Are Conceptual Models Concept Models?

Chris Partridge[1], Cesar Gonzalez-Perez[2] and Brian Henderson-Sellers[3]

[1]Brunel Univ**ers**ity, Uxbridge, Middlesex UB8 3PH, United Kingdom
[2]Institute of Heritage Sciences (Incipit), Spanish National Research Council (CSIC), Santiago de Compostela, Spain
[3]Faculty of Engineering and Information Technology, University of Technology, Sydney, PO Box 123, Broadway, NSW 2007, Australia
[1]chris.partridge@brunel.ac.uk, [2]cesar.gonzalez-perez@incipit.csic.es, [3]brian.henderson-sellers@uts.edu.au,

Abstract. The conceptual modelling community has no clear, agreed semantics for its models; or more plainly, there is no general agreement on what the models model. One mainstream proposal is that they model concepts, but there is no clear semantics for this; no clear description of what concepts are and how they relate to their domain. This creates theoretical problems; for example, it is difficult to build accurate meta-models, as these have to encompass the semantic structure. It also creates practical problems; practitioners will approach building a model of the concept of a business differently from modelling the business itself. We aim to exploit research undertaken in philosophy to construct a framework that classifies the broad semantic options. Using this we identify two major options: concept-mediated and direct-domain semantics. We focus on the concept-mediated option and examine how philosophy has analysed what a concept is; identifying three main options and exploring the issues they raise. While not wishing to advocate choices at this stage, we note that the concept-mediated view - in particular, the version prevalent in conceptual modelling, that concepts are representations – faces serious challenges as a practical semantics for modelling and languages.

Keywords: concepts, modelling, philosophy, semantics, ontology, representation, meaning, type nominalism, abstract object nominalism.

1 Introduction

For disciplines and practices to evolve, their foundations need to evolve too. The conceptual modelling community's current practices for engineering information systems are built upon heterogeneous, unarticulated (or, at least, not clearly articulated) assumptions about the structure and nature of the semantic relation that binds the model to its domain. Providing a more thought-through picture of this relation will make for stronger foundations for future development.

The semantic relation and associated topics are areas of research in a number of disciplines. In this paper, we focus on one of these, philosophy; for which semantics is a core

area of research: particularly philosophy of language, mind and psychology.

Though undoubtedly members of the conceptual modelling community have been influenced by philosophical ideas – either directly or through cultural osmosis – philosophy has actually had little real overt influence upon conceptual modelling development. In the last decade, the conceptual modelling community has shown some interest in, and exploitation of, philosophical work in ontology to help in understanding the model's domain [1-3] but its research into the semantic relation between the model and the domain has been mostly a home-grown, philosophy-free (or philosophy-light) activity. Consequently, there is an opportunity for some inter-disciplinary fertilisation; for the conceptual modelling community to exploit the research done in philosophy in order to improve their contribution to future information system engineering. In this paper, we intend to start the exploitation.

We argue here that the success of the exploitation depends upon taking an architectural, engineering approach, similar to that described in [4]. This requires an initial detachment from particular positions, in order to take an overview of the range of options. One that examines their particular strengths and weaknesses, aiming to understand the dependencies between the options and the trade-offs that should guide the choice of options. With this framework in place, the foundations can be (re-)engineered in a more rational way. This contrasts with a situation where foundation building is carried out through competition between positions derived from personal intuitions. Instead, the engineering approach provides a basis for refining and even re-engineering personal intuitions. This is not to suggest that personal intuitions are not valuable; they are a useful input to the process, but they are not particularly reliable guides.

In this paper, we start to build the framework by organising the current range of views on semantics in the conceptual modelling community into broad classifications based upon research in philosophy. We look at philosophy's analysis of the potential motivations for making the classifications as well as its analysis of the issues they face. This starts to make sense of the variety of views in conceptual modelling, albeit from a philosophical viewpoint. It provides a broad-brush structure which can be used as a roadmap for some of the basic choices that can be made for the semantic foundations of conceptual modelling; and a framework within which more fine-grained positions can be articulated. In addition, we argue that consideration of the philosophical issues begins to suggest that some choices may be more suitable than others, although no single position is predominant.

2 Background

It should not be surprising that conceptual modelling has not yet developed a clear picture of its semantics, having emerged relatively recently from physical data modelling in response to a requirement to 'abstract' away from particular physical implementations [5]. The physical data model's semantics bind it to the target system. However, for conceptual models, there is a different semantics, one that binds it the domain being represented by information in the target system; separating the two semantics can be a challenge [6].

Conceptual modelling is a discipline with a far shorter history and significantly less investment in research than philosophy; that is, philosophy has developed the far deeper picture of these topics. However, the two disciplines have different types of goals: conceptual modelling is a pragmatic engineering discipline, philosophy a pure discipline. Conceptual modelling is consequently likely to have a different perspective on some topics of mutual interest. Nevertheless, one would expect the two disciplines to be able to share a common picture of the broad outlines of the topics - as we start to sketch out here.

The conceptual model's elements are at one end of the semantic relation. There are in-

teresting philosophical issues raised by the nature of this model. For example, what is the model when there are several copies of it; presumably none of these can be the model itself? From a philosophical perspective, this seems to be analogous to, if not the same as, the type-token distinction used to explain how different tokens of a word are occurrences of a single type [7] (sec. 4.537). While researching this would be a useful exercise, it is not a topic for this paper. Instead, we talk about models and model elements as if there were no (ontological) issues about what they are. We believe this does not compromise the analysis presented here. There is one possible point of overlap. The model types could be interpreted as mediating meanings; we note this as the appropriate point in the analysis.

There are a number of philosophical terms that are used in many places in the paper, so we characterise them here. The first is ontology. In philosophy, this is technically the study of existence. This is not a particularly illuminating description, so it has been characterized in many other ways. Mealy, in an early data modelling paper [8], refers to this famous characterization by Quine [9]; the question ontology asks can be stated in three words "What is there?", and the answer stated in one: "Everything". He further says that "everyone will accept this answer as true" though "there remains room for disagreement over cases".

A conceptual model is about a domain. In other words, the model makes an ontic commitment [10] to the things in the domain. If one regards the model as a 'theory' [11], then this commitment is clear, as in Lowe's technical definition [12] of an ontology as "the set of things whose existence is acknowledged by a particular theory or system of thought."

One of the tasks of ontology is to examine the most general types of things that exist. One of the major distinctions it makes is between particulars and universals or types. Although there is much debate about the nature of universals and types and their differences [9,13] the topic is outside the scope of this paper - we talk here about universal-types, ignoring the detailed differences.

Aristotle [14] (Γ) identified a way of distinguishing between the two: a universal-type can be exemplified and a particular cannot. For example, Dog is a universal-type and Fido is an exemplification of it. Fido is a particular and cannot be exemplified. This distinction is closely related to the type-token distinction made earlier. One of the issues we shall clarify in the paper is how this relates to the difference between a class and its instances in a conceptual model.

3 Semantics of conceptual models

For the foundations of conceptual modelling, a core question is: What kinds of thing are being modelled in a conceptual model? Examination of the literature and interrogation of practitioners shows a broad acceptance that models are 'about' a domain. It also gives, very broadly speaking, two explanations of the structure of this 'about' relation:

1. Concept-mediated-semantics: The elements in a conceptual model represent concepts. These concepts then represent things in the domain. The concepts mediate between the model and the domain [15].
2. Direct-domain-semantics: The elements in a conceptual model directly represent things in a domain [16].

Yet others claim that they represent (in different ways) both concepts and things in a domain ('the real world') [3,17], where concepts play a mediating role. This dual semantics originates from [18] and is often described as the Ullmann triangle. Popular in a number of areas including linguistics and conceptual modelling, there are few if any references to it in philosophical writings. We shall not analyse this position separately but regard it as an amalgamation of the two options above.

The use of the term ‘concept’ in the mediating sense is commonplace. Good examples of this outside conceptual modelling are the foundational ISO standards for terminology [19] and [20], which are built around this term.

Prima facie, the name ‘Conceptual Modelling’ suggests that *concepts* are involved in some way. As noted above, some members of the community see this involvement as a mediator between the model and the domain. There is another, different, way of explaining conceptual modelling’s relation to concepts; that the models work in an analogous way to concepts. We shall make this link clearer at the appropriate point in the analysis below.

One of the problems in trying to work out the role of concepts is that there does not seem to be a clear understanding in the conceptual modelling community of what a concept is and whether and how it could underpin conceptual modelling. For example, the conceptual modelling languages (UML etc.) can accommodate a variety of views, avoiding imposing any particular view, even within a single model. The paper provides a number of possible meanings of the term from philosophy and explores how these might fit into a foundation for conceptual modelling.

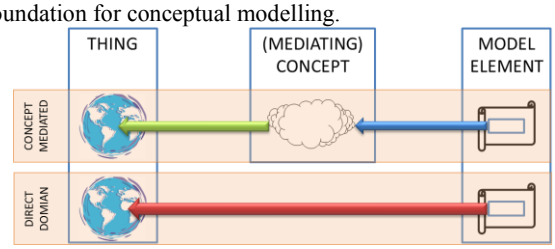

Fig. 1. Simple schematic of the two semantic structures

The first two options can be represented with a very simple model. Assume we have a model called DOG-MODEL with a single element, which for identification purposes we shall call ‘FIDO-element’. Then the different semantic foundations will result in the following clearly differently structured semantics for the model elements (shown schematically in Fig. 1):

1. DOG-MODEL contains ‘FIDO-element, which represents a concept in DOG-CONCEPTUALISATION (the container for the mediating concept), which we will call the ‘FIDO-concept’, which, in turn, represents a dog called ‘FIDO’ in the ‘DOG-DOMAIN’.
2. DOG-MODEL contains ‘FIDO-element, which represents a dog called ‘FIDO’ in the ‘DOG-DOMAIN’.

As this example shows, direct-domain semantics is clearly structurally simpler than concept-mediated semantics. So any motivation for a concept-mediated semantics needs to outweigh the loss of simplicity. It also needs to take account of the users of the models; the mediating concept needs to be at least as accessible to the users as the thing in the domain being represented.

In philosophy, concept-mediated-semantics has a long tradition stretching back to Aristotle [21] (1.16a4), but most clearly enunciated in Locke [22] (III, II), which clearly stated that only mental concepts can represent things and words represent mental concepts. This was a key part of Locke’s theory of concepts as ideas, where ideas were some kind of mental imagery. From their perspective, the mediation of concepts was an essential part of the mechanics of representation.

However, this tradition has largely died out in modern philosophy, and there has been a shift towards the acceptance of direct-domain-semantics, particularly in the philosophy of language and logic. For example, Nelson Goodman defines semantics in the Introduction to Quine’s lectures published as Roots of Reference [23] as – “… an important relation of words to objects – or better – of words to other objects, some of which are not words – or even better, of objects some of which are words to objects some of which are not words.”

He does not mention concepts or any other mediating objects. This acceptance of direct-semantics is especially true in philosophy of logic when discussing formal languages – and conceptual modelling can be regarded as a formal language. In these it is usual to adopt a simple direct semantic relation, known as the 'intended interpretation'.

4 Mediating concepts

However, despite eschewing concept-mediated semantics, current philosophy can still help us understand it. Within current philosophy of mind there is substantial research into what a concept is–understanding this is key to understanding a concept-mediated-semantics. The nature of concepts is also a particularly grey area in conceptual modelling, one where it would be useful to shed some light.

This section firstly distinguishes three 'mediating concept' positions based upon their ontological stance towards concepts. It then distinguishes two positions based on the ontological stance towards what concepts represent, and how these fit with the earlier stances. The final section shifts the focus towards epistemological concerns.

Given the ontological question 'what is a concept?' one can find, broadly speaking, three answers that fall into two categories:

1. Concepts-as-mental
    a. Concepts-as-representations; Concepts are mental representations – this is normally part of a wider representational theory of the mind, where thinking is regarded as a system of representation. The concept DOG is a general representation of a dog.
    b. Concepts-as-abilities; Concepts are abilities. The concept DOG is an ability to tell dogs from non-dogs.
2. Concepts-as-mind-independent
    a. Concepts-as-meanings; Concepts are meanings, or more technically, they are Fregean senses [24]. The concept DOG is the meaning of the general term 'dog'.

The two categories separate the location of concepts into mind-dependent (mental) and mind-independent camps. Within the mental camp, the two answers take different tacks on whether mental representation is involved in intentionality, to be about something outside the mind.

The two views that fall into the concepts-as-mental classification face a common explanatory issue. If concepts are mental, this has two consequences. Firstly, the concept must belong to a mind, and only one mind. And, secondly, the concept is private to that mind. The first aspect seems to be necessary, the second contingent; as if, for example, neuroscience were to advance to the stage that it could 'read' thoughts, then our concepts would become public.

In practical terms, these aspects do not sit well with the proposed mediating role. There is typically more than one person involved with a conceptual model during its life. One may loosely speak of these people sharing the same concept; but strictly speaking, this is impossible. Concepts belong to a single person; live in a single mind – so the best that can be hoped for is sufficient similarity that the concepts are the same type [25].

Furthermore, as models grow, they become so big that no one person can fit the whole conceptualisation into their mind. In this case, it looks as if the conceptualisation that corresponds to the model is split across a number of people. Unless a good explanation of this is forthcoming, then this implies that concepts-as-mental positions are not a natural fit for conceptual modelling.

4.1 Concepts-as-representations

Concepts-as-representations is the current mainstream view of concepts in philosophy [26] and cognitive science [27] as well as being common in conceptual modelling. It also has a long history: Locke [22] and Hume [28] were early advocates. However, if concepts are the 'words' of a mental language, then they would seem to be on a par with conceptual modelling languages. It would seem that they are 'yet another language'. From the perspective of conceptual modelling, it could look as if adopting concepts-as-representations as mediators is suggesting that we produce the model in one public language and then translate it (once for each person involved with the model) into another mental language that represents the things in the domain. For this to make sense, mental languages need to have some special properties that conceptual modelling languages lack. We will examine below some suggestions for what these might be.

4.2 Concepts-as-abilities

The concepts-as-abilities position dispenses with mental representations [29]. One of the most prominent motivations for adopting this view is a deep scepticism about whether mental representations (that is, concepts-as-representations) can do the work they need to - a judgement that traces back to Wittgenstein [30]. The core argument is that mental representations *as representations* reintroduce the very sorts of problems they are supposed to explain. If the way we process an external representation is to create a corresponding mental representation, then we presumably have to create a further mental representation of this in order to process it, thus leading to an endless regress. If, however, we use some conceptual ability to process the mental representation – say, we use a dog-recognising ability to process the mental representation of FIDO – then we could use the same ability to process the non-mental word FIDO. The argument has its critics [31].

From the foundations of conceptual modelling perspective, if one is persuaded by these arguments to adopt the concepts-as-abilities position, then probably one has to adopt a direct-domain-semantics, since concepts-as-abilities do not have quite the right features for mediation. It would be odd to think of a conceptual model as a map of people's mental abilities.

There are other ramifications. It is common practice to involve domain experts in the building of conceptual models. If one adopts a concepts-as-representations position, then one would expect the building of the model to be a transcribing of the mental representations into the model – a translation from one representation to another. However, if the concepts-as-abilities position is in fact true, then the translation from expert ability to representation will be less straight-forward [32] and has a significant impact on how to organise and budget the modelling.

Finally, this position makes a useful partner to non-mental positions; such as the direct-domain-semantics position and the following concepts-as-meanings position. There is a need to explain how we grasp the relations these imply; the answer might be a mental ability. If so, there is no need for mental representation.

4.3 Concepts-as-meanings

The concepts-as-meanings position is, as reflected by its classification as a mind-independent position, a view about semantics rather than the mind. It regards concepts-as-representations as not capable of playing the mediating role and introduces concepts-as-meanings to do this. It also plays this role for both mental and linguistic representations.

As noted above, this view is often closely linked with Frege's [24] view on sense and hence concepts-as-meanings are sometimes called senses – though it can be terminologically confusing as Frege did not use the term 'concept' for senses but for something else.

Concepts-as-meanings mediate between representations (conceptual models) and the represented domain. In this scenario, there is no need for another mediator such as concepts-as-representations; so the mental plays no explanatory role. It is possible to see concepts-as-meanings as having a role within the conceptual model itself. We earlier noted the type-token nature of models. One option is to take concepts-as-meanings as the types of token elements. In this case they mediate between the model tokens and the domain. Peacocke [33] (p. 169) argues that concepts-as-meanings are not dependent upon mental representation. There could be concepts-as-meanings that are never thought – or too complex to ever be thought; hence they cannot be mental.

Concepts-as-meanings need a criterion of identity (note: this is the identity of the concept-as-meaning, not the element in the model, to which we can easily add an identifier). Peacocke [34] (p. 2) suggests a test for concepts-as-meanings, based upon the substitution of the same concept in a proposition not adding information (where propositions are – roughly speaking – composed of concepts). Roughly, the kind of example he has in mind is where the concepts named 'Samuel Clemens' and 'Mark Twain' are different because substituting 'Samuel Clemens' in the proposition 'Mark Twain is Mark Twain' giving 'Samuel Clemens is Mark Twain' adds information. As this example shows, concepts-as-meanings are more fine-grained than the things they refer to. A concept-as-meaning will have a unique perspective on the thing it refers to – what is called a unique 'mode of presentation'. The concepts 'Samuel Clemens' and 'Mark Twain' are different, though they refer to the same thing in the domain, because they have a different mode of presentation.

There is a need to explain how we know about concepts-as-meanings; what the connection is between them and the mental. It is claimed that they can be grasped by human minds; that the same concept can be 'grasped' by different minds. Where two minds grasp a concept-as-meaning with the same meaning, they are grasping the same concept. This avoids some of the issues with sharing concepts that concepts-as-representations face (noted above).

A key feature of the concepts-as-meanings' criterion of identity is its fine-grained-ness; how it manages to make very fine distinctions. While this may be useful for some philosophical purposes, it is less clear that this is so for conceptual modelling. The example above shows the degree of fine-grained-ness of particulars. There are similar but slightly different issues for universal-types.

The fine-grained issue with universal-types is more subtle – as identity at this level is less straightforward. A common example is equilateral (equal sided) triangles and equiangular (equal angled) triangles. These concepts-as-meanings have different meanings: 'equal sided' and 'equal angled' are not the same (for example, an equilateral quadrilateral – a rhombus – is different from an equiangular quadrilateral – a rectangle). However, it is possible to show mathematically that every Euclidean equilateral triangle is an equiangular triangle and vice versa. In other words, the difference in meaning does not pick out different instances.

One might wonder whether these different meanings are more fine-grained than reality. If one adopts an ontology where what is picked out is important (for example, an extensional ontology [1,35], then two or more concepts-as-meanings will pick out the same universal-type. In other words, these differences in meaning do not pick out differences in universal-types; the semantic relation between the concepts-as-meanings and the universal-types is one-to-many. So if the conceptual model is intended to directly represent the universal-types in the domain, then concepts-as-meanings is the wrong tool. One could add a feature to the language to represent when different concepts-as-meanings represent the

same universal-type, but that would be a work-around. It is much simpler to represent the universal-type directly – switching from a concept-mediated-semantics to a direct-domain-semantics, thus avoiding concepts-as-meanings altogether.

4.4 Nominalism versus realism

Type nominalism is an ontological position that is a natural next step for those who adopt the concepts-as-meanings position. In this case, concepts-as-meanings play both a mediating and classifying role. Within the conceptual modelling community, there is a range of views on these philosophical topics, although there does not seem to be a corresponding awareness of how they are treated within philosophy. In particular, there seems to be no clear classification of this range of views into types of positions and the philosophical issues they raise that is common in philosophy. There is an opportunity for cross-disciplinary fertilization; for conceptual modelling to exploit the research done in philosophy in order to improve future information system engineering.

The two semantic views (mediated or direct) we have considered both include a domain, whether directly or via a conceptualisation. A simple obvious assumption is that there is only one possible semantic mapping structure with a one-to-one mapping between the elements of the model – or conceptualisation – and the things in the domain. But one does not have to make this assumption. One of the choices one has is between type realism and nominalism; a type nominalist will map general elements in the model (or general concepts in the conceptualisation) onto many things in the domain. The type nominalism-realism distinction is ontological. It is about whether universal-types exist; the nominalist claims they do not, the realist that they do. Locke [22] (III.iii.11) was an early nominalist. While there are a variety of motivations for the nominalist position, one clear advantage in a concept-mediated-semantics is parsimony (Ockham's razor). Universal-types are, in a sense, classifying; their exemplifications are all of the same type. The nominalists manoeuvre is to give this role to the mediating concept (or general term), eliminating the need for the universal-type. One result is the ontic 'exemplifies' relation between universal-types and particulars becomes a semantic relation between concepts (or terms) and particulars. This introduces a split in the types of semantic relation. A specific concept will refer to one and only one particular, whereas a general concept will have a number of particulars 'falling under' it. In the case of a nominalist direct-domain-semantics, general model elements are given the universal-types classifying role. This leads to a similar split in the types of semantic relation.

Within philosophy there are adherents to both the nominalist and realist positions, as well as a number of varieties of each. Within conceptual modelling there is little or no research to decide whether one of these is preferable from its perspective.

In modern philosophy, there is a widely adopted view that every entity is either concrete or abstract - a fundamental distinction. There is broad agreement on clear cases: the number one is abstract and Fido the dog is concrete. A common metric is that abstract objects are not spatially or temporally situated and, hence, are causally inert.

Abstract object nominalism takes the view that abstract objects cannot exist whereas abstract object realism takes the view that they can [36]. As concepts-as-meanings are abstract, anyone who adopts them needs to be some form of abstract object realist. However, this raises issues. For example, it appears difficult to explain how anyone can know about abstract objects if they are not situated anywhere and cannot cause anything [37]; especially as, they cannot be directly studied. This problem is familiar to practitioners of conceptual modelling, where securing agreement on a model of abstract objects can be extremely difficult – and often descends into comparisons of competing intuitions.

5 Direct Semantics

The direct-domain-semantics position is concept-free and is not affected by the issues specifically surrounding concepts. The position needs to make clear its take on the two forms of nominalism discussed: type and abstract object. However, it does have some questions it needs to resolve. There are a number of situations where, at first sight, model elements do not refer. For example, when one is designing something that has not yet been built, the element that represents it in the model has nothing to refer to.

There are two strategies for dealing with this. One can accept that some elements do not refer and provide an explanation of how they have meaning in terms of their links to other elements that refer successfully – a combinatorial approach [38]. Or one can devise ways in which reference is successful. In the example above, a referent was inaccessible to the model element because it was in the future. One can get round this by letting the semantic relation, S_R, range over the past and the future. One can then devise an example where the designed thing is never actually built – and so out of the scope of S_R. The solution is to extend the scope to include possible things – in all possible worlds [35,39].

6 An emerging framework: discussion and conclusions

A framework has started to emerge from the analysis. Two major options have been identified for the semantic structure. Firstly, one has a choice between a concept-mediated or direct-domain semantics (Figure 1). With the choice of a concept-mediated semantics, there are further options of concept ontology: concepts as representations, abilities or meanings. There are two associated ontological choices between different types of realism and nominalism: one for types, the other abstract objects. These choices, apart from abstract object realism-nominalism, have visible effects on the structure of the semantic relation, S_R (see Table 1). There are a couple of points to note about Table 1. Firstly, that the cardinality is relative to a specific model. Obviously there are typically a number of models of a domain and if this is factored in, then the cardinality would change. Secondly, it has been assumed, as seems to be the case, that concepts-as-meanings are finer grained than universals-types.

It may help to ground this structure with an example. UML is, among other things, a modelling language. It includes as types of model elements ‘classes’ and ‘objects’. While there is no formal constraint, there is a convention that classes are used for general things and objects for specific things. What the analysis implies is that these can have different semantic structures, depending upon the framework choices made. An instance of a UML Class called DOG may represent any one of the following: (i) a single universal-type, (ii) a single concept-as-meaning; or (iii) a number of concepts-as-representation. Furthermore, an instance of a UML Object called FIDO may represent any one of the following: (a) a single particular, (b) a single concept-as-meaning, or (c) a number of concepts-as-representation. One can work out how the concepts in these lists mediate with the domain from Table 1.

These classifications provide the beginnings of a clear framework for the foundations of the semantic relation. It will need further development, maybe even substantial revision. Within philosophy, a premium is put on exploring the full range of choices. There is a tradition of developing sophisticated structures to finesse the various issues encountered. This has led to a wide variety of often very sophisticated solutions. This raises the question whether conceptual modelling actually needs this level of sophistication since conceptual modelling has more pragmatic engineering concerns. Its foundations need to both support the engineering process and be easily deployable to practitioners. So the level of sophisti-

cation found in philosophy is probably not justified in terms of potential utility. Some balance will be needed between the pragmatic engineering requirements of conceptual modelling and the depth of analysis available in philosophy.

Table 1 – Semantic Structure: Model relations for general elements

Choice	Source	Target	Relation Type	Cardinality
Directed -- Realism	Model Element	Type	semantic	1:1
	Type	Particular	ontic	1:M
Directed -- Nominalism	Model Element	Particular	semantic	1:M
Mediated - Meaning - Realism	Model Element	Concept	semantic	1:1
	Concept	Type	semantic	M:1
	Type	Particular	ontic	1:M
Mediated - Meaning - Nominalism	Model Element	Concept	semantic	1:1
	Concept	Particular	semantic	1:M
Mediated - Representation - Nominalism	Model Element	Concept	semantic	1:M
	Concept	Type	semantic	M:1
	Type	Particular	ontic	1:M

The framework is one of choices. An important question is whether the range of choices can be narrowed down; maybe even to a particular set of choices that makes the most sense for conceptual modelling. Whilst too early to make firm decisions on this, our analysis suggests where the refocusing may occur.

There is a strong tradition of concepts-as-representations in conceptual modelling (as in some other disciplines), often seen as giving an epistemic explanation of mental powers. However, the lack of a suitable theory to back this up seems to make it an unsuitable candidate for the foundations.

Fine-grained-ness is an awkward issue for the concepts-as-meanings position. While a proportion of the community may express views that lean in that direction, current practice does seem to be at odds with this. It seems unlikely that it would be practical to develop systems that have an element each for Samuel Clemens and Mark Twain, especially when there is no standard way of saying they are the same person.

This seems to leave the direct-domain semantics as a favourite. This has some champions; for example, Smith [2] argues strongly against concept-mediated semantics. When this happens maybe a new name would be appropriate – something along the lines of 'reality representation' (following Smith [2]) or 'ontological engineering'. A factor in its acceptance is its 'common-sense' view that reflects ordinary everyday language semantics. It is usual to say "when I talk about Barak Obama, I mean the guy in the Oval Office" and perverse to say "when I talk about Barak Obama, I mean the concept of the guy in the Oval Office".

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