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The Taxonomy of Concepts in Architecture
— some applications and developments

H. M. G. J. Trum and M. E. Th. Bax

Introduction:
This paper describes some recent applications and developments of the taxonomy of concepts in architecture. The taxonomy was developed earlier by the authors. It was published several times (cf. Bax, Fox and Trum, 1990; Bax and Trum, 1992a, 1992b, 1992c; 1993a, 1993b; Trum and Bax 1992, 1993) and presented and discussed on a number of occasions, a.o. at the 1992 and 1994 Design and Decision Support Systems Conference. It will therefore only briefly be described in this paper. The taxonomy provides a conceptual tool for a systematic, consistent and complete description of the field of architecture. It is based on Domain Theory, a theory developed in the seventies by Bax (1979) and Trum (1979).

In 1990 the Advisory Committee for Education and Training in the field of Architecture of the European Commission accepted the taxonomy as a reference for its task to harmonise architectural education in Europe (EC, 1990). Within this framework the text of Article 3 of the European Directive on Architecture was interpreted and reformulated according to the taxonomy.

The applications described in this paper mainly concern the first experiences with a taxonomy-based inquiry in order to represent the profile of educational programmes of schools and faculties of architecture in Europe in qualitative and quantitative terms. This inquiry is being carried out in order to achieve a basis for comparison and judgement, and a basis for future guidelines including quantitative aspects.

The developments concern the structural form of the taxonomy comprising basic concepts and level-bound scale concepts, and the specification of the content of the fields which these concepts represent. These developments mainly result from comparison with similar endeavours to structure the field of architectural design: the work of an ARCUK working party, based on the 1985 European Directive and the accreditation criteria developed by the National Architectural Accrediting Board (NAAB) of the United States of America.

These confrontations and the preliminary results of the ongoing inquiry provide keys for a re-definition of concepts as building stones of the taxonomy, in order to strengthen its contents and coherence.

The Taxonomy of Concepts in Architecture:
The taxonomy of concepts in architecture is a classification that systematically describes the architectural field. It is concerned with architecture as a trade in which buildings are designed and realised, as a discipline in which knowledge about building is systematically collected, generated and taught, as well as with architecture as a meaningful interpretation of the building as a symbol, as a work of art. It contains an ordering and interpretation of architectural phenomena that are observable in reality. These phenomena are described in so-called concepts. Concepts concern both architectural objects and processes. The taxonomy may be used as an instrument for analysis of existing buildings or building designs, but it can also be used as a design-aid. It is based on Domain Theory, which in its turn again rests on General Systems Theory and the notion of structure according to French Structuralism.

Theoretical background, foundation and justification of the concepts and the taxonomy were described by Bax and Trum (1993). The theoretical background is provided by Domain Theory. It describes the phenomena of architecture, which constitute the basis of the concepts. Domain theory is an architectural design theory in which architectural design is considered a complex activity, performed simultaneously in three interrelated design or decision fields. These fields are defined by dimensions of architectural design space: formal (or morphological) levels of specification, functional domains and procedural phases. So, concepts have a functional, formal and procedural dimension. A functional description of a concept contains norms, rules and criteria the building should meet in order to achieve a desired quality of performance. A formal description includes images of the building: drawings, sketches, diagrams, etc., depicting the building as a system of spatial and material parts and the building as a part of an urban system. In a procedural description the concept is represented by e.g. operating procedures for the design project, methods and strategies.
Concepts are the building stones of the taxonomy. Such concepts are interpretations of architectural phenomena resulting from the various functions that architecture fulfills in several fields in society. In design these fields are integrated simultaneously into an architectural object.

Concepts are notional, imaginary and—especially—visual representations of a building that arise in the designer's mind as soon as he is confronted with a design task. They may guide his design thinking and action. Concepts may be used as a means to call up those images, to develop, elaborate and combine them and, in this way, using all available creativity and imagination in favour of the quality of design. If during design such an image would not come up in a designer's phantasy, he simply would not be able to go on, because he hasn't the faintest idea how to proceed. Everyone who has ever made a design, will recognise this problem. Especially in such a situation the taxonomy is a suitable instrument: as this approach does not impose any prescribed working sequence, one can simply go on with another concept. The designer is not submitted to a prescribed working sequence: at wish he can jump from one concept to another. Nevertheless there is a clear way of working.

So, a concept has characteristics both of a notion, being an abstract idea with a general nature, and of an image, having a concrete form with a specific nature. Its general properties make the concept specific and applicable to a range of situations; its specific properties make the concept legible and understandable to people sharing the same culture.

A concept is also considered a thematic architectural typology. The Concept of Makeability for instance, is the heading of a typology comprising various types of construction methods, building techniques, types of work (brickwork, plumbing, carpentry), etc., which can be used as an aid in the design of a building.

Fig. 1 shows a representation—or rather, a table of contents—of the taxonomy. It consists of twelve concepts, arranged in six levels. Three types of concepts may be discerned: basic concepts corresponding to architectural phenomena (numbered arabic), scale concepts resulting from integration of basic concepts on each level of the taxonomy (numbered roman), and hybrid concepts which can be random combinations of basic and/or scale concepts. A basic concept always is an integrated scale concept on the next lower level. The two italic typed unnumbered concepts are 'empty' concepts, finding their contents completely on lower levels in the taxonomy. The architectural phenomena described in Domain Theory can be arranged in hierarchically ordered levels which constitute the framework for the taxonomy of concepts. There are six relevant levels, arranged in order of increasing generality:

- Domains of design: usability, stability and makability;
- Orders of planning: physical, social and economic;
- Dimensions of design space: functional, formal and temporal.

The concepts are arranged in a taxonomy. This taxonomy is a hierarchical system of concepts, based on a functional definition of concepts, and on their structural properties to define the various levels. Though the field of architecture is extensive, complex and has an apparently unlimited number of appearances, it appears to be possible to systematically and completely describe the whole field of architectural design by means of twelve concepts. The complete architectural field can be described through such a limited number of concepts because of their structural properties, enabling the generation of variant solutions when confronted with a context, comparable to genotypes and phenotypes in biology.
The manipulation of these fields and their respective environments are described on three higher levels:

- **Approaches of reality**: professional, scientific and aesthetic;
- **Cultural orientation**: cultural (historical and ecological);
- **The world of artifacts**: the architectural level.

Thus, from the architectural phenomena as described in Domain Theory, basic concepts, scale concepts as well as hybrid concepts in the taxonomy are derived.

**Application on Architectural Education**: Reformulation of Article 3 of the EC-Directive on Architecture:

The first application of the taxonomy was a contribution to the Working Group of the Advisory Committee for Education and Training in the field of Architecture of the European Commission in its task to reformulate Article 3 of the European Directive on Architecture of 10 June 1985 (EC, 1985). Article 3 enumerates the demands to be met by European education and training programmes in the field of architecture. The article had been effective to draw up a European register of architectural schools and faculties. But for the further harmonisation and development of educational programmes on a European level as a condition for mutual recognition of diplomas and certificates in the EC Member States, it was necessary to make the article more operational. It was therefore tried to find an interpretation of the article based on the taxonomy, that would facilitate communication, comparison and development, without jeopardising the future European architectural richness and cultural variety.

The original 1985 text of Article 3 is shown in Fig. 2. The text seems complete (it is hard to find anything that is not covered), but there is a lack of consistency: some paragraphs deal with two or more different subjects and also the reverse is true. All the paragraphs have the same structure, involving the integration of two types of categories:

- educational categories: skill, adequate knowledge, understanding, and
- architectural categories: fine arts, technology, social factors, human needs, etc.

The new text should contain the integration of an educational and an architectural taxonomy, cover the complete field of Article 3, with about the same number of paragraphs, but with a structure related to generalised, theoretical concepts. The theoretical concepts were found in the educational taxonomy of Bloom (1968) and in the taxonomy of architectural concepts. Bloom's taxonomy is a "Taxonomy of Educational Objectives, The Classification of Educational Goals", and refers primarily to the cognitive domain. It distinguishes six hierarchically ordered levels: Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation. These levels form the basis of the educational categories in the reformulation of Article 3. Bloom's taxonomy was condensed in such a way that the six levels corresponded to the three notions used in the original text of Article 3: Knowledge corresponds to knowledge, Understanding to comprehension and application, and Skill to analysis, synthesis and evaluation. It may be noticed that the result looks very much the same as in the original text, but its contents can better be defined and interpreted with more precision now.

The taxonomy of architectural concepts articulates the complete field of design into more or less autonomous design fields in which partial designs contribute to the overall architectural design. These design...
fields formed the basis of the categories of architectural subjects for the reformulation of Article 3.

The reformulation of Article 3 implied integration of the taxonomies of Bloom and of the architectural concepts. The result of the integration was published in EC document III/D/9125/1/89-EN of 12 January 1990. Each paragraph again has the same structure: an educational category based on Bloom's taxonomy and an architectural phenomenon derived from our architectural taxonomy, followed by a short explanation.

Fig. 3 shows the text of the 1990 Article 3 interpretation according to both taxonomies. In Fig. 4 (see next page) an impression is given of the complexity of the relations of the corresponding subjects in both texts. The reformulated text containing the architectural phenomena described by the concepts is in the left column, the 1985 text is on the right.

The taxonomy of concepts can be used as a tool for the description of the contents of these educational objectives, just because of the fact that architectural design is in the core of the curriculum. We supposed that next step of the EC Committee — a quantitative approach — could be set by describing the architectural content in terms of the architectural taxonomy, the educational levels in terms of Bloom's taxonomy, their duration in study time and their position in the study programme.

At the 1990 Seminar of the Société Européenne pour la Formation des Ingénieurs (SEFI) the first attempt to represent course programmes based on this assumption was presented (Trum, 1992). Fig. 5 (see page 9) is a three-dimensional representation of a hypothetical architectural education programme. On the left vertical axis are the educational levels of Bloom's taxonomy, the horizontal axis represents the architectural contents of the curriculum in terms of the taxonomy of architectural concepts and the third axis depicts the phases in the educational process. In principle, this approach allows quantification of the educational programme, provided that adequate measuring instruments can be developed.

An EC inquiry based on the Taxonomy of Concepts in Architecture:

In 1993 the Advisory EC Committee decided to organise an inquiry in order to obtain data on the architectural study programmes in all EC Member States, so as to achieve a basis for comparison and judgement, and a basis for future guidelines including quantitative aspects (EC, 1993). The goal of the EC Committee is to ensure a comparable high level of architectural education within the EC, eventually enabling the free movement of architects, students and teachers between the Member States. If and when such a situation would be established, it is the Advisory Committee's intention to allow students to collect their study points all over Europe. In every Member State two to four schools, institutions and faculties, representative for the education of architects in their country, were sent a questionnaire with instructions and explanations, concerning information about the distribution of hours of the study programme over
the subjects concerning the concepts of Article 3.

For obtaining comparable and reliable results, extensive information and counselling with respect to interpretation and classification of educational elements in terms of the taxonomy is indispensable. In this respect, educational elements of a study programme had to be decomposed into so-called educational units, corresponding with the concepts of the taxonomy. These units are measured in study-time. Some elements had to be split up into two or even more units. It was requested to analyse the study programme in the lowest possible level of the taxonomy. The result of the analysis is the profile of the study programme. The inquiry is still going on in several EC member states. For this reason we only can show now, as an example, the results of the Faculty of Architecture, Building and Planning of EUT, which served as a test case for the EC inquiry (Fig. 6).

Confrontation of the Taxonomy with similar Endeavours to Structure the field of Architectural Design:

If the taxonomy is used for regulation and legislation, it should only contain what necessarily should be fixed and laid down. Everything mentioned that is not necessary, could unintentionally and superfluously restrict possibilities in education and design. Therefore the formulation should be as clear, as straight and as short as possible, up to the point that comprehensibility begins to decrease and the possible numbers of interpretations start to increase. If the explanations would have been omitted, it would no longer have been possible to use the article without a separate explanatory statement (which is, as a matter of fact, not unusual in legislation). The shortest explanation possible on which political consensus could be reached, is formulated in Article 3. However, for architectural schools and institutions, that want to compose or revise their educational programme and wish to use the taxonomy as a source for ideas and inspiration (so, for the purpose of design), a wide, rich
and versatile description of as many as possible contents of the concepts should be available.

As a start, concepts were described in various publications, for instance in the Dutch Vademecum for Architects (Bax and Trum, 1992a) and in a document published by the EC Advisory Committee (Bax and Trum, 1992b). At the 1990 SEFI-Conference already a reference was made to the FEANI-criteria (Bax, Fox and Trum, 1990). Though these criteria principally cover all the fields of engineering, both Article 3 and the FEANI-criteria concern the field of design using comparable articulations. In the FEANI list however, there is much more emphasis on subjects like team work and multidisciplinary cooperation than in Article 3 of the European Directive on Architecture, so in terms of the architectural taxonomy, the emphasis is on elements of the professional concept. At the same conference the applicability of Domain Theory on other fields of technological design besides architecture, was established (Trum and Bax, 1990). At the 1994 DDSS-Vaals Conference a hypertext database on floppy disk containing a.o. all the contents of the concepts available at that time, was presented (Trum and Bax, 1994).

But of course our interpretations and elaborations alone are insufficient. In every EC Member State and in numerous other countries criteria, regulations, policies and documents exist concerning this subject.

It was decided to analyse a number of such documents for three main reasons:

1. To test the content, completeness and consistency of the taxonomy (and as a consequence of the revised formulation of Article 3);
2. As a means to enrich the contents of the concepts.
3. To find subjects that are common in all these descriptions.

Especially for the first goal it was necessary that all remarks from the documents could be connected to at least one of the concepts; not even one remark should be left out, because every subject that could not be given a connection, might be an indication of incompleteness of the taxonomy. Considering its hierarchical character, every subject from the documents had to be assigned to the lowest appropriate concept in the taxonomy. If a subject was related to more than one concept, it was reported more than once in the analysis.

Arcuk Report Analysis:

To start with, the Final Report of an ARCUK working party, based on the European Directive of 1985 (ARCUK, 1992), was analysed. ARCUK is the Architects Registration Council of the United Kingdom. The ARCUK Working Group Report comments on the (original) 1985 version of Article 3, which, belonging to a European Directive forms part of the UK legislation. The comments and recommendations in the report are restricted to the curricular base of an architectural education policy for the UK.
The Working Group pleads for a UK education policy that emphasises:

- the public good: a central position of the direct needs of users as well as their perspectives on technical standards and aesthetic qualities;
- assurance for the public with regard to the architects' competence (which is the ARCUK's main criterion for admission to the Register);
- an increase of the working relationships between architects and others in the building industry;
- an explicit concern for ecological issues, energy, world material supplies and the role of developing countries;
- design to remain the central discipline of architects; therefore design projects should form the core of their education;
- the aesthetic, technological, economic and social issues of Article 3, demanding both theoretical knowledge and practical skills and the development and application of judgement.

Analysis of all the subjects raised, the remarks, comments and recommendations in the eleven sections of the report yielded up to about 300 items. Some 100 could be allocated to two or more concepts, either by their complexity (more than one subject simultaneously) or through lack of a sharp definition (e.g. some 'social' issues also concern economic or financial problems). The emphasis in the number of remarks lies evidently on the professional concept: 81 remarks and recommendations concerned management subjects of the design of buildings, the organisational aspects of design projects and the architect's role and responsibilities in society. This number is almost twice as high as the next highest score: the aesthetic concept. This concept is important among other things because of the ARCUK's interest for the position and role of developing countries, energy and environmental questions and world material supplies. The relatively small attention for the stability and the makability concept may be explained by the ARCUK's observation of a strong division between architecture and engineering. It is obvious that the ARCUK policy endorses a science-based architectural education: 41 remarks and recommendations related to the scientific concept, were found.

Not one item was found that turned out not to be connectable to one or more concepts of the taxonomy. This may be considered an important indicator in favour of the completeness of the taxonomy. But its scientific validity is limited: in fact it only indicates that the British ARCUK Working Group did not raise any issue that is not comprised in the taxonomy. It is noticeable, however that a number of subjects could only be fitted into the so-called scale concepts, as they were concerned with matters of integration of basic concepts. These scale concepts provided a much better fit to the concerning ARCUK remarks than the paragraphs of Article 3, in which only basic concepts occur. A quantitative summary of the results is given in Fig. 7.

The enrichment of the content of the concepts was considerable. A lot of new viewpoints and subjects could be added to the further elaboration of the concepts. With regard to the consistency of the taxonomy a number of imperfections became apparent. Some had to do with the nomenclature of the concepts. For instance, the "procedural concept" showed interference with the process and project-related aspects of the professional concept. As the procedural concept particularly is intended to deal with issues of...
buildings related to time, it is now indicated as ‘tempo­ral concept’.

**Analysis of NAAB criteria:**

The NAAB report entitled ‘1990 Conditions and Procedures’ (NAAB, 1991) differs essentially from the ARCUK Working Group report. NAAB is the National Architectural Accrediting Board of the USA. In this report no subjects or questions are raised, discussed or presented for discussion. The report contains procedures and criteria for accreditation of professional education programmes in the field of Architecture. In this respect it shows a strong resemblance to the EC-Directive. NAAB-accreditation is awarded if a programme meets an established standard of educational achievement. This achievement is ascertained by an evaluation process carried out by an accrediting agency.

According to NAAB criteria “education in an accredited program should ensure that the graduates have competence in architectural design, including technical systems & requirements and considerations of health & safety, that they understand historical, human and environmental context for architecture, and that they comprehend architects’ roles & responsibilities in society”. The NAAB considers the criteria and procedures described, the specific means by which education is evaluated towards a professional degree in architecture. Next to procedural prescriptions of the accreditation process, the report gives a minute description of all kinds of necessary features of the educational programme, the administrative, financial and material support facilities and so on.

The analysis carried out was limited to Chapter 3.8, titled: ‘Satisfying Achievement-Oriented Performance Criteria’.

The occurring NAAB educational categories are:

- **Awareness**, comparable to Bloom’s ‘knowledge’;
- **Understanding**, and
- **Ability**, which is defined in the same way as ‘skill’.

The NAAB architectural categories are arranged as follows:

**Fundamental Knowledge:**

Those areas of study that provide the background for and the basis of study and practice in the profession of architecture. This category is subdivided into:

- **Social**: The social context for architecture includes liberal studies, architectural history, culture, and human behaviour. This category includes issues emanating from the consideration of human nature and social interaction. Understanding and acting responsibly on these issues is considered essential to the practice of architecture in the contemporary world.

- **Environmental**: The environmental context is defined by the NAAB as climate, geography, and other natural phenomena and characteristics that affect the setting for architecture.

- **Aesthetic**: The aesthetic context is defined by the NAAB as the visual and emotional components of the architectural experience.

- **Technical**: The technical context is defined as the physical systems necessary to create a beneficial environment that responds to both human behaviour and the laws of nature.

**Design:**

The process and product that result from the synthesis of social, environmental, aesthetic, and technical considerations into a cohesive and unified architectural entity.

**Communication:**

Those skills that architects use to study, illustrate, and document their work, as well as to exchange information and ideas with others throughout the design process.

**Practice:**

Practice includes the relation of the profession to society, as well as the organisation, management, and documentation of the process of providing professional services. This category is subdivided into:

- **Project process and economics**: Project process and economics refers to typical and atypical activities included in a representative architectural project from inception through completion of construction. This includes practical aspects of building and the economics of development, as well as the different types of contractual arrangements and procedures for their administration, and the architects’ responsibilities in these efforts.

- **Business practice and management**: Business practice and management refers to the concepts, ethical principles, procedures, and techniques related to the different forms of organisation for architectural practice, including private and corporate offices, public sector agencies, and nonprofit organisations.
Laws and regulations: Laws and regulations, as related to both building and architectural practice, form a complex body of common law, legislation, and regulation.

Within this system of headings 54 different criteria are formulated. As no one-to-one relationship exists with regard to the concepts of the taxonomy, the analysis contains a total of 102 formulations. In the analysis the criteria were not split up so as to allocate the subjects to the different concepts. If a criterion contains more than one subject, relevant for more concepts, then the text of that criterion is connected to all concepts concerned. A quantitative summary of the analysis is shown in Fig. 8.

In these American criteria too, the emphasis clearly is on the professional concept, which also may be expected, as NAAB Accreditation results in the permission of educational institutions to award a professional degree to young architects. The scientific basis of the architect's education here too is an important criterion. In comparison, there is more attention for the stability concept than in the ARCUK report, but surprisingly little for matters concerning makability.

A detailed description of the results of the comparison of the concepts of the taxonomy and the text of Article 3 with the ARCUK comments and recommendations and the NAAB criteria is available from the first author in the hypertext database on DOS floppy disk, mentioned before (Trum and Bax, 1994).

Conclusion — Further developments of the taxonomy:

These applications, comparisons and the preliminary results of the ongoing inquiry provide keys for further development of the concepts as building stones of the taxonomy, in order to strengthen its contents and coherence. It is obvious that for some applications (e.g. legislation, regulation) short and sharp definitions will be favourable, while in other cases (for design) a rich and wide variety of different contents will be preferable. The definitions should contain the minimum that can be agreed upon, sources for inspiration can never be sufficiently filled. We will continue to work in both directions. Anyway we will carry on with analysis of relevant documents about architectural design, so as to enrich the contents of the concepts.

It has also become obvious that terminology and nomenclature of the elements of the taxonomy might be adapted and improved. There is some doubt and criticism about the two upper concepts, the Architectural and the Cultural concept, which are now basic and scale concepts simultaneously. The architectural concept might be considered the heading for the whole taxonomy. The cultural concept, sometimes interpreted as the total environment of architectural artifacts, could be worked out further. It now consists of two partial concepts: an ecological and a historical orientation (concerning space and time).

As far as the reformulation of Article 3 of the EC Directive is concerned, it became clear, especially from the ARCUK analysis, that in a new revision the scale concepts should be inserted. It would take a form as proposed here:

Proposal for reformulation of Article 3 — 1995:

(including the notions of scale and basic concepts according to the taxonomy)

Education and training leading to diplomas, cer-
tificates and other evidence of formal qualifications referred to in Article 2 shall be provided through courses of studies at university level concerned principally with architecture. Such studies shall be balanced between the theoretical and practical aspects of architectural education and training and shall ensure the acquisition of skill to create architecture as a multi-dimensional phenomenon. This phenomenon and the objects of study appear as follows:

1. Knowledge of architecture as a cultural phenomenon: the historic, ideological and ecological environment of the building; the building as 'milieu', with shared value and meaning.

2. Knowledge of the modalities of reality, articulated by distinguishable expert approaches towards architecture:
   (a) as a professional phenomenon with respect to the praxis of everyday's reality: the ability to organise the planning and design of the building; the professional's responsibility towards society; the management of the architect's office; the design of a building as workmanship.
   (b) as a scientific phenomenon with respect to underlaying foundations of reality: knowledge based models as the foundations of the building, the building as a hypothesis, the building as a representation of knowledge.
   (c) as an artistic phenomenon with respect to transcendence of reality: the embedding of buildings with (symbolic) meaning; the artisticity of the building, the building as a work of art.

3. Understanding of the dimensions of architectural design space: formal, temporal and functional dimensions of architecture:
   (a) as a formal phenomenon: the discernibility of the building; the building as a form (appearance, shape); the building as a system of parts; the building as a part of an urban system.
   (b) as a temporal phenomenon: the inconstancy and changeability of the building; the building as a mo(ru)ment.
   (c) as a functional phenomenon, meeting physical, social and economic requirements.

4. Understanding of the orders of architectural (and urban) planning:
   (a) architecture as a social phenomenon: the territoriality of the building; the building as a social good, a habitat, a private property, as a territory.
   (b) architecture as an economic phenomenon: the marketability of the building; the building as an economic good, the building on the market.
   (c) architecture as a physical phenomenon, meeting usability, stability and makability requirements.

5. Understanding of the domains of architectural design:
   (a) architecture as a usability phenomenon: the employability/workability of the building; the building as a utilitarian system accommodating an organisation.
   (b) architecture as a stability phenomenon: the maintainability of the building; the building as a structure or installation, directed at the preservation of a desired situation.
   (c) architecture as a makability phenomenon: the technical realisability of the building; the building as a building system, as work.

So far, the taxonomy seems to be suitable too for the description and ordering of in principle all technological design fields (Trum and Bax, 1990). This is confirmed by the first applications in the postgraduate technological design programme of Eindhoven School for Technological Design at our university (Trum, 1995). It will be obvious that for application in such a variety of design fields the terminology, which is strictly architectural now, should be adapted fundamentally. It would be a great challenge to see whether a confrontation with and application on these areas would yield new visions regarding the anatomy of the taxonomy or even the establishment of new concepts, or bring new elements or insights into architectural design and vice versa.

From some first, provisional orientations it might be possible that the phenomenological, but vast and complex work of Charles Benjamin Peirce, in which ideas and notions can be found concerning process and change with respect to substance and structure, might be relevant for the further development of the taxonomy. His notions of Firstness, Secondness and Thirdness seem to correspond quite well with the notions of Form, Function and Process which appear to have a similar triarchic relationship. Though this study is only at its very beginning, it looks as if there are 'intriguing' similarities and connections in a development towards an 'open' design theory, which stands apart from the specific artifact that is designed, a theory that would apply to any particular design context.
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