting participation as a unit_stage_of to Organisations seems to have its roots in the notion that natural persons (typically humans) will not and should not *literally* give themselves body and soul to an organisation – such that their every activity is a part of the organisation – making them Units rather than merely Members. For those used to working for commercial organisations, this seems reasonable. It seems counter-intuitive to regard *every* activity of even the most extreme workaholic as part of an enterprise.

This is mostly true. But there are a number of situations that provide counter-examples. Admission to the priesthood of religious organisations, such as

Christian Churches, seems to involve a full commitment of body and soul that would suggest a Unit rather than a Member participation.

An old fashioned view of the family seems to work in the same way. There are remnants of this in ordinary (English) language, where we talk of being a part of a family. And, it seems more natural, even nowadays, to regard children (especially young children) as being unreservedly Units rather than just part-time Members.

As noted earlier, this example also provides a useful counter-example to the notion that both the parties to a unit_of relation need to exercise intentionality. A child becomes a Unit of the family as soon as it is born – before it can exercise intentionality. The family (and wider society) provide all the intentionality required.

In many ways a very young child is more of an agent than a person (in the technical STPO sense). This suggests that Agents can also be Units of Organisations. One talks about pets being part_of the family – and there is often an intentional decision to adopt a pet.

These examples seem to indicate that TOVE is too strict; that Agents, whether Persons or not, can participate as unit_stages_of Organisations.

7.2.1.2 Restrictions on having a Unit

TOVE also restricted the participants as unit_parts_of to Organisations. Is this also too strict? For example, can natural persons have units? This raises questions about the basis of the distinction between naturally constructed and intentionally constructed persons.

An example from archaic English common-law illustrates the problem. In its jurisdiction, a husband and wife were regarded as one person in the eyes of the law[65], where a wife "lost" her own legal personality, which became incorporated into that of her husband. In this case the wife becomes a Unit of the husband. Here a natural person (the husband) becomes composed, through marriage, of more than one natural person. (Searle 1995) makes the point that socially constructed objects need to be both constructed and maintained. In this husband and wife example, the initial husband stage of the person is naturally constructed and maintained, and the husband and wife stage is intentionally maintained.

One can still make sense of the natural and intentional distinction, if one regards it as referring to the initial creation of the person – naturally or intentionally conceived. If one takes this view, then it is possible for natural(ly conceived) persons to have other natural conceived persons as units. However, this means that the distinction does not relate to the whole four-dimensional extent of the person, but to its initial temporal boundary (its start boundary event); it is not intended to characterise the later stages which may include shifts between natural and intentional stages. Given this position, it makes sense to revise the TOVE constraint and recognise that both natural and intentional persons can, in certain

[65] A practice known as *unity of personality*.

circumstances, have a unit_part_of participating relation – and so this can be generalised to Persons.

But can the constraints be loosened further, to include, for example, non-person agents? This would enable Persons to participate in an Agent, where the Agent is not a Person. This seems to happen – a mob of people may be an example. People can intentionally join and leave the mob, but it seems to have no intentionality of its own. This needs more analysis, but an unnecessary constraint can be awkward. Therefore, the STPO proposes to let Agents have Agents as Units; in other words, allow the unit_of SoA to hold between Agents. Hopefully later analysis will further clarify matters.

7.2.2 Generalising Unit to Component

Here we are coming close to the border between being a Unit and merely being another kind of Part – and these are murky waters. The problem is that there are many ways in which one Agent can be part_of another than do not seem to involve being a Unit in the technical STPO sense. One's heart is a component of one's body – but it is not a Unit as there is no intentional agreement involved.

Component seems to a halfway house between a mere Part and a Unit. It has more unity that Part and less than Unit. One can see components and units as ways of being parts, where component are a general, weaker, kind of Unit. Consideration of components takes us into much wider territory than Agents; many types of physical object that do not have units or members, have components. This is fruitful territory for analysis, but outside the scope of the STPO.

7.2.3 Restrictions on member_of

TOVE restricts member_of to being between an Agent and an Organisation. However there is a natural argument that it should be restricted further only allowing persons to be members – as only they can intentionally agree to be members[66]. This assumes that the intentional agreement has to involve intentions from both parties. While this may often happen, it does not always (and so is not necessarily) the case as these counter-examples show.

7.2.3.1 Restrictions on being members

A flagrant counter-example is the Roman Emperor Caligula's appointment of his favourite horse, Incitatus, as a consul. His motive may have been to highlight the fact he thought the horse would do a better job than most of the recent incumbents, but this does not invalidate the appointment of a non-person Agent. Incitatus' lack of intentionality causes no problems as the intentional content is supplied by Caligula.

[66] TOVE provides a counter-example - its virtual manufacturing enterprise as a multi-agent system (presumably an Organisation) with an Order Acquisition Agent and a Logistics Agent.

More mundane, commonplace and, perhaps, convincing examples are machines (agents) that enter into contracts on behalf of their organisations: for example, ATMs that process cash withdrawal requests and car park ticket machines. It seems intuitively clear that these contracting activities are part_of the organisation.

At first sight the relation between the machine and the organisation might not appear intentional. But consider the installation of the ATM. It was clearly intended – by the organisation – to allow customers to make cash withdrawals. Where this intention is missing, for example if the ATM is 'illegally' installed and used by persons other than the organisation, its activities would not be legitimised by the organisation – and so not part of it. The organisation's intentional installation creates a Member – for the intended classes of activities.

The proposed restriction of members to persons is too strict. The motivating perception that members need to intentionally agree to be members is also too strict. As these examples show, it needs to be watered down to a requirement that the activity constructing the Member needs to have some intentional content. This, in turn, means we can, following TOVE, recognise that being a member can be generalised from the level of Persons to the level of Agents.

7.2.3.2 Restrictions on having members

TOVE restricts having members to Organisations. In principle, there seems to be no obvious reason why naturally constructed persons should not also have members. As noted earlier, in archaic English Common Law a husband would have his wife as a unit – could there not be corresponding cases for members? However, analysis has not revealed any conclusive examples of (though we discuss some inconclusive ones in the Further Work Section below), and without these it is probably sensible to leave the matter open – to be (hopefully) resolved later.

However, there are non organisational Agents that have members, mobs being a salient example. So, there seems to be a good argument for generalising the member_of SoA to being between Agents.

7.2.3.3 Types of member_of and corresponding types of Organisation

So far we have been examining the restrictions on the general membering_part_of and member_part_of participating relations. It is not with the scope of STPO, but the CEO will need to look at the restrictions on the various sub-types of Member and how they relate to the various sub-types of Person. For example, the owner (owner-member) of a sole proprietorship may be restricted to humans. And, depending on the jurisdiction, the members of Boards of Directors may also be restricted to humans.

7.2.3.4 A new party ontology for agent

The analysis seems to be pointing us in the general direction of allowing party_of and its sub-types member_of and unit_of to apply more generally to agents. In this case, members and units are agents but not necessarily persons. This is shown diagrammatically in the figure below:

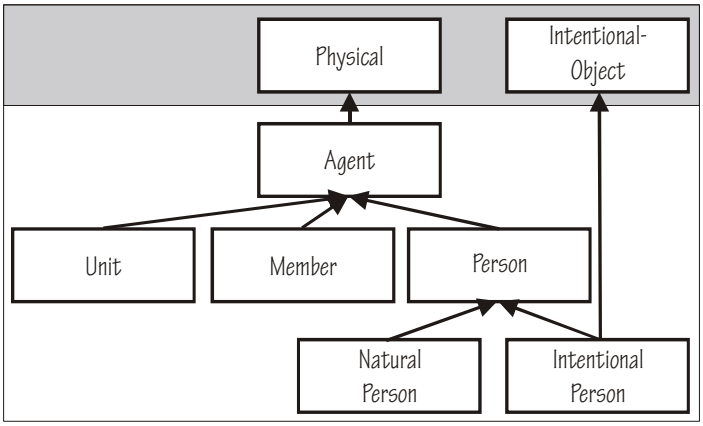

Figure 27 – Re-revised agent ontology

The party participating relations diagrams need to be updated to reflect this. This is done in the following two figures.

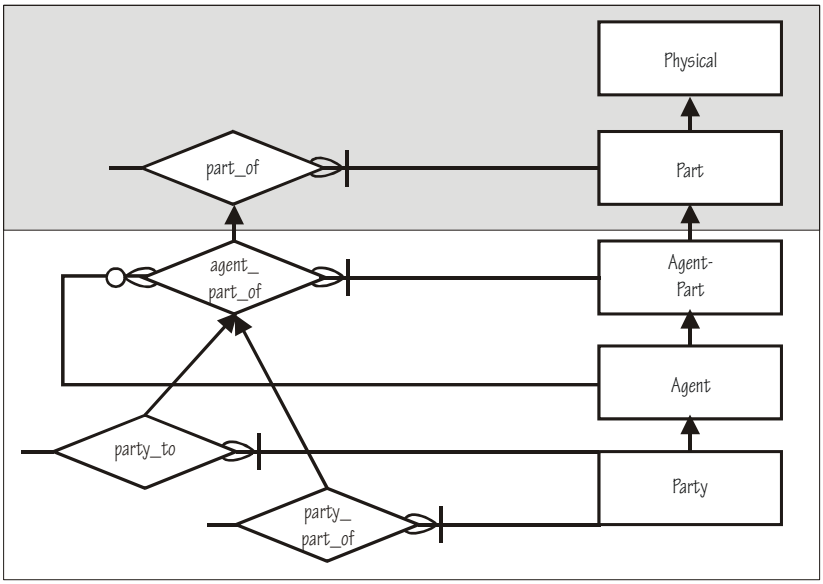

Figure 28 – Agent party participating relations ontology

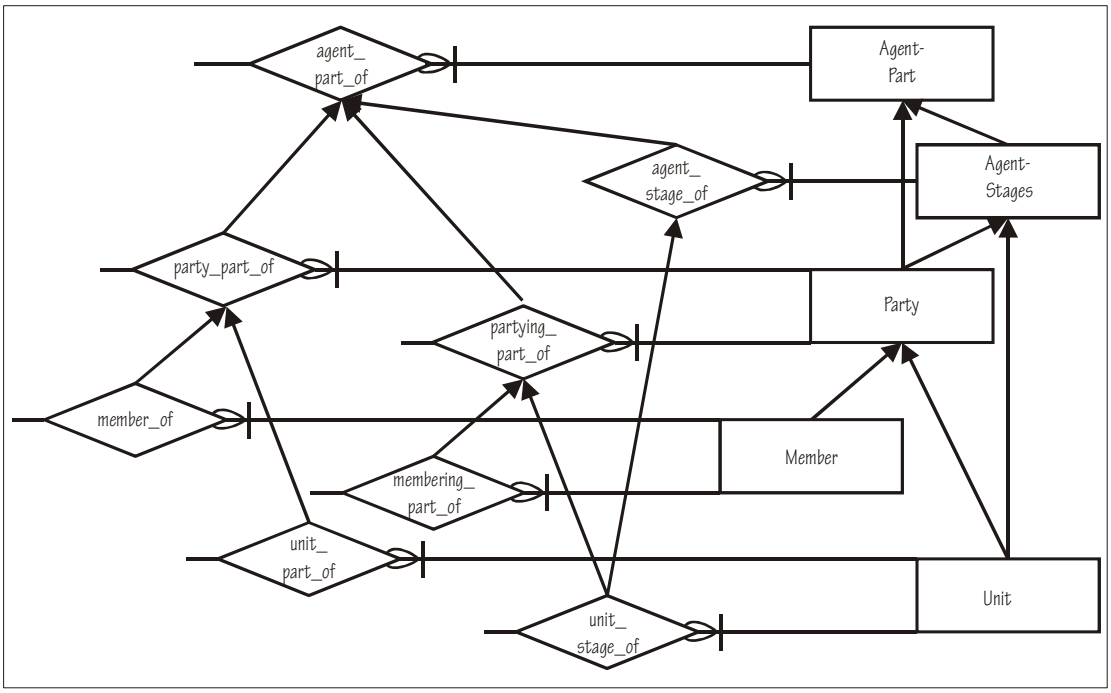

Figure 29 – Agent member and unit participating relations ontology

8 Further CEO work

As already made clear, the STPO is merely an initial stage of the CEO project. There remains much further work to do. It makes sense to summarise here further work that the STPO analysis has highlighted. This can be put into these two categories:

- Areas where the ontology needs to be extended, and
- Areas that require more analysis.

8.1 Extending the ontology

There are two main areas where it has already been noted that the ontology will need extending, these are

- Organisation types, and
- Bounding events.

8.1.1 Include a taxonomy of organisation types

At some stage, the CEO needs to develop a taxonomy showing the specific types of organisation. The notion of organisation has a broad scope including such entities as: commercial organisations, nation-states (e.g. United Kingdom), governments, and Non-Governmental Organisations (NGO), such as Chambers of Commerce (Appendix B contains further examples).

With the focus on the enterprise, commercial organisation will need to further broken down. This will include 'legal form' types such as: partnership, sole trader, corporation (company), and association – and will attempt to account for some of the variability across jurisdictions. It may also be worthwhile to try and classify their typical organisational components – such as Board of Directors, as well as positions such as Managing Director. Though, as noted earlier, this may require careful analysis as there seems to be a wide variety of types of components.

In addition, the relation between legal forms and legal jurisdictions will need to be clarified. We need a framework that can explain what it means to be recognised as a legal person by a jurisdiction – and account for facts such as that a company may be recognised in one country but not another. And also the finer distinctions in some legal systems – such as between a 'persone juridicale' and 'persone ficale' in Italian Law. This is related to questions about what a person is – as noted in the next section.

Classifications of organisations may also need to be accounted for – especially legal ones such as 'for-profit organisation'. However, it may well turn out that these are organisation stages rather than organisations.

8.1.2 Bounding events

The type bounding event was introduced to act as a placeholder for future work on classifying the how the different combinations of bounding events characterise the typical events of corporate life. This would include analysis of terms such as merger, reverse takeover, management buyout (MBO) and leveraged buyout.

8.2 Areas that require more analysis

The STPO analysis came across a number of areas where the current ontology does not seem to be intuitively right – where there may need to be further analysis to either revise our intuitions or the analysis. These areas include:

- States of affairs,
- Counting as a natural person,
- Enterprise agents and extension,
- Activities, states and extension, and
- Ownership and extension.

8.2.1 A formal analysis of states of affairs

The analysis of unit_of introduced the notion of states of affairs – and affairs – into the STPO. This analysis was relatively informal but was sufficient for the purposes of the STPO. However, it was noted (correctly) that a more formal analysis would be required for the final CEO. As also noted, this can be fruitfully used to investigate the relationship between relations and states of affairs.

8.2.2 Counting as a natural person

At some stage, 'human being' will need to be introduced to the CEO taxonomy. Then a question of whether (and, if so, how) natural person subsumes human being will naturally arise. This throws up some issues, some well-known, others less so. To resolve these, more work needs to be done clarifying how to deal with non-human natural persons and what a natural person is in relation to human beings.

8.2.2.1 Non-human natural persons

Human beings are, for us, the classical exemplars of natural persons. But, as science fiction makes clear, it is possible to imagine intelligent alien species that unequivocally qualify as persons. There are classification problems closer to life here on Earth. For practical reasons, well-codified western law currently tends to regard the categories of natural person and human as inter-changeable[67]. Against this view, are ranged arguments that we are guilty of specieism[68] when we simplify things in this way. At least, it is not obviously certain that humans are the only species currently on Earth that can act intentionally as persons and so deserve the title of Person.

The root of the problem is that the biological classification of species and the enterprise classifications based upon agency and intentionality are driven by very different considerations. And this results in both conceptual and empirical grey areas, where it is not clear how to proceed. For now a practical policy is to keep the options open. To first recognise that there can be non-human natural persons, but within the ontology to sit on the fence as which species may fall under this classification. This, essentially, leaves a decision on the matter to the users of the ontology.

8.2.2.2 Human non-persons

For most enterprises the simplification that human is subsumed under natural person is probably adequate. And we can make it seem less of an over-simplification by refining (distorting?) what we regard as a natural person.

We started with a description of person as something:

> "capable of intentionally acquiring rights and obligations".

Do we interpret this as saying that 'being capable' is an essential attribute of a person – one that they have to have all the time? We can test this against our intuitions by asking what happens if an Agent is capable at one time and then not

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[67] *Natural person* - A human being. From the *Dictionary of Law*, Oxford University Press, 1997.

[68] Where specieism is defined (in Singer (1991) *Animal liberation*) as "[a] prejudice or attitude of bias toward the interests of members of one's species and against those of members of other species." Though the main speciest arguments are directed against special rights for human rather than only humans having intentionality – and so personhood is not typically claimed for every species of animal.

capable at a later time? Is the Agent a Person that is capable at one time and not at the other – or is there an Agent and a Person (who is capable) at first and then only an Agent later? This has practical implications – as it is clear that human beings are not always (at every point in time) capable. For example they seem incapable while they are asleep or when they are really drunk. But in these circumstances we do not deny them personhood. Our intuitions seem to regard essential capability (that is, always being capable) as too stringent a requirement on persons.

There is some corroboration of this in the law, which seems to recognise restrictions on capability, without denying personhood. For example, stating that someone seriously drunk cannot enter into a (legitimate) contract. The law recognises changes in a natural person's capability but does not see this affecting his personhood. Note in passing that similar situations occur in organisations. If a board of directors is not quorate, then it cannot make any decisions, so is not capable. But this does not stop us thinking of it as an Organisation (or Agent) and hence a Person.

It seems that a more relaxed view of capability that assumes a person is normally (rather than always) capable, is closer to normal usage. But there are still awkward counter-examples. We regard small infants as persons even though they are not (at that stage in their life) normally capable[69]. We regard humans who are never capable (due to, say, a handicap or a short life) as persons. One could argue that it is possible that they might have been capable – or that we should think of personhood as a property of the type human – and inherited by all its instances. More cynically, one could recommend this as a practical simplification to avoid morally difficult questions.

Either way we need to recognise that one of the practical concerns driving personhood is the facilitation of transactions involving future commitments and rights. In everyday life this means we need to be able to easily identify who we can enter into transactions with and re-identify them when we want to exercise our rights. This motivates a simple system where humans are simply regarded as natural persons, managing by other means the niceties of varying capabilities within this classification. In this case, the key issue become determining what kinds of personal actions one can hold the person responsible for.

8.2.2.3 Legally recognised person as a relation

It may seem that legal systems are an example of this. Modern Western systems start by recognising all humans as natural persons – and then refine the shades of personhood. However, legal personhood is really a different kind of property. It is really a kind of relation between persons and legal systems.

It is often simply assumed that a legal jurisdiction is trying to establish a fact about an agent – whether it is a person. But when one considers that a corporation

[69] Gilbert (1992) *On social facts* discusses a similar case of capability of infant members of a tribe on p.233.

operating in one jurisdiction is often not recognised as one in other jurisdictions one realises that this is too gross a simplification. There is not even consistency as to what types of corporation legal jurisdictions will recognise in their territory. For example, a partnership is legally recognised as a person in Scotland but not in England.

A better explanation it that legal jurisdictions are trying firstly to establish a fact – whether the agent is a person – and secondly, if it is a person, whether to allow it to be treated as such under its laws. The original archaic process of outlawry[70] supports this interpretation – this does not deny the outlaw is a person, just his protection under the law. But severely handicapped persons (discussed above) provide a counter-example. Here the law seems to be saying they are persons, despite their lack of capability. Furthermore, in some cases, the law is not only recognising that an agent is a person, but involved in the process of conferring personhood: an example would the legal process of setting up a company.

As this discussion has made clear, there is still some work to do in refining the concept of legal person. It is anticipated that this will be done as the full CEO is developed.

8.2.3 Enterprise agents and extension

A look at the common enterprise notion of an agent also reveals counter-intuitive results that need a closer analysis. Within the enterprise, a common method of doing business is through an agent – here 'agent' is used in the (different, narrower, enterprise) sense of "a person [who] is appointed by another (the principal) to act on his behalf, often to negotiate a contract between the principal and a third party …" [71]. In the STPO approach to organisations and their members sketched here, this sense of agent has a natural interpretation: it is a kind of member_of. The agent's activities on behalf of the principal are part of the principal's activities. For organisations applying this interpretation seems intuitive; however, applying it more generally to the full range of persons can lead to counter-intuitive results.

8.2.3.1 Organisation's mercantile agents

Where the principal is an organisation, regarding the agent as a member makes intuitive sense. For example, in commercial law, there is the notion of a mercantile agent[72]. There seem striking similarities between the activities of an employee and an agent. And so it makes sense to regard them in similar ways: to regard the agent's activities, undertaken on behalf of the principal, as also

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[70] Originally outlawry was the putting of an individual outside the protection of the law of the land, by a legal decision of the King or his courts - denying him his inherited privileges at law.

[71] *Dictionary of Law*, Oxford University Press, 1997

[72] An agent "having in the customary course of his business … authority either to sell goods, or to consign goods for the purpose of sale, or to buy goods, or to raise money on the security of goods." Defined in Section 1 of the Factors Act 1889.

activities of the principal – just as the activities of an employee are. Under the STPO approach this makes them part of the extent of the principal. And this seems uncontroversial. An organisation will talk of having a presence in a country where its only representative is a mercantile agent.

This explanatory benefit of this approach is particularly obvious when the agent is acting as a broker in a contract, and so the principal is a party to the contract. It seems odd that the principal can be party to an event (the contract) when it is not directly involved. The STPO approach reveals the direct involvement.

8.2.3.2 Human's enterprise agents

When we start applying the same principle to a human person's agents the results are less intuitive. Consider Sally who lives in England purchasing a house in France. To make things easier she has a legal agent in France who will enter into the contract – in which she is a principal – on her behalf. The STPO approach suggests an interpretation where the legal agent's activities on behalf of Sally are part of Sally's activities. But this runs counter to our strongly held belief that a human person's extent is bounded by their body. On the other hand, it is difficult to explain how Sally (the principal) can participate in the contract, when she has no physical presence.

If we wholeheartedly accepted the STPO approach to enterprise agenthood, then we would need to revise many of our intuitions about humans' extents. For example, powers of attorney would extend our physical presence to the relevant actions of those empowered. Even more counter-intuitively, the actions of the executors of a will would be regarded as part of the person. Implying that even though the person was bodily dead – her life continued through the actions of the executor.

The current analysis is sufficiently counter-intuitive to warrant more work to be done to provide a better explanation, even if this is only to render the STPO interpretation more intuitively palatable.

8.2.4 Activities, states and extension

The STPO started by taking the (tentative) position that the sum of the activities of its members was part of an Organisation (why 'only a part' is the subject of the next section). This has the nice property of enabling us to differentiate two organisations with the same members: they have different activities. And it neatly explains why some of the members' activities are regarded as belonging to the organisation rather than the member – and others are not.

However, there is potentially some vagueness in relation to what constitutes an activity. In particular, does an activity have to be doing something? Or can certain inactive states count, in this case, as activities? For example, are firemen who are on duty in the fire station waiting for an emergency call undertaking an activity in the relevant sense? Even if they fall asleep, eat a meal or go to the bathroom?

In this case, it does not seem that the vagueness arises due to a lack of precision in the description of what should count as a member activity. While this can (and does) happen, here it seems there is more a lack of precision and explanation of how states in general can qualify as organisations' activities. One might be able to make a case for saying that firemen's on-duty states are part of the fire department organisation, but this seems less likely in other cases.

For example, assume John works in the support division and is on call every evening this week. This involves him carrying a pager, and being ready to call the office to see if he is needed when it beeps. Otherwise, he can do what he wants. Surely it does not makes sense to say that *all* of John's possible evening activities are in any sense part of the activities of his employer.

A better solution might be to recognise states in the person who is a member that correspond to the potential to be a member. Only the actual member activities are part of the membered organisation – the rest are just part of a potential member state.

It could be argued that this concern about vagueness is a search for irrelevant precision. But it seems to me that if one cannot justify resolving this vagueness on the basis of relevant precision, then one can do it in terms of a search for a reasonable explanation. From this perspective, there clearly needs to be some refinement of the extensional approach to explain our intuitions on these points.

8.2.5 Ownership and extension

The STPO's first description of an organisation suggested that "we can regard an organisation as the process that includes the fusion of the participations (activities) of its members." The reason for not strictly identifying the organisation with the fusion of the participations is the results of an analysis of the relation between ownership and extension are not in – and this may have implications for an organisation's extent.

In the case of humans, our intuitions make a firm distinction between the person and the things it owns. There is no sense that by using the things we own we make them, for the duration of the activity, part of us: when we drive our car, the car-driving activity may include the car as a participant, but the activity is not part of us.

The law has a similar strong intuition when it comes to companies owning other companies. Even a wholly owned subsidiary is not regarded as legally part of the parent company. This is mitigated slightly by the commercial perspective, which does see the subsidiary as a part of the commercial whole.

Things are less clear when we start considering a company's other assets. The analysis of the ATM and car park ticket machine examples lead us to accept that when making (intentional) contracts, the activities of machines are part of the company. What about less obviously intentional activities? If Sam is digging a ditch as part of his job for Zenith Inc., this activity is Zenith's activity. If Sam is using a spade, there seems to be some intuitive support for including it in the

(extent of the) activity as a participant. In this case, it is the activity that is shared, rather then the objects themselves – implying a relation more like member_of than unit_of.

As the human element of the activity reduces, so does the intuitive support. If Sam uses a tractor, we might countenance including this. But if a machine automatically digs the ditch, it seems odd to include this. However, we would be happy to agree to statements such as: "Zenith is digging this ditch", "One of Zenith's activities is digging the ditch" and "The automated machine is digging the ditch". The obvious way to reconcile these is to regard the automated machine's activities as Zenith's.

Intuitively, people seem to be more prepared to include natural objects than artefacts in the extent. It seems more reasonable to include the activities of the cows in the extent of a farm than the tractors. In this case, it seems as if the cow itself rather than any specific activity is a part of the farm – implying a relation more like unit-of than member_of.

It seems to me that this reveals the vague, unorganised, maybe inconsistent, nature of our intuitions about this subject. It may well be that this imprecision is harmless, not affecting the kinds of tasks that enterprises engage in. As the CEO project proceeds, this may become clearer. However, it is useful to be aware of the issue now.

8.2.6 Organisation conception and birth

It is not always clear when an organisation starts to exist. In some legal jurisdictions it is legitimate for someone to promote the idea for a company and even arrange for its construction before it acquires its initial owner/members. A similar situation can occur in the creation of a new position. The position is created and then a search is made for someone to occupy it. One can legitimately ask questions about where the initial boundary of these organisations is.

One answer is that the initial company and position creation activities mark this initial boundary and are part of the organisation they are creating, even though the participants are not the owners of the company or occupiers of the position. Where the boundary is can be a moot point. Merely planning to create a company or position is insufficient, there is not enough commitment. This area, like the previous ones, needs to be explored to firm up the details.

9 The STPO's conclusions

The introduction noted that a review of the 'state of the art' of enterprise ontologies found that this was an immature area with a few ontologies, none of which had yet reached 'industrial strength' as tools for semantic interoperability in operational enterprise systems. The STPO analysis has, it believes, made a first step towards such an 'industrial strength' ontology.

It has synthesised an ontology of Persons based upon the content of the TOVE ontology. It has, it believes, synthesised the good material in TOVE and also

made significant improvements in all the areas identified as key requirements. However, as has been made clear a number of times, it is not complete yet. It merely provides an input for the next stage, a synthesis of the Person content of the Enterprise Ontology.

The more detailed analysis of TOVE has provided us with some further insights into the 'state of the art' situation, which are summarised in the next section.

This report has described the analysis that has been done – an historical perspective. The results of the STPO work can usefully be developed into a tool for enterprise analysis, that will be of use in the analysis of the Enterprise Ontology. How this will be done is outlined in a subsequent section.

9.1 Specific improvements

In so far as TOVE represents a ontology building project, the STPO synthesis also provides us with some feedback on specific improvements that can be made to these, which fall into two main categories:

- General ontological approach, and
- Hygiene improvements.

9.1.1 General ontological approach

The three techniques that form the core of CEO's approach were noted at the beginning. The application of these techniques to TOVE lead to significant improvements measured against the five key requirements – making STPO a good showcase. Given that many ontology building efforts, like TOVE, do not adopt these techniques, it is worth briefly highlighting the benefits they brought. To reiterate, the core of CEO's approach involves these three techniques:

- Fitting objects into a general ontological framework,
- Investigating the conditions for an objects' identity, and
- Empirical verification of the ontology.

9.1.1.1 General ontological framework

Unlike STPO, TOVE makes no use of a general ontological framework. It does not attempt to identify the main ontological categories into which every item must fit – or the main structural hierarchies that indicate the ways they can fit. There are no general theories such as a mereology.

The STPO has developed a limited ontological framework adequate for synthesising TOVE. (It is not a goal of the STPO to provide a comprehensive ontological framework – though it is one of the goals of the CEO.) However, even this limited framework was a useful analytic tool. It both forced a degree of coherence and suggested fruitful questions that led to more general and precise ontologies. For example, the comparison of the properties of the general part_of relation with unit_of (and then member_of) states of affairs identified a number of shortcomings in TOVE's ontology – and improved the STPO.

Understandably there may be some squeamishness about committing to the accuracy of such a general framework. However, this is to misunderstand its role. This is to help organise the lower levels of the ontology in a consistent way – and suggest relevant questions. Used in this way, it is an extremely useful analytic tool.

9.1.1.2 Consideration of identity and persistence conditions

TOVE's work shows little consideration of identity (or persistence) conditions – leaving many opportunities for the STPO analysis to make improvements. There are many examples – only some of which can be mentioned here. The analysis highlighted TOVE's confusing decision to deny agency to organisations – and distinguish between organisations and group agents – leading to a more precise ontology. It also led to the identification of the opportunity to generalise positions as a type of organisation. In both these (and other) cases, it provided a more explanatory 'story'.

The analysis also led to the identification of the bounding events that mark the lives of organisations: events such as spin-offs, sell-offs and take-overs. These are completely absent from TOVE.

9.1.1.3 Empirical verification

Introspection has its uses. But, and this is perhaps an obvious point, it is difficult (if not impossible) to develop a core ontology of any degree of precision, explanatory power or fruitfulness without some systematic verification that the ontology reflects reality reasonably well.

There is no real evidence that TOVE made this kind of systematic domain-wide empirical verification. In fact, the general lack of relevant precision seems to be good evidence that they did not – or, at least, did not do this well enough.

TOVE was developed to support Manufacturing Resource Planning (MRP) activities and it may be argued that it is precise enough for this domain. However, as the many examples show, it is neither precise nor general enough for enterprises in general.

One lesson we can draw from this is that a lack of empirical validation can severly hamper the search for precision and generality. Without such validation, it will be difficult to achieve the degree needed in an industrial strength ontology.

TOVE's competency questions can be seen as one mechanism for introducing some kind of empirical validation (as well as defining requirements). But this mechanism is only as good as the content - by itself it offers no confidence that the ontology has achieved the right degree of precision and generality.

9.1.2 Hygiene improvements

We have already noted a number of simple, what can be called 'hygeine' improvements that could be made to TOVE's ontology – which we summarise

here. These do not reflect so much a lack of analysis, as a lack of attention to detail. The three main hygiene improvements noted are:

- Differentiate between 'fluents' and 'non-fluents',
- Specify disjointness, and
- Clearly name relation's inverses

The value for the CEO project of recognising these is to act as a reminder to pay attention to these details in its ontology.

9.1.2.1 Differentiate between 'fluents' and 'non-fluents'

Even though TOVE specifically defines a fluent, it does not identify these in its ontology. This makes analysis difficult. Careful analysis shows that probably almost all the 'predicates' in TOVE's restricted ontology (shown in Figure 1) are fluents – something the authors probably did not intend.

9.1.2.2 Specify disjointness

Even though TOVE specifically states that it can specify disjointness (in Section 6.0), it does not make any use of this feature. As the analysis showed, this makes the interpretation of the meaning of its main types difficult. For example, it is a not certain whether Organisation-Agent and Organisation are disjoint, when a simple statement would make this clear.

9.1.2.3 Unclear naming of relation's inverses

In the TOVE's formal definitions of relations, what are (almost certainly) inverses are not clearly marked as such. For example, under a natural interpretation, these are inverses:

- Organisation_org-unit_Organisation-Unit and Organisation-Unit_member-of_Organisation,
- Organisation-Agent_agent-position_Organisation-Position and Organisation-Position_filled-by_Organisation-Agent.

However, the dissimilar names imply that they are different relations (more different than just inverses). And as inverses are not marked in any way, it is uncertain what the intended interpretation actually is. It makes sense to mark and name inverse relations in a way that (consistently) makes clear what they are.

9.2 A tool for enterprise analysis

The improvements that the STPO analysis has identified are not only applicable to TOVE. They are also applicable to many other ontologies and enterprise systems. As such it makes sense to try and package them in a way that would be easy to use.

The benefit of such a tool would be that it would make auditing what might be called the content sophistication of the ontology or system and the identifying of a range of possible improvements much simpler.

9.2.1 Dimensions of content sophistication

The STPO analysis has provided us with enough material to identify some of the main dimensions of content sophistication. The two most visible in the analysis are:

- Generality, and
- Temporality.

The STPO analysis consistently raised the level of generality and, in so doing, reduced the level of complexity. For example, TOVE's Organisation and Organisation-Unit were generalised to Organisation then Person then Agent.

TOVE, like many other attempts at formally describing the enterprise, focused on the current status and did not account for the historical aspects. This shows up in the difficult it has in accounting for the identity of units – only able to say whether A is a unit of B at time t.

9.2.2 The toolkit

The kind of material that it is planned to include in the toolkit are:

Content sophistication models for key enterprise object

- Standard test cases for common example of lack of content sophistication.
- Content datasets for empirical validation.

It is anticipated that this tookit will help in the analysis of the Enterprise Ontology – and that the lessons learnt in the analysis will be incorporated into a revised toolkit.

10 Next steps

The current plan is to undertake two small projects before embarking on the synthesis of the persons content from the Enterprise Ontology into the STPO ontology. These are:

- The formal analysis of states of affairs, and
- The development of the STPO analysis into a tool for enterprise analysis.

The rationale for undertaking these two projects is that they should help to improve the work done on the synthesis of the Enterprise Ontology.

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Appendix A – Scope of the TOVE Organisation ontology

The TOVE Ontology is structured around a catch-all Organisation-Entity concept, which has as sub-concepts.

- Organisation [Section 7.1] (and Organisation-Unit),
- Organisation Agent [Section 7.2] (with Individual-Agent and Group-Agent as 'sub-classes'),
- Organisation-Role [Section 7.3],
- Organisation-Position [Section 7.4],
- Organisation-Goal [Section 7.5],
- Agent Interaction and Speech Acts [Section 7.6],
- Communication-Link [Section 7.7],
- Authority and Commitment [Section 7.8],
- Empowerment [Section 8.0].

The descriptions of these concepts include references to the following related concepts (in other TOVE ontologies):

- Activity
- Agent,
- Constraint,
- Organisation-Activity
- Process,
- Policy.
- Role,
- Skill,

Appendix B – Organisation Typonomy

This list has two purposes, it is intended to:

- indicate the range of things that are organisations.
- provide examples to help illustrate what organisations are.

It is not intended to be definitive in any way – and it is likely to be revised when analysed in detail. The list is in no particular order and the rough taxonomy is not intended to be more than a guideline.

Sole Practioner
Sole Proprietor/Trader
Association
    Partnership
    Limited Partnership
        International Partnership – i.e. one that is not governed by a particular national Legal jurisdiction
    Co-operative
    Mutual Society
    Amateur Sport Clubs
Corporation
    Corporation Sole
        English Monarch
    Corporation Aggregate
        Chartered Corporation
        Statutory Corporation
        Registered Company
        Unlimited Company
        Limited Company
            IBM Inc.
            Palm Inc.
Holding Company
    HSBC Holdings plc
Subsidiary Company
    HSBC Bank plc
Department/Division
    UK Treasury Division
International organisations
    NATO

- UN
- EU

Nation-State

- United Kingdom
- United States
- France
- Germany

Government

- UK Government
- US Government

State organisations

- UK Department of the Environment,
- UK Treasury.

Educational establishments

- Harvard University
- Eton school

Not-for-profit organisations

- Greenpeace
- Friends of the Earth

Churches

- The Roman Catholic Church
- Anglican Church

Project

- The CEO Project

Position – Office

- President of the United States
- Chairman of Acme plc
- CEO of Acme plc

Mutual funds

- L&G UK Index Fund

Bank Accounts

- My current account

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