STARTING WITH DRĂGĂNESCU'S ARCHITECTURAL THINKING

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ABSTRACT. We present an application of M. Drăgănescu's "categories and functors of structural-phenomenological modelling" to the "architecture" notion, also introduced by M. Drăgănescu. Our paper proposes an architecture conceptual frame and an architecture modeling approach of a new product (artifact). Four levels of the architecture of an artifact (a construction which is made by human beings) are identified: (a) the Formative Images (FI) level, (b) the Sensical inVariants (SV) level, (c) the Logical-Functional Structure (LFS) level, and (d) the Physical Structure (PS) level.

For each level, a category has been associated: Cfi, Csv, Clfs, and Cps. Only the category associated to FI can be considered as a phenomenological one. The remaining categories are structural categories. But, in a more general framework, which includes the four categories, associated to artifact architecture: Cfi, Csv, Clfs, and Cps, all these can be considered as a single phenomenological-structural category. The crossing from a category to another is generally considered to be achieved by means of an informational process, which can be interpreted as a functor. Finally, we promote the idea that within the physical structure of an artifact, there are phenomenological meanings. These phenomenological senses seem to be transmitted by the chain of the 'Cfi-Csv-Clfs-Cps' categories and the associated functors. More than that, it seems that the architectural gestalt of an artifact, perceived as a psycho-mental state, is represented by those phenomenological ingredients, which preserve themselves from Cfi to Cps, due to the equivalence of those categories from the chain.

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Introduction

The **architecture** notion has emerged from the Greek antique thinking [18], [19]. It came into view along the time [9], [23].

The subject of our work is a limited one. It is based on M. Drăgănescu's works [4], [5], [6], [7], [8] who proposed a new vision on this item. In this way, we will propose:

a. an extended framework of the mentioned notion, which was introduced by Drăgănescu [4], [5], [6], [7];

b. a modeling of the **architecture,** as a particular case of "Categories and functors for the structural-phenomenological modeling" [8].

The "Architecture" Notion In M. Drăgănescu's Works

In [6] Mihai Drăgănescu synthesized some aspects of the architecture notion, which were been put into evidence in [4], [5].

We shall take the risks to simplify what Drăgănescu wrote, and so we shall summarize from [6]:

1. There are three levels of the **architecture** of a system:

♦ architectural level of a functional structure;

♦ architectural level of a concrete structure;

♦ architectural level of the system, as a whole, conceived as composed by the above two levels.

2. In opposition to the systemic 'objective' gestalt, the architectural gestalt cannot be separated from the subject. That is due to the fact that the subject is the determining factor that creates and intercepts the 'whole' of the **architecture,** and produces a 'unique, scientifically undescriptible (psycho-mental) state'.

3. From an architectural point of view, the architectural gestalt tries to cover in every possible way all the functions of a system, including technical, human and aesthetical aspects. For this reason the architectural approach is not subsumed to the systemic approach but, instead, exceeds the latter.

4. The architectural approach is a constructive and creative thinking.

5. A human being may be an onlooker when he looks on an existent system, or an actor when he builds up a new system.

In a subsequent work [7], M. Drăgănescu goes back to the architecture **notion** with some new specifications.

Concerning the functional level of architecture**,** he said that, at this level, three types of functions emerge, namely:

♦ formal functions (mathematical functions);

♦ formal – non-formal functions which can also be reduced to formal functions;

♦ non-formal functions.

There are some new notions and concepts exploited by M. Drăgănescu later in [8].

We shall remark that, by means of the "non-formal functions" notion, the author puts into evidence the "phenomenological" aspect of the thinking, which has a "continuous" connotation. Therefore, the functional level of an **architecture** loses the structural feature, in a classical mathematical sense with a "fragmentary/discrete" connotation, being a structural-phenomenological level.

Finally, the creative feature of the mind is associated to the phenomenological aspect. In [8], the phenomenological aspects of the mind were assimilated with the *qualia* phenomena [17], [20], [22] (intuitive experiences/insights).

In the next section, we shall present our extended conceptual framework of the '**architecture**' of an **artifact** (a construction which is made by human beings).

The Proposed Conceptual Framework

We are considering that the **'architecture'** of an **artifact** lies over three spaces (**Fig. nr. 1):**

♦The consciousness (phenomenological) space;

♦The intellect (structural) space;

♦The physical (structural) space.

The phenomenological space can be assimilated, from a Buddhist-Zen world views [3], [12], [21], with 'a sea of consciousness', as G. Kato and D. Struppa wrote [11].

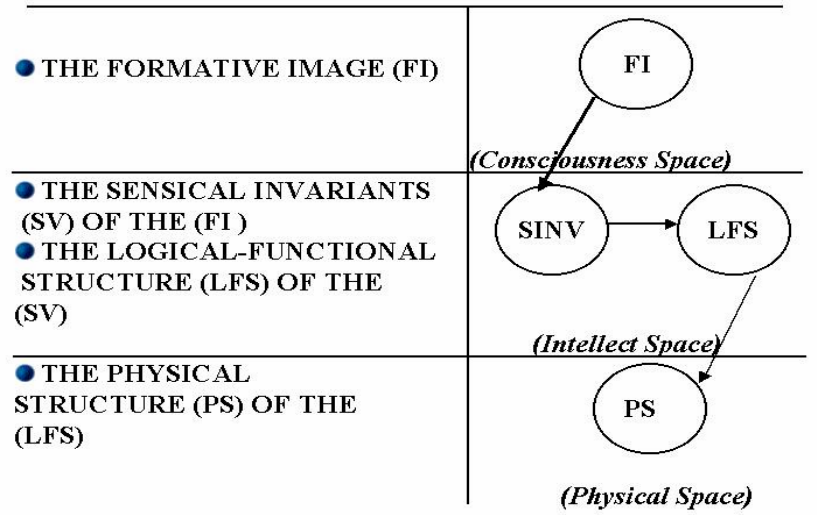

Fig. nr. 1

This "sea of consciousness" seems to be like but, in the same time, unlike – if we take into consideration some nuances, but fundamental ones –, with the 'collective unconscious' of Jung's point of view. In **the phenomenological space** an *individual consciousness* arrives, through a *Qualia (informational – intro-opening* [5], [7]) *phenomena (processes)* at a **Formative Image (FI)** [14], [16] of the future **artifact**. If the **FI** is a **natural** (non-temporal) entity one, then the future **artifact** can become an efficient and long vive **product** in **the physical space** [13], [14], [15], [16]. In this case, the **FI** will contain **true phenomenological senses**.

By the mediation of a *new informational process* **FI** is transformed from an *individual consciousness* into **an individual intellect space.** The *individual intellect* becomes aware of the 'whole' of the **FI** (as a 'high level concept' of the future **artifact** [13]) and rationalizes the received **FI** by assigning it some suitable **synthetic features.** Such synthetic features we shall call **Sensical Invariants (SV),** because the **SV** preserves, under certain conditions, the **phenomenological senses**.

In an **individual intellect space** the **Sensical Invariants (SV)** are subdued to a *new informational process* – which we shall call the *process of communication*.

By the *process of communication* the **SV** is detailed and transformed into the **Project** of a new **artifact**, which, in fact, is a description of the **artifact Logical-Functional Structure (LFS)** [14], [16]. Within the frame of the *process of communication* new links are introduced among the **SV** elements, links of a logical-mathematical kind (relations, functions, operations, operators etc.), which make also possible the appearance of some new elements besides the previous ones in **SV.** Also **LFS** preserves, under certain conditions, the **phenomenological senses** captured by **SV.**

The **LFS** finally is transformed, by *a process of construction (a physical technological process)* into the **Physical Structure (PS)** [15], [16] of the new **artifact,** passing from **the individual intellect space** to **the physical space** and, under suitable circumstances, **PS** preserves the **phenomenological senses** from the **LFS,** too.

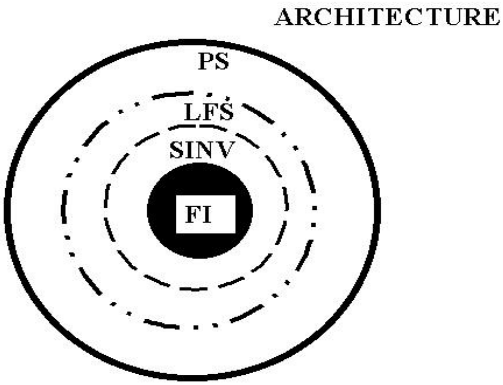

Fig. nr. 2

In **Fig. nr. 2** one can notice how the **FI** is included in the **SV**, how **SV** is included in **LFS,** and how, finally, **LFS** is included in **PS.** The picture described in **Fig. 2,** is a correct one **if and only if certain condition are fulfilled,** as we will show later on**.** In that way, according to our opinion, a human observer perception of the **architectural 'whole'/gestalt** of an **artifact** [6] can be explained.

The Modeling Approach – Preliminaries

According to [8], "structural-phenomenological theories may be 'detailed theories' or 'envelope theories' ". In [8], the 'envelope theories' point of view is taken into account. ***In the present work, the considerations that follow are exposed in the frame of 'envelope theories', too. From that point of view, we will not analyze how the functors between the various categories of our modeling approach are realized in detail*** (this aspect will be approached in future works). ***Hence, we only assert the realty of such functors.***

Also, according to [8] "A phenomenological category… is a collection of phenomenological objects… *(an elementary phenomenological sense or a set of phenomenological senses)*. The physical-informational content of morphism is a natural relationship from a phenomenological sense to another. It does not matter where these two phenomenological senses are located. In fact, the phenomenological realm there is no physical space, and still if we imagine these two phenomenological senses like two separated points, the agitation of one point – because it is a process, it may be a sort of vibration – produces an excitation of the other point which will vibrate itself in a more or less different manner. We consider, in the case of such excitation, that two points (phenomenological senses), as processes, are 'relatively neighbors' and if the phenomenological category has only such morphisms, then the category is said to be 'not to large' ". ***We will take into consideration the same point of view about the phenomenological categories.***

In the next sections we will present a **S**implified **T**heoretical **C**ase **S**tudy of the **architecture (STCS)** of a **new artifact** and a step-by-step building up of such architecture. Finally, we will put into evidence a more complicated case.

The Appearance of the Formative Image (Fi)–Step 1

Working assumptions:

♦ The *consciousness space* is **phenomenological.**

♦ A **FI** of a new **artifact** has been appeared into the *individual consciousness of a human being* by means of Qualia phenomena.

♦ **FI** contains only three phenomenological senses, as **Fig.nr. 3** shows**,** according to the **STCS** (**S**implified **T**heoretical **C**ase **S**tudy), which constitutes our discussion subject, for the moment.

Modeling approach:

♦ Let **Cfi** be the phenomenological category associated to **FI.**

♦ The objects of **Cfi** are sets of phenomenological senses. In **STCS** there are only three objects, each object containing a single phenomenological sense, as an element of a phenomenological senses set **(Fig. 3).**

♦ The morphisms of **Cfi** are the links between the phenomenological senses (there are only three morphisms – **Fig. 3**).

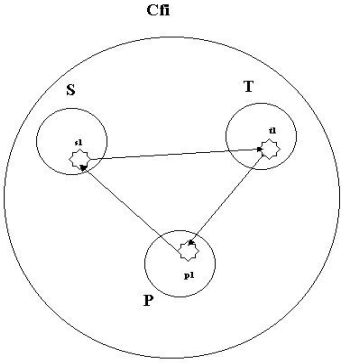

Fig. nr. 3

The Appearance of the Sensical Invariants (Sv) – Step 2
Working assumptions:

♦ The *intellect* of a human being is **structural** and the appearance of **Sensical inVariants (SV)** takes place in an *individual intellect*.

♦ The **FI** transformation from *individual consciousness* into *intellect* may be modeled by means of a **functor F'** which consists in an informational process (in the frame of an 'envelope' theory).

♦ *Different from the opinion in* [8], *we do not consider a 'neuronal automaton' as an object in* ***Csv.*** *Also, we do not consider a 'neuronal automaton' as a category whose objects are sets of automaton states and whose morphisms are transitions from a state to another state. Our point of view is that the objects of* ***Csv*** *are sets of 'neuronal automata' states and the morphisms of* ***Csv*** *are the inputs-outputs of these 'neuronal automata'.*

More precisely, if we consider that A (a set of states of a certain 'neuronalautomaton') is an object of ***Csv,*** *then a mophism with the target A is, by definition, an input under which the automaton takes a state a* $\in$ *A, while a morphism whose source is A is an output produced by a state* ***a*** $\in$ *A.* We admit that there is an approximation but, as we shall see later

on, that approximation will be more useful for the links between some senses from **Cfi** and certain states from **Csv** and conversely.

♦ Before the appearance of the **functor F'**, from the **architectural point of view**, it is considered that the 'neuronal automata' from the whole brain have been at rest. So, the associated sets of states of the 'neuronal Fig. 3 automata' initially are empty sets (the 'neuronal automata', from the brain, is working for other tasks but not for an **architecture**).

♦ According to the **STCS,** the **FI** contains only three phenomenological senses **(Fig. 3),** and when the **functor F'** appears, only three corresponding 'neuronal automata' begin to 'vibrate' in different ways, in consonance with the three phenomenological senses of **FI;** hence, in the associated sets of states only one element emerges. This is in concordance with the feasibility reason (highlighted by M. Drăgănescu) when a functor is applied between a phenomenological **(FI)** and a structural **(SV)** category (**SV** appears in an **intellect** which is structural): "in a human body there cannot be a neuronological structure lacking significance" [8].

Modeling approach:

♦ Let **Csv** be the structural category of the **SV.**

♦ The **Csv** category appears only when the **functor F'** begins to work.

♦ The objects of **Csv** are sets of states of a 'neuronal automaton' (in the **STCS,** there are only three objects, each object containing a single state; the state are singleton – **Fig. 3, Fig. 4).**

♦ The morphisms of **Csv** are the inputs-outputs of the 'neuronal automata' (there are only three morphisms in our **STCS – Fig. 4).**

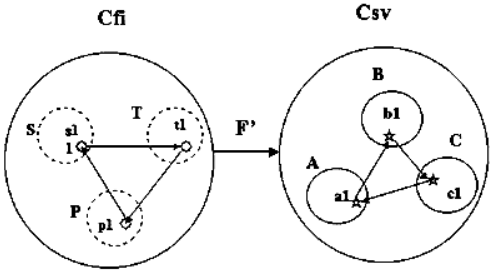

Fig. nr. 4

Consequence:

In our **STCS** the **functor F': Cfi -> Csv** is an ***isomorphism*** of categories [2], because:

♦ For each pair **X,Y** of objects of **Cfi,** the mapping:

MO (**X,Y**) -> **MO** (**F'**(**X**),**F'**(**Y**)) induced by **F'** is a bijection, respectively the **functor F'** is a **full and faithfull functor.**

♦ The mapping **Ob** (**Cfi**) -> **Ob** (**Csv**) induced by **F'** is a bijection.

The Appearance Of The Logical Functional Structure (Lfs) – Step 3

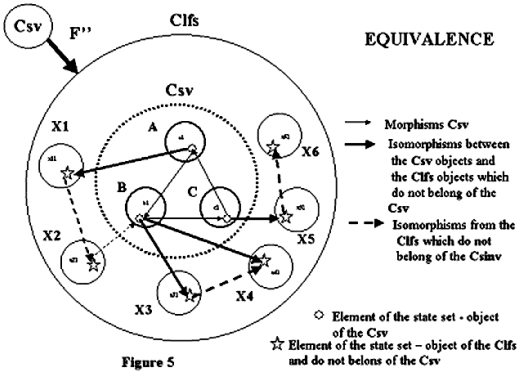

Fig. nr. 5

Working assumptions:

♦ The *intellect* of human being is **structural** and the appearance of **Logical-Functional Structure (LFS)** takes place in intellect, too.

♦ The transformation from **SV** to **LFS** is a transformation from *intellect* into itself, and it can be modeled by means of a **functor F"** which consists in an informational process, too (in the frame of an 'envelope' theory). We shall call **F"** a **"communication"** process.

♦ The **"communication"** process will explain **SV,** and also it will detail the **SV,** in a discursive-logical sense. Thus, the **Project** or the **Logical-Functional Structure (LFS)** of the new artifact will appear.

♦ The **"communication"** process may be characterized as follows:

it supposes the existence of a transmitter;

the introduction, by the transmitter, of some new linking elements like the logical-mathematical ones: relation, function, operations, operators, etc., could also produce the "stimulation" of some new 'neuronal automata'. In this case, **from an architectural point of view,** these new 'neuronal automata' will pass from an "at rest" state into an "active state";

it supposes the existence of a receiver; the receiver can be one and the same entity with the transmitter or it can be a separated entity;

Modeling approach:

♦ Let **Clfs** be the structural category of the **LFS.**

♦ The **Clfs** category appears only the **functor F"** begins to work.

♦ The objects of **Clfs** are the objects of **Csv** category and, possibly, **Clfs** contains new objects produced by the previous "stimulation" of the new 'neuronal automata' – **Fig. nr. 5.**

♦ The morphisms of **Clfs** are the morpisms of **Csv** and the new morphisms induced by the appearance of new linking elements – **Fig. nr. 5.**

Consequences:

1. The **functor F"** induces, in the **STCS – Fig. 5,** an ***equivalence*** [2] between **Csv** and **Clfs,** because:

♦ For each pair **X,Y** of objects of **Csv,** the mapping:

MO (**X,Y**) -> **MO** (**F"**(**X**), **F"**(**Y**)) induced by **F"** is a bijection, respectively the **functor F"** is a **full and faithfull functor.**

♦ Each object of **Clfs** is ***isomorphic*** with an **F"**(**M**), where **M** is an object of **Csv.**

2. A particular aspect is presented in the **Fig. 6** which is extracted from the **Fig. 5.**

The configuration of **Fig. 6** represents a ***morphisms equivalence***: **u**: **b1** -> **x31** and **v: b1** -> **x41** or a canonical ***isomorpism of both morphisms ones*** [2], because:

♦ The two morphisms are *strict morphisms* being *isomorphisms.*

♦ There is an *isomorphims w:x31 -> x41* so that the diagram from the **Fig. 6** becomes *a comutative one.*

This above case seems to be a **redundancy.** That is to say that during the **communication** process a **redundant** *logical expression* has been introduced. In some circumstances such a redundancy is a benefit

but in other circumstances it represents a lack of both concision and clarity. The redundancies could be reduced by aid of a certain process of "filtration". Although such a "filtration" process does not represent the object of our discussion, and for the present moment we are not trying to define it, the opportunity of its application will be also discussed in the next paragraph, in other context.

Equivalence *versus* Non-Equivalence:

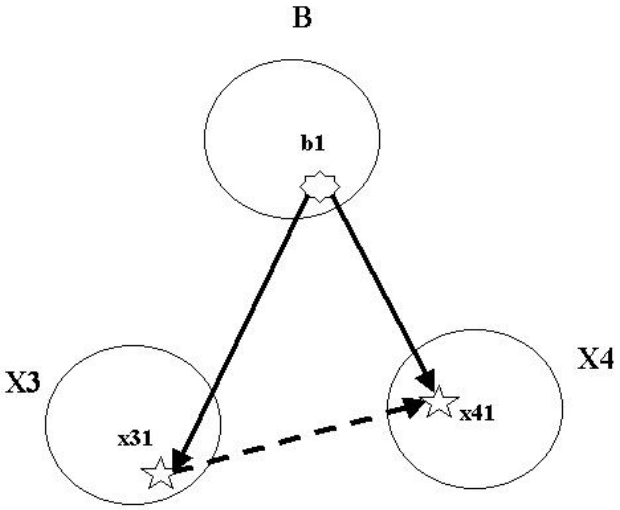

Fig. nr. 6

Contrary to the case which has been presented in **Fig. 5,** in **Fig. 7** and **8** we shall consider two cases of **nonequivalence** between a **SV** and a **LFS, which** are modeled as categories**.**

The weak/"noise" non-equivalence is presented in **Fig. 7.** In this case the non-equivalence appears due to the fact that the condition: "each object of **Clfs** must be ***isomorphic*** with an **F"** (**M**), where **M** is an object of **Csv" is** not fulfilled for some objects of **Clfs:** e.g. X7**, X8,** and **X9** objects.

From an architectural point of view, such case of non-equivalence may be a case which we shall call of a **"weak/'noises' non-equivalence"** between a **Clfs** and a **Csv**, respectively.

Indeed, we can remark that although some objects of **Clfs** (e.g. **X7, X8,** and **X9)** have not a corresponding isomorphic object in Csv, the same condition is false for ***all objects*** of the **Csv.** This means that ***all phenomenological senses which have been preserved in*** **Csv** ***are transmitted into Clfs by means of F"*** **functor.**

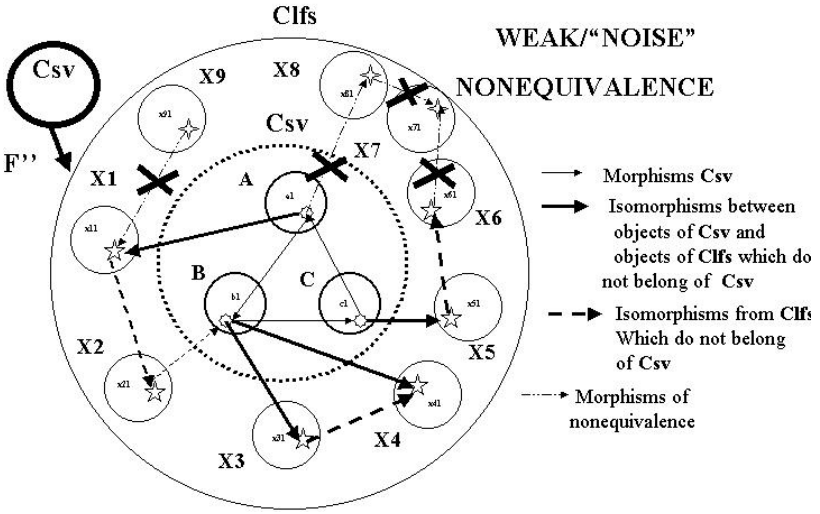

Fig. nr. 7

The appearance of some objects like **X7, X8, and X9** in a **Clfs** category may be interpreted as a "noise". That is to say that during the **communication** process some **residual** *logical expressions* have been introduced. In this case the "noise" should be reduced by a certain process of "filtration" similar to that one used in the case of **redundancies** (see the previous paragraph). More than that, if such a 'noises' are not cut off during the 3rd step, then the future physical (concrete) **artifact** which will build up in the next 4th step, it shall become a baroque **artifact,** and so it shall move away from the simplicity of the 'natural' forms [16] (see also the engineering method of the "functional analysis" for choosing only those necessary functions so that a technical product becomes full efficient from a user/client point of view).

The strong/nonequivalence is presented in **Fig. 8.**

In this case, like in the previous one, the non-equivalence appears due to the fact that the condition: "each object of **Clfs** must be

isomorphic with an **F"(M)**, where **M** is an object of **Csv"** is not fulfilled for some objects of **Clfs:** e.g. **X1** object.

But, in the present case, **from an architectural point of view,** it is a case which we shall call of **"strong/non-equivalence"** between a

Clfs and a **Csv,** respectively. And it is a **strong non-equivalence** case because also the condition that "each object of Csv has a corresponding isomorphic object in **Clfs"** is not fulfilled (the morphism **MO** (**A,X1**) in **Fig. 8,** is not an isomorphism). This means that ***some phenomenological senses which have been preserved in* Csv *are lost when a communication between* Csv *and* Clfs *takes place by means of F"*** **functor.**

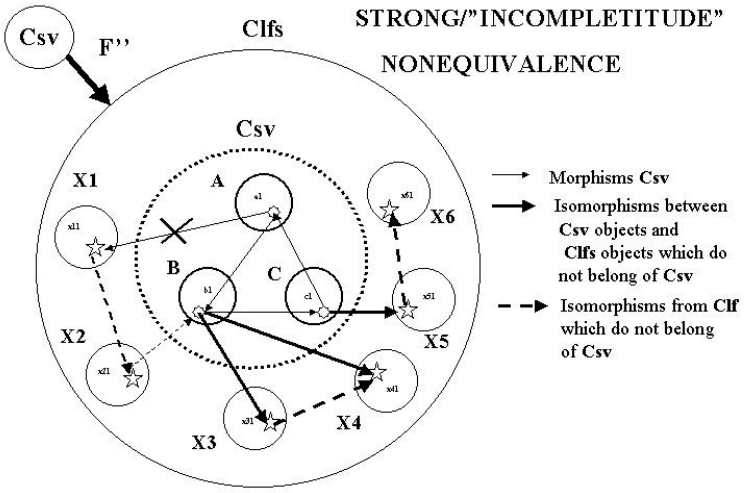

Fig. nr. 8

From an architectural point of view, a ***fuzzy function*** may be introduced for to make a difference between the cases in that one or more phenomenological senses are lost when an **strong non-equivalence** appears. We will develop this idea in a future work.

The Appearance Of The Physical Structure (Ps) – Step 4

Working assumptions:

♦ The *physical* space is **structural** and the appearance of the **Physical Structure (PS)** takes place into the *physical* space.

♦ The **LFS** transformation from an *individual intellect* into *physical* space may be modeled by means a **functor F'"** which consists in a building up/technological process (in the frame of an 'envelope' theory).

♦ During a **"technological"** process some *technological compulsions* can appear;

♦ The *technological compulsions* can introduce some disturbances and, consequently, some modifications of the **LFS (project)** of a new **artifact** may appear.

♦ The **"technological"** process will transform the **LFS** into physical (concrete) structure of a new **artifact.**

Modeling approach:

♦ Let **Cps** be the structural category of the **PS.**

♦ The **Cps** category appears only **F'" functor** begins to work.

♦ The objects of **Cps** are physical (concrete) components of the new **artifact.**

♦ The morphisms of **Cps** are physical (concrete) linking elements between the physical (concrete) components of the new **artifact.**

Commentary: When the technological compulsions lead to some modification into the **LFS**, then these ones can or cannot induce a **nonequivalence** between the **Clfs** and **Cps.**

A Feed-Back Process – A Possible Generalisation of the Simplified Theoretical Case Study

Let us come back to the 3rd step. Also, let us suppose that the **Cfi** and the **Csv** categories of the new **artifact** are unique. But, through a **communication** process (**F" functor** application), many **equivalent Clfs** categories can appear, as it is shown in **Fig. 9.**

From **Fig. 9** one can observes that:

1. For a selection making between different variants of the **equivalent Clfs categories**, the Top-Down Structured Decisions Method [15] may be applied.

2. The same thing is valid before a building up process will be implemented (see also **Fig. 9**).

NOTE: both 1st and 2nd aspects will be discussed in other work.

3. In the context of the present discussion, we consider very important the fact that the appearance of a **LFS,** which is modeled by a **Clfs** category (e.g. **Clfs1 – Fig. 9**), can produce a *feedback process* (a **G functor** in our modeling approach). The **G functor** acts between a **Clfs** and the **Cfi categories**, as is shown on the **Fig. 9.** What is the result of that **G functor** action? This is an important question.

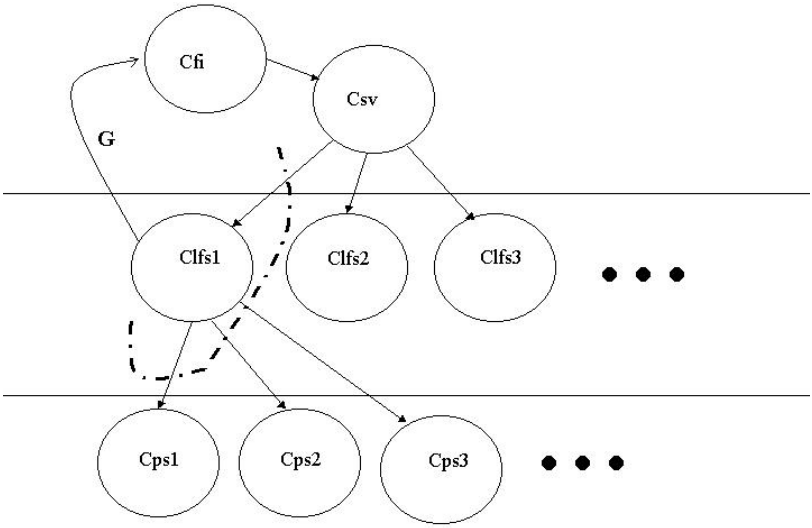

Fig. nr. 9

A possible answer is presented in **Fig. 10.**

One can observe **(Fig. 10)** that the action of the **G functor** produces the appearance of both new objects and new morphisms in the **Cfi** category and so, this category can be "enriched". Also, one can observes **(Fig. 10)** that a new **F' functor** can go into action between the **Cfi** and the **Csv** categories. So, a new interesting question appears: does the new **F' functor** induces a new *isomorphism* between **Cfi** and **Csv,** or an *equivalence* only? It seems that the ***isomormphism is preserved***, as **Fig. 10** reveals. **Thus, the results obtained from the Simplified Theoretical Case Study (STCS) seem to be valid in a general case, too**.

Final Remarks

1. We are aware of the fact that the conceptual framework, as well as the entire modeling approach of artifact **architecture,** suggested in the present paper, represents only a first approximation, and due to this reason we consider it as "an attempt".

2. There is one fundamental problem (according to our point of view) left for discussion in connection with the conceptual framework which we suggested, namely: the possibility of verifying if a formative image **(FI)** of an **artifact** is or is not consonant with a certain natural deep phenomenological entity, such a consonance assuring the efficiency and longevity of an **artifact.** In a future work we will try to find a solution to such a problem.

3. Some equivalence and non-equivalence cases between categories from the chain **'Cfi-Csv-Clfs-Cps'** associated of a new **artifact** have been put into evidence. It is our hope that such equivalences/ non-equivalences may be, in the future, used to support a Hierarchical Top-Down approach of artifact **architecture.**

4. It is possible that the appearance of a **logical-functional structure,** in the shape of **Clfs** category, may be able to induce, and mediated by a functor **G: Clfs -> Cfi (Fig. 9),** a modification of the **formative image** of an **artifact;** further, the appearance of a new functor **F': Cfi -> Csv (Fig. 10)**, may be able to lead to a reconfiguration of the **sensical invariants** (**Csv** category) and so on. Such a process may be interpreted as a "loop" cybernetic process with positive "feedbacks" that, if it is not consciously stopped at a moment, can lead to instability of the "obsessive" type with a medical-pathological meaning. Also, such a "loop" cybernetic process can be started from a **Cps**. These aspects will be approached later.

5. It remains for discussion what means a **physical (concrete) structure** in the case of some **more or less abstract artifacts** (for example a cultural/civilization system or a business).

6. Finally, we consider that we can promote the idea that within the **physical or concrete structure** of an **artifact,** there are phenomenological meanings. These phenomenological senses seem to be transmitted by the chain of the **'Cfi -Csv-Clfs-Cps'** categories and the associated **functors**. More than that, it seems that a **true beautiful architectural gestalt** of an **artifact**, perceived as a psycho-mental state, is represented by those phenomenological ingredients which preserve

themselves from **Cfi** to **Cps,** due to the equivalence of those categories from the chain, ***if, and only if, a formative image (FI) of an artifact is consonant with a certain natural deep phenomenological entity.***

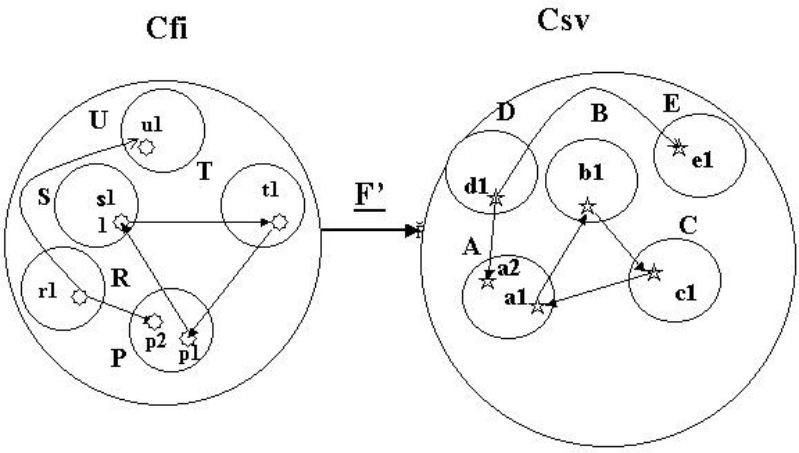

Fig. nr. 10

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