A Semiophere-based Approach for Modelling Pre-semantic Engineering Communication:

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Keywords
Philosophy of Language, Philosophy of Science, Semiotic, Scientific Paradigms, Engineering Paradigms, Underlying Ontology, Semiosphere, Engineering Communication

1. INTRODUCTION
In this reflection we present a communication approach to facilitate the progress of engineering paradigms while they are under the revolutionary phase. We focused the problem on the paradigm's underlying ontology and the stage where semantics is evolving while first models start to be designed, shared and interpreted by the research community. We call this subphase the pre-semantic stage and we sustain that there is some difficulty when new problems, new categories, new modelling languages and new solutions are expressed by using evolving semantics. We claim that it is a relevant philosophical problem because new application and new and legated engineering problems require new models and designs under a fixed semantics as soon as possible. On the other hand, a short evolution could result in an abandoned paradigm. As this problem has not yet been recognized then there is not any solution approaches. However, we can recall that general paradigms' evolution has been described by Kuhn [1], and the scientific social behavior by Bordieau [2]. However, this pre-semantic subphase has not been described in communication terms. To tackle this problem we present a communication approach based on the semiotic theoretical framework of semiospheres [3].

Therefore, we first present the differences and similarities between scientific paradigms and engineering paradigms arguing the existence of the underlying ontology as structural part of engineering paradigms. We then match the semiosphere concepts with the communicational phenomena of the pre-semantic stage in an engineering paradigm. In the third part we propose a communicational structure for a modelling language which supports semantic variability for the pre-semantic stage and we show a particular language proposal which complies with this semiotic approach.

2. SCIENTIFIC AND ENGINEERING PARADIGMS
The difference between scientific paradigms and engineering paradigms has been previously argued [4]. While a scientific paradigm represents a fundamental approach for researching - which is basically described by Kuhn [1] - an engineering paradigm constitutes an alternative way of modelling and/or tackling engineering problems. We could say that a practical halo surround an engineering paradigm. Thus while a scientific paradigm has a strong ontology commitment the engineering side has a practical commitment. Under this perspective, it becomes a novel *tool* more than a new and radical philosophical position. The relation between a scientific paradigm and its underlying ontology is explained by Hacking [5]. He says: *I hold that Kuhn has importantly advanced the nominalist cause by giving some account of how at least an important group of "our" categories come into being in the course of scientific revolutions*. That coincides with our use of the concept ontology, i.e. that an ontology is constituted not only by "material" objects, but also by classes, categories, kinds of things and their conceptual relationships. At this point we sustain that an engineering paradigm also has its underlying ontology and moreover, the high amount of work around defining, refining and applying the new ontology makes up the mainstream of that paradigm.

We also sustain that each engineering paradigm generates new modelling languages which are based on the underlying paradigm's ontology. In this language new types of solutions or methods for problem solving are proposed.

Therefore, the existence of this underlying ontology, its evolution and dissemination support the evolving process of any paradigm. Thus, the research process of discussing this new ontology and the search of new knowledge resulting in its application are the central activities of the paradigm's mainstream.

During this period the underlying ontology is evolving and, hence, the semantics of terms is also changing, therefore it is reasonable to ask: How can communication take place when semantics is evolving?. How new models and design examples are communicated when their symbols are new and changing?. In terms of Habermas [6], how can communication be possible when the symbols that mediate the interaction are not intersubjectived ones yet?

3. THE SEMIOSPHERE OF THE UNDERLYING ONTOLOGY
The Bourdieu's theory of fields [2] suggest that the social behaviour of scientific production revolve around a centre where pioneers lead the (sub)discipline (field) and therefore we conclude that they mainly are who propose the initial ontology of a paradigm. However, additional contributions and research discussion could move the field, shifting the centre to other members. We claim that the pre-semantic stage of an engineering paradigm can be seen as a meaning-construction stage which corresponds with the social interaction around thematic axes to build a unified meaning of the new ontology. Given that semiotic studies the process of meaning-construction, we review this theoretical approach.

Firstly, we refer to Eco [7]. A relevant semiotic idea is to distinguish between communication and the process of making meaning. One of classical semiotic models requires a sign (symbol), an object (element of the ontology) and an interpretant. The interpretant is not the interpreter; it is that

which gives guarantee to validity of the sign (normally it is another representation of the same 'object').

In the case of pre-semantic stage the ontology has not been set, therefore, the object is still fuzzy, the sign is new or has a previous semiotic charge (previous meanings) and the interpretant has not yet been established because application domains are still experimental.

Therefore, when a paradigm emerges we have a dynamic semiotic scenario where there is a moving soil for funding the new ideas. Therefore, internal communication such as technical reports, conversations, and papers just tackle a part of all general ideas, (normally in few pages). Thus, only some concepts can reach the rest of the research community under the same meaning. Normally, fuzzy parts will be re-interpreted under the local intensional context, under their own engineering problems and under their own research focus, which means they have different interpretants.

Lotman has introduced the concept of semiosphere to express that mono-semantic systems do not exist in isolation. These related systems are part of a continuous sphere of meaning namely semiosphere [3]. In this way, we claim that the development of the underlying ontology corresponds to the phenomena of generation of a new semiosphere and constitutes the base of a paradigmatic revolution.

At beginning of the paradigm the new ideas would be the seed of the new semiosphere. These open ideas, almost without sense try to close the concept behind a fuzzy boundary.

Lotman explains [3] that the boundary is the area of accelerated semiotic process and it is represented by the sum of bilingual translatable "filters" which delimitate the internal meaning. Therefore we can say that we have only a new boundary at the early phase of the pre-semantic stage and heterogeneity of possible meanings. At this point, the theoretical approach of semiospheres says that *in peripherical areas, where structures are "slippery", less organised and more flexible, the dynamic process meets with less opposition and, consequently, develops more quickly*. Then we can say that the new semiosphere grows letting in the centre the dominant semiotic system constituted by a conceptual kernel. At this time we would say that we are in the middle of the pre-semantic stage: we have a set of core concepts with a relative shared meaning and the border where different interpretations, new definitions and proof of concepts shape the expansion of the semiosphere.

Finally, when the pre-semantic stage ends, it is because a formalization of the semantics is produced. In terms of engineering paradigms an example is the production of industrial standards. In the semiospheres' theory this fact is described in this way: *the creation of meta-structural self-descriptors (grammar) appears to be a factor which dramatically increases the rigidity of the semiosphere's structure and slows down its development*.

Other semiotic features and particular attributes described for semiospheras seem to be also applicable ones for the analyzed case, e.g. dialogic communication as the base of meaning generation, 'invasions', limitation of penetration, filtering, among other that could be extend our approach.

4. PRE-SEMANTIC MODELLING LANGUAGES

On the light of previous arguments, we claim that a pre-semantic modelling language would allow the enrichment of the research discussion without stopping the development of the paradigm. It implies the possibility of moving preliminary results to industry.

Also, we sustain that pre-semantic communication can be enabled by a modelling language that goes beyond a particular mono-semantic. We then propose generating a modelling language which considers the semantic internal variability modelling the semiosphere's structure. Basically it means to consider a core set of categories and to define the conceptual kernel like the stable centre. For representing the unstable portion we propose using a second layer of open language constructors lying on the core concepts. Finally, the possibility of accessing an extra-semiotic space can be done if external language constructors point to their corresponding interpretants. This structure allows the representation of different mono-semantic spaces which can share some core concepts and evolving concepts beyond the centre.

We have starting to experiment this approach with the iStarML language [8] which has been defined by including different variants of a family of software engineering models. It has a set of core concepts and the possibility of specifying new ones in terms of core concepts. To point out we use the feature of XML language [9]for referencing external namespaces for implementing extra-semiotic spaces. We are now working on the specification of configurations which considers re-interpretation rules for neighboured language structures.

Finally, we think we have shown a pre-semantic engineering communication is not only possible but also it can be strongly founded on semiosphere theoretical framework and, moreover its proposal would get benefits for the evolution of engineering paradigms.

5. REFERENCES

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