Business
Object
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Working Paper

B01

Business Ontology: Overview

Business Ontology - Some Core Concepts

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Business Ontology - Some Core Concepts

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BUSINESS ONTOLOGY: OVERVIEW

BUSINESS ONTOLOGY - SOME CORE CONCEPTS

1 Introduction

The concepts behind the BORO approach will be relatively new to many IT people, and the explanation below is intended give them a sufficient idea of its core concepts to enable this case study to be understood. It should also help people familiar with the concepts to understand the approach BORO is taking. If you are interested in a more detailed description, this can be found in *Business Objects: Re-engineering for re-use*.

BORO is built on the core concept of a business ontology – where the starting point for an ontology is the categories of object that exist. This is discussed below. Identity and grounding are concepts central to the key principles we are looking at here – these are explained in the section on categories of object.

2 Business ontology

We start by looking at what Ontology(-with-a-capital-O) and ontology(-with-a-small-o) are.

2.1 Ontology(-with-a-capital-O)

Ontology(-with-a-capital-O) is an ancient philosophical discipline which can be traced back to the Ancient Greeks. It is a branch of metaphysics and its subject matter is existence and its nature.

Famously Quine[1] claimed that the problem of Ontology can be stated in three words 'What is there?' – and the answer in one 'everything'. Not only that, but Quine says "everyone will accept this answer as true." However he accepts that "there remains room for disagreement over cases."

Doing Ontology usually involves, at some stage, developing at least a part of an ontology(-with-a-small-o). And doing Business Ontology(-with-a-capital-O) involves developing a business ontology(-with-a-small-o).

2.2 ontology(-with-a-small-o)

Central to an ontology(-with-a-small-o) is an inventory of the types of object that (can) exist and a categorisation of this list, often by the types of existence they (can) have. (So a business ontology(-with-a-small-o) will include a categorisation of the business things that (can) exist and the types of existence they (can) have.) It is perhaps easier to understand what this means by starting with the notion of ontic commitment.

2.2.1 Ontic commitment

By nature, information is about something. More precisely, any system of information (whether a business computer system or a scientific theory) refers to things – and so implies that they exist. These things are the information's ontic commitment.

1. In W.V. Quine, 1948 - 'On what there is', Review of Metaphysics, Vol. II, No. 5, reprinted in Quine, 1961, 'From a Logical Point of View', 2nd edition (New York, Harper & Row).

For example, consider the specification for an oil rig that includes plans for a pump facility with the tag no. (name) PF101. This tag no. ontically commits the specification to the existence of PF101. As the specification also uses the term 'pump facility', it can be regarded as committing to the existence of a general pump facility[2].

The specification will also contain details of various types of equipment and how they are related – for example, what is connected to what. These details ontically commit the specification to a whole range of objects.

[As an aside, this is why the preferred BORO approach is to start with an existing business system, which has, however mangled, an ontic commitment. Working out the ontic commitment of a blank sheet of paper, which is sometimes recommended as a starting point for systems development, is not a serious option.]

2.2.2 A general framework

We can tease out even more general commitments. It is likely that the specification makes an almost tacit distinction between general things, such as the general pump facility[3] and individual things, such as PF101. There may be, for example, standard symbols for general things such as pump facilities. Then there may be a standard symbols, such as tag nos., for individual things, such as the individual pump facility PF101. We can and should recognise the categories of general things and individual things[4] as part of its ontic commitment.

We start to reveal an ontology when we determine the general types of objects that exist – of which the categories general and individual things are just one example – and how these are inter-related. To provide a complete ontology we need to also provide some explanation of what these types of things are – and

2. Of course, it is possible to take a nominalist position and regard the general term pump facility in the specification as denoting a multitude of individual pump facilities rather than referring to a single general pump facility. The BORO approach does not take this position – and, to keep the description simple, I follow the approach.

3. See the *MC1—What is Pump Facility PF101?* for a discussion of the nature of pump facilities.

4. These 'categories' have been rationalised in a number of ways – e.g. universal and particular or property and individual – each with its own baggage.

the types of existence they have. Together these form what might be called the general ontological framework.

2.3 Why have a general framework?

At first blush, ontic commitment may not seem very radical or indeed useful. Currently many people using a business system assume that they have a clear idea of its ontic commitment – at least at the not-too-general level of pump. Similarly many IT people assume that their systems are a good reflection of these kinds of things – that the information in the system is a map of its ontic commitment.

Many people also do not see the point of fitting a general ontological framework over these. But it turns out that there is a point to the general framework. Among other things, it reveals our current notions of ontic commitment are not as good as we think and it helps us to make them better.

2.3.1 A clear idea of the ontic commitment

This comes as a surprise to most people. They (we?) understandably think that experts have a reasonably clear and consistent idea of their ontic commitment. But it becomes quite obvious that they do not when they try to fit it into a general framework.

They certainly know what the words they use refer to, and prove this by correctly acting upon and issuing instructions using them. They can also provide a kind of model of the not-too-general things they are committing to. But when they try to fit these consistently into more general commitments, they typically run into serious difficulties.

For example, experienced engineers have a sufficiently good idea of what a pump facility is to do their jobs. They have proved again and again that they can design and maintain one. But when they try to fit their commitment to pump facilities within a general framework they run into difficulties. It turns out to be very difficult for them to do this on their own in a satisfactory way.

2.3.2 Turning accuracy up a notch or two

Perhaps we should not be so surprised, as something similar happens during the automation of manual systems. The description of what the system currently does or should do by the people working the manual system is rarely if ever adequate for an automated system (though it is a good starting point).

The shift from manual to automated systems creates a requirement for more consistent and accurate models of the business. The shift to a general ontological framework takes the requirement for consistency and accuracy up a notch or two. One reason people have difficulties is that they are (not yet) used to working at these more demanding levels.

2.4 An 'objective' reference ontology

Ontic commitment lays the foundation for a reference ontology – one which can be used as an 'objective' standard, constructed of particular applications - by focusing on the things in the world. Different specifications may model pump facility PF101 in different ways – or focus on different aspects – but in some sense they must all commit to the existence of the *same* PF101.

2.4.1 The need for a general framework

But what we are looking for is a general ontology covering more than just one pump facility. What we want is an ontology to act as a common reference point across the full range of businesses – a reference ontology. However, as the scope of an ontology expands, there is more scope for inconsistency and so the importance of a consistent general framework increases. When we have a 'big' ontology (certainly by the time we get to a reference ontology) we need to be sure that the commitments we are making are consistent across its full range. To do this we need to add a general framework to our ontic commitment.

2.5 Developing a reference ontology

How are we going to develop the reference ontology? Most people have difficulty in modelling the essential general framework and a plausible reason for this is that they do not have one to start with. And constructing one is nothing like as simple as it might seem – involving, among other things, a demanding degree of accuracy. This makes a build-our-own strategy unattractive.

2.5.1 Taking the general framework

Luckily Ontology(-with-a-capital-O) provides us with another option. Since the days of the Ancient Greeks, it has taken as one of its major tasks as identifying the major different kinds of thing (and different kinds of existence things have) and fitting them into a coherent framework – in other words, building a general framework.

An important part of this task has been developing a sufficiently accurate understanding of what such a framework is and how it fits together. In particular, much time has been devoted to understanding the issues that the framework needs to address and how these relate to one another.

2.5.2 Ontological relativity

It turns out that there are a group of closely inter-related central issues that face anyone trying to build a general ontological framework. Different groups of philosophers, motivated by different concerns, have developed a range of frameworks - each proposing its own set of inter-related solutions to the central issues, each with its own characteristics. What they have found is that their proposed solution to any one of the issues has profoundly influenced how they can approach the others.

This situation can be characterised as ontological relativity – to highlight that there is (at least currently) no single absolute ontology; more a series of intimately inter-connected ontological options.

2.5.3 Tailoring a reference ontology

Ontological relativity adds another layer of difficulty to building a reference ontology – we cannot just select the single standard ontological framework, we have to choose one. How should we choose? This is where the business ontology approach differentiates itself. It tailors the framework best suited to BORO's purposes. One that:

- is suitable for the types of things (and their relationships) that business systems typically commit to. In particular, that provides the right kind of solutions to the range of central issues that a business systems' ontological framework is likely to encounter.
- encourages the subsumption of a range of not-so-general patterns under simple general patterns.

Certainly the first of these (and to some extent the second) are not the usual concerns that motivated the professional philosophers who work in Ontology. Nevertheless what I find really surprising is that most – if not all - of the apparently (philosophically) technical central issues they discuss have direct practical analogues in modelling a business's ontology. Perhaps this is why it is not too much work to tailor an approach that suits our purposes.

2.5.4 Sources for the framework

The source for the framework is work done in a branch of analytic philosophy that starts with Gottlieb Frege, and takes in Rudolf Carnap and W.V.O. Quine and more recently David Lewis and Mark Heller. For example, the notion of ontic commitment used above to introduce ontology was developed by W.V.O. Quine.

The kind of central positions absorbed into the ontological framework include:

- Individuals are four-dimensional extensions.
- Universals (general things) are classes.
- Possibility is described in terms of possible worlds.

If you want to find out more about how these influence BORO's ontological framework, look in the book *Business Objects: Re-engineering for re-use*. There is also a good philosophical introduction to the overall position in Mark Heller's *The ontology of physical objects: four dimensional hunks of matter*.

2.6 Aspects of the business ontology approach

Business ontology's practical focus not only dictates its choice of framework, it also influences the approach to developing the full reference ontology – differentiating it from the more academic approach taken by philosophers. For example:

In general, the scope of a philosopher's analysis will be determined by his particular interests. Whereas the scope of business ontology is dictated by the ontic commitment of business systems.

Philosophers are often only really interested in the general framework and so restrict their analysis to that – as well as some well tried examples. Businesses need a *deep* reference ontology that includes most things that are committed to by a number of applications – both not-so-general and individual. For example, they will need an engineering section of the ontology that includes not-so-general things, such as 'pump facility' and an international banking section that includes individuals, such as 'The Bank of England'.

Philosophers can admit defeat, saying that they do not have a solution that meets their high standards. Business ontology does not have this luxury – it has to deliver a *complete* reference ontology. While it is good to be able to recognise when a solution is not up to a 'high' standard, if it is 'good enough' and all there is, then the reference ontology will need to go with it.

Philosophers tend to submit their ontologies to a peer review. The reference ontology is subject to a different kind of quality control. There is a natural encouragement for higher quality. A reference ontology that works well – that is useful in integrating/developing computer systems – is more likely to be used. And there is also a natural limit on the depths to which quality can sink, because a reference ontology has to be *industrial strength*. The litmus test of a reference ontology is whether it works in practice. If is does not work well enough, it will not be used.

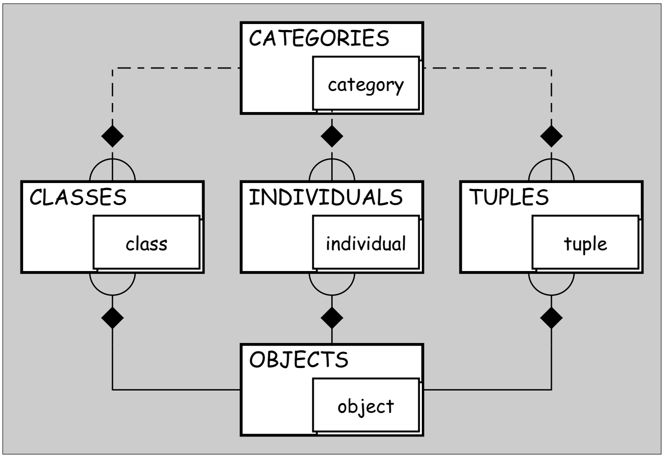
3 Ontological Categories of Object

As said earlier, central to an ontology(-with-a-small-o) is a notion of what types of thing exist and the types of existence they have. This notion is embedded in the ontological framework. Traditionally the top-most levels of the ontological framework are known as ontological categories and in BORO, as in some other systems, these classify the different kinds of existence that things can have.

Within BORO everything that exists is classified into one of three mutually exclusive categories called (as shown in *Figure B01–1* below):

- Individuals,
- Classes, and
- Tuples

Figure B01–1 BORO'S Top-most Level Object Schema



Individuals (also called particulars) are spatio-temporal extensions. These are things that are extended in space and time - typically objects that we can see and touch; like the chair I am sitting on or the pen on my desk.

Classes are collections of objects. They can be quite small, such as the pens in the cup on my desk, of very large, pens in general. What characterises them is that they have members. The class of pens has each individual pens, including the pen on my desk, as members.

Tuples are part of the ontological apparatus that we use to handle relations. A tuple is a sequence of objects. Following mathematical conventions the name of the tuple of A followed by B is written as <A, B>, where A and B are names of objects.

There are a number of structural points that are worth noting.

Every object belongs to one and only one of these types. It is clear from their descriptions that the types are disjoint.

Any object (whether individual, class or tuple) can be a member of a class or a position in a tuple sequence.

From a meta-framework point of view, the three categories and the general type objects are classes with instances of the types as members. So, all objects are members of the class objects, all individuals are members of the class individuals.

This is a very brief sketch, if you want more details see the book *Business Objects: Re-engineering for re-use* or *The BORO Working Papers*.

3.1 Identity (and 'identification') criteria

Within Ontology, identity is a key concept as illustrated by its catch-phrase 'no entity without identity'. What this means is that we cannot (or, at least, should not) claim an entity exists unless we have some idea of what its identity criterion is.

An identity criterion can be seen as a way of characterising the nature of something. It can also be seen as a principle or rule for determining whether, when we make different identifications (often linked to names or descriptions), we are talking about the same (or different) things. It will often be phrased as such a principle - " If x's [rule], then they are the same".

Within BORO's business ontology, identity criteria are given for the three categories of object and apply to instances of these categories. The brief definitions of these categories above give us a clue as to what their criteria are.

If individuals have the same spatio-temporal extension, then they are the same. In less technical jargon, if two things are always in the same place at the same time, then they are the same. A classic example is the two names 'Morning Star' and the 'Evening Star'. Ancient astronomers at first thought these were two different planets. However as their observations became better, they realised that these were in the same places at the same times – that they were one thing, the planet Venus.

If classes have the same members then they are the same. This is not always trivial. For example, the class of equiangular triangles and the class of equilateral triangles have the same members – and so are the same class.

If tuples are composed of the same objects, in the same sequence, then they are the same. So <A, B> and <A, B> name the same tuple. Whereas <A, B> and <B, A> do not – as the objects are in different sequences.

Only the three categories have identity criteria (for their members) – and they only have one identity criterion each. As the categories are disjoint, this means every object (every member of the three categories) has one and only one identity criterion. It would be complicated to have more as we would then need to show that they could not, in principle, conflict.

If we want to identify an object, then we need something other than the identity criteria. Typically an object will have all sorts of relations both with itself and other objects. In different contexts, many of these can be a basis for identifying the object. Within a particular system, there may be an identification criterion – a rule for identifying the object. Often there will be a number of identification criteria. In general, these criteria are not ontological features in themselves, just ways of using the features. There is, in general, nothing in the object itself that makes the features used by a system for identification any different from other features.

What one can say (loosely) is that within the sum of an object's properties there needs to be some way of identifying the object. Otherwise it would not be clear what the object is. Notice that this sets no upper limit on the number of different identification criteria an object may have. And in practice there are normally quite a few – some more reliable, some less reliable.

So, for example, the table at which I am sitting is an individual with a spatio-temporal extent. I need to give a reasonable description of what in general a table is and this particular table before I can identify it – in other words, pick out its spatio-temporal extent sufficiently to identify it. In this case there are obviously a number of possible descriptions – but only one spatio-temporal extension. This means the identity criterion can resolve any potential conflicts between different identification criteria. If the description picks out the same spatio-temporal extension, it picks out the same table.

The two names 'equiangular triangles' and 'equilateral triangles' mentioned earlier provide us with another example of an identity criterion harmonising different identification criteria. We have two names with different rules for identifying their members – equal sides for 'equilateral triangles' and equal angles for 'equilateral triangles'. And we can prove mathematically that these rules always give us the same members. So, invoking the identity criterion for classes (the type of the object) we say that they identify the same class – equiangular/equilateral triangles.

3.2 The ontology's grounding

From the perspective of consistency the top level of the ontological framework is important. From the perspective of grounding, the lowest level of the ontology, particular individuals, is important. They are what grounds the ontology in reality.

This is because when we experience the world, we typically perceive particular individuals. We perceive a particular horse, not the general class of horses. When two people want to make sure that they are talking about the same horse, they can go and see the individual horse. They can touch it if they want to.

Other categories of object are not rooted in reality in the same way. How would we point to the class horses? We could point to a particular horse and say it is a typical member of the class – but we cannot point to the class, at least not in the same way as we point to individuals. And, as the example showed, we tend to think of classes as 'built' out of their members.

An ontology is, in one sense, built up from a foundation of individuals. They are collected into classes and sequenced into tuples. These are then further collected and sequenced until we have the whole ontology.

This is why the business ontology approach starts with individuals – and tries to make sure that every general pattern in the ontology is exemplified by lower level example. Ontology usually carries out its analysis in a similar way, exemplifying general patterns in specific examples.

Seeing, touching what?

Grounding is not quite as simple as it may seem. Seeing and touching does not normally give us an experience of the whole individual, only part of it – the analysis of pump facility in the case study sturns on this point. Individuals are extended in both space and time. If something is reasonably small, such as a nut or bolt (or perhaps even a pump), we can see and touch most of it's outside. If something only lasts a short time, we can see it from start to finish – such as a brief pumping activity. But as things get bigger and last a longer time it become more difficult to perceive all of them. An oil rig can be a vast structure that lasts decades – it would be practically impossible to see and touch all of it.

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Book AS
AS—The BORO Approach: Strategy

AS1—*An Overview of the Strategy*
AS2—*Using Objects to Reflect the Business Accurately*
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Graphical Notation I
BG1— *Constructing Signs for Business Objects*
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MW1—*Re-Engineering Country*
Worked Example 2
MW2—*Re-Engineering Region*
Worked Example 3
MW3— *Re-Engineering Bank Address*
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MW4—*Re-Engineering Time*

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