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On the Notion of Level in Architecture

Developments in Domain Theory

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Abstract: The notion of Level (in a scale of Levels) is probably the most authentic notion in Architecture. Already in the work of Vitruvius the notion is implicitly present in the triad 'ordinatio – symmetria – eurythmia'. In more recent times, the notion always appears in relation with hierarchical organization as a means of control of quality. However used in drawings and in architectural discourse, the term lacks precision; there are many types of level like abstraction, specification, dependency, resolution levels etc., but no operational definition can be found as a notion that structures architectural objects and design processes simultaneously in a consistent way. Defining this notion of Level is the purpose of this paper. An example of application in an architectural decision-making process completes the paper.

1. INTRODUCTION

This paper aims at establishing a definition of the notion of Level, which 1) is dual in nature, i.e. it applies to both the articulation of objects as products of a process, and to the articulation of processes in which these objects are created; 2) is operational in the sense that it may articulate architectural concepts both as a notion and as an image, and 3) applies to research, design as well as to education processes.

Before going into the method used in order to arrive at a definition, it is appropriate to reflect on the nature and the general application of the notion of Level in architectural design, inspired by applications in some other fields. In general, the arrangement of an object in terms of levels entails positioning the object in a range of levels (a scale), as well as articulating the object itself in levels, based on particular properties of the object. These

properties are denoted by the term 'stratification', a manifestation of a category of thinking of architects, scientists and philosophers.

The notion of level in an architectural object always functions in interplay with the notions of Phases en Criteria. Therefore the relevance of the definition of level we want to achieve can only be demonstrated after the moment that also these notions are dealt with as subjects of separate papers. We will treat the subject of levels as independently as possible, but because of the very nature of architecture, it is sheer impossible to avoid some overlap.

In science the notion of level is an indispensable tool to abstract and represent the complex reality into reduced and simplified models, which may, because of their predictive value, be deployed again in order to bring about a new reality. In political parlance for instance, the notion of level is an essential means to communicate with other people in all nuances, varying from coarse to meticulous, either in an open or mandatory way (open: by use of general terminology in order to attain agreement on legislation; mandatory: by use of specific terminology in order to enforce execution of legislation).

In Architecture the notion of level is clarified by the more familiar notion of Scale. This notion has a twofold disposition: numerical (Scale 1:100) and intuitive (Harmony).

As to make the first type operational, e.g. for designing, insight in the nature of the second type is needed. This second type of Scale is subject of the Proportion Principle, as known from Vitruvius and Van der Laan's interpretation.

By means of the Vitruvian notions of ordinatio, eurythmia and symmetria (Morgan, 1960), the concept of proportion ingeniously conditions the accomplishment of a proper balance of dimensions within and between the parts by which the building is composed (Van der Laan, 1967). This is achieved by establishing an arrangement of super- and subordination between those parts and by adopting units of measurement by which the dimensions of the parts can be measured in a countable way. Application of this principle in Architecture, based on human perception, establishes scale in the sense of Harmony. The units of measurement again correspond to numerical scales that enable an orderly image and perception of the building. The sense of scale and the practical application of scale are brought together through perception and application of proper units of measurement.

The units and the scale, on which they can be represented, determine classes of elements that determine the content of spatial levels.

As any building, because of its super- and subordinated arrangements of parts, covers several classes of elements with their own units, several levels are simultaneously active in the perception of a building.

This simultaneous perceptible presence of several levels in an object beside the presence of an object in a scale of levels is denoted as the feature of stratification.

2. METHOD

In accordance with the paper's objective the notion of Level will be adequately defined through a number of steps:

1. Carrying out an analysis of linguistic aspects of the term Level.
2. Discerning different principles for identification of levels.
3. Discerning and defining types of levels.
4. Formulating a preliminary layered (working) definition of the Notion of Architectural Level.

Presenting an example of application.

3. ANALYSIS

A quick glance in a dictionary makes clear that 'Level' refers to 'Hierarchy' and 'Hierarchy' refers to 'Level'.

At first the term Hierarchy is considered. It is interesting to note that 'Hierarchy' refers to a principle of classification in a process of ordering as well as to the product of such a process.

Stratification or level-based ordering may be considered as 'hierarchy-as-product' (of a process of ordering, guided by a hierarchical principle).

The term 'Hierarchy' stems from the world of administration and government (of church and state). A scale of levels is the manifestation of a hierarchical principle of ordering, aimed at efficient control, policy-making and management of organizations. So, the leading principle in discerning levels must be found in a *principle of control*.

The scope of this principle should be interpreted widely and concerns both 'control' in the sense of governing institutions (leading, administering churches, states and other organizations), as well as controlling (commanding, regulating, having in hand, keeping in check) processes and projects in almost any field of human activity.

Etymologically the term Hierarchy refers to a principle of stratification, in which for instance decisions on a higher level are 'sanctified', i.e. inviolable and thereby unchangeable, irreversible and definitive for people and institutions on a lower level in the hierarchy.

Historically the term Hierarchy is used to indicate stratification primarily in social and political systems (of e.g. church and state) and secondarily to

indicate and describe forms of corresponding stratification (according to societal conventions) in physical and other systems: perceived as being organized in an ascending or descending order.

Practically the term Hierarchy is used to distinguish between main issues and side issues, between things to which major or minor importance is attached, or matters that are considered to be of a higher of lower degree of permanence, e.g. things that to have be maintained or changed in a design process, depending on the situation at hand.

Hierarchical ordering can be found in both natural and artificial systems. A tree may be analyzed and described as a hierarchically organized system. On the highest level the tree is considered a complete overall object, on a lower level as a more detailed system of constituting elements: roots, trunk and branches and on an even lower level, as a system of many more smaller parts; leaves, flowers, fruits, root-hairs, bark, etc. These types of elements may again be considered subsystems, containing their own parts on a lower level, etc. In a hierarchical description the complete system is depicted on every level, but with a decreasing or increasing degree of generalization or specification between the levels. The contents of the levels can be strictly separated and the relations between the levels precisely determined. A company is hierarchically organized, however the number of levels varies, depending on the type of organization (flat or multi-layered).

Hierarchical organization occurs in sensory perceptible *concrete* systems as well as in mental *abstract* systems. An urban plan may be described in a similar way as the above example of the tree, every element being equally concrete, but a city may also be described on various levels of concreteness, as is usual in the presentation of a plan on different scales. On a certain level a city may be described as a composition of blocks and on a more detailed level as a set of dwellings that together constitute blocks again. Moreover, on every level of concreteness (or abstraction) a hierarchical ordering is conceivable, the elements of which having the same degree of concreteness.

As to *designing* an effective organization, both types of hierarchy are relevant: the principles governing the relations between *elements* within a certain level of concreteness are also valid for the relation between *sets of elements* on different levels of concreteness. All these principles may be classified under the common denominator of Control.

This analysis leads to basic assumptions about levels on which the following distinguishing characteristics of the next section are based, namely: Levels can be distinguished by themselves and from each other; multiple levels can exist simultaneously; interactions (of any kind) can be defined between levels; it is possible to transfer information from one level to another.

4. PRINCIPLES OF LEVEL IDENTIFICATION

In literature, through observation of architectural practice, education and by authors' reflection six principles were found that are related and directed to the identification of levels in architectural objects. In order to structure the principles the object may be considered in first instance an Object as Form ('Percept' or 'Gestalt'), in second instance an Object as Product (Form & Process) and in third instance an Object as Construct (Product & Criteria), which hierarchically and cumulatively ordered threesome correspond with the three modalities of self-regulating organizations. In this section these three object modalities enable an ordering of the identification principles that will be applied for distinguishing types of Level.

4.1 Principle of Discreteness

Identification of levels by discerning elements, corresponding with perceptible qualitative articulations of the Object (as a Form).

Before going further into the nature and issues of hierarchically ordered levels, it should be noticed that the hierarchical type of levels occurs in a concatenated chain (or *scale*) of levels. This is a specification of the general (Webster) notion of level, which also includes linear scales on which levels only differ from each other quantitatively and gradually. This study however, is focused on types of levels with qualitative differences, corresponding with a distinction in classes and types.

The essence of this kind of series is (like in the example of the tree), that each level has its own quality and thus its own identity. So, the transition from one level to another entails a *quality shift*. This notion of level is comparable with the way the notion is interpreted in dialectical discourses, where a conflict on a certain level is made solvable by conversion to a higher level of abstraction. For instance, if the dimensions of a girder, in order to be strong enough, have to be so large that the height of the remaining underpass is too small, this conflict may be solved on a higher, more abstract level, where the problem of spanning may also be solved by means of an arch instead of a girder.

In a mental and artificial way, levels enable the introduction of discontinuities in complex entities, e.g. in a (whether or not imaginary) space, being continuous by nature. Herewith the space can be made *discrete* for the purpose of observation, perception and intervention.

In a concatenation of levels of this type, a (situation on a) given level presumes the presence and working of a (situation on a) lower level. The

chain of levels is principally unlimited and open at both sides; for that reason they are indicated as Open Hierarchical Systems (Koestler, 1976).

For examining a certain level and to gain insight in the working of the complete system of levels, it is possible and useful to constrain a study field by selecting repeatedly three adjacent levels and to focus on the middle one, positioned between its two neighboring levels.

4.2 Principle of Recursivity

Identification of levels by discerning similar *patterns* of elements in situations returning on other levels of the Object (as a Form).

In many hierarchically ordered systems similar patterns of ordering may be perceived on every level. For example, in the nerves of each leaf the branching pattern of the tree recurs, and in the patio-house the repeated pattern of the patio on an urban level recurs as a piazza or forum. In ancient China the pattern of walled territories was applied from the simple hedged house, via the walled (Forbidden) city in the city, up till the circumvallated town in the country and even on the level of the walled country in the surrounding world.

Application of such a principle contributes to coherence and harmony in the whole system. It is also a means to define different levels against each other; occurrence of Recursivity is an initial indication that we are dealing with several levels.

4.3 Principle of Restricted Complexity

Identification of levels by discerning situations (composed of elements) with a similar *numerical complexity* on each particular level of the Object (as a Product of a process).

A noteworthy feature of hierarchically ordered systems is that *situations* occurring on different levels are characterized by a similar degree of complexity (measured in numbers and quantities of types of elements of which they are composed). Levels in musical or architectural systems for instance, may be characterized by an equal number of elements on each level: 3, 7 (octave) or 12 (they often are ‘holy’ numbers).

This characteristic is especially important in artificial systems (being the result of human decisions) because it is sensible to assume that the capability of persons and institutions to make decisions is comparable on every level. For this reason it is important that the number of (types of) elements, that has

to be decided about (with regard to application, position, dimension, etc.), should be comparably large on each level.

However, this does not alter the fact that the complexities of the *elements* on each level may vary considerably. The total complexity, i.e. that of the situation in addition to that of the constituting elements is not constant of course, but here a regulated complexity exists.

This principle implies that for aesthetic (perception-based) reasons the numbers of elements per level are subject to limitation: too many elements result in chaos, too small an amount in deprivation.

This principle is a powerful means for identifying levels and for stratifying a complex entity into a hierarchically organized system of levels.

According to parlance every higher level in a hierarchical organization is characterized by an increased complexity of its *elements*.

This particular principle is closely related to the principle of Economy of Thought, and is applied on efficiency of mental processes.

4.4 Principle of Double Role

Identification of levels by discerning *mechanisms* that cause the transition of a situation into an element (of a lower level), and vice-versa, of the Object (as a Product of a process).

If elements of a higher level are more complex than elements of a lower level, then (in this vision), this higher degree of complexity can only be traced back to a larger number of (types of) parts (elements again) that constitute the complex element.

The complex *element* itself may be considered a *situation*, in which again elements occur (as its constituting parts) that already have obtained their specific positions, dimensions, pattern of mutual relations, etc. So, in this view one and the same entity fulfils a double role: both as an element and as a situation. Obviously two kinds of elements exist: namely the kind of elements that may become a situation and the kind of elements of which the situation is put together. In order to discern these two kinds of elements, they may be assigned to two adjacent levels in a hierarchical order. The kind of element that becomes a situation belongs to a higher level and the kind of element that constitutes the situation belongs to a lower level. Thus, this principle enables discrimination between hierarchically ordered levels, as known from e.g. a means-and-ends hierarchy.

For example, a decision-maker on a high level should be well aware that decisions about elements belonging to his ‘own’ level not only determine ‘his’ particular elements, but that simultaneously and implicitly decisions are made that influence and condition situations on a lower level.

4.5 Principle of Open Form

Identification of levels by discerning (structural) *rules* in elements, which allow for the generation of equivalent functional variants in the context of a lower level, and vice-versa, of the Object (as a mental Construct resulting from judgement).

If an element of a higher level becomes a situation on a lower level (according to principle 4.4), and if furthermore only *one* situation is involved, then this situation is already implied by the way the hierarchical system is arranged. In the most extreme case, a decided situation on the highest level completely determines (by implication) all situations on all lower levels. Such cases concern closed systems, for which a distinction in levels is merely useful for a systematic description of the object's stratified anatomy as the existing result of a completed design process.

In contrast, the principle of Open Form is particularly relevant for e.g. phased and participatory decision-making processes, but it is also of general importance for gaining insight in the nature of hierarchical systems in general. In participatory decision-making processes levels should be determined in such a way, that they not only correspond with a hierarchical ordering of spatial/material objects, but also with a hierarchical ordering of participants (individuals and groups) in corresponding process phases and in the functional criteria applied by them.

In decision-making processes, deciding participants and parties on every level and in every phase need some freedom in order to be able to contribute to the process in accordance with their own interests and needs. The transition from a higher to a lower level therefore should allow full play and provide elbowroom for parties appearing on that particular level in that particular process phase. In terms of hierarchically ordered levels this means that an element (of a situation already decided about on a higher level) should not generate just one, but several situations on the next lower level, which still may be elaborated in different ways, i.e. in *variant solutions*. Though the element of the higher level already has obtained some form, it should be an unfinished, open type of form.

As this form (just like the closed form) is intended to ensure a certain quality, yet to be worked out in future decisions, the open form inherently consists of two groups of properties: *material* properties (its dimensions, position, material, etc.) and *regulative* properties. The regulating properties set out the perspective for possible future developments of the material properties, however without determining their final form. At the beginning of a process the regulative properties of the element will be substantial, at the end of the process the material properties will be dominant, but there will

always remain a regulative constituent, which often implicitly determines its usability.

The property of elements and situations by which they contain rules for their use and development is denoted (in conformance with usage in Structuralism) as a transformational or *structural property* (Bax, 1976).

4.6 Principle of Controlled Change

Identification of levels by discerning incremental purposeful (functional) *transformations* of situations from a high-level Model to a low-level Plan, or vice-versa, of the Object (as a mental Construct resulting from judgement).

The term Hierarchy may still be used in its etymological meaning: a system is hierarchic if changes of subjects on lower levels do not affect subjects on higher levels, i.e. they remain untouched. However, the opposite is not the case: changes of elements on higher levels imply changes of elements on lower levels.

In a hierarchically ordered system decisions are carried out in a one-way direction: top down (to this the term owed its pejorative connotation in the seventies). Yet, exchange of information (in architectural modeling and planning processes) requires and is carried out in two-way traffic (for this reason the more neutral term Stratification is often preferred to Hierarchy). Such an asymmetric interdependence of transformations and controlled change of elements is typical for the arrangement of elements in levels in a hierarchically ordered system. An ordered arrangement of parts in levels of an ordered whole is that of an *organization*.

These properties concerning controlled elaboration of transformations within a level-ordered system are characteristics of a principle underlying any arrangement in levels: the principle of controlled change.

5. TYPES OF LEVEL

All above-mentioned principles contribute to the formulation of the notion of level. It appears to be possible to determine types of level by means of the number of principles being relevant for those specific types. The principles in the preceding treatise are arranged in a sequence of increasing complexity, in which each next principle is based on and contains the previous one.

Three types of level are discerned: firstly by applying principles 1 and 2 (Form-oriented) Levels of Composition, then 1 through 4 (Product-oriented)

Levels of Complexity and after that 1 through 6 (Construct-oriented) Levels of Control, in an order of increasing complexity.

Moreover, it may be informative to point out that the principles appear in pairs: the even-numbered principles perform an instrumental role, whereas the odd-numbered are more involved with content.

Levels of Composition are a type of level in which an 'Object as Form' may be characterized by elements and situations based on principles of Discreteness (qualitative differences) and Recursivity (similar patterns), representing the composition of the object. In practice Levels of Composition are also denoted as Aggregation levels, Containment levels, Distribution levels and Framework levels. This type of level plays a role in spontaneous observation of a situation at the beginning of a process, yet without the subject's attention for the way this situation arose. The subject perceives the entity as (outward) *Form*.

Levels of Complexity are a type of level in which an 'Object as Product' may be characterized by elements and situations according to Levels of Composition and additionally according to principles of Restrained Complexity and Double Role (the mechanism determining the transition of elements to situations on a lower level and vice versa). In practice, levels of Complexity are also indicated as levels of Abstraction and Concreteness, levels of Specification and Generalization, levels of Scale and Resolution, etc. This kind of level plays a role in the subject's action aimed at changing the situation, i.e. to adapt it to the requirements of the environment. The subject now perceives the entity as *Product* of a process

Levels of Control are a type of level in which an 'Object as Construct' may be characterized by elements and situations according to Levels of Complexity and additionally according to principles of Open Form (with structural rules) and Controlled Change (gradual transformation). In practice Levels of Control are decision-making levels. The Form and the Product are now perceived as *Construct*, i.e. a product in relation with the reasons, arguments and considerations that eventually resulted in the origination of the product. The term Construct also matches the Anglo-Saxon 'Control' which includes more than merely supervision of the process. The term accommodates so-called levels of Subsidiarity, tooled up according to the homonymous principle and as applied in ecclesiastic law and more recently in the European administration. According to this principle decision-making is assigned to the lowest level of competence.

The distinguished types of level again are hierarchically related. The level of Control presupposes the presence and operationality of the level of Complexity, which again presupposes the presence of the level of Composition. Moreover, as a consequence of the way they are defined, the level of Control comprises both lower levels. Thus, the levels themselves

may be ordered in levels. Therefore the level of Control is the highest level in the hierarchy of levels, in spite of the fact that it is positioned on the lowest row in Figure 1.

Principles	Levels	Reference
1. Discreteness	Level of Composition	Form-oriented
2. Recursivity		
3. Restricted Complexity	Level of Complexity	Product-oriented
4. Double Role		
5. Open Form	Level of Control	Construct-oriented
6. Controlled Change		

Figure 1. Hierarchy of Levels

6. DEFINITION OF ARCHITECTURAL LEVEL

For an advanced study of levels and hierarchy in the field of Architecture only the highest type of level, the Level of Control, is relevant. Herewith no information gets lost, because this level comprises the contents of both lower levels. Qua name and contents this type of level also joins with the leading principle of Hierarchy, viz. Control en thereby with the (work) definition of Architecture: Control of Complexity by means of Composition (Form). For this reason Levels of Control are also denoted Architectural Levels.

Though the other types of level contribute to the definition of the Level of Control or Architectural Level, they are especially intended to position the commonly used kinds of level, in relation to the ones discussed in this study. For example, the widely used Level of Scale is a level of Complexity.

An Architectural Level is a particular articulation of an Object (next to other articulations like Phases and Criteria) on a certain position in a Scale of Levels, which structures the organization of the Object in fields of perception, conceptualization and decision-making: every level being defined initially by classes of spatial elements and situations of the type of Level of Composition, secondly by the type of Level of Complexity and thirdly by the type of Level of Control.

These three instances of the Notion of Level correspond with the degrees of profundity of consideration of an architectural object, in which the first instance is a condition for the second, etc.

The instances correspond with the phases of an imaginary process. The first one concerns an open-minded observation, the second one enables closer investigation of the complexity of the object that came into being as an answer to a principally discordant request from the environment and that may be explained by the third one as the result of application of (structural) rules in a modeling and planning process.

7. APPLICATION

The powerful interdisciplinary properties of the notion of Level (of Control) become apparent by its application in structuring objects, which are subject of disciplinary fields and have to be integrated in a multi-disciplinary project. Architectural objects, even the simplest ones, are subject of such a complex type of process. An Architectural Object may be considered the result of a synthesis of three types of objects, which may be distinguished similarly as the types of Levels, viz. as Form, Product and Construct (oriented) Objects, and are articulated in Levels as any other object. In order to integrate these three types of object it is necessary to tune the levels of those objects to one another. This means that the levels of the Form Object also articulate levels in the parties and participants who produce a Product Object in the variety of phases of a process and moreover articulate levels in the rules and criteria that lead to a Construct Object.

In the sixties of the last century John Habraken (Habraken, 1962, 1972) and the Foundation for Architectural Research (SAR) introduced a new kind of architectural object in the field of social housing that was denoted as a Support. Although theoretical work, as presented in this paper, resulted 40 years after the introduction of the notion of Supports, it appears to fit perfectly well. The innovative feature of the Support object is that Form, Product and Construct aspects are conceptually integrated in a complex, but nevertheless easy manageable concept in order to make complex processes of decision-making simpler and open for participation by all involved parties.

A Support is a type of Object of such *general* characteristics that it opens to *specification* by dwellers. Beside that, the object is positioned on a scale of Levels, in which a Support is an *element* of a higher level Tissue, and a *situation* open for Infill on a lower level. As a consequence a Support is an object with *structural properties* that allows for a controlled transformation according Principle 5 and 6 of Section 4. From a conceptual point of view a support is a Construct: a Support has Form properties (zones and margins and sectors) and beside that Product properties in so far it addresses specific parties in the design process, and more specifically it contains rules, which control the generation of variant plans.

A Support functions not only in a mediating role between the various Levels of an Object as Construct, but functions also in a mediating role between the Object as Form and the Object as Product. The Object as Form is represented in its Levels of Block Building and House Building, and the Object as Product is represented in its Levels of Block Dwellers and House Dwellers.

This twofold mediating position of a Support Plan is rendered below in Fig. 2. On a higher and lower level a Tissue Plan and an Infill Plan are distinguished respectively. The schema of Fig. 2 is an adapted version of a scheme developed by John Carp (Carp, 1979).

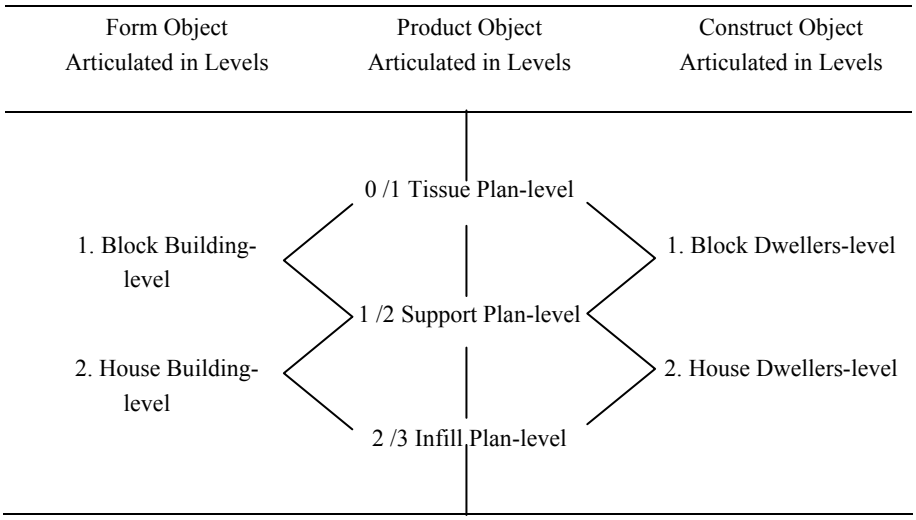

*Figure 2.*Levels of decision making in a Support-structured process

The scheme represents principles for decision-making in the field of spatial organisation. The scheme may be extended to higher levels of decision making – even to a national level – and to lower levels, but always following the same pattern as indicated by the arrows in the scheme. In the process of tuning of the various Levels of Form, Product and Construct objects, the notion of Support appeared to be a crucial instrument.

A Construct object, in general, is a determining factor for the demarcation and articulation of a territory, because, by its hierarchical and cumulative position, it integrates and harmonises the Form- and Product objects it encompasses. Such a territory is denoted a Domain.

A Domain is a complex articulation of an object that regards the object as Form, Product and Construct. In a more general terminology a Domain regards the Material, Procedural and Organic capacities of an object.

A Support is a first specific example of the application of the general notion of Domain, a subject that inspired the theoretical work of the authors since a long period of time. The study into Domains as the most complex units for the articulation of architectural objects and related process in a project are subject of so-called Domain Theory. This paper is a presentation of developments in this theory; hence the sub-title of this paper.

The paper fits in a series of papers, which aim at the establishment of a connection between Domain Theory and the pragmatistic philosophy of Ch. S. Peirce, one of them previously presented in the DDSS 2000 conference (Bax, Trum, et al., 2000).

Beside this example of application, numerous examples may be given. They are all specifically situated in the field of multidisciplinary design in the form of concurrent design, integral design, participatory design, or whatever other name may be given to this kind of activity. Designing processes is the subject of a separate discipline, of which the Postgraduate Designers' Course 'Architectural Design Management Systems' at TUE is a good example.

An annotated document on the topic of this paper in Dutch language (30 pages) is available via h.m.g.j.trum@bwk.tue.nl

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