

SEMIOTIC FOUNDATION OF MODELS AND MODELLING

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ABSTRACT: The paper analyses the model as an artefact sui generis establishing the role of semiosis, as a homomorphic representation, as an artefact securing the function of an interface between the author and the receiver. The receiver's ability of accepting the model and its interpretation possibility and/or quality depends on the receiver's competence including the linguistic competence, his knowledge of the represented sphere and the knowledge of the applied sign system and its rules.

Keywords: model, homomorphic representation, artefact, interface, competence.

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1. The concept of "model"

The term "model" was introduced in the sphere of the designing, e.g. in the works by Vitruvius, on the basis of the Latin term "modus" denoting the measure, the manner or fashion. For planning or stimulating human technological activities it was useful and favourable to prepare these activities, i.e. to elaborate conceptual or intellectual preparation of planned works and to apply a measure for mapping or representing the future work. (It was, usually, a radius of the column.) A model of the planned building was, in principle, a diminished representation of the planned work, using the mentioned measure (Frey 1960). On this basis, there existed the possibility of a generalization of this form of representation.

For constructing or creating models we have to utilize signs or sign system, to take the advantage of representation function. Therefore, the models are established as artefacts with a specific function, i.e. the function of semiosis (Moris 1938, Moris 1964). On the basis of various sign systems or languages we could distinguish various types of models, especially:

- models using verbal means, using natural languages,
- models on the basis of formal means, formalized languages, mathematical or logical models,
- models using means or sign system of graphic languages (Kaneff 1970, Nake 1972).

Concerning models based on the applications of formalized languages, we have to distinguish various types of these languages. A special type of these languages represented by languages for modelling an organized sequence of operations or procedures established on computing systems are programming languages. Since computing systems include means and tools of computer graphics, these systems of modelling include mutual transformations of pictures and graphic representations and digital forms of data.

From the methodological point of view, the creator of models has to presuppose receivers or users with sufficient competence, i.e. with the ability to receive, to accept given types of model, to establish an adequate interpretation. The receivers' competence plays an important role in all spheres of creation and/or application of models. The decisive role of receiver's competence or, using the Chomskyan expression, of the priority of competence in comparison to performance (Bar-Hillel 1972) could be demonstrated by the following aspects:

- The model could be defined as an artefact establishing the role of semiosis, i.e. of the information transfer between the creator and the user.
- The model represents a homomorphic representation, i.e. is not identical with the original. It means the representation in the sense of the traditional Latin slogan "pars pro toto", the part instead of the whole.
- The model is able to secure the function of an interface between the author or the creator and the receiver or the user if and only if he has a sufficient competence.

The importance of the mentioned aspects of modelling could be expressed by the following questions:

- Why the builder (or better, a master builder) is able to construct a building, a house or a bridge on the basis of a design or a project documentation which shows or demonstrates only a global picture, e.g. the ground-plan, a global outline of some important features of the planned work?

- Why are we able to establish a general view of the given terrain, place or a part of territory on the basis of a map or of another twodimensional picture?

- Why the specialist in musical affairs is able to establish the melody on the basis of a sequence of note signs?

2. The model as an artefact with communication function

For establishing a model we are in need of a system of signs. There exists a large spectrum of various types of signs beginning with artificial signs, i.e. things founded by man in the nature and finishing with various forms and types of artefacts. The majority of these signs are artefacts arranged in systems characterized by specific rules enabling the assignment of meaning, the concatenation of various signs, their interpretation and using in communication. The signs and sign systems secure two fundamental functions of signs: means of direct information transfer and means of information transfer in space and time, i.e. means of memories.

The utilization of one sign system for modelling does not exclude the transformation possibilities, e.g. the transformation of graphic and/or iconic signs into the digital ones and vice versa. The transformation of various forms of data, especially the digitization of data enables an effective data processing, transfer and other forms of working up. The transformation of various forms of data expressing types of models enables not only an effective transfer of models, but also their storage and other applications of contemporary information technologies. Then we have to do with problems or evaluations of users' friendly forms or types of models.

Models are always models of anything. This context or meaning orientations of models means that this "anything" could be conceived as a part of actual world, as a state-of-the-affairs of various possible worlds including future, designed or expected states-of-the-affairs, as a part or situation of the external world or a state of the "internal world", of human mind including representations of feelings, attitudes or emotions. In other words, it is possible to establish various types of models assigned to different and very heterogenous domains. Some models are directed only to the selected and competent receivers or users, the other ones are conceived

as general representations for common users with common human equipment.

It is possible to distinguish concrete models assigned to singular actual or possible state-of-the-affairs and abstract models assigned to certain types of states, procedures or actions. Abstract models represent a general structure of a problem-solving task e.g. a structure of diagnostic procedures, a structure of possible concrete models, e.g. digital terrain model, a system of rules for constructing inductive generalizations on the basis of factual data by computers (Hájek, Havránek 1978). The algorithms for solving the given type of tasks are, in principle, abstract models.

Analysing models as specific artefacts with communication functions we have to stress some typical semiotic dimensions of models. From these dimensions the most important are the following ones:

The models are usually established for a type of tasks or goal oriented activities, for solving some problem situations. Therefore, we have to take into account some pragmatic aspects of modelling. A model has to stimulate or could initiate an orientation of the given type of activities: A master-builder, on the bases of the presented graphic scheme of parallel and sequential activities is able to organise the realization of the work, to select the necessary collaborators, teams, capacities and means.

Any model has some specific relations to its author or creator. It holds for all types of models including models of technological works, organizing procedures. Nevertheless, for some models with aesthetic functions, for models representing aesthetic or cultural values these relations play an important role. These models are able not only to picture their originals, the represented state-of-the-affairs, but also the creative ability and competence of their creators. In this sense, the model presents a double information: an information concerning the original of the given model and the information concerning its creator and his competences or capabilities.

The model has always a semantic function. It means that the model could be interpreted, where the interpretation means the assignment of meaning. Interpretation cannot be, of course, limited to one general scheme, e.g. to the scheme of sense, intension, denotation, extension, expression of values, attitudes etc. Therefore, the representation function of a model has many levels or dimensions. The factual interpretation of a model also depends on the receiver's or user's equipment, on his competence, a priori knowledge and value structures including his goals, actual situations and the whole environment of the interpretation procedure. Evaluating the receiver's informational gain we have to take into account

not only the informational content of the given model (usually embodied into the model by its author) but also the transmitted -or pragmatic information (Tondl 1989)- information accepted by the receiver or user. This situation does not exclude the creative interpretation by the receiver, e.g. the enrichment of the original meaning embodied into the model by its author.

3. Models as a homomorphic representation

A model as an artefact sui generis, as a model of "anything" is not identical with the original. This relation of the model and the original means that the model is able to substitute the original only in some functions, enables some important aspects of decision-making or evaluations concerning the original, nevertheless the model is not able to replace all functions of the original. Therefore, a model is not a complete or entire copy, it is a sufficient representation of the original for a selected set of tasks. Therefore, we are able to express the following explications:

An artefact *a* is the model of *A* if and only if it fulfils an adequate set of semantic functions fulfilled by *A*.

The term "fulfilment" in connections with models and modelling was mentioned in the pioneer work by A. Tarski in his study on the concept of logical inference (Tarski 1936). This means that the model enables some important spheres of reasoning, decision-making or evaluating concerning the original. This important idea concerning relations between the sphere of modelling and the sphere of reasoning, inference and decision-making has the fundamental importance for explaining the semiotic functions of models and modelling.

If the model represents a selected set of elements, attributes or functions of the original, there exists in these connections the problem of adequate selection. In principle, the selection procedures have the fundamental role for creating models in the given sphere of problems, tasks or goals. Therefore, a model is not a copy or an isomorphic representation of the original, it is its homomorphic representation. If only a group of selected features is able to represent the original or, in other words, to transmit adequate or sufficient information in connections with the original, with the intentions of the creator, with the main goals or functions, it is justified to use the term "the kernel of the isomorphism".

Since the kernel is represented by a subsystem of selected elements, features or functions of the original and has to represent the whole original

for an competent receiver or user, it has, in principle, the function of transmitted information or pragmatic information (Tondl 1989). The selection of such a kernel is the most sophisticated sphere in modelling procedures. For establishing an adequate, comprehensive and (for the users or receivers) acceptable selection the model creator is in need of:

- the sufficient competence concerning the object, the selection and/or application of means or sign systems,
- of the knowledge concerning the general domain or environment of the object, the acceptable value system,
- of the knowledge concerning the ability, absorption capacity or competence of actual or potential users or receivers,
- of the regards to the expected functions or applications of the model, its acceptance in the given situation or claims, wishes or expectations of the users and receivers.

Emphasis given on communication functions of models, on information transfer including the sphere of knowledge and value structure, the function of models expressed by the term "interface" (introduced in these connections by H. Simon (Simon 1969) does not exclude other functions of models, especially aesthetic and cultural functions, increase, extension or enrichment of the whole cultural environment of human life.

4. The receiver's competence and its role

Concerning the receiver's ability of accepting the model or his interpretation possibility, we could express -as examples of those problems- some questions, especially;

- Is anybody able to understand the uncertainty relation usually connected with the name Heisenberg, e.g. without knowing the value comparable with the value of Planck's constant?
- Is anyone able to make adequate interpretation of a special thematic map?
- Similar questions could be expressed concerning the ability of accepting or understanding some other cultural artefacts. This aspect is, of course, depending on the ability or competence of the receiver or interpreter.

For any adequate acceptance of a certain type of models we are in need of a sufficient competence including

- the linguistic competence,
- the knowledge of the represented sphere or domain,
- the knowledge of the applied sign system and its rules.

We have to stress that the acceptance of a model does not mean positive acceptance, i.e. full agreement, establishing rational belief etc.

The creator or the author of a model has to take into account (not at all to be submitted to) the following aspects:

- receiver's capabilities, capacities, disposable delays and memories including disposable levels of knowledge, experience atd.
- receiver's needs, interests, his problem-solving situations,
- his value structure, priorities or preferences.

As an example of the first aspect we could mention the situation, in which the creator of a model has to keep or respect the rules of the used sign system, i.e. syntactic, semantic and pragmatic rules.

As we have stressed, to take into account does not mean to be submitted, to retreat, to insinuate. In principle, the relations between the model creator and model receiver have the character of mutual communication or feed-back. (I am able to confirm these interrelations by my proper experiences from my work in the computer-aided design sphere, from my connections with specialists in the engineering domains.)

5. The model as an interface

The concept of "interface" was introduced in the analysis of artefacts by H. Simon in the sense applied in the sphere of computer science. The interface, as it is typical in information technologies, has the function of links or connections between the internal system of an artefact (as it is typical for the computer) and the external environment including the human user. Model as an artefact with communication function connects the creator or author and the actual or potential receiver or user. The author of a model puts in his model an informational content or, in other words, delegates into the model a certain intelligence. Establishing a model of anything represents the delegation of a certain intelligence including cognitive elements, attitudes, values, preferences etc. Such a delegation could also include the delegation of intentions, claims, priorities or values of the model's creator or author.

If the model represents a delegated intelligence, we have to take into account that this transmitted intelligence must be received, accepted and

interpreted. The model as an artefact with communication function, as delegated intelligence of the creator or author has to be created, as it was stressed by H. Simon (Simon 1969), with a certain foresight in connection with the possible future acceptance, interpretation and fructification. Such a foresight assumes a parallelism or a sufficient correspondance of competences of the authors and the actual or potential receivers or users. Simultaneously, this foresight includes a reciprocal knowledge of the used sign system and its rules. In some situations connected with models, their creation, use or interpretation, an external observer with sufficient competences could be very useful for all problems of modelling procedures and their functions in communication processes.

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MUTUAL BELIEFS AND COMMUNICATIVE SUCCESS†

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ABSTRACT: The paper explores the notion of communicative success as a match between the speaker's communicative intention and the audience's interpretation. The first part argues that it cannot be generalized to all kinds of communication. The second part characterizes various types of relations between the speaker's and the audience's beliefs on which this kind of communicative success can be based. It shows that the requirements concerning agreement between these beliefs are rather modest.

Keywords: communicative intention, interpretation, utterance meaning, mutual beliefs.

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1. The notion of communicative success

Here are five possible parametres of communicative success which, according to my view, should be kept separate, since they need not (though they typically do) coincide:

- (1) the fulfilment of the speaker's intention (I_1) to perform a particular speech act (identified by propositional content and illocutionary force);
- (2) the fulfilment of the speaker's intention (I_2) to be understood by the audience as having performed a particular speech act;
- (3) the fulfilment of the audience's intention (I_3) to grasp the speech act performed by the speaker's utterance;
- (4) the fulfilment of the audience's intention (I_4) to grasp the speaker's intention I_1 ;
- (5) the fulfilment of the audience's intention (I_5) to grasp the speaker's intention I_2 .