A Sociomaterial Glance to Formal Ontologies

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Abstract. In this position paper I will present some reflections about the ontological modelling activity interpreted by leveraging on the philosophical account of critical realism, proposed by Karen Barad. I will try to reason on the implications of seeing the modelling activity like an *agential cut*, an act which allows the properties of entities to become locally determinate and provides meaning to the concepts that are used to talk about such entities and their properties. I will conclude by sketching some possible research directions that can be pursued to reflect the sociomaterial aspects of the modelling activity.

Keywords. sociomateriality, ontoepistemology, angential realism, constitutive entanglement, modelling.

1. Introduction

I would like to start this position paper with some reflections about the role of formal ontologies in information systems (IS). Roughly speaking, they can be seen as tools to express a certain representation of a domain of interest within which the IS is expected to operate. My reflections will start from the assumption that what is expressed by an ontology is a *view*. Following this perspective, some fundamental questions immediately arise: Whose view is it? What is being viewed? Which are the means/apparatuses that allow such view? Do they have an influence on how what is viewed is actually viewed?

Up to my knowledge, all such questions are not usually asked in current ontological modelling endeavours, and this is because classically *within the information system* the answers are *assumed*: the ontology is *the* representation of the domain (in a sense the modeller is assumed to be omniscient with respect to it), what is being viewed and represented is the domain (the part of the "world" that is of interest and within and on which the system is going to operate), the means are the definitions and axioms of the ontology and their influence is exerted on the functioning of the information system, not on the domain which is represented[2]. The axioms are supposed to describe the domain, without influencing it.

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[2]I'm not claiming that modellers or users are not aware of the fact that the ontology expresses a partial and fallible view, but that *within the system* all these aspects are taken as unproblematic.

Already in the 80's scholars began to realise that a socio-technical perspective was needed in IS studies, namely that the understanding and the functioning of IS depends neither only on the performance of the technology nor only on the abilities of the users, but the interaction between the social and the technical component is paramount. These considerations resulted in a more socially-aware computer science, which gave rise to studies in Human-Computer Interaction, Computer-Mediated Communication, Computer Supported Cooperative Work and Participatory Design [1]. Such studies leveraged on methods and techniques developed in the social sciences, ranging from mock-ups and other Participatory Design strategies, to focus-groups with prospective users, participant observation and videoanalysis in workplace studies. (cf. e.g., [2]). Concerning modelling, it translated in the attention paid to the social dimension and in the representation of actors ("inhabitants" of the domain under analysis) and their activities within the models.

All these approaches have concentrated on the involvement of the social (the users) in the building of IS or on including the social in the domain to be modelled, while what I'm focusing on here are the modelling activity itself and the application of a socio-technical or, better, sociomaterial —as we will see in the next section— approach to it. In other terms, the shift I am arguing for here is from *sociomaterially-aware* modelling to *sociomaterially-driven* modelling, in the same vein as in [3] a shift from *ontologically-aware* to *ontologically-driven* information systems was advocated by Nicola Guarino.

2. A brief overview on sociomateriality and agential realism

My current reflections on modelling are inspired by the ideas proposed starting from the late 90's and systematised in [4] by the philosopher Karen Barad, whose theory has been called *agential realism* and has informed much of the current debate on organisation theory, especially the works by Wanda Orlikowski and colleagues [5].

A neologism that has been introduced to talk about the consequences of Barad's philosophy on organisation studies is *sociomateriality*, to be written without the hyphen, as to underline the indissolubility of the two dimensions and to be distinguished from socio-technical, where the accent is instead on the mutual influence of two substantially separate dimensions.

> [. . .] we identify a promising emerging genre of research that we refer to under the umbrella term: *sociomateriality*. Research framed according to the tenets of a sociomaterial approach challenges the deeply taken-for-granted assumption that technology, work, and organizations should be conceptualized separately, and advances the view that there is an inherent inseparability between the technical and the social. [6, p. 434]

Even though the main interest of Orlikowski and colleagues is to use the sociomaterial account for analysing organisations, in this paper I would like to argue that the modelling activity —regardless the domain to be modelled— is a sociomaterial practice, as the social and material environment in which the modeller is immersed, as well as the social and material aspects of the domain to be modelled are all intertwined components that constitute a dynamic and evolving whole.

I will try in this section to provide a very brief account of the main notions constituting agential realism and I will try to show in the following what the consequences of taking them seriously could be for the modelling activity.

The first thing to point out is that agential realism is a *relational ontology*, i.e., relations and not *relata* (the entities that are supposed to be related) are ontologically primitive and, as a consequence, stand-alone independent objects and their intrinsic properties cannot anymore be considered the ontological unit of analysis. Objects' identity is rather dynamic and their properties are dynamically acquired and relinquished according to the relations in which they participate. More precisely, in agential realism the most fundamental entities are *phenomena*, that are relations in which the components are *constitutively entangled*, i.e. inseparable. In the words of Barad:

> [...] the primary ontological unit is not independent objects with inherent boundaries and properties but rather *phenomena*. In my agential realist elaboration, phenomena do not merely mark the epistemological inseparability of observer and observed, or the results of measurements; rather, *phenomena are the ontological inseparability/entanglement of intra-acting "agencies."* That is, phenomena are ontologically primitive relations— relations without preexisting relata. [4, p. 139]

In classical formal ontologies the idea of a relation without relata does not seem to find a place, thus the ontological status of phenomena is not clear. In Barad's description, they seem to resemble to processes, whose components continually re-shape and transform themselves.

Barad introduces also the notion of *intra-action*, as to underline that within phenomena there aren't independent entities that interact, but rather components whose dynamics are intrinsic to the relation.

> Phenomena are produced through agential intra-actions of multiple apparatuses of bodily production. Agential intra-actions are specific causal material enactments that may or may not involve "humans." Indeed, it is through such practices that the differential boundaries between "humans" and "nonhumans," "culture" and "nature," the "social" and the "scientific" are constituted. Phenomena are constitutive of reality. Reality is not composed of things-in-themselves or things-behind-phenomena but "things"-in-phenomena. The world *is* intra-activity in its differential mattering. It is through specific intra-actions that a differential sense of being is enacted in the ongoing ebb and flow of agency. [7, p. 817]

Therefore, it appears that the components are already there within the phenomenon, but they emerge in their specificity only when some intra-action takes place.

A first important consequence is that agency is no more only ascribable to humans, as all the components of the phenomenon *intra-act*. A second one, very relevant for the present enquiry, is that observation is no more described as a relation between two independent entities, the observer and the observed object, one external to the other. Observation becomes a specific intra-action of a phenomenon, in which a specific material configuration of an *apparatus of observation* (which includes as components the observer, the instrument and the observed object as ontologically entangled) enacts what Barad calls an *agential cut*, that is a "*local* resolution *within* the phenomenon of the inherent ontological indeterminacy" [7, p. 815], which allows the properties of the components to become locally determinate and provides meaning to the concepts that are used to

talk about such components and their properties[3]. The point that Barad makes is not that with different instruments the observer has access to different properties of the observed object, but rather that such properties *come to existence* and *become meaningful* only through the agential cut enacted by the apparatus of observation.

> It is through specific agential intra-actions that the boundaries and properties of the components of phenomena become determinate and that particular concepts (that is, particular material articulations of the world) become meaningful. Intra-actions include the larger material arrangement (i.e. , set of material practices) that effects an *agential cut* between "subject" and "object" (in contrast to the more familiar Cartesian cut which takes this distinction for granted). That is, the agential cut enacts a resolution *within* the phenomenon of the inherent ontological (and semantic) indeterminacy. ln other words, relata do not preexist relations; rather, relata-within-phenomena emerge through specific intra-actions. Crucially, then, intra-actions enact *agential separability*—the condition of *exteriority-within-phenomena*. The notion of agential separability is of fundamental importance, for in the absence of a classical ontological condition of exteriority between observer and observed, it provides an alternative ontological condition for the possibility of objectivity. [4, pp. 139-140]

For such reason, she claims that hers is neither an epistemology nor an ontology in the classical sense, but an *ontoepistemology*, as she specifies in footnote 10 of chapter 1 of [4]:

> The neologism "ontoepistemological" marks the inseparability of ontology and epistemology. I also use "ethico-onto-epistemology" to mark the inseparability of ontology, epistemology, and ethics. The analytic philosophical tradition takes these fields to be entirely separate, but this presupposition depends on specific ways of figuring the nature of being, knowing, and valuing. [4, p. 409]

It is only through the agential cut exerted by an apparatus of observation, which classically can be seen as a complex device to acquire knowledge, that epistemic access to entities and their properties can be granted and the meaning of the concepts used to refer to such entities emerge. At the same time, in Barad's account, the entities and their properties are disentangled, become determinate and, in a sense, come into existence as such entities and such properties, again, only through the agential cut. Hence, both meaning and existence are the product of the agential cut; as a consequence, in agential realism the classical notions of epistemology and ontology are conflated into that of ontoepistemology.

3. A sociomaterial approach to ontological modeling, preliminary thoughts

I will turn now to an attempt of using the notions introduced by Barad as lenses through which one could interpret the activity of modelling. I will then try to explicitly answer the questions that I posed at the beginning of the paper.

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[3]The example that Barad typically mentions is the one of diffraction of light, in which the latter displays a wave-light or particle-like behaviour depending on the apparatus of observation that is employed. For a succinct exposition see [7, p. 815], footnote 21.

As an example, I will take a modeller who is being asked to model an organisation, for instance by producing a formal ontology (an axiomatisation) to represent its actors, processes, environment, etc., to be built using a certain language and implementable in an/some information system(s).

Now, if we look at the organisation from an agential realist's perspective, this is primarily a constitutively entangled phenomenon, in which the components are inseparable, as they don't have properties that are definable independently of the relations to which they participate. The processes take place in different ways when different actors are involved, and when they happen in different premises, and when different resources are available, with different organisational structures etc. At the same time, actors acquire different properties when they play different roles within the organisational structure and when they have different tasks in different processes etc. And the organisational structure may change because of the changing competences of the actors involved etc. It seems clear, under this point of view, that the components are not separable. Furthermore, the information system(s) is/are also component(s) of the phenomenon and its/their properties shape and are shaped by its intra-actions within the phenomenon.

A modeller engaged in the modelling activity (but also anybody simply looking at the organisation), is a component of the phenomenon[4], with all the available background information they can possibly gather or been provided with, the (possibly axiomatic) theories they can build and the languages they can use to express them.

But this line of thought is not limited to cases in which what is modelled is already something obviously social, as an organisation: if we think about a model behind a recommender system for physicians, which should associate symptoms, diseases and recommended medical treatments, we see that many components are inextricably involved in determining how the system works: the medical information and the protocols that have been used as background for the model, the perceptions of the patients, how the patients describe such perceptions. With the modelling activities the phenomenon is disentangled in a certain way and the properties of such components and how they are connected into the system are locally determined. This will determine not only the recommendation given as output, but possibly also the evolution of the disease and its symptoms.

In such contexts, the modelling activity can be seen as an agential cut, an intra-action enacted by an apparatus of observation, which includes as components a specific modeller, with the background information they have available, the axiomatic theory and the language that they have built or chosen to use and the whole domain of interest. This whole apparatus is what allows to locally determine the entities that are being observed, the concepts used to represent them, but also the other components of the apparatus (including observer/modeller and means of observation/modelling). Following Barad and the reported quotation, if we interpret the modelling activity as an agential cut, this comes out to be not only epistemologically, but ontologically productive:

> Intra-actions are agentive, and changes in the apparatuses of bodily production matter for ontological as well as epistemological and ethical reasons: different material-

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[4]It is not clear to me whether this is a correct way of phrasing it. A possible hypothesis could be that the modeller and the whole apparatus are temporary components of the phenomenon, but this does not seem to be what Barad has in mind: "Phenomena are not located in space and time; rather, *phenomena are material entanglements enfolded and threaded through the spacetimemattering of the universe*" [8, p. 261]. This also poses problems in interpreting phenomena as processes.

discursive practices produce different material configurings of the world, different difference/diffraction patterns; they do not merely produce different descriptions. [4, p.184]

This means that the same modeller using different background information and/or a different axiomatic theory and/or language will enact a different agential cut, which will result in a different local determination of the entities to be represented. Similarly would happen for a different modeller, with same or different means of observation/modelling.

To sum up in very rough terms, my own reading of an agential realist interpretation of the modelling activity is the following: before it begins the modeller is a component of a continually self-transforming indeterminate phenomenon; when the modelling activity begins, the apparatus of observation, that is the modeller with their background information, the axioms and the language that they decide to use, become determinate and acquire their properties. That is, the modelling activity is the agential cut that locally disentangles the phenomenon.

We can now turn to the initial questions: Whose view is it? What is being viewed? Which are the means/apparatuses that allow such view? Do they have an influence on how what is viewed is actually viewed?

The first three questions can be answered only once an agential cut has been enacted, while the answer to the fourth one is on the affirmative, but, if we want to be faithful to Barad's ontoepistemology, it should even be strengthened, by saying that the apparatus of observation determines what there is[5].

In the concluding section, I will sketch some very preliminary intuitions on how these reflections may be translated in some aspects of the modelling activity.

4. Concluding remarks

The main aim of this short paper was to encourage a discussion on the modelling activity, by looking at it from the perspective of a debate that is currently very lively within the social sciences.

Nonetheless, in this concluding section, I shall try to explore how this theoretical framework could re-shape the modelling activity and propose a possible direction of research.

If one holds that the agential cut performed by the modeller disentangles the components of the phenomenon, one should be able to keep track of such components in the model. At the same time, the agential cut ascribes a local meaning to the concepts that emerge as constituents of the domain under observation/modellisation, but also constitutes the entities of the domain themselves.

In classical formal ontologies that accept social concepts, there is a sharp distinction between these and ordinary objects, while in Barad's ontoepistemological account, such distinction is not present, as every particular entity emerges as an effect of an agential cut. Nonetheless, we could observe that their properties are only locally determinable, and they are dynamic and relational, thus their behaviour seems to resemble that of *social roles* and *social concepts*, as depicted in [10]. In that paper, social roles and concepts could be seen as the effect of an act of *classification*, in a sense they "come into

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[5]Van Fraassen held a similar position in [9].

existence" in the domain of quantification through a *reification* move. Similarly, in [11] *observations* (also seen as the effect of an act of classification) were also reified and included in the domain of quantification. My intuition, with which I would like to close this position paper, is that we could see the agential cut as presented in Barad's account as an "ontoepistemological act of classification" that locally creates the entities populating the domain of interest, disentangling them from the general phenomenon. Thus, under this perspective, all entities of the domain of quantification should be represented as reifications. Differently from [10] and [11], agential realism does not admit objects as primitives (basic categories) —they are disentangled from phenomena— so it appears that phenomena are the primitives.

But phenomena appear not to be representable, as to represent them, we should disentangle them, so what we are left with is the possibility to represent in the model all entities *by making explicit their being connected* with the other components that constitute the phenomenon. In [12], we developed an approach to represent objects as constructed, as opposed as already given as primitives. By leveraging on Formal Concept Analysis, we constructed objects based on observations and keeping track of their identity, re-identification and unity criteria, the latter taking into consideration the observer and the apparatus that was used to retrieve the observations, with the underlying theory describing its functioning. Very roughly, my proposal is to use a similar account to formalise the entities of the domain, as the outcome of a particular view, which becomes part of their definition. Even though this would complicate the models, on the other hand it could be helpful to compare different representations of the same domain, by providing some better explanations of why entities are taken to exist in a particular domain and what they explain.

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